The Universe:a Philosophical derivation of a Final Theory

Abstract

The reason for physics' failure to find a final theory of the universe is examined. Problems identified are: the lack of unequivocal definitions for its fundamental elements (time, length, mass, electric charge, energy, work, matter-waves); the danger of relying too much on mathematics for solutions; especially as philosophical arguments conclude the universe cannot have a mathematical basis. It does not even need the concept of number to exist. Numbers and mathematics are human inventions arising from the human predilection for measurement. Following Aristotle, a single fundamental cause is proposed to explore the efficacy of using pure non-mathematical philosophy to explain the universe, contrary to current quantum physical views. The cause is taken as Time, which is then defined, surprisingly leading automatically to a definition of a three-dimensional space answering the question into what can a universe be placed (space before space seems non-sensical). This enables the philosophical arguments to derive a universal rule giving clear-cut descriptions (definitions) of force (both gravitational and electromagnetic), motion, energy, and particles. The formation of atomic nuclei and atomic properties together with an unexpected role for neutrinos follow. In particular, a Popper-test can be prepared by introducing the concept of measurement to allow the philosophy arguments to be tested in another discipline - mathematics. The solution agrees with human physical observations to a remarkable degree of accuracy, automatically explaining and predicting values for Planck's and the fine-structure constants. Although mathematical, it is included as confirming the efficacy of philosophy in attaining a final theory.

Foreword

This article is a full philosophical derivation of a final theory of the universe based on Thompson (2023) which argued that the universe cannot be mathematical in nature. Furthermore the universe does not even need to know the number one. Consequently mathematical physics can never hope to derive a final theory. The only way of attaining a final theory is thus by non-mathematical (philosophical) analysis of human experience. Much of Thompson 2023 is presented here to explain the motivation for this final theory.

The full work includes a discussion of standard quantum mechanics and field theory in comparison to the final theory derived here. This particularly includes transcribing it from mathematical to non-mathematical language in accordance with Persson's thought: we calculate in mathematics but do we understand in mathematics. Thus transcription can expose illogical ideas that are hidden behind mathematical jargon. I have removed this discussion as the part presented here is already long. It also includes mathematical derivations from first principles of Schrödinger's equation and various dynamics equations. These missing parts can be found in Thompson 2024a: The

Universe Founding a Final Theory Zenodo.org/records/10795183. The section and Chapter numbers are maintained between both articles.

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CHAPTER 1

Preface and Introduction

1.1 Background

The theory of how the universe functions, and why it exists, has been developing over thousands of years from purely mythological concepts, through general philosophy, gradually fostering more practical ideas, and eventually rigorous physical theories based on observation. Leaving aside mythology, Aristotle's ([350 BCE] 1923) original philosophy aimed at discovering the first causes of existence, and the universal structure, but these were purely deductive philosophy rather than based on experiment. Consequently, the introduction of experiment, or testing of theory, by Bacon (1605) and Galileo (1632) towards the end of the Renaissance period, showed up falsities in the earlier interpretations of the world. The result was a rise of experiment and change from Aristotelian metaphysics, to scientific reasoning based on observation, while imposing suspicion on common sense and reducing the role of reasoning (Feyerabend 1993:291; Sankey 2010; Yu&Cole 2014:679). Nevertheless, the structure and existence of the universe has become a subject that is no longer limited to scholars but is now of great interest to the public at large, as suggested by the number of television programs screened.

However, despite the huge resources thrown at it, no complete, or 'final' theory of the structure and processes of the universe has been produced. If these could be uncovered the result might lead to better living conditions for both humanity and for protecting the ecology of the Earth itself. Consequently it seems essential to examine the nature of contemporary physics as well as its methods to ascertain whether there may be a more useful approach. And if so, to build the result into the complete theory.

As Popper (2006) states, it is impossible for any theory to prove itself; a theory by itself is uncertain; but examination via a different discipline may succeed. It therefore seems worthwhile to avoid the usual methods of mathematical construction and turn to carefully argued human logic by which I mean sapient thought based on the principle 'if A, then B *must* follow'. That is, to use non-mathematical philosophy to initiate and develop a new approach to completeness. The result can then be tested using the different discipline of mathematics based on human observation and measurement – a principle similar to Galileo's questioning of Archimedean philosophy.

Such a study must take into account the nature of human thought rooted in the developments of millennia. Chapter 2 looks at the earliest known ideas to build a picture around the development of the human psyche. This is consolidated by analyzing the current methods and beliefs of how our knowledge is accumulated and used. The result suggests three possible lines of investigation: philosophy, mathematics and physics, which are then reviewed separately. Chapter 3 develops the review into a completely new approach to finding the desired theory.

The best result would be if the new approach completes a theory that can be tested against human observation, and moreover can answer most if not all the major problems facing physicists. There are many unknowns in physics: the origin of the universe, why it should exist, why stars formed and became trapped in galaxies. Even the structure of the nucleus of the atom is unknown despite much research; then there are the mysterious particles called neutrinos; why should atoms have mass and what exactly is it? In particular, as Stephen Hawking pointed out, why are there so many constants in nature and especially why do they have their peculiar values? In biochemistry the birth of life is a mystery as is the peculiarity that the major biochemicals are 'right handed' in structure. These are only a minor speck of the problems under investigation by scientists, but if they could be solved it would help enormously towards dealing with others.

But more fundamental than these is the question why anything should exist. This would require a fundamental cause, something which is not accepted by modern physics. Chapter 4 follows on from Chapter 3 in developing a possible cause from which Chapters 5-7 deduce how this would create a Universe (labeled with capital U as it only applies to what follows from the fundamental cause). It is deduced by purely philosophical reasoning so that it can be compared to human perceptions without a need for mathematical equations. Indeed, it demonstrates the Universe has absolutely no need of mathematics to exist, a concept totally strange to all physicists' beliefs.

Many of the ideas put forward by physicists appear to work but, as this article is purely to demonstrate the effectiveness of philosophical analysis, I have left these ideas to be discussed elsewhere. However, the effectiveness of such philosophical argument needs confirmation so I have included a mathematical test of the fundamental basis by introducing the human concept of measurement in Chapter 8.

CHAPTER 2

The shape of human reason

2.1 Introduction

Nobody will ever know when the first footprints were laid in the quest for an ultimate theory. In fact, the first steps will have been laid long before the idea came to the human mind; possibly before it was even able to reason, possibly before the Australopithecine ape-men. As they roamed the grasslands hunting for food they must surely have come across large carcasses that could only be carried by the bigger and stronger members of their group while other fare such as berries, leaves or roots were easily handled by small children. Such a concept would have been a step in learning and even cognitive thinking. How many animals will kill prey that is too large for them and then have to waste energy standing guard against scavengers? Even scavengers could outnumber the most powerful.

If the group could cut up their meal and carry it back to their lair they would not have to hunt so often. The idea of sharing work according to their abilities would have been an advance in the animal world. In the dawn of comprehension some being must have moved one step further to consider that size was not so much what counted. Some objects could be large but a small child could carry them over large distances, while others were small but only a full-grown man could pick them up. And then he might only walk a short distance before his arms became tired. He might have added a new grunt to his language to indicate the idea 'heavy' and followed this later by the idea 'weight' as a comparison between objects. Like the universe, nothing is stationary in time, everything evolves including human ideas.

The search for an ultimate theory should then start with the development of human sapience over the ages, for it is only from the human mind that such a theory can evolve. Even if one was to consider the theistic concept that such an explanation can only come from God, one must accept that if humans are ever to know how it works it has to be in a form that can be understood within the human brain. Either way, the human mind and language has an enormous role to play as it is both triggered by our personal perceptions of the world as well as by other peoples' ideas, in particular those passed on through education. Thus I start with what little is known of primitive religion and mythology. Here I am not so much interested in the stories themselves but the genetic evolution (survival of the fittest) and certain psychological factors that led to human creation and transient belief in these stories.

2.2 Ancient beginnings

The earliest known written mythology, the 'Epic of Gilgamesh' from Sumeria, dates to around 2150-2000BCE, depending on the historian. However, mythology must assuredly have been alive much earlier than this date as rock art from the Indonesian Island of Sulawesi has been dated to about 44

000BCE. The art of the Lascaux caves about 17 000 BCE is well known and more recently from the Maltravieso caves in Spain dating to about 64 000 years ago, both assumed to be Neanderthal. Rock art animals are believed to have been used symbolically to bring good luck in hunting. More recently geometrical scratches made on cave walls at Dinaledi in South Africa are dated between 240-330 000 years ago.[1]

Myths can be of many forms: they can refer to historical events such as earthquakes, floods, volcanoes, disease; history of the tribe or great tribesmen (Gilgamesh mentioned above, for example); lessons of morality and behaviour; or the creation of the world, in most cases in association with water as the primary life giving force. Even the plainest of water left outside and protected from visible intruders could suddenly be found full of tiny living creatures; bare earth would suddenly sprout plant-shoots when watered.

The Sumerians believed there existed an initial primeval water, Nammu, who gave birth to Ki and Anu, Ki being the earth and Anu (An) the chief god and ruler of the sky and rain[2] and his subordinate chief of the earth and wind god Enlil. The wind brought rain and fertile land, but it also brought destructive dust-storms and locusts. As far as can be ascertained Anu and Ki had children: Enki (god of wisdom), Enlil who married Ninhursag and various others who all interbred to produce a pantheon. This is not dissimilar to Egyptian mythology of approximately the same age, around 3000BCE in the first dynasty, as pieced together from archaeology. Again there was a primordial water, an ocean called Num that filled the entire universe. From these waters came the Ogdoat, or eight first gods which included Amun and Amunet, and Nun and Nunet.[3] These gods represented chaos from which Amun created himself on a hill that arose from the water (in relation to the observation plain water could inexplicably produce living creatures). He then created the other gods who married or had other relationships to produce a vast array of gods and goddesses.

Chinese mythology is somewhat different. It was based more on venerating ancient rulers,[4] the first of these being Fu-hsi (Fuxi), about 2850BCE, who unified the tribes from the chaos of petty wars. Creation theory was of less importance, and not well recorded, being passed down only by word of mouth. As its first references appear to be from around 1200BCE, it was possibly a later addition to satisfy evolution in human curiosity. It believes the earth grew from a cosmic egg, P’an-ku (Pangu), which split into a light part, the sky, balanced by the heavy part, earth – the concept of yin and yang or balance between all things. Fu-hsi then became interpreted as the father of humans and it was his divine duty to keep harmony against chaos.

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[1] Berger (2023)
[2] (Ions 1974:10)
[3] (Brier 1999)
[4] (Ions 1974:178)

Passing to the Americas, mythology is much more recent, but this is expected because it seems certain that they were not populated by humans until about 8000BCE. Due to the lack of writing materials, the earliest records are only from about 500BCE in the form of wood and stone carvings or textiles, and seem to be more of a history than mythology. The inhabitants appeared to accept the existence of the earth and cosmos as a fact rather than questioning its creation. Consequently their myths centred on the geological structures, animals and plants they found around them or the winds and weather.[5]

In any case an overview of the Americas is difficult because the continent is broken up into many regions and tribes. Where divine intervention exists it is often of the form of three deities: the power above, the earth-mother, the trickster. A super deity, such as Viracocha, does appear in some areas but where such a deity deals with the heavens it seems to have been more of the form of finding reasons for the sun, moon and star configurations to exist. Some regions also worshiped the sun. Death was not certain as, in many areas, the spirits of the dead passed into their surrounds. In North America the myths, or folklore, were passed on by appointed story tellers which helped to bond each village with its own identity.[6] Longfellow's (1855) Song of Hiawatha reflects exactly the sort of stories that might be told and reflects a summary of everything suggested here. In particular he states the stories come from the animals and plants themselves.

Thus there are some similarities and some differences throughout the earth's early thinkers. But they all reflect a view of the human mind at its earliest known workings and they had a far greater value than just being plain stories. Myths formed a religion that shaped people into social groups necessary for effective existence against external forces, much as wild dogs and hyenas form packs under a leader. This pack mentality is fundamentally a genetic trait established through survival of the fittest. The ability to speak allowed the pack-leader to establish rules, often in particular reinforcing his and his offspring's position[7]. It produced over time a fundamental culture, sometimes explaining not so much how, but why events occurred, particularly those associated with death and destruction. But it also produced ways of avoiding such catastrophes, at the same time providing rules by which to live that could be transmitted from generation to generation (as in the Song of Hiawatha). It provided a sense of security and acceptance in the group not only for the present but in a hoped for future. This was a major role for the leaders helped by people of experience, often elders. Knowledge of 'why?' should lead to principles of avoidance. As the psychologist Rami Gabriel[8] says, beliefs lead to feelings of security 'guided by emotion'. But leaders could not avoid death. But they could induce the

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[5] Boas, F. (1914) "Mythology and Folk-Tales of the North American Indians". *The Journal of American Folklore* , **27**, (106): 374-410.
[6] (Ions 1974:220)
[7] (Masse et al 2007:24)
[8] Gabriel (2021)

view they belonged to a group of immortal leaders living in the stars, or they were in the first place born in human form from the gods. Gods provided the continuity against final disaster. Such ideas would stabilize their reign as a leader and trust in their decisions. The strongest societies were those with strong beliefs.

The concept of gods would prove useful in order to give continuity to an unstable world with its beginnings and particularly endings. For example, the sun with its life giving warmth rises and sets day after day. What if it failed to rise? If controlled by an immortal god, it is guarded from final disaster. But, then, are the gods related to human actions? Humans carry out acts of aggression, revenge and appeasement so why should the gods be different?[10] It would be in the tribe-leader's interest to instill this view. Consequently, the gods must be kept both happy and appeased for supposed transgressions. Human sacrifice seems to have been rare except in South America where it was carried to its extreme by the Aztecs – the rain god Tlaloc at one time requiring sacrifice of a thousand children. Sacrifice of enemies served a double purpose, they (Aztecs) thanked their god, Huitzilopoctli, the Aztec war god, for victory, and at the same time sent their captives to an honourable sojourn in the afterlife. While human sacrifice also occurred in other South American groups, the Maya and Inca, it is not certain whether it occurred elsewhere on earth, though the possibility is certainly referred to in the Bible (Abraham). There may be instances in China (5000-2000BCE) and again during the Shang dynasty (1600-1050BCE);[9] in Mesopotamia (2600-2450BCE) and Egypt (1070-712BCE), the last two being the possible slayings of servants on the death of their royal masters to wait on them in the afterlife. Personal sacrifice was another matter. Individuals learnt that honour in the afterlife came to those prepared to give up their lives for survival of the whole; reinforced strongly by Jesus in Christian religion, and Abraham's preparedness to sacrifice his sons in the Hebrew faith. Thus pressure was imposed for individuals to think of the good of the whole by keeping to the prevailing mythology – interpreting mythology as being social norms engrained in the many by the many.

A leading god was a necessary concept in order to reinforce the leadership principle in humans. The need for a leader is a basic human need for security of mind as can be seen in times of stress and war when a leader, however unacceptable he may have been in halcyon times, gains popular support so long as he leads. A chief god reinforces the concept of a living chief of a clan, especially if he is considered to be divine and will take his place among the gods; or as became the norm, to be the gods' representative on earth – the divine right of kings.

The lesson is that, although a tyrant can enforce his rules, the overall group view is one of belief. If humans were completely free there would be perhaps as many ideas as people, tugging in different directions with little achievement. As with animal packs, group action, co-operation, is a good way to

[9] Campbell (2019: 52, 56, 71)

meet adversity and to maintain survival of not only the group but oneself. "Belief is our guiding star. Believing in something is an act of commitment guided by the emotions and solidified by habit and repetition".[11] As the American philosopher William James argues in *The Will to Believe* (1897): with difficult arguments our emotions decide. Belief is then not a guide to truth, only to co-operation, an innate form of peer-pressure.

With a lack of formal education, those able to write and calculate, had a higher standing in the group. Consequently it was in their interests to maintain the ruler system with the working lower class merely following the educated leaders' directions. This led to stability and, in this sense, happiness as every person knew their place and worked for the good of the whole. Thus the social group was largely cohesive. With the hunter-gatherer groups there was little need of formal education as children naturally learn from the actions of their parents. Modern young children enjoy bedtime stories and fairy tales which one can imagine would have instilled in primitive groups their current folklore. But as populations grow they need to harmonize so that the group mythologies become closer to a binding religion, especially in the rise of cluster living such as larger villages and towns. This could only be in favour of the leaders to install group rules of living and settlement of disputes. Children learn at an early age, sometimes through fighting and bullying, that cooperation usually works better than antagonism. If not they end up in various degrees of punishment. Thus group mores are established as a natural process with little formal education. But as the towns turn to city states and rival other cities to build empires individual group beliefs have to merge with others.

Here we see a difference with Egypt in that the Mesopotamians and Chinese had become mainly city states forming empires rather than unified nations.[10] However Egypt emerged around 3100BCE with the upper and lower kingdoms combined under the one ruler demanding a larger administrative base than those of the Mesopotamian area. A slightly different structure was then required with the area being divided into regions under supervisors appointed by the Pharaoh. It needed a widening class structure: the ruler, advisors, upper echelons, scholars, artists, middle business classes, and workers. The pharaoh's business was to defend the region and to ensure chaos was prevented through a system of balances (ma'at similar to the Chinese disposition of yin and yang). Nevertheless, the mythology of Egypt from the philosophical-psychological point of view was probably little different from that already described: reinforcing the feeling of belonging and safety in a group.

There is little to be added to the thoughts of maintaining the group system until the Greek ideas of democracy took shape around 500BCE, which allowed a new understanding of the world and society to arise. It is the written works that have survived and reinforced the burgeoning Christian religion forged out of rebellion against foreign empires. They provide a freedom to investigate new methods of survival in a social world. However, the question arises why the ancient Greeks broke away from

[10] Times Book (2005)

their ancient traditions to produce one of difference of opinion and debate. It seems to be accepted that it originated with the Greek philosopher Thales (c. 620-545); but very little other than references made by Aristotle is known about him. He is attributed as being the first to consider the composition of natural objects with the idea that water was a major element of everything, to which his pupil, Anaximander, added another element: air. However, Thales is said to have studied in Egypt,[11] so it maybe that he either followed, or was influenced by Egyptian thinkers,[12] and it was the written works of the major philosophers from Greece that gives the impression of a change in thought being theirs.

On the other hand it may be that the Greek city states started to rise at a time when the Persian and Assyrian empires were at their peak. As a result the Greeks had to be strong warriors in order to exist independently with a consequent reaction against Mesopotamian ideology. The two major city states were Sparta and Athens both of which considered education of their citizens to be of major importance to their survival. The former was possibly the first state to introduce state education (around 700 to 600BCE), for both girls and boys; but there was to be a major difference in Athenian education. The Spartan system was against change or independent thought. It was primarily to build up fighting character in patriotism and service of the community. The best students became the leaders. Due to the military training, literacy was ignored. Nevertheless, Sparta was the first state to use education in support of its social system, producing an exceptionally strong and well-motivated army well able to defeat assaults from the Persian and Assyrian empires[13]. Athens, seeing the value of Spartan schools followed (50 to 100 years later) but with a much wider system based more on the concept of attaining wisdom than the ability to fight.

There were two parts to both Athens and Sparta: the (free) citizens and non-citizens. However, Athens forged a new group dynamic through forming a council of citizens to vote on important issues. As a result, their leading departure from previous ideologies became the freedom of thought and consequent philosophical debates on both ethical and scientific subjects (though science at that stage was far removed from the principles that started with Bacon and Galileo). Nevertheless, this freedom of thought was mainly inspired to attain a majority decision for the good of the group – the concept of democratic rule. Education was seen to be a central role of citizenship – for the art of government. Wisdom, the development of new ideas, unlike Sparta, became a fundamental aim.

> "The task of philosophy was to educate the citizens in practicing their ethical en political skills. The Greek citizen gained awareness of his individual ethical being through his awareness of the limits of the universe, guarded by gods, destiny and social structures." (Muller 2016:14)

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[11] Allen 2000

[12] cf Letseka 2014

[13] Petraki 2010:71-73

The male citizens were trained in the arts of rhetoric, reading, writing, mathematics, philosophy, music and gymnastics (sport). Up to the age of 16, education was private depending on the wealth of the parents though within certain government rules. Afterwards the young men attended state gymnasiums tending to athletic abilities with attached schools for development of rhetoric skills run by fulltime philosophers, among them Plato and Aristotle, thus breeding a search for truth to replace past myths. The non-citizens were mostly slaves or peasants. Girl citizens were only educated in domesticity.

Both the Athenian and Spartan education contrast to the other nearby regions. Sumeria was mainly for scribes obtained from wealthy families. Royalty taught their own children. Egypt was mainly parental with fathers passing on their knowledge to sons, and mothers teaching domesticity to girls, although rich girls were also formally taught to dance and sing.[14] Most adults were illiterate, only the elite males had some education – in the subject of ma'at by priests. Severe discipline to maintain cultural uniformity was maintained in both Egypt and Mesopotamia.[15] All of these together with Sparta, despite its schooling which was to maintain the concept of strict discipline with no thought of variation, thus maintained the old mythology. On the other hand all of them, including Athens were aimed at sustaining the identity and lifestyle of the group. (China started state education about 500 years earlier but philosophy started with Confucius (551-479BCE) a little after Thales. As this had no effect on Western ideals it is not included here).

These observations suggest the rise of group mentality and dynamics in sustaining the human fight for survival in a competitive world. To understand the universe through modern eyes we have to include the modern approach where the educated person can advance what is now considered a right of all men (at least in western society): a freedom of thought and choice that has developed with ever increasing rapidity over the last 2500 years, that is, since the ancient Greeks. Keeping the above background in mind, the next step must be to survey the latest methods of physics, mathematics and the philosophy of science in general. This should start from the ancient Greeks because that is where physics started: physics being the underlying theory for all science, be it chemistry, biology, medicine, industrial design, architecture or psychology. The remaining sections of this Chapter thus review the main groups of interest to this work starting first with philosophy, then mathematics and finally physics.

2.3 Philosophy

Contemporary philosophy covers many subjects including ethics, theology, politics as well as the nature of things. As noted the basis of Western philosophy follows from the ancient Greeks, through

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[14] (Zinn 2013:1-2)

[15] (*Encyclopedia Britannica*, 1 Nov. 2021, ttps://www.britannica.com/topic/education. Accessed 16 March 2022.)

to Aristotle who could be said to have laid the concept of science, though it remained to Galileo to separate it into a discipline by itself.[16] The difference between philosophy and science, as it has become in the contemporary world, is that science relies on creating and testing its theories by experiment whereas philosophy relies on pure thought.

Aristotle wrote two series of books on the subject. In particular he started his investigation of natural science by considering exactly what I am investigating here: the concept of thought and how to use it to find the real truth of our existence – not that he succeeded in finding the truth, but he did launch a method of investigation. This took two forms, starting from apparently known facts, that is, what he regarded as known.

The part of interest, the fundamentals of nature and existence, falls into metaphysics, 'the after the physics', as ascribed by Andronicus of Rhodes to the series of Aristotle's works, the books A-N (alpha to nu).[17] As suggested by the title, these followed Aristotle's "Physics", books I-VIII,[18] in which he laid the foundation of what was to become the subject of science. The limits of knowledge, epistemology, falls more under the title 'philosophy of science' which also considers the physical methodology of experiments and derivation of laws together with their interpretation and application. This is of major interest to this article as it suggests reasons for why standard physics has failed to explain major outstanding problems such as the structure of atomic nuclei, the concepts of dark energy and matter, how electric charge, force and gravity function (physics only calculates the outcomes, not the fundamental cause behind them, or in the case of dark energy, matter, force and electric charge, their essence).

Metaphysics was primarily based on observation and Aristotle's interpretation thereof using the principle of reducing generalities, be they material or abstract, to specifics (particulars), a classification process similar to the modern biological system of phyla, orders, classes, et cetera. The more important subject, in his view, was the philosophical extension of the second set of books (1923:A-N) in an attempt to determine the overall concept of existence: what he called first causes, or 'first philosophy', the ancient equivalent to the modern 'why does anything exist in the first place?' As Aristotle attests in the opening of book A, his so-called 'metaphysics' should be distinguished from his 'physics' as knowledge should be distinguished from experience. The latter is of little value without knowledge – "For men of experience know that the thing is so, but do not know why, while the others know the 'why' and the cause". And he goes on to say "the most universal, are … the

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[16] Bernal (2001) has disputed whether the basis of western philosophy arises from the Greeks or from Afro-Indian sources, as the Greeks (Hellenes) probably originated from Hyksos tribes that had settled in lower Egypt. These were eventually driven out by the Egyptian Pharaoh Ahmosa around 1550BCE. The fact is that Thales changed the course of philosophy as developed in the western world irrespective of the origins of his antecedents.

[17] Aristotle[350BCE](1923)

[18] Aristotle[350BCE](1991)

hardest for men to know; for they are farthest from the senses". In particular he links these to first principles as being the "most exact of the sciences"[19] and relegates those dealing with what we would call physics to a lower place, that is, below metaphysics. This is as it should be because physics cannot prove itself from its own laws. The first principles then become the most important knowledge as everything else follows from these.

An excellent example of what Aristotle means, that will form an important part of this philosophical exploration, is that of time. In the literature there is no definition for time. Here, we have to distinguish between two very important fundamental concepts as questions: 'what is it?' and 'what does it do? For example, time is usually measured on a clock though, of course, it can also be measured in terms of days or revolutions of the earth around the sun (years) or between full moons as often done by ancient humans. So the question of what is time is often answered by 'something that is measured on a clock'. That measurement is really only a property of time. It tells us that some mechanism causes a change in the hands on a clock, that is, it gives us a property of time – the 'does' part – though it is the spring or battery that runs the clock that actually causes the motion in the hands. But why should this spring or battery manifest these intervals of time? The clue to the problem lies in the answer: the '*something*' that is measured. What *is* that something? Even if in high precision caesium clocks run by atomic vibrations as an electron regularly changes from one state to another, we should ask why there is an interval between the vibrations. That is, why should there be an interval in the first place? What is so special about this thing we call time that is somehow responsible for division into then and now? Philosophers consider this as the essence or *qua* of time. So returning to Aristotle's difference between experience and knowledge, what time does – causes intervals – is easy to say, but the 'why or is?' is far harder. I will provide what I claim to be the first ever definition of time shortly.

Unfortunately it is very hard to define metaphysics as it has expanded somewhat beyond Aristotle's original work, so much so that even philosophers cannot agree on its range. It may be easier to describe it from what physics does not consider (section 2.5). Its most fundamental form must obviously be the form of arguments raised by Aristotle.

> "… we do not think that we know a thing until we are acquainted with its primary causes or first principles, and have carried our analysis as far as its elements. Plainly, therefore, in the science of nature too our first task will be to try to determine what relates to its principles. … The natural way of doing this is to start from the things which are more knowable and clear to us and proceed towards those which are clearer and more knowable by nature;" ([350BCE] 1991)

[19] Van Inwagen &Sullivan [2014:1] point out that Aristotle uses first science, first philosophy and wisdom interchangeably.

This means categorizing observations of objects "from universals to particulars", that is from something that is generally true of many things to something true of only one thing – similar to the contemporary biological sequence of grand phyla down to families, genera and species.

His second consideration was in the use of contraries to facilitate arguments to attain the reductions. Thus 'is' and 'is not' are contraries but this may depend on the context. For example, time may refer to spring or winter but not all springs represent the same time in terms of this year, next year, ten years ago. Or, two things may be in motion together so that they are not moving one from the other, but they are both in motion relative to other things.

By these methods Aristotle was perhaps the first to aim at discovering the *cause* of existence, and the universal structure, even though using purely deductive philosophy rather than experiment. It is at least the first known literature attempting some form of logical exposition. As a result his ideas ruled Western religious thought for nearly two thousand years. Some of these ideas are a little peculiar to human views today, but nevertheless they represent an honest hunt for knowledge. Some, possibly starting with Empedocles (c. 450BCE), believed everything was made of four elements, Earth, Air, Fire, and Water. Perhaps not surprising as these must have been among the most primitive ideas discussed by the earliest thinkers as they sat around their fires at nightfall, be they ape-men or hominids. Not all philosophers shared this view. Leucippus (c. 430BCE) and Democritus were the first to propose the idea of an atomic structure, but this fell away under the views of Aristotle plumping for earth, air, fire and water, with air and fire, by being light-weight, having a natural tendency to move upwards while earth and water would tend downwards.[20]

Nevertheless the cause, or first principles, then became the most important quest for knowledge as they should answer the basic concept of 'why?' – that is, assuming that the universe has a root cause, as the ancient mythmakers must have intuitively believed. Everything else would then follow from this cause. Together with Plato's views these could be transferred directly to Christianity, the causes of which I need not go into other than saying it arose at a time when part of the Roman Empire wished to throw off its yoke. When leadership falls out with the needs of the group, the group will look for another course.

This Greek philosophy was what Thomas Kuhn (1970) refers to as a paradigm change, that is, a complete redirection of human thought. Its, neo-mythology, philosophy, held for nearly 2000 years before the next change.

Francis Bacon (1620) wrote:

> "It is not true that the human senses are the measure of things; for all perceptions—of the senses as well as of the mind—reflect the perceiver rather than the world.

[20] Aristotle (1923 :138 225a24-255b31)

> The human intellect is like a distorting mirror, which receives light-rays irregularly and so mixes its own nature with the nature of things, which it distorts."

These distortions are due to the individual's upbringing, tuition, reading, particularly of authors the individual admires, and his environment. (Of course, these will have all changed from the first rays of mythology, in particular with language, especially true now with difficulties over precise meanings of words in an ever increasing science driven complexity). What Bacon said is as true now as in 1620.[21] He referred to rules and laws, a (falsely) believed order and regularity in the world; supposed proofs of facts from single events. He called all these mirages "idols … that beset one's mind": Idols of the tribe – errors in human perception; idols of the cave due to an individual's upbringing and social contacts; idols of the market place – difficulties with impreciseness of language; idols of the theatre – entrenchment of human derived dogma. These are very much views I had in mind from an early age when thinking of the universal structure before I heard of Francis Bacon.

Locke (1690) was later to add what is somewhat a condemnation of the dogma that had held sway for those 2000 years: "But because a man is not permitted without censure to follow his own thoughts in the search of truth, when they lead him ever so little out of the common road, I shall set down the reasons that made me doubt of the truth of that opinion".[22] They, taken together with those of Bacon are fundamentally the start of the branch of philosophy that has become known as the 'philosophy of science'. Here I include metaphysics for ease of discussion although the two are usually considered separate by philosophers.

To grasp the relevant current philosophical principles we need to look at some of the writings of more recent philosophers. They lead to a number of important considerations in attaining an overall theory of the universe. For example, Lowe (2002) is an 'essentialist' believing that metaphysics deals with the essence or nature of things – what it is to be. As a result he contends metaphysics should be used as a science in its own right by analyzing classification as a rational exercise.[23] A point he raised is the thought that an object must have essence in order to exist: "essence precedes existence", although he added it does not necessarily imply the actual existence of a specific entity, Bacchus, for example; his essence is clear even though he is only a myth.

Here there is an element of uncertainty on the concept of essence in the sense of determining an absolutely precise reality of anything – what Locke (1690) attempted to define as 'the very being of any thing, whereby it is, what it is'. Aristotle,[24] for example, puts his finger tacitly on a problem in his opening of arguments in physics, using whiteness as an example. He argues that whiteness depends on

[21] Bacon ([1620] 2017)
[22] Locke (1690):28§2)
[23] Lowe (2002:1)
[24] Aristotle ([350BCE] 1991 Book1§1-3)

the view of the beholder and should not be attributed to the concept ‘is’ as if it is a property of nature. In this case whiteness could not be an essence of a given thing if the thing could also be blue or yellow. From here one can see that it is possible to go round and round in circles by developing the subject of the whiteness of an object depending on the context of its use. This is somewhat equivalent to the Duhem-Quine thesis raised more recently (Duhem [1914], Quine [1955]) known as underdeterminacy which should, in the contention used in this treatise be, in fact, indeterminacy; I question throughout this article whether scientific experiments are complete because they must include assumptions about the background to the test. A good example of such a problem arose in experiments by Michelson and Morley (1887) in determining whether an experiment involving the passage of a wave of light in an interferometer could be affected by passing traffic on a road outside their laboratory thus possibly invalidating their results. (They took extraordinary precautions to avoid the possibility). The Duhem-Quine argument then implies that we cannot know with certainty that any belief we establish by observation is true to nature. As far as Aristotle is concerned, however, the whiteness of the object is real to the beholders – an important point in the human view of the ‘reality’ of observation in our minds. With more recent knowledge it could be described in terms of wavelengths: but again context plays a role – do all animals see it as whiteness in view of the fact that not all animals have the same perception of colour as humans?[25]

Such arguments *are* important to full understanding of nature. Consequently I shall develop this vein a little longer.

For example, returning to Lowe: essence goes further than knowing an exact structure such as water consisting of two hydrogen atoms combined with one oxygen. That certainly is incomplete from most peoples’ knowledge of water. In fact, it may be that there is no perfect description that can say everything that many minds might suggest. One could carry on detailing every attribute of water and possibly attributes of those attributes. Again, for example, we know that everything is made of atoms, but what are those made of. Heisenberg (1927) and Schrödinger (1926) would say they are made of huge numbers of waves, but then I would ask, define these waves. They could tell me some things the ‘waves’ could do but not exactly what they are – their essence.

This type of problem was first raised by Hume (1739) and then Kant (1781-87). It is well worth looking briefly at their arguments because they exemplify the fundamental dilemma of knowing the universal structure; an argument that perhaps is the most fundamental problem in both philosophy and science; one that is essential to the direction of this treatise in understanding the basic structure of the universe.

25 Gerl and Morris 2008

Hume pointed out that all our thoughts are formed by our perceptions.[26] *A priori* assumptions, of the form raised by Aristotle – as Hume called them 'hypotheses and systems' – should be removed from philosophic thought: "All the laws of nature and operations of bodies can be known only by experience"… "our *a priori* reasonings will never reveal [the laws of nature]". That is, we only have our perceptions from our surroundings which may be completely different from what lies underneath. Now we believe in atoms and molecules, which we cannot see, and which quantum mechanics declares are made of matter waves with only a probability of producing our views of the world we see – admittedly with a very high probability (see section 2.5 physics for a larger description). But it is a common view that our science is founded upon concepts that have no absolute definition. Therefore they must be open to suspicion (as will follow in the section on physics). (Einstein refused to accept the proposals of quantum mechanics and tried to find some better mathematical construction even on his deathbed).[27]

Almost immediately Kant put forward a partial answer that our knowledge in fact consists of two forms: that being empirical, meaning what we observe, and that which we can deduce from those observations to give a "synthetic" view of why they should arise; cause and effect.[28] Our perceptions would then become a mixture of the two. Using Hume,[29] who had (to explain his reasoning) used the concept of two billiard balls: if one was projected to strike the other with some force, what would be the result? He suggested we could not know *a priori*. However, Kant's synthetic knowledge built from mathematics would suggest that at least the second ball would be induced to move. Thus we would have some idea of a preconceived result.

However, as De Pierris and Freidman (2018) point out, there are obvious, strongly debated problems over whether Kant's attempt to "remove Hume's doubt" is as clear as Kant assumed. In particular they find that Kant believed that metaphysics as a science depends on his "synthetic judgments" and that this has proved a major problem for the concept of metaphysics.

The point is that the synthetic reasoning does not necessarily explain everything. For example, using Hume's billiard balls, why does the striking of a second ball by a first ball cause the struck ball to move? We may, using contemporary physics, assume that the first ball contains momentum, whatever that might in essence be, which is passed to the second. But it does not confirm that momentum is an absolutely defined concept giving no other possible explanation of the expected result belonging to our intuition – that the second ball will respond in a given way. We therefore still cannot escape the problem, by Kant's reasoning, or any other reasoning, that we have no *a priori* knowledge of the outcome. We only have an intuitive explanation based on our perceptive

[26] Hume ([1739] 2017:13-14 Book1,iv)
[27] E.g. see APSNews https://www.aps.org/publications/apsnews/200512/history.cfm
[28] Kant ([1783] 1902:endnote)

experiences. Snooker players believe, as they have never observed the opposite, that if they successfully cue their ball in a particular way, the hit ball may move off quickly or slowly and their striking ball may stop dead at the point of impact, or move on a short distance, or even reverse its direction of motion depending on the way that particular strike was applied. They can give supposed rules for this action, but why or how the force applied to the particles making up the cue and balls works is unknown to contemporary physics. Only the indirect cause of the player taking the decision to put a particular spin on the struck ball is known. Even that may be in doubt; for example a spectator cannot be sure, even if the player asserts it, that the outcome of the strike is exactly as the player wished. Hume, despite Kant's assertion, therefore has some validity in his view.

From these last few paragraphs it is not clear where philosophy, philosophy of physics, or metaphysics stops and physics begins. Consequently we cannot be clear at this stage about the role mathematics and physics are playing or should play in the scheme of everything. Are they real players or human invented bystanders unable to actually determine an overall theory? I opened this chapter with Aristotle's metaphysics and his argument that it should be distinguished from physics as if metaphysics was the more profound treatment of the world around us – which would place physics as a mere bystander. Before we can consider any conclusion of the relative importance of either, it is necessary to consider the philosophical background to mathematics and then physics. The role metaphysics is to play will then become clearer as will my determination of its function in the human mindset.

2.4 Mathematics

Mathematical theories can be developed within themselves without any reference to perception. They can thus deduce ideas outside of universe reality. For example, root –1 especially if –1 does not exist in nature. See Weinstein "background structure".[29] Mathematics, in this case, would be free from background structure from which, it will become clear as this work progresses, means that mathematics has its own reality which may be completely different from the reality of the universe.

I shall thus open with a very relevant quotation from Persson[30]

> "We prove propositions, theories and lemmas in mathematics, but do we explain in mathematics?"

Mathematics has been exposed to a great deal of philosophical debate. It is therefore important to see what affect it has, and has had, on our mindset. It is all very well to explore mathematical theory to extremes but one should keep in mind the question whether these theories fit the universe and explain its fundamentals, or are these explorations more of a mathematical game or challenge to human

[29] Weinstein and Rickles (2015:24,40)
[30] Persson (2011:2)

sapience? Much has been written in text and popular books on these theories so that I need only explain in the briefest terms the scholastic elements. Therefore I shall concentrate on the philosophical aspects and its effect on mathematics' place in the structure of things including the direction of human thought and its subsequent role in physics.

It is not clear when mathematics was first formed as a discipline but documents and tablets have shown that both the ancient Egyptians and Mesopotamians had knowledge of geometry around 3000BCE. Two papyri from 1890BCE and 1650BCE, thought to be teaching documents, are known with problems in the use of fractions and algebra. Multiplication tables were also in use. The Egyptian number system was based on tens with symbols up to a million. The Mesopotamian (Babylonian) system was based on 60, with the 24 hours to a day, 60 minutes to an hour and 60 seconds to a minute, though why 60 was a chosen base is unknown.[31] They also employed multiplication and division tables. However, the concept of number was probably invented earlier than 20 000 BCE, that being the estimated age of the Ishango bone carrying a large number of notches in three columns suggesting possible calculations formed on a base 12 number system. There is, also a recently discovered older notched bone, possibly a tally stick, from the Lebombo cave dating to between 35 and 45 000 years ago but it has not yet been decided whether these marks represent numbers or decorations.[32] Nevertheless it shows that the concept of quantity and possibly mathematics was understood long before the Egyptians or Babylonians.

We all count, learning the symbols 1, 2, 3 … which humans have defined as one, two, three; three being larger than two or one, and so on. Comments are sometimes raised on the way numbers seem to conveniently add and subtract but it is nothing more than the definition of sounds or symbols based on the form 1 meaning singularity – thus 1; 1,1; 1,1,1; … being called one, two, three, It is clear that these can be split, for example, to (1,1),1; = 2+1, which degenerates into 1,1,1 which can be separated into 1,(1,1) = 1+2 so that 3 is an association of 1 and 2 together. Then four would be two lots of 2, and so on.

It seems obvious how we came to these definitions of number. They would have become essential from the earliest days of animal sapience. Nine people in a group might have needed nine rabbits for food – one finger less than the amount of fingers on the hand of the leader of a hunting party. (Or three knuckles less than the knuckles on a single hand if base twelve is used). From there it is a short stage to making marks on a stick or bone, adding and subtracting to know how many arrow heads were traded and so on. Fractions would have developed equally easily through cutting food into parts to serve to the family. Simple thought would have led to the basic axioms without the need for formal

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[31] (Imhausen undated). Maybe it counts as the number of knuckles including thumbs and big toes on both hands and feet = 4×15. (JT)
[32] (Pletser 2012)

deduction, though this would have come later – which is just as well because, as mathematics has developed, some of these rules have had to be carefully amended to cover the developments: for example in matrix theory where if A and B are matrices A×B is not commutable in general.[33]

We can also employ the symbols + and × and by inference – (subtraction), and then include the reciprocal function to × or multiplication as ÷ or division; again easily obtained both from modern and ancient logic. For example it would appear from ancient artifacts that the common method of recording quantities such as the number of boxes unloaded from a delivery van in fives as ~~1111~~ goes back tens of thousands of years. It is equivalent to the form, for example, (1,1) (1,1) (1,1) as three lots of two being six, or dividing six rabbits, caught by a group of ancients for three families, by making three piles and adding one to each pile until the collection of rabbits (six of them) runs out. From these simple definitions we can build up some axioms such as the transitive theorem: if A implies B and B implies C then A implies C. Or the commutative theorem: if A and B are two simple numbers then A+B = B+A, or A×B = B×A. These are basically self-evident truths. If all mathematics is derived from these and other such conditions it should be unequivocal and computations derived from them should be true.[34] Fundamentally numbers are measurement so that mathematics itself can be construed as measurement but it first needs something to be measured. That is numbers *are not a priori*. As mathematics has developed, some of these rules have to be carefully amended to cover the developments, for example, as written above, in matrix theory where if A and B are matrices A×B is not commutable in general. As this has all been assiduously examined by both philosophers and mathematicians, I shall go no further into this subject.[35]

From these simple axioms, deductive reasoning can be used to prove theorems. In a sense these could be considered as a game of logic taught early on at school using geometry, for example, the theorems of Pythagoras. This is an approach which has led to the assumption becoming ingrained in educated people that all deductively reasoned mathematics is true. As Brown points out, mathematical (logical) proof equals certainty, such mathematics has yet to find an exception and this on-going accuracy is a reason for our belief.[36] Consequently, once proven a mathematical theorem lasts forever. Furthermore, as mathematics develops, always through logical arguments, new rules are based on unequivocal definitions. In theory, such mathematics should be truthful to itself, and where errors occur it is due to incorrect application or human error. I shall not go into the philosophical concept of ‘nominalism’ on the existence and abstractness of mathematical objects other than to say that the

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[33] A×B may not be the same as B×A when matrices are multiplied.
[34] Allowing for Gödel’s incompleteness theorem that says given an axiomatic mathematical system it is always possible to find unanswerable questions or even statements that can be both proved and disproved. This is similar to saying no theory can prove itself, or deriving the liar paradox that if a liar says he is lying, is he lying or not?
[35] Hilbert [1899] 1950; Russell [1903] 2019; Gödel 1931; Zach 2019
[36] Brown (2008:2,60-62)

abstractness of so-called Platonic mathematics, being independent of other structures, should not be muddled with abstraction as in abstract art – drawing out of ideas from concrete observation. Mathematical abstractness should be taken as being not concrete in the sense of not having material existence. However, the subject of Platonism is important as it appears to sharpen the strength in favour of mathematical arguments supplying the fundamental concepts of universal structure, in particular those of quantum mechanics and field theory.

As Derek Abbott points out, many mathematicians are Platonists meaning that mathematics is akin to Plato's belief in certain divine concepts in the construction of the world.[37] Plato's discovery of abstract objects corresponds to a view that mathematics is an autonomous discipline whose concepts are abstract entities, existing independently of time, space, humans, and the physical world.[38] (This abstractness will be brought up later in Chapter 3 but needs a basic explanation here). For example, if we take the concept of 'oneness' mathematically, it refers to anything so does not need a specific object to exist and in this sense it is abstract. On the other hand the idea does exist because it is useful. Under this view it can exist as a method of at least providing some basic details behind why universal processes work. It may even suggest the universe is purely mathematical, see Tegmark in section 2.5 on physics. The abstractness takes on an existence in the formulation of the universe. Under either of these views it would seem as though it is a Divine invention in order to create a universe. It would be the same for any universe that might exist as Nunez points out.[39] This is virtually the opposite of the quantum mechanical views that the universe is not independent of humans – or at least sighted beings![40] The platonic view could mean that, as Brown suggests: "Mathematics is *a priori*, not empirical", and then notes that no physical result has ever overturned any mathematical calculation.[41] Linnebo, for example, believes mathematics is discovered, not invented, which perhaps fits in with Lappas and Spyrou that it is genetically embodied in the human brain. Certainly, humans seem to have a predilection for number and measurement.[42] The thought that numbers were first in the world tracks back at least to the Pythagoreans,[43] although Aristotle himself remarked at the end of book N that "objects of mathematics … are not the first principles".

However, to be of complete use to physics these theories must be truthful to the universe as it actually exists. Otherwise they can lead us up false alleys. A problem I find is that mathematical theories can develop from themselves without any reference to human observation or thoughts of our

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[37] Abbott (2013:2148)
[38] (Brown 2008:61, Linnebo (2009:1), Colyvan 2011:88, Bueno 2013:§1, section 1.3.1 (i))
[39] Nunez (1999:48)
[40] Views discussed by many mathematicians and philosophers. See e.g. Lappas and Spyrou (2003), Nunez, Edwards and Matos (1999), Quine (1951), Putnam (1975) among many more including those already mentioned. For further reading see bibliography.
[41] Brown 2008:61,14)
[42] Linnebo (2009:1), Lappas and Spyrou (2003:2)
[43] Aristotle ([350BCE] 1923:bookA§6)

background. They can thus produce theories that might have absolutely no reality to the universe itself, especially in the case where mathematics is considered *a priori*, or separate to the universe as Platonists believe. For example, the square root of –1 is a purely imaginary number. –1 arises, in its most basic sense, as an accounting procedure whether in the form of banking overdrafts or enabling subtraction on the number line to record position such as five paces to the left followed by six paces to the right producing –1 paces from the left-hand point of view. As Weinstein[32] said, mathematics is free from "background structure".

In line with this concept of truth and logic Ancient Greek geometry is well known through modern school lessons. Euclidean geometry relates to the human perceptions of an apparent three dimensional rectilinear space which can be represented by three orthogonal axes used to form a coordinate system. A plane is intuitively described as a two-dimensional space in which any two intersecting or touching straight lines lie. However, an extra straight line does not necessarily lie in this plane unless it connects the original two lines or an extension of them. It is furthermore possible for a line to exist perpendicular to the plane. But in fact, none of these concepts should be taken as anything but intuition because it assumes the universe is actually three dimensional. We have to first settle the, as yet unanswered, question in human reason: why does the universe appear to us as three dimensional? It is similar to some questions that will arise later on the nature of a line: what is a line? Is it a collection of points, or a collection of short lines? In either case is the number of these parts forming a line infinite? For example, if the line is thought of as made of a number of short lines, then can each of these short lines be divided into shorter lines and so on an infinite number of times? If not why not, and how do you prove it?

The ancient Greeks also rested on the concept that if two lines crossed in such a way that any two of the angles formed on one side of those two lines were equal then all the angles would be right-angled. It seems to us as true because we have been taught it is true and it looks true, and it works for engineering and architecture. But it assumes the continuity of a straight line and the absolute nature of a three dimensional space. If we live, as is possible, in a huge curved space then an element of scale would become important as can easily be seen with curved longitude and latitude maps of the earth. On a small scale circular map the crossing latitude and longitude lines are clearly not right-angled although as the scale increases the lines come closer to being right-angled. A square on a plane is a quadrilateral with equal sides and four angles being right-angles, therefore adding up to 360°. But consider a quadrilateral with four equal sides and four equal angles drawn on a sphere. It is possible for this quadrilateral's angles to all be equal and of magnitude, say 120° thus adding up to 480º.[44] (And a quadrilateral on a saddle[45] would add up to less than 360 degrees). Returning to the question of a line: a curve can be described as a series of connected infinitely short straight lines, say between

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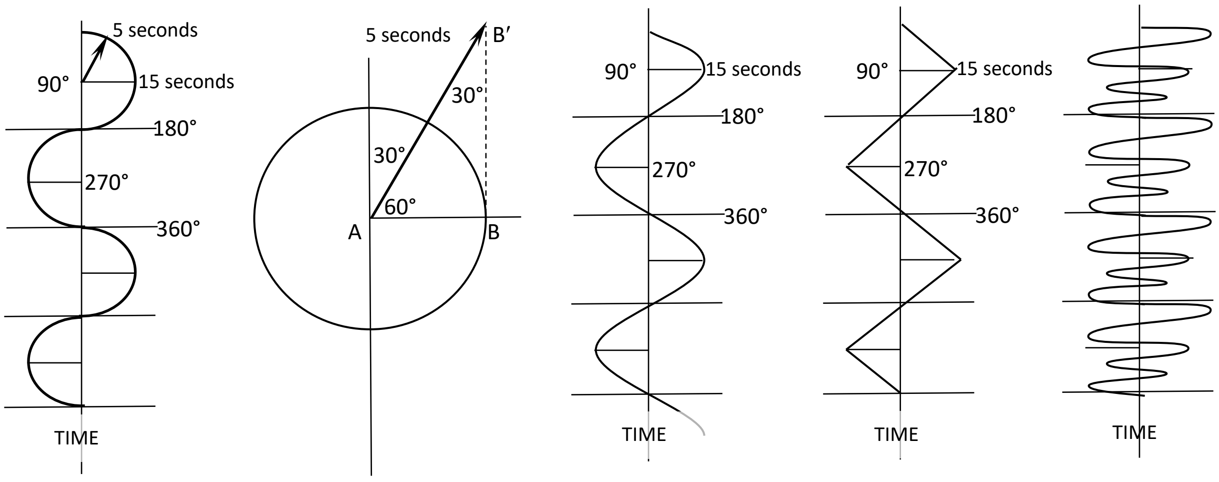
[44] SLU Saint Louis University (2016).

[45] Saddle here is a geometric term used because the form is similar to that of the saddle used for riding a horse.

atoms, but should the distance between the atoms be described as straight or curved? So we cannot be certain that Euclid's theorems are true under all circumstances, especially as we do not know under what circumstances our world exists. So I can legitimately argue that a square is only right-angled if it is on a plane in flat space. But, in view of Einstein's general relativity and curved space-time we do not know whether we live in a Euclidean space with flat planes. So we humans, despite the availability of generalized coordinate systems cannot be certain that our mathematics could in fact reflect the universe because we cannot be certain of a metric (unit of distance for a specific purpose) at the smallest scales. These thoughts may not seem important for engineering design but it is important for rules about the micro-universe.

The building of theorems in an assumed three dimensional space is comparatively easy but in a curved space it is notoriously difficult. Astrophysics is mostly built on curved space requiring advanced university level Riemannian mathematics for which only simple solutions to its possible equations have been established. The average person only experiences simple Euclidean (rectilinear or 'flat' space) geometry and accompanying trigonometry. The latter is built upon the concept of similar triangles of different sizes allowing ratios of triangle sides to be related to angles between them (for straight lines – not curves, for which spherical trigonometry is required). I now give a simplistic explanation of trigonometry, the reason for which will become clear.

Trigonometric functions can be represented by waves. As an analogy think of the second hand on a clock: it starts at zero hours, it passes through a right-angle at 15 seconds past the hour, then to two right-angles at 30 seconds past the hour which is equivalent to a straight line from the starting point at zero to 30 seconds. Then it moves again on the left side of the clock face, as you look at it, through another right-angle and finally ends up where it started. If we define a right-angle as 90º then it passes through ninety to 180º completing the right side of the clock. This can be represented graphically (by marking the position of the tip of the second hand as it passes round the clock face, see Figure 2.1(a)) using two axes to draw a wave representing the angle on the horizontal axis against the time it takes to get to a specific angle along the vertical axis. This is the same as observing the position of the tip of the second hand and plotting that on the graph.



(a) (b) (c) (d) (e)

Figure 2.1. Wave-forms

So at zero time the angle is zero, at 15 seconds past it reaches the maximum width horizontally equivalent to 90º, then to 180º where it meets the vertical line again, which also represents no angle or zero. After that we can continue the process differentiating the fact the angle formed is now on the left side by drawing the wave on the left hand side of the vertical axis until it returns to zero after 60 seconds. Then we can repeat it again and again as the time runs from one minute to two minutes and so on. The line we have drawn on the graph looks like a wave in that it is a set of semi-circles as in Figure 2.1(a). But the angle of the clock hand can also be represented using Figure 2.1(b) which gives the angle subtended at O as a ratio of the radius to the distance above the horizontal line.

The ratio 2.1(b) is independent of the size of the radius as the distance above the horizontal intuitively varies in accordance with the change in the radius. (It can be *demonstrated* geometrically using similar triangles but, as queried before, a *proof* depends on the nature of a line and the idea of straightness. This may seem pedantic but is in fact of fundamental importance).[46] Consequently the ratio allows us to calculate the lengths of all sides of a given triangle if the length of one side is known. Thus looking at Figure 2.1b if the triangle represents the side of the hill and we know that the distance between the two points A and B marked on the diagram is 200 paces 'as the crow flies', we can almost intuitively tell that if B represented a house on a steep hill at an angle of 60 degrees to the horizontal, the distance we would have to walk would be 400 paces. That is, the ratio of AB′ to BB′ is 2:1. Reversing the ratio gives what mathematicians define as the cosine function value for 60 degrees.[47] However, the collection of all the ratios for Figure 2.1(b) as the angle at O changes is the

[46] See e.g.SLU 2016 above

[47] For a right-angled triangle the cosine function is defined as the ratio of the side adjacent to one of the two acute angles divided by the hypotenuse of the triangle. i.e., AB/AB′ = cosine 60° = ½ in Figure 2.1(b). The sine function would be for the other angle and ratio opposite side over hypotenuse which in this particular case also gives AB/AB′ = sin 30° = ½.

sine function, which forms a progressive wave as the angle passes through many right-angles as in Figure 2.1(c). Thus the 60° cosine angle corresponds to the clock hand having moved through 30° in 5 seconds.

As I said, this may seem a rather simplistic explanation of a high, or even junior, school mathematics lesson but it is not to explain trigonometry as such, it is to point out that the relationship between the sine function, or any other basic trigonometric function, fits in with our basic intuition. It is the intuition that is the important concept. We are used to such perceptions which become imagery in our minds when faced with problems. Thus, the concept of a wave and its repetition is not obscure from us. So we take it in our stride without further consideration. But what *do* we mean by wave? And here I am thinking towards the quantum mechanical concept which I hope will clarify the problem of intuition versus definition in physics (see section 2.5).

The simple conception of the semi-circular wave of Figure 2.1(a), is just as much a wave as the sine wave. Another shape is a sea-wave, especially as it approaches a shore and gets close to breaking. It is a trochoidal wave which only approaches a sine wave in shape when the two are very shallow. Furthermore if the clock-wave as described above is drawn by relating its increase in angle of 6 degrees every second up to 90 degrees and then down to 180 degrees as in Figure 2.1(d) the result is a zig-zag wave. Square waves can also be drawn. So it is necessary to consider the elementary question why sine waves are used when applying Schrödinger's wave theory of matter. Sine (and cosine) waves are easy to deduce and easy to apply for a number of reasons. They can be easily added and multiplied together to produce variable waves as in Figure 2.1(e). By adding a number of waves together (Fourier analysis) any form of repeated wave can be reduced to simple trigonometric functions. If mathematics is taken beyond the simple rational number system to complex number systems to include numbers following from the square root of –1, sine and cosine waves can be expressed in terms of the easy to use natural logarithm. They are also easily assimilated by axiomatic mathematics as envisioned by, for example Hilbert in 1899, who attempted to place mathematics on a completely consistent basis.[48] (This was shown impossible by both Bertrand Russell in 1903 and Gödel (1931) who demonstrated that mathematics was susceptible to the so-called liar's paradox: [49] it is always possible to find unanswerable questions or even statements that can be both proved and disproved. This is similar to saying no theory can prove itself, or deriving the liar paradox that if a liar says he is lying, is he lying or not?).

Hilbert's quest was not a new thought as it was based upon his belief that for mathematics to be fundamentally true it had to exist independently of the human brain, and possibly the universe itself. More than two thousand years earlier Plato also had believed in certain divine concepts in the

[48] Hilbert ([1899] 1950)
[49] Russell ([1903]2019)

construction of the world. Arithmetic, for example, compelled "the mind to reason about abstract number", which he regarded as useful training in logical argument. Numbers, to him, represented pure truth as did geometry, knowledge of which "ís eternal". "… geometry will draw the mind towards truth, and create the spirit of philosophy". Linnebo expressed it as "Platonism entails that reality extends far beyond the physical world and includes objects which aren't part of the causal and spatiotemporal order studied by the physical sciences".[50] Dedekind (1888) who is responsible for the real number system currently in use, had a slightly different concept:

> … I consider the number-concept entirely independent of the notions or intuitions of space and time, that I consider it an immediate result from the laws of thought. … numbers are free creations of the human mind;

In modern terms the view has become, again in the words of Linnebo:[52] "Mathematical objects are independent of intelligent agents and their language, thought, and practices." In Kant's language mathematics is *a priori*. In which case, as Dedekind suggested it should pass beyond the human concept of three dimensions.

Hilbert's project based mathematics on a set of axioms that could be applied to any number of dimensions thus taking it out of the human perception of a mere three dimensions or Euclidean space. These axioms, such as the transitive axiom, are, in fact, fundamentally intuitive, meaning they exist without the need for additional thought: "before all thought" as Zach says.[53] Then, to keep Hilbert's proposal human independent, the operations of mathematics such as addition or division or calculus would also have to be *a priori*. This implies that all of its operations should exist without necessarily having a *specific* use – a concept known as 'Formalism' in which mathematical formulae can be manipulated without the need of those formulae to have a meaning. That is, an intelligent being can use these operations for his benefit: for example trigonometry can be used to calculate the angle at which a ladder can be rested against a wall without its base slipping, or trigonometry can be used to calculate the trajectory of a spacecraft, the wind-pressure at a specific point on an aircraft wing, the shape of a hanging chain or the sound of a violin – a disparate list of uses all using the same mathematical concept. Similarly, a simple equation could be used to calculate how many oranges can be bought for five dollars, or, using exactly the same algebraic symbols, it could be used to determine how deep a diver goes in five seconds, or the weight of five cars. As Zach says,[51] Hilbert's mathematics "becomes an inventory of provable formulas", or in Wittgenstein's words "it is only a description of symbols and asserts nothing about what is symbolized."[52] Linnebo argues that "mathematical truths are … discovered, not invented" – which opens an even bigger can of worms: what do we mean by truths?[53] But I will leave that one until Chapter 3.

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[50] Linnebo (2009:§1.2)
[51] Zach (2019:§1.3)
[52] Wittgenstein (1922:3.317)
[53] Linnebo (2009:1)

From Hilbert's simple axioms, deductive reasoning can be used to prove theorems. In a sense these could be considered as a game of logic taught early on at school using geometry, for example Pythagoras. It is, perhaps, worth suggesting here that it is an example of how deeply rooted mathematics is in our schools. As Lappas and Spyrou claim, geometrical proofs are a basis of our culture.[54] I was introduced to them at the age of nine or ten years old. It may be that, as Plato considered, it is a good training for logical thought rather than for its value in everyday mathematics, but it still places a suggestion in the scholar's brain as to the truth value of mathematics in general.

Here it might be worth amplifying these thoughts by looking at a couple of simple cases showing how mathematics can extend itself. An interesting example is the concept of a square root of a negative number since for example -2×-2 gives 4, but in, say, physical mathematics it becomes necessary to deal with square roots of negative numbers. The reason is that transferring physical concepts to mathematical equations to solve problems can involve functions such as the sine function which can have negative values. It is questionable whether this exists by itself in nature – quantum physicists would claim it does but doubt will be thrown on that view in Chapter 7. But, whatever the case, it is a wonderful tool for calculations as it can be used to approximate very closely any difficult to manipulate function. Consequently it is necessary to overcome the difficulty of the square root of negative numbers and this is done by inventing another set of numbers, the complex numbers. Thus we see that mathematics can be expanded in terms of its own rules, and man's imagination, to do things which do not appear in the natural world as such – again quantum physicists might consider such roots as part of their world which they think represents the world we live in.

Another such concept is the series expansion and Zeno's paradox. Such expansions are frequently used in advanced mathematics to handle difficult mathematical problems. For example, one may want to work out how a natural process in nature works so that one can use man-made processes to emulate it. But in many cases the mathematics required to formulate the man-made process arrives at an extremely difficult equation. Nevertheless, a close approximation may be formulated from a series of terms. For example, taking a number such as ½ and by squaring it again and again and adding all the terms one has a half plus a quarter plus an eighth plus … and so on ad infinitum, the sum will get closer and closer to the number one but will never quite reach it. That is a particularly simple series but one can work out other series of similar types to approximate difficult functions. These may even include sinusoidal functions. The advantage may be that after adding, say, ten terms the approximation is close enough to work with. It cannot be used to explain nature's process because, as I shall demonstrate in Chapter 4 and onwards, nature does not need mathematics to attain its goal, but it allows humans to attain a similar goal with human-made products. For example, natural processes can produce proteins without having derived any special theory of how to do so, but if humans wish to

[54] Lappas and Spyrou (2003:2)

manufacture protein from basic chemicals rather than use up valuable land on feeding cows then they first need to think of a process.

These examples together with the sinusoidal function show how mathematics can be extended by human thought without necessarily having any prior rationale in nature. Mathematical physicists may then regard mathematical development as a perfectly logical step in explaining the universe, as for example, the quantum wave theory of matter using trigonometric functions.

In theory, such mathematics should be truthful to itself, and where mistakes occur it is due to incorrect application or human error. It would thus be wrong to move from here without mentioning the Frege-Hilbert controversy over the correctness of Hilbert's axiomatic approach, which turns around Hilbert's interpretation of 'axiom'. This has been largely dismissed in Hilbert's favour by philosophers of physics such as Resnick and Blanchett.[55] However, I see a potential problem. To my mind they take the contemporary physical view that definitions are not necessary to explain the universe. They seem to support the view that only the laws that physics says govern the universe. If these are known (in the sense they always provide testable answers) then that is sufficient. Thus referring to Hilbert's geometrical axioms he does not exactly define the concepts of, for example: line, point, parallelism, *inter alia*. Consequently it is not possible to state his axioms are absolutely true to reality, a very important point when dealing with the reality of the universe (see section 3.5). However, within the terms of geometrical rules (axioms) they produce a workable system and, from this point of view, can be adopted. I shall refer back to this later in section 3.5 on reality concerning the subjects of rotation and infinitesimals. As a result of this general position, despite Gödels and Russell's objections, Hilbert's theory in the form of Hilbert spaces has become a primary basis of pure mathematics.

From there it has become a major mathematical background to quantum mechanics. However, I shall leave quantum mechanics until later. This section is more to explain why mathematics is held in such high repute.

In the meantime I introduce one of the most interesting arguments on mathematics raised by Eugene Wigner: the Indispensability Argument "The Unreasonable Effectiveness of Mathematics in the Natural Sciences" which he refers to as mysterious.[56] This discussion should perhaps more appropriately arise in the section on physics but it fits here as well. His essay is based on the fact that humans have used perceptions (observations) of our surrounds to suggest physical laws governing the universe. These laws can be, and have been, expressed mathematically although they sometimes need amendments as new observations do not quite fit them. So we change our theories or even add new dimensions in an attempt to make them more comprehensive. But this is a natural process due to

[55] Resnick (1974), Blanchett (2019)
[56] Wigner (1960:1-14)

uncertainty and fallibility in new and surprising observations. For example, the succession of satellites exploring our view of deep space outside the Earth's atmosphere leads to observations previously obliterated from our view by that atmosphere. In particular Wigner uses the example of the physicist Max Born recalling knowledge he had of matrix mathematics and using it to good effect in quantum theory. Another is the case of Neils Bohr suggesting a special wave formation for electrons in orbit about a nucleus, and then realizing that his suggestions provided a mathematically based agreement with the spectra of light given off by changes in those orbits. Apart from these there are the cases of Pauli (1930) predicting the existence of the neutrino and Yukawa (1935) predicting mesons through the need to balance mathematical equations on which they were working. These are all factors pointing to the use of mathematics as a basis for the universe. Wigner's point is that mathematics has been surprisingly effective in predicting and explaining human observation, a point agreed by other authors.

Lappas and Spyrou take a rather different view to the autonomy of mathematics, instead believing that it is embodied in the human mind and in social groups, aided by schooling.[57] By embodiment they mean unconscious actions of the mind, so that in terms of mathematics it would be the unconscious, for example, measurement of distances every time we see something, or the number of people in a room. In other words mathematics is a natural concept of the mind which can be extended by teaching; this is a different function to the active function of using it, say to calculate which tin of tomatoes is best value for money (it is the instinctive reaction to some people but others merely buy by brand without noticing the shelf-price). But, of course, for mathematics to be recognizable even if 'divine' as Plato says, we have to use it, or, rather, recognize its usability.[58] In this respect measurement is an inbuilt quality even in most animals when they consider a safe distance from approaching danger compared to the distance to a hiding place.

For humans with language, and other animals bordering on definitive meanings to sounds, such as prairie dogs, mathematics runs hand in hand with survival. Low warning, predator/eagle[59] a long way off, high screech, it's too close! So measurement is ingrained and clearly a survival tool though not available to all living objects. But does the apparent lack of measuring ability of some living objects suggest it is not necessary to existence? For example, we say that atoms have size and thus spatial dimensions, and they move which requires a concept of time – as in change of position over time which is a form of measurement.

On the social scale animals are aware of overcrowding, though perhaps not in number, or in numbers per unit measurement. Humans tend to have a personal space around them. Size and shape react in our brains forming pleasure, indifference or dislike. We cannot even necessarily put this down

[57] Lappas and Spyrou (2009)
[58] Plato ([370BCE] :204-207), translation undated
[59] Slightly different set of sounds – 'it's a jackal'; so everyone knows whether to look high or low.

to experience that, for example, some other person's features may recall some unpleasant earlier experience from a similarly constructed person. Even when very young we can look at a member of the opposite sex and know they are good-looking while someone else may disagree. So shape and size are personal experiences depending on our own brains. And brains are first and foremost dictated by our genes. Different neural connections may set up as we age but these are results of our experiences; the fundamental genes do not alter. Therefore I am led to believe that mathematics is a result of our need to measure and that mathematics has arisen as a result of our evolutionary development from instinctively measuring the distance to an animal needed for food, or of knowing how much is needed to feed the family.

Measurement and mathematics are then fundamentally tied together in use. In this respect mathematics is tied to space, time, and motion, and our recognition of these factors. The question is whether it can be free of space and time? Could there be any use of mathematics without space or time? Could we even say that mathematics creates space and time – if indeed it is 'divine'? Or might it be the other way round? I can argue that if mathematics is tied to measurement then it must require space and time, that is, it cannot be *a priori* to space and time. But without space and time the universe as we know it could not exist. In any case without a universe there would be nothing to measure. Then at best, mathematics could have been born with the universe, but not preceding it. In any case, mathematics is based on numbers and thus measurement in that numbers are principally a form of comparison, which implies these must exist for mathematics to exist. This in turn again implies that if the universe appeared from nothing, numbers and thus mathematics could not be *a priori* to the universe – there would be nothing to be numbered.

Of course, it could be argued that numbers occur because of the rules of mathematics. That is, the rules themselves provide for the numbers as the universe comes into existence – the divine factor of Plato and the mystery of Wigner. Or it may be that the view that the universe began from nothing is incorrect. These are, however, arguments that may be used to defend contemporary ideas. So they must be born in mind but not allowed to interfere with the current investigation whether there is another way of assessing the construction of the universe not based on mathematical principles. We are bound very much by the abstract nature of mathematics, which is avoided by the role of a fundamental or **foundational** philosophy. Thus space and time should take a new significance as they are fundamental to measurement and thus possibly to the existence of mathematics, be it divine (Platonic) or not. This may have a great role in determining why physics has so far failed in its quest for an all-encompassing theory. We shall have to see what transpires from these investigations into the fundamental existence of our universe.

From the comments made by Brown, Hardy and Russell it seems clear that mathematics is considered a precise discipline.[60] This is certainly true in the sense that calculations according to simple arithmetical rules are true. But approximations such as power series expansions[61] cannot be considered precise; they may be very close to true but through additional calculations approximations can diverge from accuracy.[62] However, this is usually taken care of in estimated error factors. But where mathematics can fail is where it is applied to extraneous theoretical rules, or more 'inventive' ideas, formulated by physicists (among others) to explain their observations. It becomes a 'black box' where if rubbish goes in rubbish comes out. Here it requires translation into common language, because, as I will argue and demonstrate later, common sense can be accurate in discerning falsities.

In 'The Structure of Scientific Revolutions' Kuhn deals with the philosophy of change to scientific theories. In it he suggests that mathematics *may* play an aesthetic role.[63] In particular he points out that mathematics is a much neater expression of laws and explanations than a general description. However, I should add that it does still depend on the interpretation of what it actually means. Applied mathematics, the mathematics of physics, has two parts both of which are necessary for a successful explanation. The first is the derivation and use of relevant formulae utilizing mathematical symbols. As mentioned before these are often very general in structure, sometimes up to the limit of having no number meanings at all – mere symbols as expressed above. The other part is the interpretation of these into cognitive language. By that I mean into language which any reasonably educated human can understand. As Persson wrote in discussing the point of philosophy: "We prove propositions, theories and lemmas in mathematics, but do we explain in mathematics?"[64]

Here it is important to consider the Wittgenstein-Quine problem arising from different people having different interpretations of individual words and sentences. This requires clear descriptions of meanings but as will be seen later this, especially in totally new ideas, depends on existing language. Any new, invented, words can only be described in terms of existing words. This will be found to be particularly true with totally intuitive concepts such as space and time, both of which so far have defied any attempts to define them. Many definitions are looped, a classic being energy as the 'amount of work done on a body' and work being defined as 'the increase in the energy of that body'. What information is contained in that? Kuhn argues that paradigm changes are usually small and not completely explicit so that it needs at least one or more scientists to back them by demonstrating they have something to back that is better than the previous. Mathematical changes are often clearer, and,

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[60] Brown, J.R. (2008:2, 60-62); Hardy (2029:4); Russell (1902:73)
[61] A series of numbers in which a given number is added to its square plus its cube and so on as long as one wishes to carry on multiplying it by itself and adding the result to the series. It is useful for approximating numbers like logarithms. If the original number is well less than unity then the additions to the series will get ever smaller so that the series approaches a value beyond which it will not pass called its limit.
[62] Cf Guth (1981:348)
[63] Kuhn (1970:155-158) and p81
[64] Persson (2011:2)

as Brown believes in accord with many people, no clear proof of a mathematical formulation has ever been demonstrated incorrect.[65] Consequently Kuhn believes they are likely to gain acceptance more quickly than those not expressed in mathematics.[65] By example he mentions one of the most difficult theories to understand but speedily accepted: "Even today Einstein's general theory attracts men principally on aesthetic grounds, an appeal that few people outside of mathematics have been able to feel."[66]

Another view backing mathematics was given by Hardy in 1929:[67]

> It seems to me that no philosophy can possibly be sympathetic to the mathematician which does not admit, in one manner or another, the immutable and unconditional validity of mathematical truth. Mathematical theorems are true or false; their truth or falsity is absolute and independent of our knowledge of them. In *some* sense, mathematical truth is part of objective reality.

From these few paragraphs it therefore seems clear that mathematics is heavily entrenched in the human psyche, and particularly in physics. Humans are logical (on the whole!) and thus prefer logical objectivity. Nevertheless, the question should be asked whether mathematics is the be all and end all of research. Under Platonism it is regarded as being independent of humanity, that is, not shaped by human intuition, whereas human sapience depends on perception of our surroundings. Those who practice it believe in its honesty and breadth of expression. Aristotle wrote "The chief forms of beauty are order and symmetry and definiteness, which the mathematical sciences demonstrate in a special degree." Bertrand Russell agrees; "Mathematics, rightly viewed, possesses not only truth, but supreme beauty ..."[68]

This is another aspect to mathematics, its structure or intellectual beauty. It is clear cut. Its features are created by logical deduction. In that respect, it could be said to be the epitome of scientific competency. On the theme of social groups it is not so different from the ancient Greek philosophy schools.

These paragraphs are intended to demonstrate the way in which mathematics with its Platonic features has influenced our thoughts. Humans should ask whether this fixation on mathematics as an absolute necessity to answer universal problems is in the best interests of human deduction. Does it hold back thoughts outside the 'box'? Consideration needs to be given to (1) what extent is this apparent usefulness of mathematics self-centred; (2) whether it could possibly be at the root of the universe; and (3), if not (2), what is the root of both mathematics and the universe? There thus arises the concept of other human views, that is, through philosophical reason or logic. This, after all, must be based on the structure and processes of the universe because the human mind has grown out of the

[65] Brown (2008:2,60-62)
[66] Kuhn (1970:158)
[67] Hardy (1929:4)
[68] Aristotle [350BCE] (1923 M§4). Bertrand Russell (1902:73), (1910:73-74)

universe. From the aspect of an overall theory of the universe it will prove valuable to consider contemporary views of these subjects – views that have developed with the advance of physics.

However, I shall only take those concepts relevant to attaining a final theory. As suggested, our minds should continually consider the questions of mathematical egoism as well as whether it is truly the root of the universe. It should be remembered that mathematics is mindless. It is quite possibly only the result of human thought. It certainly, in our universe, depends on humans to put in information to produce calculations. Humans may play games with it and use it for developing the mind at school. If, as I suggest, the universe requires no mathematics to exist then there must be more to the universe than a set of calculations based on measurement, especially where those calculations involve mind-twisting ideas such as Feynman's calculus or Riemannian geometry.

Finally, one would have thought that if mathematics was inbuilt in our brains, it would be enjoyed by everyone rather than just a few. Perhaps its growing abstract nature stemming from the use of advanced mathematical processes, almost as if mathematicians are treating it as mind games, is daunting. It enters a realm far removed from mere common usefulness to everyday life. Thus mathematics might be viewed by some as impersonal or without personal value.[69] This view is perhaps advanced through the use of algebra which can be seen as particularly abstract compared to the 'reality' of numbers. Many people may also fail to realize how much they add, multiply and divide in every-day life, instead associating mathematics with often boring school tuition – by rote in learning tables et cetera. There is also the possibility that many people consider understanding of advanced mathematics as requiring brilliance of mind.[70] This may be true for the most advanced mathematics required for QM and QFT and would imply that the universe is too difficult to understand without this mathematical brilliance. The mythology of the tribal groups has changed to a new set with mathematics as the leader.

My interpretation of mathematics into plain language depends on human perception whereas mathematics-derived laws may be 'anti-human interpretation' if they deal with unperceivable ideas that cannot be related directly to common sense. Therefore my interpretation may lead to different conclusions to mathematical background ideas though it should agree with instrumentalist outcomes.

The final part of this initial investigation belongs to physics. So it is to that that I shall now turn.

2.5 Physics

Having explored the seductive fixation on mathematics it becomes necessary to consider its relationship with physics, and also to obtain pointers on whether another approach to obtaining an overall theory of the universe is necessary. If so, what should this approach be?

[69] (Dowker, Sarker and Looi 2016); (Gafoor and Kurukkan 2015)
[70] (Chestnut et al 2018)

The introduction of experiment, or testing of theory, by first Bacon (1605) and then Galileo (1632)[71] introduced the modern concept of science based on careful observation and measurement, at the same time imposing suspicion on common sense and particularly the role of philosophical reasoning.[72]

As a result, the discussion of physics' position in human knowledge must include its relation to philosophy and mathematics. In particular it should consider the questions: What is physics? What does it do? What are physical questions and what belong to philosophy? Physics would claim that those questions that can be answered by observation and experiment are acceptable physical areas of research but there are some "deep metaphysical questions" that cannot be answered by observation or experiment, such as why are there physical laws,[73] or why does anything exist in the first place. To a large extent, physics, following Galileo's refutation of Aristotle's dictates, has held that only observation can determine the laws governing the universe, and the deep philosophical questions are incidental. But these questions of existence seem to me to be the most important questions for a fundamental physical theory irrespective of how deep they may be. Surely the answers to these questions are necessary to understanding the universe?

While physics aims towards a so-called theory of everything, this at present refers only towards a mathematical theory bringing the four main forces (electro-magnetic, weak, strong and gravitational) under one uniform theory.[74] Ellis suggests that physics deals with "how do mechanisms operate".[75] I shall show that this is certainly not true: it deals with establishing outcomes from known inputs, that is producing laws by which the universe works so that calculations can be run, but these laws do not necessarily, in fact few of them do, detail *why* they work. Force is one such problem; for example Feynman's calculus allows calculations to be made using the assumption of a virtual particle that operates outside of time, but with absolutely no attempt at describing *how* it may operate.[76] Nancy Cartwright divides physical laws into two types: phenomenological and theoretical of which the first are those derived from observation, and the second "unobservable" which are fundamental and can be inferred.[77] Hume and Kant are of the opinion this is impossible.[78] I argue that inference can only rely on perception which itself is responsible for proposing the phenomenological laws and therefore must be avoided. A phenomenological law cannot be used as a basis for a law supposed to explain its

[71] Sir Francis Bacon: Instauration Magna in two parts 1605 and 1620; Galileo Galilei: Dialogue Concerning the Two Chief World Systems, 1632.
[72] Feyerabend (1993:291); Sankey (2010); Yu&Cole (2014:679).
[73] (Ellis 2012:27)
[74] Peskin and Schroeder (1995:781)
[75] Ellis (2012:27)
[76] (Peskin and Schroeder (1995:13-21)
[77] Cartwright (1983 introduction)
[78] Hume ([1739] 2017:Book1,iv: 13-14) and Kant ([1783]1903:§40)

existence – no law can prove itself. A survey of the general concept of contemporary physics should bear this very much in mind.

The experimental concept of testing ideas, starting with Galileo, destroyed many previously false beliefs, for example that heavier objects dropped faster than light ones, or that heat contained an element of fire, 'phlogiston', which objects carried in differing amounts. The first was tested by Galileo by measuring the time taken by balls of different weights rolling down a leaning trough – the time taken was unaffected by differences in their weight.[79] They took the same time. The second was shown to be false by Antoine Lavoisier (1777) demonstrating that burning objects required oxygen.

A better known, and as a result more explicit, example of the empirical process of building theories is that of electromagnetics. Although the ancient Greeks had been aware that certain products such as amber, when rubbed on fur, could produce shocks or even sparks, the earliest, what might be called scientific investigations started with Gilbert (1540-1603) discovering a range of products capable of producing the same effect. This was before Galileo, but nevertheless laid the ground for further thought. Du Fay (1698 -1739) imagined that these peculiar observations were caused by two forms of fluid which he called vitreous and resinous. Benjamin Franklin (1706-1790) also adopted the idea of a fluid, but he explained it with only one form based on his experiments on electric discharges (such as lightning) or Leyden jars used for storing 'electricity'. Objects could either have sufficient, too little or too much of the fluid. A surge of experiments then resulted in Coulomb's 1785 publication that electricity consisted of positive and negative charges and his corresponding law that like charges attracted and unlike repelled. Since then developments in other fields have led to the modern views of negatively charged electrons and positive protons among other charged and neutral particles – a clear example of how scientific theories arise and change over time as they are tested. Nevertheless current physics has still not deciphered what the actual difference between positive and negative charges is, nor the real mechanism causing this apparent attraction and repulsion. What does attraction and repulsion actually mean in inanimate objects? It seems to be no better in this respect than those of the ancient Greeks, for example Aristotle in his philosophical approach (though titled physics) attempted an explanation of attraction and repulsion between his four elements, earth, air, fire, and water.[80]

As Thomas Kuhn wrote in his respected treatise 'The structure of Scientific Revolutions',[81] theories start with ideas which are suspect until thoroughly investigated. In particular he noted an important point that will be thrashed out in the following chapters:

[79] According to a painting by Giuseppe Bezzuoli (1784-1855) in Florence though painted more than a 100 years later.
[80] Aristotle ([350 BCE] 1991)
[81] Kuhn, T.S. (1970)

> "Both history and acquaintance made me doubt that practitioners of the natural sciences possess firmer or more permanent answers to such questions than their colleagues in social science. Yet, somehow, the practice of astronomy, physics, chemistry, or biology normally fails to evoke the controversies over fundamentals that today often seem endemic among, say, psychologists or sociologists. Attempting to discover the source of that difference led me to recognize the role in scientific research of what I have since called "paradigms." These I take to be universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners." There is "ground for profound doubts about the cumulative process through which these individual contributions to science were thought to have been compounded."

This reflects an important point that I, too, at school long ago had considered, and runs firmly through this work: that all physics is based on human interpretation from perception and cannot therefore be considered absolute. There is a similarity in human thought processes leading to both ancient myths and 'so-called' physical laws.

Turning to the basis of contemporary physics, the structure of matter and how it forms the universe. Even now after a great deal of work; thoughts of the form described above, developing existing ideas; developing ideas with atom smashers, with space satellites, radio astronomy, advanced telescopes – I claim it has missed the fundamental points. It has not started from the 'beginning', but has picked up isolated threads from human experience without connecting them back to a true fundamental basis from which to work. For example, physics asserts four fundamental entities space, time, mass and electric charge, none of which are defined. Of these, mass is believed to be somehow responsible for gravitation; and charge for the properties of attraction and repulsion between particles, causing them to bind into specific forms. But the actual constitution, what is, how and why questions of these effects, is still unknown. In an attempt to answer the question of what everything is made from, instead of asking about the actual entities of space and time upon which our human insight rests, it traditionally advances from ideas that have failed to produce these answers. Quantum mechanics (QM) and quantum field theory (QFT) have arisen as an attempt to explain, respectively, the concept of matter including mass, and its interactions including electromagnetism, (see Chapter 3). These theories produce some, what even their protagonists would admit, seemingly absurd ideas including a question over the reality of existence itself.[82]

Scientists should consider the meaning of reality in terms of human concepts, the human feeling of solidness, concreteness and 'material being' created by the ability to touch. In this sense the question has to be asked whether quantum physicists have thought far enough to overcome some of their more peculiar ideas, for example, as given in section 2.6, their idea that the world is made of

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[82] Schrödinger (1935:3); Penrose (2004:507); Rees (1987:46); d'Espagnat (1979:158) and argued against by Einstein, Podolsky and Rosen (1935) (**EPR**)

objects that cannot be considered real (comment attributed to Bohr)[83] and now adopted as a QM principle. They should have explored the senses of touch and observation by sight of what we regard as solidness and occupation of space in expanding their ideas. These and allied concepts become 'problems' when confronted by human common sense, a point that will arise throughout this article. As a result, common sense becomes an interface between science, philosophy and education with a commonly held view that, as above, human common sense is unreliable,[84] it being assumed to be based at best upon human perceptions and interpretations of our surroundings. There may be far more than one interpretation to each perception (see Chapters 3-4).

To quantum theories should be added Einstein's (1916) General Relativity (GR). Much of the last ninety years has been spent trying to correlate this to quantum theories. GR, as with most relativistic field theories, is mathematically so complex that only the simplest solutions have so far been obtained, providing ideas for exploration rather than confident conclusions. A possibility of coordinating the two (GR and QM) has recently arrived, loop quantum gravity (LQG), but this, too, has its problems; it requires reforming some sacrosanct physical concepts (for example, spacetime continuum see Chapter 4). If these problems could be overcome allowing QM and GR to be amalgamated, it would be a major step in producing the so-called 'theory of everything' (TOE) – a combining theory of the four forces thought to rule the universe, the electromagnetic force, gravity, the strong and weak nuclear forces – also called the grand unification theory.[85]

These last paragraphs deal with the standard cosmological questions of physics. I should also include what might be called engineering and architectural physics. These rest on the classical equations taught at high school: Newton's second law relating force to mass and acceleration, the energy and momentum equations, stress and strain, power, rotation and so on, and, of course basic electrical engineering. These are taught as basic established, absolute facts written in 'stone'. In fact none of them are derived from first principles, that is from an absolute understanding of the terms they use. They are purely hypothetical concepts that have so far never been found to fail. If they are true and if a fundamental cause of the universe can be established, then they should all be deducible from this cause. If not then one has to ask how they relate to the probability theories of quantum mechanics (described briefly in section 2.6). Bohr's concept was that while quantum theories relate to the micro-universe, quantum theories also have to meet human beliefs in classical physics on the large scale; the so-called correspondence principle.

The last hundred years has seen advances and exchange of knowledge in the physics of the universe increase at an almost exponential rate; not only through the ability to construct ever larger

[83] Cf Leggett (2002:419)
[84] Yu and Cole (2014:680); Maxwell (1966:295)
[85] Peskin and Schroeder (1995:§22.2)

and more powerful telescopes (e.g. Hubble and Keck) and research equipment, (e.g. the CERN accelerator) but through the introduction of computers enabling viciously difficult calculations to be carried out in seconds and information transferred equally fast. Indeed this article could not have been finalized without such technology. But despite the huge resources, both mechanical and human, the attainment of an all-encompassing theory seems as far away as ever as more and more problems appear with every observation.[86]

Putting a value on a few of these resources reveals a huge expenditure. The CERN large collider responsible for the so-called discovery of the 'God-' or Higgs-particle cost $4.75 billion to build let alone run (about $280 million a year). There is also talk of a successor, a super collider, estimated to cost €21 billion. The ITER (International Thermonuclear Experimental Reactor) is running at several $100 million dollars per year. Its total cost is expected to be as much as $65 billion by the time it works, if it ever does – forecasts of fusion reactors being viable have continually been said to be within 10 to 20 years since the 1960s. NASA's 2021 budget is $21 billion. Hubble has cost about $15 billion. Planck missions about €700 million and the Herschel observatory about $1.4 billion to date. These estimated costs, of course, are only for these pieces of equipment, so do not include the costs and expenses of general university research throughout the world on other projects and research. The question has to be asked why, with all these expenditures, physics is still nowhere near providing a complete theory of the universe.

Perhaps the most valid comment is that of Hossenfelder (2020) in "Why the foundations of physics have not progressed for 40 years" – new methods are needed with greater care over financing research. "The major cause of this stagnation is that physics has changed, but physicists have not changed their methods".

With this in mind, I shall take a look at the main theories behind physics research at present starting with quantum mechanics. This is fundamentally a mathematical theory and this I feel is part of the problem. No theory can prove itself. The problem with mathematical theories is that they become reduced to formulae with no interpretation into plain language. As a result it is difficult, if not impossible, to check them against another theory. When considering such theories recall Persson's contention "We prove propositions, theories and lemmas in mathematics, but do we explain in mathematics?" Forgive me, I shall repeat this as and when necessary. Consequently I intend to rule out mathematical statements, instead converting their intent into plain language so that they can be tested by the methods of logical deduction and their sense established or rejected as seems required.

2.6 Indeterminacy and reality

Quantum mechanics originated from four major proposals made over the period 1905 to 1925. The

[86] Witten (2005)

first was the concept proposed by Einstein (1905a) and Planck that energy is transferred in bundles. In 1911 experiments by Rutherford suggested a nuclear-electron structure of the atom, which Bohr concluded would collapse rapidly. Consequently, Bohr, in 1913, introduced the concept of non-energy-radiating electron orbitals on the assumption that electrons could only radiate energy in the quanta, or energy bundles, proposed by Planck and Einstein. Finally, in 1923/4 de Broglie proposed that all so-called matter might be composed of waves, in conformation with Bohr's orbital-energy concept – which had been validated by spectroscopic analysis of light emitted from hydrogen atoms. Formal QM followed from these proposals when in 1925 Heisenberg produced the first conceptual statement of QM now known as the Heisenberg picture. Later in the year Schrödinger gave a second picture in which he proposed a fundamental wave-energy equation based on the mathematical 'wave function' which has become the central theme of QM. This wave function is a purely mathematical function which is said to contain all the information about the wave representing a particle.

The QM waves themselves have been called 'matter waves'. They are said to build up with one another to form a particle in which case their name of matter waves becomes clear – they form particles. But being a conglomeration of a number of waves, a wave packet, or particle, formed from them has no certainty which one of the conglomeration of waves actually takes part in any specific interaction with another particle. There is then no certain outcome that can be predicted before-hand.

Furthermore these matter waves are actually taken as having different energies in the same way as light and cosmic rays carry energy. This enables physicists to relate them to momentum so that they fit in with existing mathematical expressions. But, as just mentioned, there is a draw-back: as the packet contains many individual waves with different momenta extending over the length of the packet, the interaction does not necessarily take place at any particular point in that packet. Consequently an experimental or observational outcome of the velocity (momentum) of the particle gives no true idea of the particle's exact location at the time the interaction takes place. This is Heisenberg's uncertainty rule which forms an important part of all quantum theory, often expressed in the form that if a good idea of the velocity (momentum) of the particle is found there is little knowledge of its exact position, or vice versa. Consequently these problems require special new rules to cover them which do not fit in with normal concepts of human intuition and understanding of our surrounds accumulated over the history of the human race.

It leads to peculiar ideas because the uncertainty means that in any interaction the interaction itself leads to an outcome (observation by a beholder) that picks out the conditions held by a particular matter wave in the packet. Einstein objected to this because it meant that what is called local reality is lost. That is, no particle could be guaranteed to perform as expected. This would mean that we could only know anything by causing an interaction. A point also made by Hawking and Mlodinov.[87]

As a consequence Bohr, one of the main founders of quantum theory with de Broglie, Schrödinger, Heisenberg, Pauli and others, asserted, as a result of mathematical work, that the world is made of things that are not real: “Everything we call real is made of things that cannot be regarded as real” (Bohr). “The doctrine that the world is made up of objects whose existence is independent of human consciousness turns out to be in conflict with quantum mechanics and with facts established by experiment” d’Espagnat (1979). “In the beginning there were only probabilities. The universe could only come into existence if someone observed it. It does not matter that the observers turned up several billion years later. The universe exists because we are aware of it” Rees (1987).[88]

I shall not go into this further here though these peculiarities will be mentioned again in various contexts.

The other major basis for modern research is Einstein’s (1916) General Relativity (GR) referred to a few paragraphs ago. Like quantum mechanics, its idea is simple and, as it turns out, important to understanding some basic aspects of the universe. It is founded upon human perception. For example, many people have experienced the sensation of sitting in a stationary railway carriage and on seeing another train slowly moving past mistakenly thought that they had started to move. Exactly the same concept occurs in a lift. If it rises steadily its occupants feel no sense of motion but if it accelerates upwards they feel themselves pressing on its floor. Conversely, if it starts to move downwards they feel lighter. But equally if a descending lift slows down the occupants feel pressure on their feet and the opposite if it speeds up. There is therefore no difference between a rising lift slowing down and a descending lift speeding up, and vice versa, as far as our perceptions are concerned.

Similarly, if a bucket of water rotates in the universe its water moves towards the bucket’s edges. But suppose the bucket is stationary in a uniform room and we are floating on the surface of the water. If we notice the water appears to be forced towards the edges of the bucket so that it rises there slightly in relation to us, it could be that the universe is rotating to cause that rise, but not us.

Forces are created by a change in motion (and vice-versa), for example motion in a circle automatically provides a centrifugal force, so motion in a curved space should also produce a force. Einstein’s principle agrees with Newton’s that mass is responsible for gravity and this was indistinguishable in human perception, but goes one step further giving a cause which Newton realized was essential though he could not explain it. Einstein saw it as a circular field of force

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[87] Hawking and Mlodinov (2011).
[88] Bohr cf Leggett (2002: 419); d’Espagnat (1979:158); Rees (1987:46).

created by a mass against whatever form of structural volume the universe has. A simple idea but one that is mathematically extremely difficult to formulate, and even more so to combine it with quantum theory. Physicists believe that such a combination would pass into solving problems in other scientific fields so that it would in fact be a theory covering all science.

However, there are those who question whether such a combination would present a complete, or final, theory which overarches all processes of the universe. Ellis for example, [89] states that physical laws cannot answer ultimate questions on themselves – why do they exist or are they complete (see EPR Chapter 8). This is equivalent to stating that no theory can prove itself. It must therefore be capable of being tested outside of itself[90] – a somewhat difficult process in QM as QM refutes the concept of any local reality.[91] Consequently, doubt should arise whether an overarching theory can ever be reached, using quantum mechanics anyway, and of what form it may take. This view has been the subject of a large number of writers, both physicists and philosophers.

An interesting article in Nature in 2005 surveying eleven physicists gives three hopeful of success: Weinberg, Smolin, Stachel; six reserving judgement: Ellis, Randall, Fukugita, 't Hooft, Witten, Susskind; and two believing such a theory is far off: Rovelli, Penrose. Baumgarten in 2017 argues that such a theory will arise through clarifying existing physical theories. Of those quoted in Nature, only Ellis expresses real doubts concerning this, while Rovelli and Penrose believe that, like EPR, something is missing. Ellis later called for a conference on "the wildly speculative nature of modern physics theories" (in Wolchover 2015). None of these scientists appeared to consider that perhaps a totally new approach might be necessary (String theory, not considered in this treatise is approximately 50 years old).[92] But Baumgarten points out that if the final theory arises under current conditions then it has to be a tautology, it will add nothing new. He also rules out "like Weinberg" that any such theory can be derived by reason alone. It can only come from fully explained physical laws.[93] Physical content must destroy a final theory's truth value as foreseen by Ellis: as he points out equations are limited to predictions, especially as they are built around limited knowledge of local observation about particular rather than general problems; physicists cannot create experiments that answer the metaphysical questions. [86] Physics can tell how to use the so called laws but not what the universe is – "conditional statements" according to Wigner[94]. Eddington in 1928 put it that science constructs a world symbolic of "commonplace experience" which can be misleading and thus not

[89] Ellis (2012:27,28)
[90] Popper (2006)
[91] EPR (1935); Bell (1964)
[92] Cf Greene (2000:136)
[93] Baumgarten (2017:2, 4,11), contradicted by Feyerabend (1993:291)
[94] (Wigner 1960:7)

necessarily truthful to the underlying structure.[95] So, as with Feyerabend, we must consider that physics is "not sacrosanct." It "may have basic faults" and be "in need of global change".

Thus the views of mathematical necessity in the methods of physics are not surprising. These, now traditional methods of research and thought over the last hundred years have been shaped by the views of Einstein and Dirac.[96] They reflect exactly 'the state of the game' at present. The physicist determines by experimental means the measurements of the universe that give values according to human systems of measuring units. He then determines the assumptions that will allow interpretation of these results assuming them to be generally representative of every part of the universe. From these he formulates rules, or laws, that combine the experimental results into predictive equations. He performs further experiments to ascertain whether the rules he has imagined are correct. The basis of his research then becomes **measurement**, that is, mathematically structured valuation based on some human system of measuring units. The process is thus, human perception proceeds to measurement followed by interpretation. Both Einstein (1936) and Dirac (1940) are clear that the laws of nature are to be expressed mathematically.[97] In this view observation, and only observation, forms the basis of physical laws which themselves form human scientific knowledge of the universe.[98]

As a result of these two maestros of the physical fraternity, mathematics has been taking an ever increasing role in the hunt for an all-encompassing theory of the universe. At the very least, mathematics is now entrenched as the only way in which any theory of the universe can be expressed.[99] Its ability to underlie the human construction of rules to predict conclusions – and formulate rules such as Maxwell's (1865) electromagnetic equations (cf Krauss 1984) – has had a massive impact on advancing physical theory, and has been treated at length from the philosophical view by many philosophers.[100] As mentioned earlier it gave the lead to Dirac (Field theory in 1927), Pauli (The neutrino in 1930), and Yukawa (mesons in 1935), reinforcing its apparently eternal quality as a basis for everything.[101] Indeed mathematics' rhythmical undertones can be perceived in music, art and advertising.[102].

However, one physicist, Max Tegmark[103], has gone a step further. He believes that the universe is purely mathematical. "There exists an external physical reality completely independent of us humans" or any other sentient beings; and "Our external physical reality is a mathematical structure." How this would work is not clear as the mathematical formalism does not exist at this stage; rather it is a

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[95] Eddington in (1928:141)
[96] Einstein (1916):221); Dirac (1940):122)
[97] Einstein (1936:324) and Dirac (1940:124)
[98] (cf e.g. Stenger 2015:1-4; Einstein 1933:274)
[99] (e.g. Baumgarten 2017:1, Penrose 2005:18) as well as others already mentioned
[100] For example Kuhn (1970) and Cartwright (1983:5, 11)
[101] Lappas and Spyrou (2003)
[102] (Bhat, Wani and Anees 2015, Tubbs 2014, Gamwell 2015)
[103] Tegmark, M. (2007).

collection of theories, but he points out ideas that might eventually produce reduction to a single overarching fundament. His concept is similar to Aristotle's philosophy (see Chapter 3) of trying to find a first principle by analyzing human thought structures from the general to the particular. Tegmark considers various forms such as scalars, vectors and tensors, or rotations and translations, being functions of a more simple structure – what mathematicians call an irreducible representation – one which cannot be any more elementary. Further, he believes it should be possible to reduce measurements (units of scale) to a commonality, that is, to pure number form. To some extent he puts his finger on a problem of observation. Our universe is complicated in that we see the large picture composed of enormous groupings of minute entities forming their own group structures. Consequently it is extremely difficult to work back to the real underlying fundamental structure. (This will be seen clearly in the following chapters even down to 'hidden from us' factors).

Clearly, physicists believe mathematics works for them and provides answers to properly constructed questions. Here properly constructed means unequivocally defined input for, as computer analysts say, rubbish in – rubbish out! It is also here that we have to be careful because 'applied' mathematics, that is, physical mathematics whether it is for astrophysics, rocketry, industry et cetera, depends on its applicability. So while mathematics may be seen as true in itself, it depends very much on its interpretation and usage when applied outside of itself. The question might even be asked whether some of the more recondite mathematics might be beyond any requirement of a mathematical description of the universe. Have these advanced concepts arisen because of themselves, meaning that they are muddying the waters of far simpler explanations? The belief is that we only need to determine mathematics' rules and apply them to ensure proper construction.

To finish, it is well worth looking verbatim at two passages used by Einstein in an address for Planck's sixtieth birthday as much emphasis can be lost in paraphrase.[104] They limit the scope of physical endeavor and to a large extent decry the possibility of transcendental thought in the armoury of methods available to the human race. They thus need to be examined in the light of the failure of physics to achieve its ultimate target.

> "Man tries to make for himself in the fashion that suits him best a simplified and intelligible picture of the world; he then tries to some extent to substitute this cosmos of his for the world of experience, and thus to overcome it. This is what the painter, the poet, the speculative philosopher, and the natural scientist do, each in his own fashion.
>
> It demands the highest possible standard of rigorous precision in the description of relations, such as only the use of mathematical language can give. In regard to his subject matter, on the other hand, the physicist has to limit himself very severely: he must content himself with describing the most simple events which can be brought within the domain of our experience; all events of a more complex order are beyond the power of the human

[104] Einstein, A. [1918] 1960.

> intellect to reconstruct with the subtle accuracy and logical perfection which the theoretical physicist demands."

These paragraphs seem to reject any thinking outside the 'box', that is, ignoring intuition in favour of only observation. Is this in the best interests of human deduction, especially when viewed in relation to Einstein's ability to produce completely new ideas? But then he did, I suppose transfer all his ideas into mathematics. Maybe this is why he was unable to produce his final hoped-for theory of everything, because he only thought at the end in terms of mathematics – a thought that maybe should be constantly kept in mind. On the other hand, I should perhaps not ignore Einstein's principle that every process in the universe should be transcribable into mathematics. It would make a good test for a totally philosophical deduction.

I should state here these are mostly the views of physicists and mathematicians. I put them in as forthright way as possible without arguing about their truth or falsity – that will come later. In any case, it is hard to find any sensible contrary statements against them in the literature. The usefulness of mathematics to physics is not in doubt (see Hughes), and, as above, according to Wigner,[105] where he refers to its effectiveness in promoting physical theories, its apparent accuracy appears to be also equally mysterious. The adopted implication would be that the effectiveness is due to a close affinity between the laws and structure of the universe with mathematics – taken to the extreme by Tegmark. Hamming in a similar essay writes "Constantly, what we predict from the manipulation of mathematical symbols is realized in the real world."[106]

Einstein and Dirac, among many others, are clear that the laws of nature are to be expressed mathematically. Consequently the relationship of mathematics not only to physics but more importantly to the human psyche should be considered, because that must play a role in the methodology adapted.

2.7 Philosophy v physics, a pointer to a new methodology?

The arguments raised above appear to have devolved into a struggle between philosophers and physicists perhaps polarizing the two sides, maybe even subliminally leading to the concept that metaphysics should follow from physics rather than plying an alternative road to an overall theory. Unfortunately, the distinction between 'philosophy of physics' and 'metaphysics' is not always considered by physicists, the two sometimes being conjoined and then rejected in the physical consideration of natural laws; for example Weinberg writes "the teachings of philosophers…[won't] provide today's scientists with any useful guidance."[107] Stenger records[108] most physicists believe philosophy is only of interest to philosophers; that "observation is the only reliable source of

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[105] Hughes (1985:40-59); Wigner (1960:1-14)
[106] Hamming (1980:82)
[107] Weinberg (1993:Ch 7)
[108] Stenger (2015:1-4) in article on discussions by physicists. Krauss, Baggini, Tyson, i.a.

knowledge about the natural world". A 'logical positivist' view originally suggesting that *only* physics can provide factual knowledge about the universe but now somewhat relaxed in the view that, although observation is the centre of physics, philosophical input is used by physicists in its interpretation. Nevertheless, an extreme stance was taken by Hawking and Mlodinow who declared that "philosophy is dead" because it has not kept up with advances in science, not that this is true:[109] in the philosophical literature there are numerous references to contemporary physics in the form of cosmology, quantum mechanics and field theory[110].

However, a question rises over the meaning of Hawking and Mlodinow's bald statement, as indeed of Weinberg and others of the same ilk: Do they accept or refute that the principle of metaphysics was, and still is, the discovery of the fundamental reality of the foundation of the universe? Their statement seems somewhat arrogant in assuming that all the peculiarities of contemporary science are absolute, and philosophy has not been able to particularize these deductions. Or do they mean that philosophical questions concerning the truthfulness of modern science are null and void? They may here have a point: human perception may differ from one person to the next so that many views can be entertained, none of which can ever be regarded as absolute although every one may appear to agree with apparent observation. There may be more than one explanation for a given set of data.[111] The same problem would apply equally to all physical theory.

Against this, de Haro (2013:5) pointed out that not all of theory is purely scientific; it has to take into account that theory, even when based on experiment, is an interpretation of the human mind, as pointed out earlier, and therefore open to philosophical review. As with Ellis, Zinkernagel, or Feyerabend, he sees the possibility of philosophical enquiry giving new insights into knowledge[112]. An examination of many of the theories will show that physicists adopt philosophical arguments, particularly on aspects of reality.[113] Weinberg in his much cited 'Against Philosophy'[104] states that physicists use their own philosophy with no need of external sources – often expressed in unintelligible language. He complains that philosophy is a "*great danger*" because it may cause physicists to question established theories. This is actually perhaps a strong argument in favour of philosophical questions (see Ellis[109]). After all, physicists, possibly more than in any other discipline, are entrenched in 'accepted' theories.[114] These 'accepted theories' are often without fundamental definitions and assume absoluteness without any form of proof. They cannot even begin to answer questions such as why anything exists, or what mass or electric charge actually are, or even more

[109] Hawking and Mlodinow (2010:13)
[110] See e.g., philosophical articles by Esfeld (2018), Fraser (2018), Myrvold (2014), Dorato and Laudisa (2014), Frigg (2014), Weinstein and Rickles (2015), Vaidman (2014), and Ney (2016).
[111] Kuhn (1970:76)
[112] Ellis (2012:27-29), Zinkernagel (2011:215,217), or Feyerabend (1993:317)
[113] see e.g. Mermin (1981), EPR (1935), Ellis (2012)
[114] Bird (2000:37,45); Duck and Sudarshan (1998:5); Fischbein [(1980]1982); Sherin (2006); (Ogborn 2011); Feyerabend (1993:164,207)

fundamentally what time or space are. As a 2007 University of Florida philosophy course says "Some of the simplest questions we ask about things are also the most fundamental and the most difficult to answer. … When [they] go deep enough, they are philosophical in character"; a point that will need to be taken into account in constructing the arguments formulating a theory of everything, or final theory. By ignoring the philosophical side physicists may be ignoring valuable pointers to unexpected solutions. If we do not know the nature of something how can we formulate laws about it? Stenlund suggests a further view that when physicists engage in philosophical discussions they are between physicists using their own mathematical-physical arguments and methodology.[115] External views can provide insights that do not arise through physical observations or mathematical constructions.

Returning to Hawking and Mlodinow, they unintentionally raised, or rather missed, a very important point: Physical theories are based on human perception which may vary from individual to individual. If they are not to be tested at an extra-theoretical level how can anyone 'know for certain' they are correct. Merely calling them mathematical neglects the problem raised earlier that this depends on both human observation of the universe and interpretation of these observations. The resulting mathematics will only follow the data it is given. There should be an underlying foundation that can be determined as truthful. Here, Kant's problem raises its head: reality must be the primary (*a priori*) or foundation of existence. The establishment of such reality can only be made by human sentience.[116] However, there is a partial way round this difficulty, the concept of a self-evident premise. Again, one has to veer away from the often used concept 'self-evident truth', due to its self-evidence being purely in human interpretation. Nevertheless, self-evidence seems the closest we can ever come to truth, provided such a 'truth' contains the possibility of a contradiction should it actually be false. In the case of a universal foundation, one would guess that it would reflect the most basic notions of human perceptions: those of space and time. This would agree with Aristotle's fundamental causes.

In any case, the nature of reality is not necessarily the first foundation because it depends on the existence, or being, of something in the first place. So an overarching rule, something that determines foundational reality leading to human observation, must follow from existence. But this creates a vicious circle because, again, humans can only conceive of existence by existing themselves. Thus we must be led to the principle that a first cause – or foundation for a theory of the universe – must, by its end, establish two things: (1) the reason for existence, and before that (2) the other fundamental problem, into what is anything that might come into existence to be placed? Thus the concept of metaphysics in the study of reality and Aristotle's first causes cannot be separated from a

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[115] Stenlund (2003)

[116] (Kant [1783]1902: Part3), cf Wilshire and Walsh (2018) who reflect on the concept of knowledge allied to the concept of truth, also cf Carter (2003:159).

comprehensive, or final, theory of the universe. It must, in fact, provide an overarching rule which itself will determine the physical laws. Therefore I am using the concept of a first cause to be a concrete step rather than the instigator of the step. The 'why' of existence becomes the creator of the first cause, not the first cause itself. 'Why does anything exist' becomes the ultimate question as this would motivate the first cause or foundational principle. Hopefully then an analysis of the first cause, engendered through tracking its development into creating a universe, might lead to suggesting the initial 'why does anything exist'.

Furthermore the complaints that metaphysics does not take into account the latest views of physics should consider two points: (1) Physics' main theories are founded upon extreme hypotheses, or guesses – for example, de Broglie's idea in 1925 that matter is composed of waves, or Schrödinger's equation which he formulated in 1926 as a pure guess and has not yet been derived by physicists from first principles.[117] Many QM ideas appear illogical and so cannot be accepted without question. It should not then be surprising that *traditional* metaphysics, which is concerned with 'being' does not take onboard such views.[118] (2) and more importantly: Physics does not have to be the only method of deriving the essential knowledge of the fundamental structure and existence of the universe. Physics cannot prove its own ideas and in any case has not provided such an outcome. Other methods could be efficacious and should therefore be pursued. Perhaps this is a philosophical point but nevertheless the possible usefulness of 'think tanks' and external (meaning outside of physics) thought experiments should not be scorned. Current empirical thoughts have failed so human sapience has to pass into the transcendental.

The trouble is that there exist views, like those of the philosophers French, Maudlin, and Ladyman and Ross, that believe physics has advanced to the stage where it should be accepted as correct and philosophy should now follow from physics rather than challenge it (see Chapter 3).[119] These can only add to the entrenchment of the absoluteness of mathematics and physics as the sole determinants of understanding the universe. The more obtuse their views, the more it seems to add to their apparent profundity and to the deference of non-professionals. Instead of broadening the area of enquiry they restrict it. While they may suggest mathematics can produce ideas "beyond the capacities of individual minds" (Ladyman and Ross),[116] they forget that mathematics is the product of human beings and is restricted from transcendental thought by its axiomatic nature.

To end with two contrary views, even Einstein, perhaps the epitome of philosopher-scientists, believed reason alone could never explain the basic structures of the universe.[120] But this, to me, is a

[117] (Renn 2013)
[118] French (2012); Ladyman and Ross (2007); Maudlin (2007)
[119] Ladyman and Ross (2007:300)
[120] Einstein (1933:274)

challenge, and I believe a falsehood, that must be engaged; see also Hume although Einstein had accepted Kant's revision.[121]

And from Colyvan:[122]

> "Those who would dismiss mathematical explanation are on very shaky ground. … The job of philosophers of science and mathematics is to help make sense of, and contribute to, science and mathematics as practiced. The role of philosophers is not to overrule the pronouncements of mathematics and science on philosophical grounds."

This conflict between physics and philosophy must lead to a question on the direction of human studies. It seems to me that the philosophical arguments and physical theories raised must, by their failure to explain these questions, be highly suspect, especially when they lead to peculiarities that defy human common sense such as the universe being constructed from entities that are 'not real' (section 2.6). If this criticism is even possibly correct, it means the standard methods have to be amended or replaced by a new methodology. It is towards this new methodology that the next chapter is addressed. As Stenlund (2003) suggests, philosophy is at its best, "alive", when it questions its own methodology.

It can thus be said there are clear changes in the direction and form of human thought. Some of these take time to shift such as belief in a pantheon and mythical heroes establishing human mores. Using Kuhn's concept of paradigm changes there seem to be two types of changes: minor – those which keep the main theme intact, such as in the development of electromagnetic theory which started in terms of a liquid basis, and then set on a field force based on two different charges; and major changes where an entire method of thought itself changes. For example, it is firmly established (entrenched) that mathematics is essential to understanding the universe and any overall theory will be set in mathematics while philosophical reasoning cannot achieve such a theory. Safety relies in accepting that dogma. I argue that mathematics has absolutely nothing whatsoever to do with the construction of the universe; and I will argue the only possible route to finding that universal construction is through non-mathematical reasoning based on a fundamental cause. That would represent a total change in methodology if it can be tested to provide an explanation for all the human observations of this universe.

Consequently, taking into account all the comments in this chapter, I shall turn to the possibility of a new philosophical approach to the subject of the fundaments of the universe. The underlying theme so far has been the suspect nature of our perceptions, especially their shaping by group mentality, the over-reliance on mathematics and its truthfulness, the lack of definitions, and entrenchment of physical views by various means. In particular, the theme has questioned the idea

[121] Hume (1777:§25); Einstein ([1939]1960:2)
[122] Colyvan 2011:88

that mathematics is fundamental to the universe. The implication has arisen that mathematics could not have preceded the formation of the universe; which in turn implies it is, in fact, a product of the human mind as a science, and as pure measurement in the living minds of animals. It arises from the evolutionary protective and/or hunting mechanism. This must place doubt on the methods so far employed and it should obviously form a basis for a philosophical intervention raised in Chapter 3.

Much of this treatise will then rest on examining the most fundamental aspects of human reasoning concerning the basic structure of the universe. It should be expected that this may impinge upon some of physics' most entrenched ideas, particularly if such an investigation signals the need for a fundamental cause of the form denied by quantum mechanics. It should then further be expected that this work: (1) will produce a completely new method of looking at the universal structure; and (2) will challenge some of the most accepted physical ideas. .

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CHAPTER 3

Foundational thought-experiment to definition of Time

3.1 Introduction

Chapter 2 suggested that current ideas, by relying on human perception of our surroundings, are highly suspect, being of the form of a modern mythology entrenched by group norms. There is obviously a much greater reliance on observation and research today than in those early theories but somehow it still seems as if we are groping in the dark with ideas rather than true knowledge. Nothing is clearly defined. It is supposition which does not seem to come round in a circle to back itself but leads off into evermore obscure ideas. In particular QM uncertainty denies the possibility of a fundamental cause for the universe[1] – something which humans have always believed in from their earliest myths of creation by Devine beings. The questions 'why does anything exist?' and 'why the so-called physical laws?' are regarded (by physics) as inessential and 'only' of philosophical interest. Questions were also raised over the ability of contemporary philosophy to undertake this action as it seems to be ruled by traditional (ancient) methods, though perhaps in a modern disguise, instead of having developed with the revolution of art and thought that has marked the modern era. It is thus necessary to revise philosophy principles into a form that can deal with a modern approach to the nature of our universe. As made clear this is not by merely rubber-stamping peculiar modern physics ideas.

The question is how? Physics has declared anything other than observation and mathematical manipulation is outside of its interests and thus philosophy, 'armchair physics', is irrelevant. The fact physics has no specific definitions of its main concepts, space, time mass, electric charge, force energy, et cetera, – this arising from reliance on mathematical principles and beliefs in mathematical rigour – rules out even these as a starting point. Consequently, it should be expected that a project based on philosophy will be more intensive than a purely mathematical-physical approach as even the most basic ideas in our perceptions have to be analyzed and defined. Furthermore, a search for the fundamental nature of the universe implies a search for the underlying factors in the human concept of reality, so that this, too, must always be at the forefront of any deliberations. But it must be remembered that deliberations into the nature of reality are bounded by human perception. So this, again, requires considerable philosophic thought to see whether anything lies beyond these bounds. Nevertheless, I shall argue that pure reason alone should be able to produce an answer. This will necessarily require three fundamental exercises, an examination of what is meant by philosophy, the replacing of mathematics by explaining its concepts in plain language, and use of common sense.

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[1] (Ladyman and Ross 2007:4, Heisenberg [1935]2011:18

This new chapter will therefore investigate how this can be achieved. In this respect I shall apply the thought that a philosophical first cause must imply that the entire structure of the universe could also be derived philosophically without the need for mathematics, especially if the implication of the last chapter is accepted that mathematics relies on the existence of space and time for its own raison d'être. Physics with its empiricism would then become a test of the efficacy of philosophical arguments, a role reversal of the current concepts where philosophy of physics is supposed to check whether physics fits in with our common sense. Should it prove possible to derive such a theory of the universe it would demonstrate that the thoughts concerning mathematics and physics in the previous chapter are justified and further it would explain why mathematical physics has failed in its attempt to provide a workable structure of the universe. Consequently, to establish a cause I must review some of the most basic human perceptions.

3.1.1 Education and common sense

I will start with education and common sense which have to be linked to understand the problems that beset them as a basis for our contemporary thoughts as well as a basis for reason. By reason I mean the principle 'if A then B' where common sense takes into account the conflict between reason and absurdity, for example the concept that the world is made of things that are made of things that are not real – surely reality implies existence and vice versa making a so-called self-evident truth?

Much has been written on common sense but these writings apply more to education and health issues. A clear definition of its meaning has not arisen, some believing it to be through education, some through life experiences and some who accept it has not been clearly defined. Dictionaries seem to define it as good sense which is no help at all, or even as good sense learnt through life experiences. But this does not seem to me to go deep enough. Some people have a demonstrable ability at solving problems, others are quite hopeless. Some people give good advice, others shy away or inflict poor advice. Yet we must all share similar basic life experiences. Life experiences produce perceptions but different people can have different perceptions of the same object or event. Some can look deeply into phenomena before them, others only notice the superficial. Then is good advice or common sense considered so because it fits the local group? The quality of common sense may also be associated with upbringing or social connections. This is where education raises its head as group intelligence fuels interchange of ideas.

Here, I consider more the concepts of theory relative to observation and particularly common sense. I would like to say innate common sense but, it seems to me, to a large extent this is being supplanted by an individual's scholastic development (rationalism) and the ideas he/she has been exposed to. These in turn determine, especially in the case of philosophic thought, the lines of deduction and openness to different ideas. Common sense seems to be regarded as suspect in the philosophy of science (see for example Yu and Cole or Ogborn),[2] and especially in physics, perhaps not surprisingly as it is more often than not

[2] Yu and Cole (2014:680) or Ogborn (2011)

subjective, that is, based more on sentiment than constructively thought out. Yet, when we find concepts arising that seem to defy everything we believe sensible, should we not treat them with suspicion? Einstein certainly did until his death even though the results of experiments on quantum entanglement allowed physicists to claim he was wrong. Thompson (2021) casts doubt on the correctness of the experiments and argues that, if anything, they support Einstein.[3]

Children are viewed as relying on common sense but Yu and Cole also suggest that this sense is "conveniently and unfairly" seen as antagonistic to certain scientific concepts. Common sense and science have become regarded as completely different: one is "comfortable ignorance" that things could be different, and the other "ongoing self-examination of the evidence and subsequent corrections." I am not sure which way round this is intended! To my mind common sense leads, or certainly should lead, to reason, especially when science (physics) challenges it. Quantum theory certainly seems to be entrenched with the only 'corrections' directed at *reinforcing* its peculiarities.

Common sense must also apply to the ability to reason from an intuitive knowledge of one's surroundings which, of course, will produce different reactions from different people depending on their circumstances. As with knowledge, I see three types: inborn, or genetic common sense, that acquired by life experience, and that acquired by education, reasoning being part of both the last two. As Sankey points out the first is that attained through the survival of the fittest.[4]

Throughout history first ideas have been mostly sparked by observation. These have developed with further study to obviate what had previously been thought as sensible.[5] Sankey suggests "appearances do not change. Nor does common sense experience. What changes is what we think happens. Our understanding of what takes place is altered."[3] True: our views of common sense change with acquired knowledge, as opposed to genetic sense acquired by the human species through survival of the fittest.

Genetic or innate common sense is perhaps the most difficult to quantify as much of our intuition arises from our experiences. I have already mentioned our ideas of space and time, which follow directly from our earliest observations of distance, and being able to reach out to feel things around us. If on our first meeting with a river we see it rushing past us we might see a tree branch turning over and disappearing beneath the water as it was swept past us and realize it might be dangerous to step into the water. Similarly on seeing water for a first time we are probably not afraid of it until we submerge and feel uncomfortable as it chokes us. Hence the danger of small children drowning in unfenced pools. So there is a great deal we still have to learn by experience.

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[3] Bhaumik (2015:1,3); Einstein-Podolsky-Rosen (1935)
[4] Sankey (2010:14,16)
[5] see Kuhn (1970)

For example, the idea of dividing caught rabbits among three families by making a pile for each family and adding one at a time to each pile. With the development of brain power, it would not take long for a leader of a group to establish his superiority if he could simply calculate the number required to be caught and to know that if there were two adults and two children to each family then three rabbits per family should be sufficient so that he would therefore need nine rabbits. Similarly if the available caves in an area became over crowded some members of the group might have to build houses in trees to be away from other predators at night. They would learn that some branches would be insufficiently thick to make a platform for a whole family. If thicker branches were too few they might experiment by using the thinner branches with support from a few larger ones. Thus the better brains would be fitter to survive in a dangerous environment and their owners would tend to become leaders and teachers. The concept of problem solving, enquiry and experimentation, would become instinctive. The ability to problem solve could certainly be a measure of common sense and of giving good advice. This would be in many cases genetically derived through the formation of the brain from the fertilized egg.

The changes to our understanding I see are also three-fold, those acquired through experience as we age – as children learning from deeds adults would refer to as “stupid”; those acquired from learning the knowledge derived from forebears; and those through imagination and reasoning or questioning. Thus, we have an idea even from birth, in common with some other species, of number.[6] For example, a cuckoo on placing its egg in another bird’s nest always removes one of the original eggs so that the numbers remain the same. Many birds may abandon their nests if they notice a difference.

We then learn the integers, the basic operations, number systems and so on; then Newton’s laws, dynamics equations; some go on to relativity changing our whole concept of measurement, or even quantum mechanics and beliefs in reality – concepts which for most people border on incredulity and disbelief. So what was common sense for one, and changed over growing older, is nonsense for another. It is not that anything in the universal structure has altered, it is our interpretation that has altered, or rather the interpretation of some humans that has altered. This reflects in our search for reality and truth. And common sense has played a far greater role in this respect than current views seem to allow.

Without this change of ideas, through common sense, would we still believe the Earth was the centre of universal rotation and flat, or that heavier objects fall faster, or that so-called electric charge or heat are liquid in nature? As Ogborn notes: “The upshot of a few centuries of development of scientific knowledge is that the imagination turns out to be a great deal more important in understanding reality than might have been supposed.”[7]

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[6] Feigenson, Libertus and Halberda (2013:74)
[7] Ogborn (2011:2)

But, this can be viewed from the opposite position. As stated earlier, science and human common-sense can be opposed. Sankey expands:[8] "Throughout the history of science, scientific advance has been made by the elimination of commonsense beliefs in favour of scientific theories which show common sense to be mistaken." Here, there arises a significant metaphysical problem which until now has been moving in favour of the scientists as experiments conducted seem to support the views of relativity and quantum mechanics. I have tacitly suggested that *both* philosophical and physical arguments for a given concept should be constructible and must match each other. This is mainly to be realized through the physical aspects being expressed by mathematics which should be interpreted into common language so that it can be compared to non-mathematical philosophical logic. The difficulty is that when a collection of physicists combine they tend to reinforce the common view as with Bohr, Heisenberg, Born, Sommerfeld, Pauli, et cetera in opposition to Einstein on quantum mechanics. As suggested before, experiments can be conducted in ways that 'prove' the accepted lines (cf Chapter 9).

The most important aspect governing physics today is education. This does not necessarily even include at school or through textbooks. We are used to seeing the successes of contemporary life, electrical equipment, computers, television, smartphones, aircraft, spacecraft and all the photos of deep space they acquire. Children playing sci-fi games on their smartphones are already subliminally visualizing possible new avenues for reality: ones different from our surrounds which means, should they enter physics, they may be more easily open to ideas that conflict with former traditional beliefs – the changing mythology of the age.

At school they learn a basic set of subjects which includes mathematics as a fundamental basis of living. As already mentioned, apart from its necessity in life it is also a standard method of producing logical thought. Children may then follow on to physics, if so inclined, and in many cases the history of changes to physical thought. Textbooks and schools point science in a given direction from which it is difficult to adjust the mind. A fundament of this education often runs through proofs requiring exam reproductions. If the child does not follow the accepted path, that is learn the physical laws almost by heart, then he fails his exams, his parents, the teachers. The rules are drummed into him as if to become 'second nature'. But in any case, physics is usually a subject of choice and therefore of interest so that the child is open to instruction in new ideas and in many cases ideas that run against some of his previous beliefs, for example the applied forces in a collision between objects of different mass being equal whereas the natural instinct is that the heavier object will apply a greater force on the smaller – a heavy boy will probably overpower a smaller one. Reinforcing the words of Sankey given above Yu&Cole state:[9]

> "Some misconceptions in science are so resistant that many past and present instructional remedies have been ineffective in conveying the correct ideas. … Thus,

[8] Sankey (2010:13)
[9] Yu&Cole (2014:679)

> science teachers must devote tremendous efforts to undo common-sense-based misconceptions held by students in order to redirect them to the right concepts."

Others have expressed the same views.[10]

Thus the old views become ever more entrenched. Scholastic time is fully utilized in contemporary methods of preparing students for examination based on 'established knowledge'. As a teacher of mine at high-school said: do not accept anything without thoroughly examining it in your own mind and deciding for yourself it is true. No-one has that time in the modern rush through life. Entrenched views in a group mindset are very difficult to shift. This is even more difficult due to peer pressure under rigorous academic conditions. As Kuhn says,[11] entrenched views "come to exert a deep hold on the scientific mind". As a result, mis-conception of the original theory may go unchecked for decades, as I argue in section 9.8 is the case in special relativity, which is of particular significance to this treatise. An allied problem is the extensive use of scientific and philosophical jargon.[12] In the former case, in physics, the jargon is the use of advanced mathematics, which makes physical arguments difficult to understand in everyday language, which after all, is the fundamental language of the mind learnt from birth. The full meanings of many concepts are thus initially recondite for the young postgraduate student. Mathematics becomes the language of their knowledge, removed from that of common sense.

A major problem in this respect is that senior researchers and especially lecturers gradually reach a position of absolute belief in their knowledge as if it is written in stone and thus become likely to consider queries by those external to their group, or PhD students that disagree with them, as misunderstanding. This may indeed follow from an inability to translate mathematical ideas into more easily understood concepts (plain language free of mathematical jargon). There may even be a tendency for refusal to understand contrary arguments or the insistence of falling back on mathematics.

I fear that standard science has become so entrenched[13] that there is a serious danger that attempts to overcome common sense may both stifle novelty and worse actually stifle truth. (I do not here include sci-fi games on tablets where they open the mind to new thoughts, although one must take into account this opening of the mind can work to rejecting common sense views in favour of educational views). Educators should be absolutely sure of their position; the comments of Fischbein, and Yu and Cole, must be taken as possibly, and incorrectly, raising the status of academic stricture to entrench what may be false

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[10] such as Ogborn 2011, Fischbein 1982, Savinainen 2005, or Bao 2002 express similar sentiments.
[11] Kuhn (1970:4)
[12] Weinberg (1993)
[13] See Bird (2000:37,45), Duck &Sudarshan (1998:5) Fischbein (1982), Sherin (2006), Weinberg (1993:ch7), Savinainen (2005:176) and Bao et al. (2002:1), (Kuhn 1970:5) "*Normal science, for example, often suppresses fundamental novelties*" and Kuhn (1970:77) scientists never "*renounce the paradigm that has led them into crisis*."

science rather than guiding students towards a reasoned appraisal. (Give me a child at an impressionable age and she is mine forever – Prime of Miss Jean Brodie)[14].

Common sense should have a much greater role to play in scientific theory even though it is considered unreliable. As Ogborn says:[15]

> "Science is reality re-imagined. It populates the Universe with an ontological zoo of entities, some mundane and at one with commonsense, some exotic and beyond but not disjoint from common experience; but some almost beyond belief, and some which seem to be purely theoretical fancies. What distinguishes this zoo from certain others is that its denizens are taken to be real. That is, once imagined, they are taken seriously as actual constituents of the physical world, existing and able to act or be acted on in their own proper ways without regard to what we may wish or expect."

So the young physicist proceeds to postgraduate research armed with *current* beliefs and, as Kuhn points out, takes off from accepted theories and uses them to develop new ground "upon the subtlest and most esoteric aspects of the natural phenomena that concern his group".[16]

Turning then to the second point: can the universe be mathematical in construction, in which case mathematics would become the primary cause of the universe. It would then have to produce the concreteness of observed objects. This might seem extraordinary at first sight but, considering the wave concept of quantum mechanics, all it would need would be an abstract harmonic vibration as suggested by standard cosmological theory in Chapter 7. Here quantum physicists suggest that the universe arises from a zero-point energy, where the zero point is the absolute zero temperature at which, theoretically, energy would cease to have any worldly function. Instead it would be an uncertainty function as derived by Heisenberg. A harmonic vibration is interpreted mathematically as a repetitive sine wave, so from this view physicists can claim the universe is mathematical in origin: the sine function produces a harmonic vibration which gives a zero-point energy from which a universe can arise and so on.

However, from the philosophical view I cannot see that such a claim could arise from a supposed nothingness; if a field of zero-point energy exists, it exists. It is not a pure starting point. Then mathematics becomes a result rather than a first cause. A first cause must be singular; it cannot have a number of causes because those would then be reducible to a first cause. For example, mathematics in the case of a sine wave requires both number and addition, and a subsidiary cause such that numbers can be added to produce a peak, following which they are subtracted back to zero. They then fall below zero before being added to again to return to zero. This requires more than one cause. It needs the cause of addition, plus the cause for the addition to reduce as it nears the peak, a cause for negative numbers so that the addition reduces the peak towards zero, and a cause for repetition of the whole process. In any case,

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[14] Film by CBS Fox, Producer Robert Fryer.
[15] Ogborn (2011:1)
[16] Kuhn (1970:19)

one of the fundaments of quantum mechanics is that uncertainty refutes the idea of a fundamental cause. This certainly seems to suggest that mathematics would need a precedent from which it can be derived.

On the other hand there is another point which may be raised: does this overlook the completely abstract concept of Platonic mathematics? In other words, that mathematics as a principle could exist by itself without anything necessarily existing for it to be applied to. It would seem unlikely, but recalling the human spiritual needs, many humans might claim the concept of Divine intervention providing a mathematical basis. In this respect the mere thought is enough for consideration, even if one is an atheist of the strongest belief, because it allows the concept as a pure hypothesis of an *a priori* correlation between mathematics and the creation of the universe. Therefore the mere thought that mathematics could have been first is enough to make it impossible by reason alone to state that it could not have come first. As suggested above, I do not see this as at all likely (unless a Divine power does exist) but one has to admit it does rule out certainty on the concept.

However, there is another approach to the subject, one which is *a posteriori*. Instead we can consider whether the universe has to know any specific numbers in order to function, or if it has any need of mathematics in order to exist in the form in which we see it. The answer can be obtained if reason can create a universe without the need of actual number values. This does not necessarily mean ruling out comparison in general. For example one time interval can be obviously longer than another without any need of numbers to distinguish the fact. Comparison and distance need not, as such, be measured in any defined metric; that is, distinct *a priori* measuring units. Here I mean measuring in the human sense where humans have determined some material form of measurement such as a human foot or distance between knuckles on a finger. The universal construction itself could lead to some form of unit which cannot be measured in terms of anything smaller (cf section 3.2). In this case measurement and mathematics follows from the universal construction; the construction causes mathematics, not vice versa.

An aim will then be to show that a universe can be constructed without any mathematical requirement, at the same time showing why we should have believed in mathematics in the first place. I shall therefore take the assumption suggested in section 2.4 that numbers are the outcome of human predilection and not fundamental to Universal construction. Current physical laws would then be purely human ideas in an attempt to rationalize observation. They could no longer be regarded as definitive, meaning that they might not be causal laws in the overarching causal sense aimed at. They must then be open to philosophical examination for at best they could only follow from a fundamental cause.

I have already detailed the general principles of thought in vogue at present. These seem out of touch with the views I am requiring. This means I first have to derive a new look philosophy, one that will provide a fundamental basis for a universe which must include why anything should exist in the first place. But that should, in any case, come from a foundational cause. It is a question that appears to transcend human experience: Physics is wrapped in its own methodology which does not require such an answer, although there are physicists who regard this as a legitimate question, but not perhaps for science. For example, George Ellis,[17] but he raises it specifically as a metaphysical problem. In fact, its solution touches on both general philosophical and metaphysical problems because it depends entirely upon human thought processes. I have already pointed out that, in any case physics has become theoretically dependent first and foremost on observation and experimentation in order to avoid such ideas as heavy bodies falling faster than light ones. This action still relies on interpretation so that its laws are still perceptions and, as in (Thompson 2021) even experimental arguments based on human perception can provide false answers. This new look philosophy should build up a complete theory of the universe from this cause. Neither the attainment of a first cause, nor a complete explanatory theory of the universe based on a first cause have been considered in contemporary philosophy and as already seen are not on the agenda of mathematical physics.

As I said, this will require an intensive new method of philosophical reasoning. For example, if one assumed there was an individual cause for mass, and an individual cause for space, and another for time they would have to interact to give the (one) universe in which we live, irrespective of whether one might divide the result into spiritual and secular levels. In any case, one would have to ask what caused or generated the three causes or different levels. So we will always come back to a possible first, or single, cause.

To determine the best methodology the concept of metaphysics raised in Chapter 2 needs development as it is an obvious choice for an initial approach. I shall then consider other methods. The rest of section 3.1 looks at the establishment of a philosophy centred round causal principles in contradiction to QM's anti-causal beliefs. 3.2 Discusses a serious problem of measurability which must come to the forefront of finding a first cause. Section 3.3 then follows on towards finding a fundamental cause. Finally, a fundamental definition is raised in section 3.4 followed by a discussion on reality including the concepts of objectivism and subjectivism in human thought.

Finally, there is the huge problem of the effect of group pressure on common sense and innovative thought. There are often individuals who tend to be thinkers with interesting ideas rather than leaders, but usually there are those who are leaders of the pack with an axe to grind in the fear of being replaced. We can take the divides in common sense mentioned above in two parts: innate and acquired and then look at a further concept in our common sense views. Both divides are exposed to group pressures. Our fear of ostracism in the group may easily lead to our common sense being dictated by the group. On the other hand there may be those with a strong innate common sense that conflicts with the group to such an extent that they leave the group either to set up by themselves or to join another more open minded group. These may be the ones with greater enquiry and experimental needs and will therefore be those who bring forth the major paradigm changes.

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[17] Ellis (2012:27)

If common sense is a group attribute then it is important to consider how it agrees with some of the ancient mythologies or even current old wives', tales for group lore may not always be true common sense so should not be confused with it. This makes it difficult to assess common sense because it becomes bound up with the beliefs of the group at a given time. It must therefore be assessed in conjunction with the education of the time – a point that must be born in mind in attempting to find a new method of approach to attaining a complete theory of the universe.

3.1.2 The fundamental principles of the arguments.

Chapter 2 pointed out that mathematics is the language of physics which means that observations of the universe are automatically interpreted into mathematics through the concept of measurement. This leads to twin problems; (1) that observations are reliant on human measurements, which may give a completely different view to the actual functions lying below human perception. Observations are interpreted purely in accord with our beliefs and perceptions of the universe. Furthermore (2), an individual's perceptions may be coloured by that person's life experiences and internal thoughts in relation to group beliefs and questions. By producing apparent laws the physicist can associate the result as giving greater truth to the original observations. In other words objectivity is always related to subjectivity. On the other hand scientific theory is seen to always be subject to corroboration. Even so, observations may provide 'answers' to questions. But underlying both answer and question there may be a false assumption. For example the concept of mass has no definition and may be purely a human invention that does not exist naturally, so answers based on mass may not actually reflect the true situation (see Chapter 5 for major examples).[18]

Apart from false impressions there is also the probability that existing beliefs may lead to observations being bent in ways that reinforce these beliefs rather than choosing from among other more tenable interpretations.[19] This certainly appears to be true in the case of EPR and other QM concepts discussed in Thompson (2024a). As Kuhn infers there may be other explanations.[20] It is also difficult to overcome views that have been enforced by education, as suggested in section 3.1.1, especially when it is advanced education, or when making a willing impression on joining a new group.[21]

The removal of physics in favour of a philosophical approach to the universe needs a new line in contemporary human thought. It may have to border on the transcendental. As a 'break-away' it is likely to have little immediate correlation with human perception. It may test the limits of human conception, going where no thought has yet gone. It will be based on the search for that which factually is responsible for

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[18] See Bogen 2017 "Theory and Observation in Science" in Stanford Encyclopedia of Philosophy for greater depth of discussion.
[19] Feyerabend (1993:80-82)
[20] Kuhn (1970:144)
[21] Yu and Cole (2014:679); Sankey (2010:13) reinforced by peer pressure, Kuhn (1970:5,7,24).

everything humans see around them; what might be called reality.[22] The line will no longer be that of uncertainty, locality, indeterminism, or even measurement, raised by quantum theory but the more mundane thought that what humans see may not be as we imagine it should be below our vision; that is, in the microscale universe. It will also have to consider how this will affect our vision of the macro-universe.

Interminable philosophical arguments could be raised on the question of existence and the root causes of the universe,[23] but it seems to me their use is questionable unless they produce recognizably concrete answers. This is not a new thought. Kant (1724-1804) believed that a complete "framework" should narrow reasoning (as Persson suggests much more recently)[24] and also that intuition is necessary to obtain understanding of intangible things beyond our immediate experience. This understanding must include the root causes and underlying structure of the universe which Kant calls transcendental philosophy: "a philosophy of pure, merely speculative reason"[25]; which he reinforces: "… absolutely no concepts must enter into it that contain anything empirical". In other words, as I have already suggested, deriving physical laws and ideas from just observation is dangerous. Kant suggests that a true philosophy, which must obviously be from the human mind, to be truly formed by logical deduction cannot look to things that we see for inspiration. This is exactly the concept to be followed here, though it becomes impossible to hold to completely because we have to form any truly transcendental ideas in a language that can be understood – that is one using existing words that are already based on observation!

To some extent there is a way out. The existence of a fundamental cause would imply that everything in the universe must arise as a result of this cause either directly or indirectly. It should therefore be possible, and desirable as a check, to derive an entire theory without reference to existing ideas by deductions from the fundamental cause, or in the case of a projected guess, a foundational principle. In view of the failure of current methods to provide such a principle the expectation must then be that the principle itself may lead to deductions that will differ significantly from, and even contradict past ideas and methods. Should such a final theory be established it must be capable of expressing current observations and particularly successes of current theories and physical law-like deductions.[26]

The results that contain the measurements, physical laws and empirical theories are obviously physics but placing the rest, the discussion of root causes and underlying structure, into metaphysics, or philosophy of science is not so clear cut. As pointed out in Chapter 2 there is no firm commitment to a specific definition of the last two. Different authors have different opinions. Fine regards metaphysics as studying the nature of reality, Ellis, Lowe, Farr and Ivanova as investigating deep underlying questions, both of which views tie in with Aristotle's belief that, what we call science, is superficial and the real

[22] David (2020); Smith (2018)
[23] Kant ([1787] 1998:109§Bxv); Persson (2018:52)
[24] Kant ([1787] 1998:114§Bxxiv-xxvi); Persson (2018:68)
[25] Kant (1998:132§A11),(1998:135§B29) (1998:134§B28)
[26] Kuhn (1977:321-22)

wisdom lies in understanding the why.[27] Kant despite his transcendental reference included “pure rational concepts, which never can be given in any possible experience”.[28]

However, a more worrying recent development, naturalistic metaphysics, was exemplified by Ladyman and Ross in 2007 that metaphysics should be *dependent* on science (an idea also evident to Bertrand Russell much earlier in 1913),[29] which for reasons above, is completely opposed to my position that demands a first cause. They argue, in line with Hume (section 3.1.2), that metaphysics cannot determine *a priori* fundamental causes, nor prescribe physical theories, to which the obvious contra-position should be: why not? – provided such deductions are measurably testable. They say metaphysics has “proceeded without proper regard for science”.[30] Since philosophy and science have diverged, surely metaphysics should not be scientific? Science seems to be almost universally described by dictionaries using the words ‘systematic study’, ‘understanding the natural world’, through observed facts and tested truths; that is through evidence. What use would metaphysics be to merely copy that form of description? It should provide a totally different method in order to open new channels of thought. Its objective should be to avoid perception and intuition which bind to observation. We need as far as is possible, to avoid falling into a methodology that I contend has failed, and is to an increasing extent failing, to produce sensible and worthwhile results. That way we can test the plausibility of the quantum peculiarities and see if there may not be some other better way of describing the universe. We can hardly test them by accepting them. If philosophical argument should lead to physical theories then that is an additional benefit. To say it can’t be done is a cop out. We have to find a way. And that way, I believe, is to find a first cause by deductive argument. Chapter 4 produces one such idea. That is, the concept of a possible cause of existence.

On the other hand, Ladyman and Ross do say that metaphysics should unify physics; but, it seems to me, merely ‘rubber stamping’ physics, as Bertrand Russell[31] and Maudlin seem to do, is not true to philosophy.[32] Naturalistic metaphysics becomes the mere elucidation of physical theory, which is no help in uncovering the fundamentals of the universe.[33] French and McKenzie see metaphysics as reflecting on the acceptability of physical theories.[34] The last view is better but not, I feel, the full use of philosophical reasoning. Reasoning is to develop by logical argument, and to question ideas that appear illogical (such as existence depending on ‘unreal’ objects) and provide alternatives. In 1930 Hans Reichenbach had a

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[27] Fine (2014); Ellis (2012); Lowe (2002: vi); Farr and Ivanova (2019:3-4); Aristotle (1923:A1)
[28] Kant ([1783]1903:§40) also denied the possibility of attaining *a priori* causes except with the use of synthetic reasoning ([1783] 1902§5,27) which Hume had also denied, though not taking into account synthetic reasoning ([1739] 2017:Book1,iv p13). But as this thesis shows that it is completely possible to do so I shall not go into these arguments.
[29] Russell (1913:6)
[30] Ladyman and Ross (2007:7)
[31] "I should say that the universe is just there, and that's all” in a BBC discussion with Father Coppleston, 1948; cf htpps://homepage.uc.edu>cosmological_Argument>
[32] Ladyman and Ross (2007:1); Maudlin (2007:1)
[33] cf Stenlund (2003)
[34] French and McKenzie (2012)

different idea "Philosophy should produce *results*, not manifestos", which is a principle of the philosophical system being developed here.

Views like those of French and McKenzie, Ladyman and Ross add to the entrenchment of the absoluteness of mathematics and physics as the only determinants of understanding the universe. The more peculiar the views (those of QM) they apparently support, the further they are removed from the average human, and the more it seems to add to the deference of the non-professional. Instead of broadening the area of enquiry they restrict it. While they may suggest mathematics can produce ideas "beyond the capacities of individual minds",[35] they overlook that mathematics is the product of human beings and is restricted from transcendental thought by its axiomatic nature. There is a danger that such views become paradigms to the masses, especially when made or reinforced by well-known authorities. In any case mathematics is at most a means to describing the universe but not the description itself – unless mathematics is the *cause of existence* which QM apparently denies, as will I.

Quantum mechanic's lack of reality, as accepted by Ladyman and Ross – the world is not "'made of' anything at all" – may be interpreted, as for example by Hoefer, Goswami et al.; Greenberger, Horne & Zeilinger, as well as many others, as destroying the hope of a first cause, thus constituting a clash between Aristotle's metaphysics and contemporary natural metaphysics.[36] This lack of causality stems from originally Heisenberg's uncertainty principle and then from the realization by Einstein together with Podolsky and Rosen [EPR] in 1935 that the Bohr-Heisenberg concept of QM (the so-called Copenhagen convention) would lead to the condition where *two different outcomes could be realized from a single experiment* performed on physically related (entangled) events; thus creating the idea of the beholder determining the outcome. As Einstein objected, such a possibility would indeed destroy a fundamental caused reality as it would require the input of measurement by an external object to determine *by chance* which of the outcomes should stand/be selected.

Causality was demanded, apart from Aristotle, by Newton in his very firm letter to Bentley in 1693 – though Newton's is on a different plane, that is, a secondary causality between interacting objects, as opposed to the one considered here: the cause of everything in our universe, including the so-called physical laws and theories and how the cause generates the human perception that creates these theories; or, as Kant wrote:[37] "the understanding, which judges about the nature of things." For Newton, his principle worry was the concept of action at a distance seemingly created by gravity. He believed that there had to be a cause even though he could not conceive its action. As such, discussions on the subject would fall under philosophy of physics. They would be a method of testing whether physics is on the road towards 'truth' – but they can hardly take this line if they are to 'depend', according to natural metaphysics, on what they test. This consideration of physical theories suggests a difference between

[35] Ladyman and Ross (2007:300)
[36] Hoefer (2004); Goswami et al (2018), Greenberger, Horne and Zeilinger (2005:1)
[37] Kant ([1783]1998:133§A13)

metaphysics as suggested by Fine or French and McKenzie, which examines the nature and cause of objects and their existence, versus philosophy of physics discussing the nature, interpretation and relevancy of physical arguments and experiments – although when considering epistemological or ontological aspects of the arguments, philosophy is regarded as metaphysical, or even meta-metaphysical (discussing the merits of metaphysics).

However, there is causality and causality. Here I only deal with a fundamental causality, not that caused by living, or viral, action. Causal laws are purely human ideas formed from repeated observation of similar events producing given outcomes – particular interactions. They therefore may not reflect the actuality of foundational causes underlying the 'laws' themselves. Much of thinking about causality revolves around these laws and what may be described as cause and effect of 'everyday' events. But in the main they bypass the fundamental cause, or nature of the universe, which determines why these apparent laws should exist in the first place. Causality has been a heavily discussed concept over many years. For space reasons I consider only a few views on its fundamentals, bearing particularly in mind the views of quantum mechanics.

Russell, for example, decided (before QM) that the so-called 'law' of causality, was a falsehood ("its complete extrusion from the philosophical vocabulary [was] desirable").[38] True in that a law cannot precede its determinant, but not in the same vein as saying a fundamental cause of the universe cannot exist. Dowe, picked up on Russell to suggest that empirical analysis of causality, meaning as a universal cause, "an objective feature of the actual world", relies on physics for its "justification".[39] This seems to me to miss the pointed dogma of QM that uncertainty belies causality (which Aharonov et al., claim is even more fundamental than Heisenberg's principle), that is, that human observation determines the outcome of events as shown by the quotations above, or Hawking and Mlodinow's interaction between two objects.[40] Such views strike me as nonsense because if I receive a ray of light from the sun I have not caused that ray to be emitted nor has anything on the Earth. If the Earth did not exist, that ray, it seems to me, would still be emitted. One can always *argue* that the non-existence of the human race would exclude the existence of the sun, or moon as in the famous Einstein-Pais case,[41] but arguing a ridiculous cause does not make it true. Humans could not have existed without the sun having existed. It would, of course, be possible to infer that the absence of humans could mean that the sun did not exist, but not the human species is responsible for the sun.[42] Returning to more logical thoughts: if QM denies the existence of causality then the suggestion that a universal cause relies on physics for its justification must be false. In

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[38] Russell (1913:1)
[39] Dowe, (2010 §6.5)
[40] Aharonov et al., (2017:6484); Hawking and Mlodinow (2011:103)
[41] Mermin (1985)
[42] The question must arise whether humanity, or indeed any living things have a causal line, it being assumed that pure chance gave rise to life. However, experiments, e.g. by Gibson, et al. 2010, Lincoln and Joyce 2009, Powner, Gerland, and Sutherland, 2009 show that this chance would be extremely high, by which I mean of orders of trillions to one on.

any case, surely the opposite must be true, physics must rely on causality for its (physics) justification. This is the case pursued here. Causality must then at least be covered by some form of reasoning other than physical, for it seems that some form of fundamental causality must exist in order for any form of causality, or even apparent laws to exist. It is this form of causality that I intend to introduce and demonstrate by test to be relevant to human understanding of the universe.

Dowe in 2010 also discusses Russell's 1913 concept of world lines as an object proceeds from one state to another, that is, local cause and effect.[43] As it does so, it intersects with other lines in Minkowski[44] space to create an event; not so different from the concept of tropes discussed in section 6.2.3 which he also raises in 2010.[45] However neither of these ideas is definitive in meaning other than being concepts for cause and effect. D'Ariano, later still in 2018, has suggested that causality and QM indeterminacy, Heisenberg's uncertainty principle, have been incorrectly linked as contradictory, which to some extent is true, as it is the concept of entanglement and associated observation that destroys a *fundamental* reality. For example, if a particle is split into two parts that travel in opposite directions thus forming a bipartite system, the question arises whether the parts have distinct properties that can be determined, such as spin. This will require intercession in a bipartite particle system by receptors on each part of the bipartite system to find out. Consequently there is an interaction between each part and the receptors which extracts the state observed in the recordings. This is part of quantum mechanics dogma, which says that only one 'observable' can be determined by a single experiment at a time as the state is changed by the experiment; and then that a subsequent experiment to determine another observable will interact with the new state created by the first experiment, not the original state. Thus if one takes this concept, there is a very clear cause and effect; one that is in accordance with the concepts of Dowe and others as a time-line or Minkowski world-line. The problem lies in the uncertainty of the original state of the two parts of the bipartite system. This has been destroyed by the test itself and is therefore uncertain. This goes to the root concept of causality. If one takes every possible interaction backwards along its world line one has to ask: do all these world lines meet? Is there a fundamental cause and is it in this meeting of world lines that one has to consider causality?

This uncertainty over causality may also stem from another principle. In physical theory there are several fundamental entities (for example, space, time, mass, electric charge) which are regarded as too fundamental to be expressed in more fundamental terms, plus others which are poorly defined or left to intuition (such as force, energy, motion, rotation). They must therefore be considered as disconnected, as would their world-lines, for any connection would itself be fundamental to more than one of them. In this sense QM must therefore say that we cannot ascertain a fundamental cause because this would require an

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[43] Russell (1913:5)

[44] A 4-dimensional system consisting of the usual 3-dimensions of space to which is added a dimension of time to cover the situation that an object can have different spatial positions at different times.

[45] Dowe (2010§7.3)

interaction between two or more of the fundamental quantities and we could only observe the outcome, not the original input. Among other things it suggests that the study of universals can never uncover a fundamental cause. There is therefore more to attaining a fundamental cause than considering a few apparently fundamental entities which do not appear to have any unequivocal definitions. Fair in (1979),[46] for example, suggested that energy or momentum are acceptable fundamental causes through their transfer from point to point or particle to particle. However, the suggestion still lacks the knowledge of what is energy or momentum, what originally causes this energy or momentum, and causes it to be transferred.

It should now be clear that all these views deal with a secondary causality and not a primary causality that leads to the universe itself – what might be called its reason for existence. As a last thought recall section 2.3, that Hume and Kant as long ago as 1739 queried whether it is possible to prove causality, Kant linking it to experience.[47] Equally the question must arise whether it is possible to disprove causality. In both cases an original cause is beyond our knowledge. It can therefore only be guessed at. However, it would give credence to a positive answer if the guess should lead to developments that explain our universe from a fundamental conception up to its current status. This completion must form a major role in this study. Here I state I do not distinguish between divine or secular, for one would still have to ask how the Divinity acted to bring entities into being.

3.1.3 Metaphysics, philosophy of what?

The acceptance of the QM statements that the world needs sapient minds to exist (in the hope of keeping philosophy of science alive against the attacks of Hawking or Weinberg?), and worse supporting them without argument thus refuting the possibility of a cause for the universe, is an anathema. As de Haro,[48] a physicist, states "One of the tasks of philosophy is to scrutinize the concepts and presuppositions of scientific theories, to analyze and lay bare what is hidden and implicit in a particular scientific paradigm." This investigation should then not only consider the QM indeterminacy-reality issue but also redress any other QM fundamental, or 'nature of primary existence' oversights.

Such an issue cannot be physical because physics is based on observation and experiment, which are both suspect, to produce laws and theories which are then equally suspect. Neither can the reasoning be metaphysical in the sense of factual-counterfactual or Aristotle's contraries because these rely on human perception,[49] and human perception does not see the fundamental causes of nature – only the results – if fundamental causes do exist. (Human perception may, of course determine the cause of effects as, for example a smashed window hit by a cricket ball).

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[46] Fair in (1979:245)
[47] Hume, ([1739] 2017:45); Kant, ([1781]1988:a244)
[48] de Haro (2013:7)
[49] Aristotle ([350BC] 1923:A5)

On the other hand the nature of things is accepted as metaphysical, but again, as just argued, this relies on human perception whereas causality must border on currently transcendental ideas beyond human comprehension. A complete description of the structure of a universe based on a fundamental cause, or attendant principle, and only on that cause or principle,[50] and which agrees with experimental measurements, should carry an aura of reality. Furthermore, all of Kant's and Hume's problems should be answered. This would include Kant's objection, upheld in this book, that empirical laws of nature cannot be considered laws because they are only human perceptions. The only laws that may be considered true are those formulated from an overarching rule from which deductions fit exactly all human observations of nature. Again, I stress that it cannot represent absolute reality because there may be other possibilities.

If this inquiry cannot be physics, nor directly philosophy of physics, and has a question over metaphysics, what else could it be? Considering the problems of reality in contemporary physics, and requisites of a new approach, its generation by exotic reasoning in the mind, suggests the word 'noetic' in the form given in YourDictionary[51]. This definition includes the words "… *specifically, able to be understood only by the intellect*" which fits the thought that a fundamental cause cannot be itself observed – only its after effects. Krader saw noetics as bound to metaphysics,[52] but, in view of the wider aspects of this inquiry, I shall consider the use of noetic to be broader in essence than metaphysics. Unfortunately, both the words noetics, and transcendentalism, have been given spiritual meanings far outside their use here.[53] I use them only in the sense of thinking completely from the mind, without reference to physical or measurable perception. I cannot say completely 'without human perception' because we appear to live in a temporal and spatial world – although if time and space are true factors of universal reality, why is there no definition for either in human language – because maybe their (space and time) description is beyond true human comprehension, and passes into the realm of the transcendental?

There is one further problem concerning the nature of philosophical questions which I feel somewhat strongly about because I think this may be largely behind the failure of human thought to have arrived at an ultimate theory. That is, I feel philosophy has excluded itself from a role in finding the answers to the fundamental questions of the universe irrespective of the position taken by Ladyman and Ross given in section 3.1.2. The problem arises as a result of the philosophical view concerning philosophical questions.

Floridi declared these to be questions that do not have an empirical or mathematical answer and are open to disagreement.[54] Russell in 1912 gave a similar view by suggesting that as soon as something is certain it becomes part of a science while those with indefinite answers are called philosophy.[55] Much

[50] that is, accepting Kant's view ([1781] 1998:134§B28) refusing anything empirical,
[51] www.yourdictionary.com/noetic.
[52] Krader died before publication which was carried out by his editor Levitt in 2010(:xxxvii).
[53] For example Institute of Noetic Sciences deals with parapsychology, ESP, alternative healing and after death experiences. Transcendentalism was adapted as a religious and idealistic 19th century U.S. movement.
[54] Floridi (2013:203)
[55] Russell (1912:chXV)

more recently in 2020 Acar-Erdol agrees,[56] adding that scientific questions are objective while philosophical answers are subjective and should "generate" a new bout of questions. That is, they should have no final conclusion. There also seems to be a belief that they must consist of what Aristotle referred to as 'contras' or contrapositions, for, as Russell contends, a "theory of truth must …admit its opposite".[57] This may be true for a theory of truth but as this treatise will assert, there may always be other answers, so we can never ever be certain of truth. Thus such an argument should not be placed across the entire philosophical discipline where it deals with deduction. I shall argue by demonstrating that such ideals can never lead to ascertaining the nature of anything and thus will fail Aristotle's main theme, the discovery of the nature of our world.

On the other hand Floridi said philosophy without answers is useless and Reichenbach stated the objective of philosophy should be to produce firm outcomes.[58] Without such outcomes we cannot know the nature of anything for knowing is the end of enquiry because, if there are additional questions then the knowledge is not complete. One perhaps can consider the three 'laws of thought' raised by Russell in 1912,[59] not that he accepted them as absolute. If the contra is to be part of philosophy and questions are to be open it is hard to consider them as laws. Laws (2) and (3) are of particular interest as they appear to be self-evident and therefore as a principle presumably act as a fundamental guide to human argument, be it intuitive or learnt through education external to intuition.

"(1) *The law of identity*: 'Whatever is, is.'

(2) *The law of contradiction*: 'Nothing can both be and not be.'

(3) *The law of excluded middle*: 'Everything must either be or not be.'

Since this treatise is in the first place focused on human failure, these 'laws' must be subject to non-acceptability, as otherwise they become unnecessary limits to enquiry. If they should in fact be false, as will eventually appear, then in probability they are partly responsible for the lack of an ultimate theory.

As with everything else in this treatise, it appears new ground needs to be broken, or the boundaries of philosophy need to be extended. It is therefore essential to pass beyond current philosophical principles to investigate whether current methods have taken a false track, as seems highly possible in view of the peculiar ideas of contemporary physics that do not seem to fit ordinary common sense. It needs the concept of a special '**foundational**' philosophy with the sense that all human perception and thought must surely depend on a fundamental cause of the universe. A cause that, if it could be established, would settle the questions of reality, how and why we see what we see. If then, a foundational cause can be shown to

[56] Acar-Erdol (2020:225); Reichenbach (1930:1)
[57] Russell XII (1)
[58] Floridi (2013:199)
[59] Russell (1912:ChVII)

exist, as Kant says:[60] the foundational philosophy "would also have to contain an exhaustive analysis of all of human cognition a priori" to be complete. Otherwise it could not be said to be the only cause.

The problem here is there is no pointer on how to formulate a first cause as such a cause has not been uncovered. This philosophy, being transcendental/noetic, will need, then, to pass outside current human views possibly by guesswork (at novel assumptions) and by pure non-mathematical deductive reasoning. But being of the human mind, I can only establish a first cause by taking an intuitive guess based on ideas taken from my mind – here Hume seems correct,[61] *we cannot back-track logically from existing perceptions*. However, once this fundament has been presumed it then becomes necessary to avoid any other preconceptions and only to use whatever can be derived from that cause to test its efficacy. This is where there must be a major departure from metaphysics revolving around human perception. It means dismissing all physical ideas, laws, mathematics, unless and until they can be derived directly from the first cause. They must arise naturally without previous thought as to how to introduce them. Should an existing idea be needed as an argument the answer is simple: it is only a human idea, not *a priori*, nor a true process of the universe.

I thus propose a very different form of reasoning that diverges from standard methods. It incorporates metaphysics in the sense of the fundamental nature of things to be derived by pure non-mathematical reasoning. It cannot be *a priori* because it must determine the *a priori* and in this sense it must be transcendental. But it must also deliver a full structure for the universe by pure reason that is testable against human observation. This cannot be 'philosophy of physics' because the reasoning, as projected, will contain no mathematics or physical laws or ideas as such. Nevertheless the results will project *into* physics where they agree with physical laws and human observation. This is a necessary outcome of a properly causal argument. On the other hand, when dealing with shortcomings of physical theory, where necessary, philosophy of physics will be needed, particularly as an aid to understanding differences between current human ideas and ideas arising from a fundamental cause. The foundational philosophy will then provide the alternative suggested as part of logical requirements mentioned in the previous section. Furthermore, unlike contemporary philosophy with open ended arguments for and against a concept, a foundational cause cannot be preceded and therefore its associated generating (foundational) philosophy should be definitive, that is, it should give an unequivocal (closed) outcome. This should be possible because it should aim to transcend human reason which by its nature has to be based on perceptions of the universe.

Having decided on a 'foundational' philosophy the next question is how to proceed. Two major directions of enquiry can be immediately identified:

(1) Why does anything exist?

[60] Kant says ([1781] 1998: 134§B27)
[61] Hume (1777:XII3§79)

(2) If the universe is to exist into what is it placed; is there a pre-existing volume and if so how large could this be?

These are in any case fundamental questions of philosophy, and as such must be an essential key to understanding the structure and processes of the universe. [62] Surprisingly in my opinion, they are not considered in physics. According to, for example, Ellis, physics does not answer "ultimate" questions.[63] Surely these two questions should be the basic requirement for a complete theory of the universe? But I suppose if it is true that physics only deals with immediate 'whys' – those creating hypothetical laws – and cannot answer deeper 'whys' then the fundamental causes of physical 'whys' should become, as raised in Chapter 2, the subjects of metaphysics. Thus question (2) is dealt with in Chapter 4 as it will have a major role in shaping a foundational structure for a Universe (given a capital U to distinguish it from the current physical description of our universe). Question (1) requires information derived from this foundation to conclude an answer, so is postponed to Chapter 8.

But first, as the current human physical description of our universe depends almost conclusively on measurement, section 3.2 opens with a few important observations on this subject. Section 3.3 raises options for a guess at a foundational cause of the universe. The final sections 3.4-3.5 formulate a possible fundamental 'cause' and take the first step (section 3.5.2) towards a possible humanistic reality by showing that this cause leads to both answering question (2) above as well as giving a construction for space-Time that humans would perceive as three-dimensional.

3.2 Measurement

One of the most interesting problems towards determining a foundation can be found in the discovery made by Einstein (1905) of relativity, although here I introduce only the basis of his theory as a problem of measurement.[64]

Measurement has been the subject of debate from Aristotle through Kant, Helmholtz, Russell, *inter alia*. The immediate considerations here run along different lines which will eventually naturally answer some of the views discussed by philosophers. A general discussion of the concept of measurement is important and will be tackled in Chapter 5.

Measurement has also been raised many times in relation to mathematics. It is a form of comparison, [65] one which is usually imagined in terms of a system of units. These units can be added, subtracted, compared, divided in terms of sub-units to fit the growing needs of humans, and multiplied by numbers. But this is an instinctive human view determined for human convenience in the choice of units, as well as

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[62] (Glymour and Serafin (2018:52); Kant ([1781]1998); Aristotle [350] 1923)
[63] Ellis (2012:27)
[64] As there are some highly contentious issues arising from the way it is now taught at universities, Einstein's theory is covered in Chapter 11.8.
[65] Tal (2017§3)

by relation to human surroundings. As human units are purely arbitrary to suit human perception they cannot feature in a first cause itself, though this cause may produce a structure that humans *can* measure. Such a view automatically questions traditional concepts. Principle among these is the idea of a frame of reference, which by definition requires a coordinate, and thus measuring system. But in this treatise, I am assuming my prospective Universe (and the universe) is not mathematical in construction, and does not need mathematics to explain it. This frame of reference, from the foundational point of view, must then be free of mathematical construction.[66]

Unfortunately, there is no word that accurately describes what is required – a general purpose, non-mathematical, view of an isolated observer's surrounds. An observation only occurs at our eyes/brain, meaning that light, or some other sensation has to travel from the observed to us. All we know is that it has arrived from ahead of our eyes but we cannot be sure of the distance; we can only guess a distance by triangulation from our two eyes. But by observer, for my use of the expression 'frame of reference', I do not mean a two eyed object but a single observation point. Thus observations are made only at the origin of that frame of reference. Consequently some form of directional connotation can only arise if one observed object can be seen with reference to another. And even this does not allow a complete geometrical description because the observer cannot tell which object is furthest from him by the mere receipt of light. He can only obtain some idea of direction with respect to himself – and this only if he has a single point of view which we would call his front. I shall use the expression frame of reference, or just frame, in this context. The conventional frame of reference is then a phantasm, even though an extremely useful one, for physical and descriptive purposes (– touches of instrumentalism).

In particular, human units, for example feet or metres are used in connection with determining difficult to measure distances such as a straight line between two mountain peaks, or from a point on Earth to a point in distant space. In modern terms this can be done by sending a laser beam from a point on one peak to the other where it is immediately reflected back. The time taken for the operation is recorded by a clock which remains stationary with respect to the measuring apparatus. The speed of light is then assumed constant, and the time taken is divided by two because the light travels out and back. Thus the distance is determined in terms of the time taken. The question is whether this is an acceptable method and if so is the distance absolute? Here it is necessary to consider the concept of motion versus stationary, as defined by Einstein in 1905 (see Chapter 9).[67] For example, again assume the speed of light is a constant and that when the above measurement was made everything was travelling in the line of direction of the mountains according to some observer. Then the laser signal of light will take longer to travel towards the far peak, because the peak is moving away from the signal, and a shorter time to return.

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[66] I see a difference here between hermeneutics (human interpretation) and frame of reference which, admittedly, has distinct mathematical connotations as a coordinate structure.
[67] Einstein ([1923]1905:40)

On the other hand, suppose everything were travelling in the opposite direction to the signal. Then the far peak would move towards the signal, so the signal would take a shorter time to travel out, but a longer time on the way back. So it makes no difference which way everything is travelling, only that it is in the direction (or anti-direction) of the two peaks. Either of shorter-time-out-longer-back, or *vice versa*, will always give a longer time (see section 9.8) than if we somehow were 'stationary' in the sense that the travelling time of light outwards were the same as its return. Einstein demonstrated this would alter our perceived measurements in accordance with the assumed constancy of the speed of light in all frames of reference. *Thus from both the foundational* and physical *point of view we cannot consider any measurements we make as being absolute.*[68] We can only say that they refer to time as measured on a clock stationary to ourselves. (Mass will be dealt with later as far more profound concepts will arise). This means the physical frame of reference (including coordinates) attached to an observer, in which he locates objects according to his clocks and units of measurement, is open to question. Then his ancillary deductions depending on his readings such as motion, force, et cetera, are also open to question reducing them to a mere set of ideas that influence his opinions and decisions. This question needs to be removed through developing the foundations of the universe to give his observations the validity that can be gained from a tested first principle, derived in Chapter 4. As explained, this will require non-mathematical reasoning as mathematics, being an autonomous discipline, determines its own rules which may go far beyond what is needed to make sense of observation. Thus, physical principles derived by observation may not necessarily agree with the natural world.

These questions came to light from an experiment by Michelson and Morley (1887) using an interferometer. Their original experiment was to test the Earth's speed through an expected ether, one which was shown by their experiment not to exist. Instead, it appeared that it made no difference to the speed of light irrespective of our motion. This was originally assumed to indicate a possible contraction of the interferometer in the direction of its travel – the so-called FitzGerald contraction used by Lorentz in his electromagnetic researches, and used by Einstein in 1905 to explain the contraction in terms of space and time. Einstein realized that this amendment of time and space measurements occurred in the direction of motion. But as Tal much later (2015) points out, it is what humans regard as realism, in the form of being measurable, reaching back to the beginnings of sapience, that raised the possibility of measurement.

Thus the point is, we do not need to know whether we are moving or not; we only need to know that we *may* be moving, in order to cast doubts on our perceptions of what to some people are fundamental

[68] Physicists overcome the problem by declaring that the time measured by our stationary clocks is our proper time and clocks travelling relative to us will experience a time dilation relative to our clocks. And our clocks will equally experience a time dilation relative to theirs. Furthermore our length measurements will be altered relative to theirs and vice versa. This is more complicated than it sounds so will be dealt with in section 9.8 as it needs mathematics (of measurement) to clarify. It then becomes legitimate to use our 'proper' time as a general time and apply a built in correction to the traveling clocks so that they maintain their time with ours. However, here I am only referring to a problem of measurement and not a solution.

beliefs – the absolute concept of space and time and thus with it the accuracy of measurement.[69] This questioning is not due to the discovery of a physical theory (special relativity) or uncertainty principles, although the former appears to have been proved through for example, satellite navigation systems. It is due to a natural difficulty over measurement which had not been expected until Michelson and Morley's experiment.

Furthermore, if we are in motion relative to another object then equally that object is in motion relative to us. Then its length and time measurements will be similarly affected. This provides a simple physical test which it is important to consider. Suppose we observe a star similar to our sun travelling with respect to us. We assume it has the same constitution as ours and that light has a measurable wavelength and frequency. Then the light it emits will have the same colour configuration as the light our sun emits. If its time units are dilated then according to the physical laws of light we would expect to see the colour of its emitted light to change. Assuming these laws are correct, a time dilation is equivalent to a lowering of its frequency. But physics dictates that light travels at a constant speed and that this speed is given by frequency × wavelength. Consequently, we must have that its wavelength is also dilated.[70] Similarly, an observer nearby the distant star would see the same effect in our light. This effect has been established by experiment, for example, Ives and Stilwell in 1938 and Kündig in 1963.

Before leaving this section, further consider the following thought picture. It is purely to sow an image for future use concerning the relativity of measurement. Imagine a sphere with a man inside it holding a rod which he, inside the sphere, would say was one metre long, half his height, and a third of the diameter of the sphere. Now suppose that the sphere and *everything* inside it can shrink. If the man could not see outside his sphere he would have no idea that any change had taken place. He would still measure his height as twice the length of his rod and the sphere three times the rod's length even if the sphere became immeasurably small to us. Similarly, if the sphere were to grow from a minimum size, the man would be none the wiser if he cannot see beyond it. The same would apply to time if, for example, he noted that it took approximately one minute on his clock for a beetle to travel the length of his rod. That would not change for him inside his sphere. Nor would we expect him to see any change in, say, his mass because, for example, the beetle travels at the same rate in the man's sphere and the rod doesn't change relative to the man (no change in momentum); a point that will have value later. Everything would be exactly the same to him. How we interpret the last two measurements – does his mass grow smaller relative to our kilogram measurement, or his second of time grow smaller relative to ours – is more complicated but will become apparent in future sections.

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[69] van Fraassen (2013:146)

[70] Physicists will note this is a different result to the one they are used to, but in Chapters 4 and 11§8 it will become clear time dilation coupled to length dilation, as put here, is both physically and mathematically correct.

Consequently, whilst we adopt units of measurement suitable to ourselves, the fundamental concept of measurement is not as easy as human perception sees it. That is, the application of measurement in a human frame of reference depends very much on how the foundational cause of the universe is constructed. Measurement is, then, purely a form of comparison, and a question mark remains over the basis of this comparison in the universe beyond our immediate perception. And this must form a consideration of philosophical reasoning since it should articulate on the quiddity of our concept of unity.[71] Even the Planck units adopted by physics must be considered suspect in this respect.

So far time has been used in terms of measurement as a part basis for referring to human surrounds, that is, frame of reference. It turned out to have an effect on another important human concept, that of length (wavelength) as observed from rapidly moving celestial bodies.[72] This in turn relies upon the human sense of space or volume. But neither of these ideas say what time (or space) actually is. Without this knowledge there is always going to be a question over human understanding of anything perceived, especially from the point of view of existence. Thus, what is real to us through measurement may not be as real as thought, ostensibly validating the quantum mechanical derogation of reality below the level of human vision. As Tal (2017:3) says "*realism is concerned with the metaphysical status of measurable quantities*";[73] in this work realism in human perception is concerned with 'the foundational state of measurability'.

3.3 Towards a fundamental premise

These fundamental concepts of measurement, although showing a highly indeterminate base, characteristic of human susceptibility to misinterpretation, have a major bearing on considering a foundational, or first, cause. I now turn to establishing a suitable premise.

Previous sections have raised the possibility that a single first cause might exist together with an associated definition based on what a human might believe to be a self-evident truth. I do not know whether any humans can imagine anything outside of this universe to weld into a fundamental concept; consequently it seems that, as suggested, the basic premise will have to be a guess, which implies it must come from analysis of human beliefs. It therefore has to be a metaphysical-foundational assumption, because it deals with humanity's most basic questions – the so-called nature of reality. In view of the conjecture required, such a foundation can only be justified by the total deductions attained. If it produces answers in line with experimental measurements then *perhaps* the conjecture is correct. Even if it agrees to an extraordinary degree with human observation and common sense/logic it cannot be considered absolutely correct because there could always be a better guess. Only in this sense should foundational philosophy be open to question. It should otherwise be closed in its overall internal structure.

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[71] cf Aristotle 1923:D[Δ]§6(3)
[72] (see e.g. Goldberg and Scadron (1995:37-38) and the above mentioned Kündig 1963, Ives and Stilwell 1938)
[73] Tal (2017:3)

3.3.1 The fundamentals of physics and definitions

The acknowledged fundamentals of physics are space, time, mass and electric charge, none of which are clearly defined in standard physics as there appears to be nothing more fundamental on which to define them. On the assumption that our universe, as we see it, is a reflection of all the processes available to it, the first choice of a single premise should then fall upon one of these. Mass and electric charge are comparatively new ideas as they had been unidentified until the last few hundred years, although 'weight' must go back to perhaps the age of the first sapient beings. Both mass and electric charge have been subject to many different explanations over time so they can really be no more than hypotheses, leaving the possibility there may yet be another better account of the properties they convey to objects. Thus it is fruitless to try to find a premise based on them.

Next space: is it necessary? The question of a pre-existing space has already been raised into which a universe could be placed. Supposing there was no such thing, maybe a dream world such as that suggested by Bishop Berkeley in 1713 or more recently Tegmark's mathematical world which would be just as ethereal.[74] Then what of the supposed existence of particles? Do they actually need space to exist? Point particles such as photons or even leptons are said to exist in mainstream physics, but if they live in a pure mathematical world then one could consider the existence of these pure points without the need of a volume. Furthermore, it should be mathematically possible to consider that all objects could be created without the need of an actual volume[75]. Even more so in a dream world, but I think the latter can be left as an idea raised to answer some of the problems in earlier philosophies. So the question of a pre-existing volume, or space, is a non-trivial problem that requires a solution. And it cannot be solved in reference to itself, that is, in a looped explanation. It would have to be defined in terms of something else.

Thus of the four mainstream elements the only one left is time. It, at least, is abstract enough not to require a questionable space in order to exist. It could exist perhaps as a single point or even set of points. So it is upon this that I shall concentrate.

This leads to a major problem: How do we suggest, or describe, something that might be outside of human perception, but perhaps not conception, when we only have language based upon perception and not conception? For example, if I produce a fundamental definition for Time, it can only be given in terms of words such as 'point' for which there is no *satisfactory* definition in human semantics. The same is true of space and volume. In terms of physics 'space' is one of the fundamental elements and is considered so fundamental that it cannot be described in terms of more fundamental elements. This has left it open to

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[74] Tegmark (2007), Immaterialism outlined by Berkeley (1713).

[75] I distinguish between space and volume. Space has multiple connotations being used as in 'deep or outer space', mathematical space, fields, surrounds, gap, et cetera. Volume is simpler. It must first be deduced from the foundational principle and then shown to be three dimensional. It may seem that this is a form of space but the volume's nature will be seen to strongly contradict current human interpretation of this concept.

questions such as: is it a continuum or discrete (grainy); is it isotropic and isomorphic; what is its form; and if a field, what is meant by field (see section 6.2.2), and so on? Similar problems apply to Time, so it is not only a lack of unimpeachable words to define it. Time's position and apparent properties in human cognition need to be analyzed (sections 3.3.2 -3.3.3). Space and volume should then become easier to define because if Time is the fundamental cause then space and volume must follow from it, as in section 3.5.

3.3.2 Time and existence

Most people have an intuitive idea of the inexorable passing of time but philosophers have spent many hours trying to decide exactly what it is. There are probably as many views of time as there are people who write about it. I have not managed to find a single unequivocal definition,[76] but many passages that avoid the issue. The issue itself seems to be mainly decided on disciplinary lines: physicists are not concerned with its quiddity but only with its apparent effects leaving its true nature, as seen, to the philosophers to wrangle over: such debates can be found in van Fraassen (2015:108), Baumgarten (2017: 5), or Ellis (2012:27).

The question of time has always been a problem for philosophy from the earliest thinkers, and certainly Aristotle, through St Thomas Aquinas (1225-1274) to Maudlin. As late as 2011 Shevchenko and Tokarevsky say it (and space) are foremost metaphysical problems.[77] Ellis concurs – physics does not answer "ultimate" questions.[78] Baumgarten says "The impossibility to define the concept of time is insofar unproblematic … as the concept of physics itself presupposes time." Rovelli believes it to be a complete illusion. Page and Wootters consider it an internal concept of the human world, a thought tentatively raised by van Fraassen and for different reasons by McTaggert in 1908.[79] Van Fraassen and Markosian discuss a host of views on time without leaving any concrete conclusions; as Bryan and Medved say, the ideas are wide "leading to disagreement amongst the wide range of contributors."[80] But still physics and philosophers alike do not seem to take it seriously though it may be vital to understanding the structure of the universe.

Rovelli's opinion is interesting. Being obtained from quantum mechanics it carries the problems of time over into the problems of observation. That is, a system in a given state can have different observed states, depending on the observer, as suggested by Schrödinger in 1935 and later Zurek in 2003. This is close to Hawking and Mlodinov's view that an observation depends not only on the observed but on the

[76] There is a mathematical method of defining time in Costa and Sant'Anna (2008) but it contains a fundamental problem, that of a mathematical space, bounded or not (cf Costa and Sant'Anna (2001), nor is it simple in the sense of a unique fundamental cause. As I have rejected the idea of a completly mathematical universe, or that mathematics is necessary for universal existence, I shall remain with my, in a sense 'classical', word definition.
[77] Tokarevsky (2011:1)
[78] Ellis (2012:27)
[79] Baumgarten (2017:5); Page and Wootters (1983); van Fraassen in (2015:108); McTaggert (1908)
[80] Markosian (2014); Bryan and Medved (2018:2)

observer as well;[81] in quantum mechanics it changes the state for all other observers. Some of these states are, in QM, observably mutually exclusive, for example, momentum and position of a particle; determining one changes the state of the observed particle so that the other has to be determined by a new observation at a later time. A basic concern is that these statements are only human perceptions allied to so-called physics rules; rules that are largely entrenched to the level of dogma without a fundamental foundation (known as QM monism). Persson for example, doubts that physicists will ever unearth the fundamental concepts but philosophers might do so by the nature of their uninhibited arguments (cf Chapter 5).[82]

Many authors consider time as something measured on a clock,[83] (for example, even Einstein balked at a definition of time or the concept of an interval (as did Aristotle although he saw an incongruity – see section 2.3).[84] The internet ‘definitions of time’ contends “There is no one simple definition”. It gives many ideas of the form ‘a measure in which events can be ordered from the past….” which is not a definition of time but what time does. The two concepts are distinctly different. If an early clock is considered, it has a round face marked into sixty intervals each representing a circular movement of a hand by six degrees of angle. So the measurement is actually an interval of change by one unit of circular length, or six degrees. A number of these add up to one rotation by the Earth; and an even greater number to one revolution of the Earth around the sun. But that does not tell us anything about the fundamental concept of time; why or what in the universe leads to the passage/expression known as time for which we invent mechanical systems to represent it. Or more recondite still, is time continuous (a continuum) or discrete (grainy)? Nor will it prove satisfactory to consider time as the difference between changes of one state to another, because that requires a specific extra definition of an interval from one condition to another, where interval is defined by dictionaries as between two events (or space between two points).[85] How is that difference measured? As the differentiation between points on a clock face, all points of which exist simultaneously irrespective of the moving clock-hand. That is, if an event occurs when the clock-second-hand is at *A* and another event occurs when the second-hand is at *B*, we can at time *B* count back the number of seconds between the two events because *A* is still on the clock face when the second hand is at *B*. But if we note an event without being able to record its time, and we cannot count until we can find something to compare it to, we cannot say how long ago it actually occurred. In that respect events are fleeting as is the interval between them. Furthermore, what if a clock (of any form such as an egg-timer) should not exist? The suggestion shows that the concept ‘*something* that can be *read* on a clock’ is even more mundane.

[81] Schrödinger (1935:3); Zurek (2003:1); Hawking and Mlodinov (2011:103)
[82] Persson (2018:58)
[83] See for example https://www.exactlywhatistime.com/definition-of-time/ which contends “There is no one simple definition”. It gives many ideas of the form ‘a measure in which events can be ordered from the past….” which is a definition of what time does but **not** of time itself.
[84] Einstein ([1905:39]); Aristotle ([350BCE]1991:§218-220)
[85]E.g. World Book dictionary 1989, Cambridge English Dictionary 2020.

The questions are still, then, (i) whether time does exist in nature rather than being a spiritual quantity in human imagination; (ii) what it is; and (iii) whether its existence could be concrete – meaning being involved with the reality of objects. But on what can arguments be based? Only on human ideas which may be totally false in relation to the actuality of the universe. To have any chance of success they must be based on a fundamental truth. But, then, arguments can be made on the existence of a single fundamental truth, or what that truth actually is, a major debating point in philosophy and especially philosophy of physics.[86] Consequently the best answer is to take a flying guess and ignore open ended arguments that can never be decided. Metaphysics as envisioned by Aristotle, it seems to me, was not to be inconclusive but to arrive at a final resolution by reasoned analysis. The fact he did not succeed in uncovering this cause is not an excuse for half measures but a challenge to bring his idea of a first cause to a conclusive finality. Consequently, let the result of the guess determine its efficacy. If it does not provide a suitable outcome, think of something else and try again.

In view of this approach I enter two further views both suggesting that trying to find a definition for time is impossible. In my view a 'cop-out' because the first order must be to find a fundamental principle on which to base the so-called laws of nature.

> We can not 'explain' time to someone who does not know what it is because it is unique. A unique concept can not be explained by other similar concepts since it is unique. But though clocks don't explain or define what time is, clock's [sic] define how we measure time. And this is all that is required: Physics is neither able nor obliged to tell what things are, but physics can tell us how things behave (Baumgarten).
>
> The concepts of the laws of nature and of the passage of time play central roles in our picture of the world, and the arguments that these can, or need to be, reduced to something else strike me as flimsy (Maudlin).[87]

Despite these two views, as time appears to be possibly the most important entity in a frame of reference I will assume that time does exist. Then I must take a more ontological view of its apparent traits so that some idea can be formulated of its most fundamental attributes – that is, to ascertain precisely what in its structure causes our perceptions.

Aristotle raised the problem in Book IV of 'Physics' noting apparent contradictions: 'now', for which 'nows' cannot be simultaneous, so must be separate but cannot be separate.[88a] Time forces change which can be fast or slow but the flow of time must be constant but not movement,[85b] which implies time "is neither movement nor independent of movement".[85c] He gives the principle of ordering, that is 'before', 'now', 'after', using this as an argument for the fundamental existence of time.[85d] Thus he believed that everything in the universe is in a constant change of state but that this could not allow the fundamental construction of the universe. There must be a group of 'first causes' that would be unchanging; something

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[86] (cf Reichenbach 2019:§6.1).
[87] Baumgarten (2017:5); Maudlin (2007:5)
[88] Aristotle ([350BCE] 1991 from §218a4 onwards; [85b] (§218b10-20); [85c] (§219a2). [85d] In 219a30-219b1

that would motivate the changes in the universe, and would cause a single first eternal motion: "The first principle or primary being is not movable either in itself or accidentally, but produces the primary eternal and single movement."[89].

Aristotle's views can be tied to a modern context. Our basic experience tells us life begins, it ends. The sun comes up, it goes down. Everything changes. The universe is not static. Clocks have been invented to mark the passage of time between events. These may click every second or may run at atomic rates. These last two statements have an ontological significance. The first is that in our frame of reference time creates an interval between events which we can measure; and second, that humans need discrete intervals for this measurement. For example, even the running of a caesium clock has a defined frequency/period[90] between ground states. The defined nature of measurement is essential to the concept of time because humans believe in the ability to determine time precisely so that two measurements made of the same event, or type of event, can be compared with prescient knowledge of accuracy. For example, assuming, just for this argument, the homogeneity of space and time throughout the universe, measurements of light emitted from celestial bodies moving at relativistic speeds relative to us can be measured in terms of frequency. This gives a spectral shift due to a number of possible effects. Take, for instance, the special relativistic, or transverse Doppler effect:[91] we need to be certain that the period (of time) in the emitter's frame of reference is exactly the same as in ours (if both of us were at relative rest). Then we are able to compare the spectral shift observed of the celestial body to the spectrum seen in our frame of reference.

Proper comparison requires that the start and finish of the period, called endpoints by humans, in the emitter's frame must be precise, as also must be ours. This at present we have to assume to be the case. But it leads to a specific suggestion that in nature's construction of the universe, time is 'constructed' in such a way that this sort of determination can be made exactly. That is, the ends of the period are not blurred into either a preceding or following period. The question then devolves to ever smaller clear-cut periods. To have such periods requires a distinction between the start and finish. (I hesitate to call the start and finish of each individual period endpoints because this will cause confusion later). So in a continuous stream of periods such as on a caesium clock the question of frequency arises, thus demanding a clear cut distinction between each period. This, of course, does not mean that time itself is not continuous. But one should consider that if each end of a period is to be distinct, the question of 'is'-'is not' for the period arises. Thus for any period, however small, there must be a clear differentiation between the 'is' of a period and its 'is not' demarcating the beginning of that period and the same for the end. Adjoining periods must be contiguous as otherwise an undefined 'empty' gap could exist between any (or all) of

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[89] Aristotle [350BCE]1923:123§8)
[90] "Physics: the interval of time between the recurrence of like phases in a vibration or other periodic motion or phenomenon". The World Book Dictionary 1989.
[91] See e.g., Goldberg and Scadron (1982:36)

them. Gaps might allow an interval of a specific number of identical periods in one frame of reference to have a different temporal length to the same number of periods in another frame, unless the periods can be reduced to a set of minimal (meaning cannot be smaller) units (such as for example Planck units) so that any gaps themselves are minimal.

Without a firm unit no confidence could be given to comparisons between different measurements and, if it was not a minimum, then it could be divided. But it cannot be ‘infinitesimal’ because then it could always be divided further. Therefore there has to be a minimum indivisible unit or minimum **interval**.[92] In this case I can define such a minimum unit as a **unit of Time**; that is, any so-called gap cannot be of any length, it has to be the same as one or more minimal units, that is, any gaps are themselves minimum Time units (before relativistic considerations). Because a Time unit is indivisible it cannot have beginning and end points, nor can these be external because all external points are also units of Time. Thus the beginning and end to a Time unit must be the same as the totality of the unit. It would then be a point in the sense of existing but without a size – how could it be measured except against itself as there can be nothing smaller? This further raises an open ended but absolutely fundamental question to which I could find no answer, and very little consideration in the literature – what is a point? The most basic idea seems to be given by Euclid ‘*that which has no part*’. A point then would become an adimensional abstraction that exists only as a human notion. But this does not give it a concrete form, so that does not, as required here, define exactly what a point of time is other than *something* on a clock. And we are back to ‘square one’. I thus see a difference in these considerations between human ideas built upon apparent beginnings and endings to everything, and concepts of a possible fundamentalism beyond human perception. So for the moment I can only assume that there is an entity, being, or object that corresponds to the human concept of time, and with this in mind continue with the concept of time in the view that a full definition may appear.

3.3.3 Towards a definition for time

Now the question of a definition satisfying the above issues. To be foundational, or as Aristotle would have, a first cause, it would have to be based on a single premise.[93] Otherwise it would be a complex premise needing simplification to a single more fundamental form. Then any growth in the universe would have to be by repetition of a single form. Under the assumption taken in Chapter 2 it will not have a mathematical cause. Consequently mathematics will not be considered. In the concept of ‘building by repetition’, single should not be taken as a number, but as just the human device to denote nothing else but a simple cause. Without prior conception it may be that it will lead to a system which humans see in terms of numbers. That is, a single form may arise as an original stage and produce another single form, or maybe a set of single forms. This, or these, will provide the next stage; and so on. The whole will depend purely on the first action provided; this action must determine everything else in the foundational

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[92] cf Russell (1913:5)
[93] Aristotle([350BCE]1923: A§1-2)

reasoning and thus the Universe derived. It must be capable of answering any problems that might appear and provide only one route to the formation of a Universe. Without these provisos, the action would require a restriction thus rendering the fundamental cause composite, not singular.[94]

The fundamental cause of time should then form a continuous immutable progression with each stage being distinct from the previous. That is each stage either is or is not, there are no half stages or divisible stages. Thus a sequence of actions will arise in which every action clearly follows a previous action. Each stage is distinct and must thus be recognizable from any other. It can be assigned some particularity or symbol distinguishing it from any *previous* stage; but not to future stages because the universe is inanimate, just a continuous action. I assume only a sapient object can attain a future thinking ability. Furthermore, if it is to create a universe, which, I assume here, consists of concrete or substantial, material objects, the foundational principle should be one that will have an essence of concreteness about it, even if it is not concrete in itself, – it will provide what humans see as concreteness to the objects produced.

If time is to be assumed as a first cause then the question must arise: Could anything exist outside of time? The answer would have to be "no" because, if time was to be the foundational cause of Universal existence, everything in that Universe would have to relate directly to that cause. If it is to be a simple single cause then it cannot be composite. Therefore it could not contain a subsidiary cause which would remove time from the picture as the Universe developed. Consequently, the entire Universe would have to form around the existence of that time. Thus nothing in that universe could exist outside of time. So this case allows the premise, which I will also call a first assumption, that everything that results from the first principle exists in time, while time is responsible for everything that exists. Such a premise, recorded as 'time exists', would be recognized in human sapience as a self-evident truth. In fact, this still has to be conjecture because one cannot be certain that existence 'in itself alone' implies time as the first cause. It might imply something completely beyond any human imagination. The best possible outcome of such an investigation is then attained if the resulting development of the premise produces a workable, testable theory on the construction of a universe. As Aristotle himself wrote: "if there were no time, there would be no 'now', and vice versa" which agrees with human sapience. Baumgarten too, agrees that time is fundamental.[95] So time as a first cause must be pursued to testability as if it fails, a new first cause must be discovered.

Finally, time in human cognizance is associated with number. The question must then arise: if, as projected, number is not necessary for the existence of a universe why does number feature so strongly in human thought? As with the views of Ellis and Baumgarten this question falls within the class of unnecessary information for physical deliberation and therefore is an ultimate question in the realm of

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[94] This book would become boringly and excessively long if all possible ideas that led to contradictions were aired. Only the viable route will be described.

[95] Aristotle (1991:220a1); Baumgarten (2017:3)

metaphysics and foundational philosophy.[96] The use of numbers in calculation or to form mathematical systems falls under the remit of pure and applied (including physical) mathematics – although, as will be seen in Chapter9, mathematical calculations can be used in a purely philosophical manner. But if 'time exists' is a true foundational premise it seems possible the causality of the human concept of number must arise from time itself. Even the concept of singleness is inspired by number. Humans have the concept of 'one' because they also have the concept of 'one-one' and 'one-one-one' where each 'one' represents an object. To some extent this casts back to the concept of comparative intervals of time based on minimum units raised above.[97] One-one is defined as (called) two and one-one-one called three and so on through the natural numbers, each 'one' being defined in turn.[98] Using these as groups gives quantity. But humans can also see a number of objects lined up and assign adverbs to give an order of first, second, third and so on. Each adverb (ordinal) is then isomorphic to the sequence of natural or counting numbers, *N*. Note that in such a sequence zero does not occur, and cannot occur, because it means 'no thing' and so is not seen in a sequence of *material/concrete* objects.[99] Note that this numbering is purely a human concept that is irrelevant to forming a Universe.

These factors suggest the direction of an unequivocal definition outside of current human assumptions and perceptions, in as far as language allows: a possible first, or foundational, cause from which a structure would follow that would automatically (causally) develop into a universe. This inference does pre-assume a universe might follow, but this is necessary in this instance as a statement of intent. The target will still remain to use the definition for deduction without expectation of any particular result.

3.4 Definition of Time

I therefore raise the following preliminary definition, the second assumption of the proposed theory:

The fundamental action of the Universe is one that creates a self-generated ordered progression of recordable points all of the same form but such that each point is distinct from any other.

Some of these words need clarification.

- Self-generated implies some operation, fundamental action, or Time generator,[100] $\hat{T}$ by which time creates new points in the progression. The determination of the form of this operation will explain the most fundamental processes of the universe.
- *Ordered progression* here means the orderly operation of $\hat{T}$, so that a point produced in the first instant, or stage, of the progression can be called the first point and assigned the 'number one'. The

[96] Ellis (2012:27) and Baumgarten (2017:5)
[97] Campbell and Jeffreys (1938: 123-4)
[98] Goodstein (1968:73)
[99] cf Tyson (2013)
[100] In mathematical terms this would be the same as an operator but to start with I use the term generator to suoort the idea that the universe needs no knowledge of mathematics. The same applies to terms used later such as q_i which should be taken as mere symbols in philosophical logic to shorten word descriptions

point, or points (the possibility of more than one depends on the determination of $\hat{T}$), generated in the second instant (stage) belong to the second place in the progression and so on. Points are then produced in sequence allowing the progression to have sub-sequences of stages, each consisting of a string of single stages in order, starting with a first stage, second stage, et cetera, in a particular subsequence where each point in the subsequence corresponds to a position in the overall progression– similar to an evolutionary 'tree' (as in Figures 5.1 and 3 of Chapter 5). The action/form of $\hat{T}$ must include the cause for this progression. Humans would consign to the progression the set of counting, or natural numbers but nature has no such need. Points cannot be divided because there can be nothing smaller; if splitting were possible the progression would not be well defined.

- In terms of semantics, by point I have to use the words 'it is dimensionless', it has 'no size'*. The form of the points has to be determined and this, as well as the distinctness principle, will depend on the form of the Time generator $\hat{T}$. Here, this total formation is assumed to be the fundamental defining cause of the Universe, which for the next few sections considers point as specific to Time, that is a point of Time, and it is this theme that will form the original development of the concept of Time as the fundamental instigating principle of the Universe.
- Recordable. The dictionary definition is "to put in some permanent form; keep for remembrance". The concept that a point is recordable must follow from the form of the points. (Cf section 3.5)
- The distinctness principle depends on the form of the points.
- This definition is absolute, meaning that it applies to each and every point of Time in its frame of reference (as described in section 3.2).

* Size in the absence of space or volume in the cause, needs description. It is part of our perceptions because we can reach out and touch objects and look through telescopes at 'distant' objects from which we infer the existence of space and volume. But this does not determine the nature of space. Its existence must follow from the above cause. Until then (Chapter 4) volume and size, or lack of it, will have to be considered in terms of our usual perceptions of a space – since no such physical definition of its nature exists.[101]

I shall use Time with a capital T to distinguish it from any other human preconceived notions of time. The reason for using 'Time' will become obvious despite the intention of avoiding preconceived ideas. Thus the following definition becomes equivalent to the above generalization once all the bullets have been answered:

Time is a self-generated ordered progression of recordable points all of the same form but such that each point is distinct from any other.

It now rests on determining whether such a definition can generate a Universe of any form. It does provinde a point of Time, as an arguable cause though it does not as yet explain why this point, or Time,

[101] see e.g. (Regge and Williams 2000)

should exist; but it is to be hoped a full description of the processes involved may lead to answering this question. – as well as, more immediately, the question into what is it put?

Completing the definition depends heavily on the self-generator $\hat{T}$. The action of this generator must also determine the form of the points of Time. Before developing this line it is worth considering the concept of reality that forms a basis of human perception and that, as seen, has been a question of debate in the latest physical theories.

3.5 Towards human perception

The first step must be to think more clearly about definitions since anything real must surely be clearly definable?

3.5.1 Definitions

Definitions are not a categorical measure of reality though the reverse, a real existence of an object or concept should be definable. However, definitions have one problem: they are no more than creations of a human perception of the visible world. They are then only hypotheses that work within the framework in which they were imposed. They should never be regarded as 'set in stone', nor allowed to become entrenched in more advanced work without being proved to be acceptable. They only fit the physical criteria for which they were defined and, as the theories become more complicated, the chances of required revision to cover new circumstances should at least be investigated. It may be that definitions cannot be given without serious contemplation following construction of theories and laws but theories and laws should always eventuate in definitions. Without them, as for example the case in physics – mass, space, time, electric charge, work, energy, force, field, matter waves, et cetera[102] – there must always be doubt over the accuracy of the theories and truth of the laws.

Theories on the construction of definitions can be found in Belnap but will not be pursued here because they are themselves as subject to human perception as any human idea.[103] In any case there can be no certainty that any physical definition is complied with by the universe, even when it is centred on axiomatic theories, set theory or mathematics. Mathematics allows the arguably unlikely existence of infinities, infinitesimals and singularities. Then there is the problem over the true meaning of zero. Is it real or an accounting procedure? Does 'nothing' exist? These problems will be engaged as they arise. But they do lead to the question whether a purely mathematical theory might lose any connection to reality, irrespective of how axiomatic the theory is, or however beautiful it might appear to be to mathematicians and physicists.

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[102] Some of these have looped definitions and are thus not properly defined.

[103] Belnap (1993)

Many of the contemporary physical theories are ill-defined or rely on mere expressions of ideas.[104] In any case, my interest is not so much on the worth of the definiens, except in one extremely looped case, but the absence of definition of the main entities in physical theories. This centres primarily on a need to know the nature of the definiendum, as will be seen, for example, in the meaning of a physical field (section 5.6). In both these cases the 'definitions' are limited to what is required for mathematical procedures but say nothing of their full nature, a point made by Pilkington.[105] Hawking wrapped this up in his questioning what knowledge we have of the world given by our physical theories when we have no knowledge of why they should rely on the values of a large number of constants.[106] Current physical definitions, where they exist, seem to me to be only sufficient to allow extension of existing theories rather than describing the fundamental nature of the definiendum. In many cases they are more theory than true definitions.[107] They thus become more jargon for the specialist than descriptions for any interested party.[108]

Consequently, as humans are a product of the universe, unlike in physical reasoning, I shall regard definitions as less likely to be true to this structure or functions if they do not fit human common sense/ reason. The idea that the universe is made of things that are not real is one such apparent illogicality. A definition that feeds this idea I would class as fundamentally weak. A definition such as rotation being the change of position about a central point or axis in a plane over time fits human experience (though it is not complete – see section 3.5.2). Even so, no-one can be absolutely sure that it covers all possibilities. There may be something more fundamental which leads to this observation. Consequently, I regard it as strong but not absolute.

Absolute truth could only exist if a fundamental first cause could be constructed which could be proved to be true. However, definitions which follow from a projected first cause that produces a completely workable theory for the structure of the universe could be considered as ontologically the most strong. It is towards this realization that I aim. This sometimes requires lengthy preliminary investigations and often figurative (metaphorical) or ostensive (in the sense of diagrammatic) descriptions; what Pilkington refers to as definition chains, except that here I pass from the figurative to the formal. Thus there are cases, for example rotation, where a full definition arises long after its general description.

3.5.2 On Reality

Definitions must rest on the concept of reality, which extends to that of why anything exists, but this will entail a full understanding of the structure and processes of the universe. Since humans only have their own sapience on which to debate reality, it can only be conducted in terms of human perception. Reality

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[104] Feyerabend (1993:28,45)
[105] Pilkington (2019: 593-595)
[106] Hawking (2002)
[107] Belnap (1993:124-126)
[108] cf Weinberg (1933:133)

has been a question over the ages, possibly more in line with the reason for existence and how the universe began, rather than how good our perceptions are. But following the dictates of quantum wave theory and the necessity of our interaction to observe anything, the question of reality in both physics and philosophy pertaining to theories of the universe has become more a question of tying in the non-reality of contemporary physics with our perceptions and beliefs, especially common-sense beliefs. It is very much an open ended debatable subject,[109] used in this book only to find a viable causal basis for a Universe.

For this section, it is sufficient to consider only those peculiar aspects suggested by Bohr, d'Espagnat, Rees and Mermin in section 2.6. This needs a short explanation concerning measurement according to quantum mechanics. Quantum wave theory demands that measurement, here meaning experimental determination of an existence of an object or some specific property, requires us to interact physically with that object. Due to its wave nature the object itself can carry a huge array of different inputs from previous interactions. Which one of these is picked up in experiment depends on the measurement process. We can only measure one possible outcome in QM theory from all these inputs and consequently there is only a predictive chance of obtaining any given one. What we observe also depends on what we put in with our experiment, that is, attempted measurement. Richard Feynman derived a mathematical system in 1948-49 which utilizes a huge number of possibilities some of which have practically no chance of being pulled out by our experiment, but all fit together to give possible outcomes. Obviously a possibility with an exceptionally low outcome expectation is not at all likely to appear. Nevertheless, according to this principle the object has no true underlying instruction that forces it to always react in a given way, and thus it has no underlying defining reality. The only reality we have is the interaction between observer and observed.

This has then been extended to include ourselves viewing an object, as in Hawking and Mlodinow: "you must interact with the object you are observing. For instance, to see an object in the traditional sense, we shine a light on it". This may be just an illustrative example but it has a distinct air to those expressed by Rees and d'Espagnat. The quantum requirement of an interaction between observer and observed has become further extended, as in the pronouncements of Bohr and others above, to the view that the universe exists because of our observations of it. But it seems to me we have eyes with which to see because their development has aided our survival as a species. Our eyes developed because of light from the sun. In fact, without the sun we would not even be here in any form!

On the other hand it seems clear that we need input through our senses to experience objects and even to experience our own bodies. For example, if a bird flies past us, we receive light from it but we do not previously send out light from our eyes towards it. In other words we have not carried out any form of experiment to interact with it. Our eyes do not radiate out light like a radar transmitter. There is little connection between this reality where the flight of a bird past us has nothing to do with us (unless we

[109] see for example Heelan (1965), Fine (2001), Karakostas (2012), Saatsi (2017)

frightened it), and physical experiments where we *cause* an interaction. Consequently, quantum theory might claim that in the case of us seeing the bird there is a mutual interaction with the light from the bird interacting with the rods and cones in our eyes and thence to our brains. But this is still completely different to the experimental tests where we have to send out detection signals.

We have come to understand various concepts through our experiences and particularly through schooling/teaching by superiors and peer pressure. In particular we have learnt from birth, concepts of space and motion. But these have led to certain problems such as the size of the universe, or the question: if the universe started from a miniscule volume, into what is that volume expanding? There is no human definition of space and thus there can be no unequivocal definition of motion so how can we judge our knowledge to be completely truthful about anything that is related directly to space? We only have our experiential belief. For example, take the human concept of rotation as a form of motion. We have a so-called definition based on the proposition of space, position, direction and time. But these are all reliant on our experiences. Aristotle was worried about time as he could understand the concept of 'now' meaning the instant of a current experience but this was fleeting as our experience moves to the next 'now' giving the problem of past, present and future all being separate, yet each now exists. So we have to wonder at reality in terms of existence because what was real an instant ago may no longer be real 'now'. It is only real in our memory or imagination.

Taking for example direction, it depends on space and time. Using human perception, if I see an object on my left what do I mean? If I look straight ahead so that it appears at ten o-clock, or 30° to my left (330° from my right – or is it 60° - it depends on how the direction is measured [clockwise or anti-clockwise]) then it is on my left, but if I turn 90° to my left it is now on my right. Its position has changed in my frame of reference at a different time. So, whilst I might know where it is, another person may not be able to tell from my directions. To obtain a 'real' answer I need another object which we can both determine as a reference-point at a specific time.

Now taking a 'deeper' example for rotation, rotating or to rotate, say in a plane to make it simpler, as it will prove essential to understanding the Universe, there is an important ambiguity arising from the lack of an exact definition. For example we have the following[110]: "Dictionary.com: to cause to turn around an axis or center point; revolve. Merriam-Webster: the act or process of moving or turning around a central point · a complete turn around a central point. Cambridge English Dictionary: to turn or cause something to turn in a circle, especially around a fixed point. Vocabulary.com: to circle around a center point. Wheels on a car rotate, planets rotate. Collinsdictionary.com 1. the act of ***rotating***; a turning around as on an axis ; 2. Astronomy. the movement or path of the earth or a heavenly body turning on its axis. Study.com: A ***rotation*** is the movement of a geometric figure about a certain point. Oxford Dictionary:

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[110] All retrieved from the World Wide Web on 13th November 2021.

the action of an object moving in a circle around a central fixed point. World Book Dictionary: to move around a centre or axis: turn in a circle; revolve". Consequently different people may have different interpretations, and thus uncertainty in its exact meaning – very much a Fregean (Shapiro 2005) complaint (cf section 2.4). Furthermore these definitions all include the concepts of space, time and motion which themselves are undefined. (And perhaps as an interjection: 'turning' is another word for rotation! – which would give us the meaningless 'rotation is rotation'). Mathematically, rotation can be determined in terms of a rotation matrix using coordinate geometry but this is no closer to the 'what is' question or really any different to the dictionary definitions given above.

Taking this to another level, and leaving, for the moment, definition of circle and movement: Everyone is used to the concept of a 'rotating wheel', but this is highly ambiguous because the wheel is said to rotate about an axis. If revolving is the action of an object following an orbit then all the points in the wheel are orbiting, or revolving about the axis – which returns to the case of a circle in some definitions. How large does this circle need to be? Suppose a reference-point *A* (bearing in mind that a point of any sort itself has theoretically no volume or radius) moving around *O* is actually adjacent to (touching) *O*, then it has no radius of rotation (points have no volume). But we still have a rotation (cf §4.4.1). Consequently arguments can be made that the concepts of space and time are extraneous to the actual idea of rotation although they become of use in *measuring* the concept.

Then there is also the classical problem when ancient civilizations imagined the Earth at the centre of the universe with the heavens revolving around the Earth. It is completely possible to be rotating without knowing it. If we see a top spinning we can claim this to be true relative to our frame of reference, but as with Mach's problem[111] it could be that we are in a rotating frame of reference and the top is actually not rotating with reference to something outside our frame of reference-top system. But then again Mach's problem arises that the outside object is rotating and our frame of reference is not. Rotation appears to be purely relative. It could even be that all three are rotating at different rates and maybe even different directions. To determine the 'truth' of such a case we would need to somehow pass outside of the total system as if there could be some 'pretend' or (outside of pretend) a 'God-given system' in which everything can be known.

So what is reality in the concept of rotation? It appears we cannot have a complete definition (taking into account measurement of the effect) unless we can in the same expression also define both space and time. And even then we have to define the concepts of motion and direction with respect to rotation, or vice versa. That is, should rotation be defined in terms of direction and motion, or should direction and motion (in a circle) be defined in terms of rotation?

[111] See (Einstein 1916:112)

Since there is nothing clear in our descriptions, a thought experiment should be raised in an attempt to ascertain whether there are concepts beyond our immediate perception which might provide a solution to the problem. Perhaps rotation should then be considered in the same light as time and space in contemporary physics. Maybe all three are linked: neither motion nor rotation are properly defined in human terms as they, as above, rely on space and time which are undefined in physics. In our perception they only have their action but not how this action arises, that is, what is their essence or quiddity or nature. It is thus essential that we consider the fundamental cause of how the concept of motion arises and in this respect with 'no space' as a fundament it seems rotation might be a strong possibility. Here, we shall have to think outside of anything thought of before.

The problem is that everyone has their own perception of reality based partly on genetic factors acquired over the ages as a species, by experiences, and by schooling. We can develop these by original thought. But there is always a tendency to listen to the experts, for example the remarks just mentioned by Hawking and Mlodinow. It is this perceptive mechanism that rules out complete certainty over any scholastic assertion because the possibility must exist that any assertion, however great it may appear to be, has an element of error attached to it. Care should be taken because such assertions may lead to entrenchment of ideas. There may always be a better idea. A useful concept is to explore reality by exploring the possibility that non-mathematical reason can produce an explanation for the universal structure and processes. Accordingly, it would be satisfactory to proceed from the definition of Time presented if rotation, as a primary form of motion, and space, arose with the definition of Time as a first cause. They are fundamental to the Universe and will therefore need to be explained in terms of that first cause.

How would this relate to a fundamental reality itself? A fundamental cause can only have one definition (if two should arise then either they are equivalent expressions of the same thing, or the idea they are fundamental must be false because they will be combinable into the true fundament). If this one definition is fundamental then the cause it defines must be all that is needed to create a Universe. Everything in that Universe is bound up in this one cause. That would be the reality of the Universe produced. If that cause also describes our universe, humans will be bound up in that reality. They will have perceptions of that universe, but only perceptions and it is from these that they derive laws, definitions and descriptions. But because they are perceptions there is no certainty these perceptions are truthful to an original reality. Thus we get a split into the fundamental reality of the universe as it was caused, I will call it the **natural universe**, and a different idea of reality, that which we believe to be the reality drawn in our minds from our surroundings which fits in with, for example, some views of Reiss and Springer or David[112]. It is only from these perceptive observations that humans, both as scientists and non-scientists, have derived the so-called laws of nature, descriptions, and definitions which humans believe describe our

[112] Reiss and Springer (2020); David (2020)

perceptions. The uncertainty of these perceptions, descriptions and definitions can be seen in the 'isms', that arise in philosophic thoughts and the ever increasing complexity of our mathematics and physics with a large variety of human-made definitions to deal with the seemingly insurmountable problems that contemporary physics has built for itself. These definitions cannot therefore be considered real because they are not based on an original cause – only on perception. None of these can then have any absolute truthfulness in the determination or description of the supposed fundamental cause. Our arising perceptions have forged a 'box' from which we must somehow emerge. In fact these perceptions have in some cases, for example quantum theory, led so far from a fundamental cause that they actually deny it. It is therefore imperative that we pass out of our 'box' and consider there may exist two forms of our universe, a fundamental cause or natural universe which encompasses our perceptive universe.

Further to the search for reality, or truth, the concepts of objectivity and subjectivity should also be mentioned.[113] The principle is that theories should be objective. However this, I argue, is impossible because just the consideration of any new theory will always have some subjectivity thrust upon it by the author in an attempt to get it established. In the case of empirically based theories the subjective angle is far worse because, as Feyerabend has pointed out, historically based and apparently successful theories become entrenched through continued development and peer pressure.

They thus become progressively more subjective, as was seen in the development and argument, for example, with Einstein over the reality of quantum mechanics as an acceptable theory – the famous 'God does not play dice with the universe'. Disagreements lead to subjectivism in the determination of groups (and individuals) to establish group beliefs. In the case of quantum mechanics this has led to the setting up of more and more experiments to prove what has for some time been seen as an established 'fact': QM indeterminacy. The physicist sees what he wants to see – blindered as Einstein often put it.

Arguments have been made, for example by David, trying to link truth, and thus objectivity, with fact, but this misses the point that for the closest ideas to fundamental physics, even for apparently established laws, human perception is purely that – perception. Without definition of the fundamentals (mass, charge, etc) how can any physical theory be regarded as anything but subjective?

New theories start out as objectively as possible within the ambit of the aforementioned prejudices of the author. Subjectivism can be reduced by developing an apparent self-evident truth. Nevertheless, even this still depends on human perceptions of self-evidence – more so when dealing with ideas that are too fundamental to be defined for which human perception, thought and especially imagination are essential elements. This will particularly be the case for the self-generating or Time generator mentioned under the definition of Time. It is completely subjective in that it can only be described through appealing to human imagination as all definitions can only come from this source. But imagination on the whole depends on

[113] See e.g David (2020); Smith (2018); Feyerabend (1993)

prior human experience which follows from fundamental actions instilled by the universe. Definitions are then abstractions from more fundamental principles. The question is the determination of which action could be *the* fundamental one leading to the human perception of a Time interval. Once this has been uncovered it should then be possible to produce a Universe based on this alone without the thought of any other human physical perceptions, but within the natural meanings attendant to normal word usage.

But there is also the subjectivity of the reader to be considered. Most readers will have their own views which may conflict with those written and may have an effect on their consideration of the degree of subjectivity of the written work.

This raises a further important concept concerning human ideas of reality and semantics. Each discipline has its own language, methodology, and mode of arranging its arguments. These again arise from the perceptions of the practitioners of the various disciplines. But the development of a first principle should avoid all these individual differences to attain an overall concept that fits everything. The problem here is it has a different 'reality' from the practices of these disciplines and thus its 'reality' is different from theirs. This must be taken into account. For example I have raised the concept of a foundational philosophy to surpass metaphysics and the philosophy of science (and any other philosophies). It should be seen as a different sphere in the same sense that the foundational principle of the universe may have a reality different to the 'reality' of our perceptions. As I have said, it has to be written in existing human language because even if I was to invent a special language, it would still have to be related to current language. Readers must see this work as an attempt to break out from the 'prison' ('box') of our surroundings, schooling, and peer pressure in a new search for truth.

I have already raised the concept of foundational philosophy in terms of perceived shortcomings in arguing about the structure and processes of the universe. I shall now consider the concept of mathematics from the point of view of its language (and its effect on our intuition and perceptions). Colyvan introduces mathematics as the "most rigorous and certain" of all the sciences. Fundamentally it is an exact science in that its equations are expected to produce exact answers within its rules (allowing for limits to deal with infinitesimals and infinities). These rules are operated through a series of symbols (formalism). As Brouwer (1913) wrote "Because the usual spoken or written languages do not in the least satisfy the requirements of consistency demanded of this symbolic logic, formalists try to avoid the use of ordinary language in mathematics". Mathematical rules and symbolism can be, and have been, expanded over the years: for example, the addition of complex numbers, calculus, matrix mathematics, set theory, Lie algebra et cetera from the original concepts of addition, subtraction, multiplication and division of integers then real numbers and surds as the desire arises. Nevertheless these are all done within strict rules developing as necessary. That is the beauty of mathematical-physics. It obeys a man-made mathematical reality allowing physicists and to a lesser extent mathematicians (Gödel and Russell for example uncovering mathematical ambiguities) to relax in the belief it is the perfect theory through axiomatic processes. But as mathematical-physics has been unable to explain the universal structure and is subject to making peculiar demands (as in Chapter 2 on QM) there appears to be a tacit warning that it might be better to try another approach –as already suggested.

A causal universe is somewhat different. Philosophy does not have such stringent restrictions. If it has a fundamental cause then that cause will have certain ramifications that follow from that cause but none that lie outside that cause. It can do anything that operates within that cause but this will not necessarily agree with human and especially mathematical perceptions. In physics human inventiveness has to fit mathematical strictures (the explanation of the universe being expected in mathematical terms as in sections 2.4-5). The trouble is mathematical strictures can be advanced according to human needs. It becomes a game for mathematicians to see how far it can go. But mathematics certainly should not dictate what the universe may or may not have done. What the universe does may well lie beyond human imagination to date. This is a fair comment if one thinks about quantum mechanical concepts and particularly the peculiar (from the common sense point of view) statements of Rees, d'Espagnat, *inter alia* (see quotations section 2.6). Mathematics has been advanced in quantum theory to cover the concept of Heisenberg's uncertainty with the superposition of waves. In the philosophical approach the question becomes what can be deduced from the fundamental cause without considering any particular mathematical rules. There are then three different concepts of reality at work: human perception, mathematical and that based on a cause.

There has also been much discussion on what I see as the concept of atomism – originating from the fifth century BCE Greek philosophy discussing the ability to split objects or spatial lengths indefinitely versus the existence of a minimal or atomic unit – in relation to continuity, in the form of a continuum, which will highlight the fundamental difference between these three realities. The discussions centre on the continuity of a line, but this can be equally relevant to the concept of point raised in the definition of Time. Aristotle also raised the concept of infinite and infinitesimal in relation to minimal parts as a condition for the existence of anything. Since then the problem of continuity and minimal has passed through a series of mathematicians including Galileo, Leibniz, Kant, Cantor, Brouwer, Dedekind, among many others: Into how many parts or points can a line be divided? Can the divisions be infinite, if not then can a line, or a continuum be formed from indivisible objects? Without any firm basic concepts on which to make decisions there is no clarity; although according to Bell, the current feeling is that a "continuum admits of repeated or successive *division without limit.*" I suggest that the problem fundamentally depends on the lack of clarity on a definition for point. I have already determined the need for a minimal unit of Time (section 3.3.2) and the continuity of a progression of points of Time in part consideration of the definition of point, but the full concept needs further work.

For example, the concept of surds should be included, numbers such as $2^{1/2}$ or the natural logarithm *e*, that cannot be written exactly on a number line, and which therefore, in terms of a number line of exact points, do not exist. This logically suggests that between each rational point in an infinite set of number-line points there exists a non-rational number, and vice versa, between all surds there exist rational numbers. Dedekind overcame the problem by formulating a continuum of 'real' numbers. The question then becomes that if this is considered mathematical reality, is it imposing such a description on the universe itself. In view of Zeno's paradox and the concept of limits the answer is probably no. But nevertheless it is a concept that needs to be considered as relevant to attaining a possible causal reality. That is, can a causal reality remove such a problem. If so can it equally remove the problem of the possible infinite requirement of points to a line and the difficulty over atomistic (in the Grecian sense as opposed to the nuclear physics sense) principle of indivisibility as well as how this even refers to space itself. There is thus the possibility of very different concepts of reality between mathematics-physics and causality, or rather philosophical causality as suggested in this treatise.

Of equal importance is the concept of infinitesimals in calculus which has been carefully investigated by, for example, Ely and Oehrtman.[114] Ely found that as an infinitesimal approaches zero some people/students visualize it as collapsing to adimensional. Oehrtman found that students reactions lead to interesting perceptions on how infinitesimals operate showing a big divide in knowing what infinitesimals are in mathematical 'reality' and what they are semantically (in human perception). It demonstrates the psychological difference in understanding mathematics and causal deductions based on philosophical reasoning. This sort of swapping mindsets between different methodologies (disciplines) has to be considered in attaining a causal final theory of the Universe. What may seem real to the physicist may seem odd to the causalist and vice versa. Perhaps most of all it affects the mathematician, who, not withstanding Gödel's and Russell's incompleteness theorems, believes in the exactness of mathematics against the possibility the universe may not be mathematical, or that mathematics has gone considerably further in its concepts than needed for a universe.

There seems to be a big difference between manipulation in accordance with mathematical rules and understanding the exact implications of linking them to physics, especially if, as I argue, the universe has absolutely no need of mathematics in any form in order to exist. As discussed, mathematics is often considered to be exact, or precise in its language. But one must realize this precision is only in terms of man-made rules which have been shown above (Russell, Gödel, Frege, Duhem, Quine, Wittgenstein) to be suspect. Consequently the efficacy of mathematics should surely be doubted when it is used to explain the basis of the universe, which has so far remained beyond human understanding? The understanding of the background, the cause which has led to our existence, is the prime 'mover' as Aristotle would put it, the first in importance to lead to a comprehensive theory of the universe.

Obviously the connection between rotation, space, time, direction and motion, together with giving them first definitions, is likely to form a totally new way of looking at the universe and its structure –

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[114] Ely (2012) and Oehrtman (2009)

unlike anything that has gone before. The definitions themselves are likely to be different to what humans may have to date imagined. To produce any reality in human perception they must produce a natural universe that has the ability to generate everything we see by some simple method that follows directly from the concept of Time-points. Herein lies another vital concept of our reality as opposed to that which lies beneath our perception. That is, the attainment of our view of space in relation to the thought that if a universe is to be created into what can it be put.

This is obviously a major question that should play a great role in how any universe may be constructed. Consequently it is left to a new chapter.

CHAPTER 4
Space-Time

4.1 Introduction

The previous chapter produced a definition for Time to be used as a basis for the creation of a universe. At this stage it can only be used as a theoretical possibility, but not necessarily identical to the universe we live in unless it can be tested as suggested in Chapter 3 and found to agree exactly with the universe in which we live. In this case, if Time is the fundamental cause of everything, that is, of being, then it must also lead to our perception of space. The principle aim must then be to define the Time generator $\hat{T}$ and then to determine how Time can lead to our experience of space. This is where we really do need to consider the 'nature of things' as opposed to our bland acceptance of its attributes of distance.

As the use of mathematics in its advanced forms must be considered suspect, that is, not necessarily having anything to do with the actual structure and processes of the universe, derivations based on this fundamental cause to obtain an overall theory of the Universal structure can only be philosophical – the foundational philosophy decided on in the last chapter. To some extent this will cover concepts regarded as physical but then, despite the view of physicists that philosophy should be avoided, there is a distinct overlap between philosophy and physics in its basic ideas. Sections 4.2 to 4.4 develop the definition of Time showing, among other attributes, that it must have the most important property of a minimal interval. The remaining sections then show how this minimal interval becomes synonymous with the production of our concept of space and space-Time.

This chapter then ties our most fundamental perceptions of the passage of time, and the three dimensional spatial volume we see around us (sections 4.4 and 4.5), to the abstract definition of Time raised in Chapter 3, finally ending in section 4.6 with a fundamental rule that everything in the Universe must follow. The first problem in order of importance is one surprisingly not often thought about, or perhaps I should say, one taken totally for granted. If a Universe is to be created into what can it be put?

4.2 Into what can a Universe be put?

Neither space nor time are defined in physics. As a result there is also a problem over the concepts of direction and motion which both rely on time and space. Consequently the connection between rotation, space, time, direction and motion, together with giving them complete descriptions in terms of human sapience, is likely to form a totally new way of looking at the universe and its structure – unlike anything that has gone before. An exact definition in terms of our current language as suggested before is impossible. For example space? It is expressed in language formed from our perception of space so it needs words other than 'space' to define it. But these cannot be invented because they then have to be explained – without using the word space. The same applies to words such as distance between objects which rely on space for human understanding. The best then is a description on how and why the perceptions these words lead to arise. However, it may be imagined these descriptions are likely to be different to what anyone may have to date imagined. To present any reality in human perception, they must produce a natural universe that has the ability to generate everything we see by some simple method that follows directly from the concept of Time-points. Herein lies another vital concept of our reality as opposed to that which lies beneath our perception; that is, the attainment of our view of space in relation to the thought:

if a universe is to be created into what can it be put?

By this question, I mean any form of universe, be it a multiverse, a bubble or even a universe that has existed forever. This particularly must answer the difficulty over the concept of the size of into whatever it is put. Humans have created the word space for this supposed container. But without a definition can we answer with the slightest certainty "Does this space extend forever?" "Is it perhaps limited and if so how?" It is not satisfactory to say the universe is space, or the universe creates its own space or just to ignore the problem. Or that its structure is irrelevant, it just exists. The answer may determine exactly how the universe functions. In fact we should expect this.

Bishop Berkeley (1713) argued the universe is just in our mind. Quantum mechanics seems to argue a similar view if human existence is needed to realize a universe, that is, the universe exists only because our minds exist, presumably with an ability of our minds to imagine all the things we see. This would indeed suggest a meeting point between religion and contemporary physics by the transcendental nature suggested for our minds. Even if a Divinity is rejected by some it could well be argued that this problem of a prior space might be solved by our imagination, and that quantum mechanics points to this solution in its necessitating our minds for a universe to exist. I mention this only as a possible argument for completeness sake and to point out that the solution of the problem must be absolutely fundamental to our perception and therefore of major concern to this study. The solution will obviously not be easily determined but it must be established as a possible reason for the failure of physics and mathematics to find a plausible structure for our universe.

The human concept of space has been an enigma from Aristotle's works, his *Physics*, to the present day.[1] As with time, the concept of space seems to have been taken as a fact of existence rather than questions being raised on its fundamental nature.[2] Einstein in 1905 with his theory of special relativity (see section 3.2 on measurement and the Addendum) challenged its previously assumed absolute nature of measurable length followed by his general theory ten years later which tied space to the mathematically

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[1] Aristotle ([350BCE] 1991 Books III-VIII) and *Metaphysics* ([350BCE] 1923 Book K:10-12)
[2] van Fraassen (2015:122) citing Leibniz and Newton in terms of its geometrical nature or its relation to motion and force; or, similarly, Maudlin (2007).

difficult Riemannian geometry.[3] Since then several geometries have been considered as a solution to the Riemannian field[4] but none of these question the fundamental nature, or existence, or boundedness of space, (cf the concept of fields in sections 5.4 and 6.2.2). Furthermore, quantum mechanics seems to challenge its reality, in the sense of consistent measurability, through the concept of entanglement and Heisenberg's uncertainty principle. Standard physics has assumed space to be a continuum[5] until recently when new theories of gravity have led to a number of scientists raising the possibility that it has a discrete or grainy nature.[6]

Over 300 years ago Leibniz ([1714]§32) believed that everything "real, or existing," must have a cause, though as mentioned in section 3.1.2 this became open to conjecture by philosophers such as Kant and Hume, and is still unsettled today with QM denying such a possibility – a problem which worried Einstein. There is also the *kalam* argument (Reichenbach 2019) that everything that begins has to have a cause – which rests on the assumption that the universe did begin, a consideration of both religion and the physical 'big bang', but a question that must rest on the veracity of causality being examined in this article. These theistic views were aimed primarily at demonstrating the existence of God and will not be raised here as my aim is only to produce a complete testable theory based on a founding cause.

First, in the attempt to attain answers to the question of reality and existence from the concept of Time, I will consider the concept of recordability, without which Aristotle's,[7] and the human, concept of past 'nows' could not be known. Following that I shall move on to derive the concept of space. (Here there is a difficulty over the avoidance of a pre-assumption because the concept of space and volume is so engrained in human perception that there are no contrary words. It is therefore impossible to proceed without the use of spatial words when their existence and meaning should emerge from the definition of Time without *a priori* knowledge of the visual aspect of space. I shall have to accept the fact of this perception, but overcome the *a priori* objection by demonstrating that it must in any case arise from the assumed first cause, the definition of Time).

4.3 Recordability

Although progression, number, singleness and action have been broached, they have yet to transform the concept of time/Time into a complete foundation of the universe. That is, the definition of what is still an abstract idea (assumption) has to be turned into something 'concrete' and recordable; something which humans understand by perception of their surroundings. By 'understand' I here mean that it is observed, without which humans could not know of its existence; and too, that it has some meaning, even if this meaning should be faulty; for example 'look at that fish blowing a spout of water' (whale = mammal).

[3] Einstein ([1905b] 1923), general theory ([1916] 1923)
[4] E.g. Ashtekar (2008)
[5] Maudlin (2007 ch3: 6); Ashtekar (2008:2)
[6] Regge (2000:2) and Chiou (2014:2)
[7] Aristotle [350BCE](1991):§218a4 onwards.

This ability has to come from the form of the generating action, which in turn provides the form of the points. In order to project a concrete, or even just an ontic basis, these points have to be recordable so that they have a relative existence to any other recordable point. Consequently the question arises on what we consider to be material. First and foremost this must require that Time, as the first cause, should be both causal and recordable. By recordable I mean that the result can be noted by some method whatever that may be. The causality will give the result meaningfulness (as in Chapter 3, correct – real in terms of the universe – or not). An example is, using human semantics as the projected Universe has as yet no derived concepts, the click on a clock giving a specific time: it is caused, it is recordable and it has meaning.

My definition of Time embodies an ordered progression of points generated by the Time generator $\hat{T}$, where the ordered progression is seen in human terms as the counting numbers from one upwards applying to the first stage, second stage and so on. The human interpretation is nothing more than giving each point (each 'now') a name q_i to distinguish it from past 'nows' and possible future 'nows' – as above, what humans call the natural numbers, N.[8] For now, we can only say that Time starts from some initial state, call it Φ, to obtain the first 'now', q_1, and then operates on that 'now' to produce the next, q_2, and so on. The subscripts then run through the natural numbers. This can be written as a foundational definition quite simply as $\hat{T}(\Phi) \rightarrow [q_1]$ and $\hat{T}(q_n) \rightarrow [q_{n+1}]$ where $n \in N'$ is a given instant of Time and N′ is the sequence of natural numbers referring to Time.

This numbering is irrelevant in Universal terms as it makes absolutely no difference to the action of the Time generator; the generator provides a source – from which the human concept of numbers could arise. For ease of description I will, for this section, use Aristotle's term 'now' in place of 'point' as although each stage in the progression is singular, there is no suggestion in the definition that it cannot produce a number of points bearing in mind that number is not a universe interest. If there was such a suggestion, then it would indicate that another condition should be introduced to govern the fact, and that would render the definition composite. Similarly there could not be any suggestion that *more* than one point would emerge from the definition. Consequently we cannot rule out that deductions in section 4.6 may lead to the establishment of subsequences. For the moment we can only say that Time starts from some initial state, call it the **creation state** Φ, to obtain the initial 'now' which corresponds to the human concept of the first point, with symbol 1, of Time. It is our thoughts of counting that symbolizes a natural process for our convenience – nature did not do so.

Each 'now', q_i is distinct from any other by definition. Consequently, a sequence, or subsequence, may be written as, for example $[q_4]$,$[q_5]$,$[q_6]$,… each bracketed term indicating a single (unique) 'now' of Time

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[8] This ties in directly with measurement theory, see Campbell (1938) rationalizing the human creation of numbers as symbols and the properties they develop as human derived concepts, including the recognition of 'more than' and 'less than' (1938: 123), plus, of course, the idea of addition. He (1935: 128-130) regarded the most important measurements to be mass, volume, length and angle followed by the concept of period which then gave rise to the human idea of time.

corresponding to a stage ('now') in the progression of Time. The square brackets are defined as meaning that each 'now' is purely a single unit with no subsidiary beginning or endpoints, or if arranged as a sequence of 'nows', e.g.,[q_7, q_8 … q_{22}, q_{23}] then each 'now' in that sequence is unique but contiguous with consecutive 'nows'. Furthermore, sequences of 'nows' can be divided into smaller sequences or combined into contiguous longer sequences. Each stage in the generation of 'nows' arises without any break in the progression, or break in the production of the progression, and without any 'now' being a part, however miniscule, of any other 'now' – they do not **intersect** each other or any 'nows' that might arise in a subsequence, that is, any point q_i cannot intersect any other point q_j. *Each sequential point will then be distinct*. I shall refer to this as the **uniqueness principle** of points of Time.

Thus we see how the human concept of number can rise from a numberless Universe. From this concept minimal *periods* equivalent to a point ('now') may be expressed in human understanding of beginning and end points by the temporary addition of the real number zero. Then the first 'now' can be written in the beginning and end form of a period as [0,1].

One might very easily stop at this point thinking that we have raised the idea of the natural numbers. And this is where humans run into trouble. They often relax in solving one problem and think everything is 'hunky dory'. They do not go far enough and thus do not discover the real meaning of the structure of the universe. We now have the metaphysical (and mathematical) problem of zero because zero fundamentally means 'nothing' (no thing). If it means no thing then as suggested by a recent conference (Tyson 2013) it cannot exist as a concrete entity because that automatically will be something by the semantic definition of concrete. Then zero cannot be a point in the sense of something concrete. But, if Time is to exist, it has a concreteness in the form of existence about it, so zero cannot be a point of Time and therefore cannot exist as a concrete concept in the Universe. (That does not stop, obviously, humans from *inventing* such an idea!)

Consequently the first point of Time only consists of the last point in the human idea of [0,1], and is denoted by the human symbolization '1' (the concreteness of the point itself is still an open question to be finalized). In any case, a single point cannot be split into beginning and end points because the concept of ordering would be lost so that Time would no longer be well-defined. But all points are of the same form, and are generated by the same Time generating action. Therefore, although all points *may* be written in the form [0,n] where n is a natural number to correspond to human ideas of an interval, I shall not adhere to this method. Instead I shall say that the 'endpoint' of human semantics and the ordered point n are the same thing in the Time scheme.

From this view, although individual nows can correspond to natural numbers these do not need to be valued for this philosophical deduction in order to form sequences, thus showing the independence of this Universe basis from specific values. Only when 1 is used as the starting point does a sequence attain ordinal values for each now. Nevertheless it is useful to use the value 1 as the first point of Time created at the start of the Universe. Time can then be said to form periods represented by sequences of the form [q_1 … q_7] and [q_1… q_8] and so on from the start of the Universe, or from any other point giving the forms, say, [q_{17} …q_{29}]. These periods (a) must be distinguishable from each other as they contain a number of points that are, by the assumed definition, all distinguishable from each other; whereupon (b) they are thus naturally comparable to each other (in both cases by a process still to be determined).

This introduces a further concern which Aristotle,[9] among others, tacitly noted by the difference between 'nows' in the sense of a past instant, a present 'now' and a future instant; the flow of time. That is, every point of the progression of Time is unique so that different 'nows' cannot arise together because their uniqueness (haecceity) is their position in the sequence. Therefore no point (now) could in human connotation exist[10], or be, at the same instant as a different Time point (different now). So the foundational question (the first bullet in section 3.4 in the definition of Time) is what in the Time generating action causes this instantaneous commutation but also allows points to be recorded. And then, specifically, and more importantly than the human ability to note the passage of Time, how does this provide for a Universe for which Time has been assumed as the prime, or "moving" cause, as believed to exist by Aristotle?[11] That is, for any recognition of a past now to be possible, that past now must in some way be recordable. The same concept must be possible for sequences to be comparable. Logic suggests that somehow a trace of the old point must be left. More formally, if a point is created as a 'now' but the 'now' instantly becomes the past, then it must be that, as Time generates each new point of Time, the action of creating the new point from the old leaves a '**trace-point**', *s*, of some form behind. The trace-point becomes the 'recordable' part of the definition of Time. Now we have to suggest exactly what this trace-point must be.

Recordability suggests that points must have a 'substantial' existence within the progression although this 'substantialness' cannot be measured as such because it is minimal and cannot therefore be measured in terms of something less. But it does mean two or more points cannot be placed in exactly the same position in the progression, (which, if it occurred, would be the same as being superimposed in QM terms) and it is in this sense I mean having substance – they are still points as given in section 3.3.2, as an 'adimensional' abstraction for now, until their nature arises as the investigation progresses. This distinctness of Time points must transfer through to the trace-points creating a corresponding progression, but one in which the points remain behind as the progression advances. Since their minimalist "adimensional" nature would have to be the cause of 'having substance', these trace and Time points would themselves be out of human perception although their effects would be noticeable in terms of much larger human measurements.

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[9] ([350BCE]1991:§218-219)

[10] Exist is a problem word in the sense expressed in section 2.3 in that it has obvious connotations with 'existence' in the sense of why does anything exist in the first place. Here the 'exist' arises in response to the definition of Time and the action $\hat{T}$ and will be used in this respect throughout this thesis even for the concept of points of Time which have only an instantaneous or fleeting being. On the other hand 'why anything should exist in the first place' can only be explained in Chapter 10.

[11] Aristotle [350BCE] 1923§4)

However, this does not yet have ‘meaning’. Still the metaphysical questions of ‘how’, ‘why’ or ‘what is’ have to be extracted from the action involved; that is, the foundational existence of points. As declared by Ellis or Baumgarten physics does not consider such questions, only the existence of the flow of time, not what causes it.[12] To further this line of enquiry, the requirement of recordability intuitively implies that the definition must lead to different sequences of points in the progression: ‘active’ sequences consisting of trace-points and a final Time point, that is the sequence grows as Time progresses; and ‘passive’ sequences consisting of a fixed sequence of trace-points. Thus the points themselves can be considered active (time points) forming sequences of the form $[s_i \ldots s_m,\ \hat{T}(m)] = [s_i \ldots s_m,\ q_{m+1}]$, that is the sequence grows as Time progresses; or passive (just trace-points existing independently of Time – that is, once generated *trace-points exist for the duration of the Universe*, and passive sequences would have the form $[s_i \ldots s_k]$. With the existence of the trace-points, sequences of a number of points *can be countably* compared – in human terms, but without significance to the Universe – reaching Aristotle’s assertion[13] that nows correspond to numbers created from a first cause.

The condition that the operation of Time production leaves a trace must then be a fundamental natural effect. Time itself is only generated directly from previous points of Time (which suggests that the original ‘creation state’ must also be a point of Time, but this can only be clarified once the question of existence has been finally concluded in Chapter 8). The trace-points exist independently of Time as soon as they have been generated. Countable comparison (bearing in mind, as always, that this refers to human perception) means here that if one sequence contains more trace-points than the other it must be greater. But the points, at this stage, are nothing more in our minds than an ethereal abstraction so, in Universal terms, the sequence is an abstraction.

Furthermore, the action of the Time generator, being part of the principle cause begetting concrete objects, has not been defined; knowledge of its active process should be expected to give ‘meaning’ and thus ‘concreteness’ or causality and clarity in our minds. The points cannot all be produced together as the progression of one point only follows the Timed destruction of the previous point and that trace-points are similarly produced only on the **collapse** of each Time point; that is, each Time point only has a fleeting, or instantaneous existence that shuts off as soon as it arises. The automatic generation therefore suggests an ‘abstract’ but constant (as each point is identically produced within the minimal interval as described above) rate of generation. As an example, in the human perceptive context of ‘the man in the minimal sphere’, he would note a rate at which the points of Time increased on his clock (which he would call the passage of time) although we outside the sphere believing it to be sizeless (if we could actually see it) would not be able to note any increase. So the action itself provides what the man in the sphere would call the rate of the passage of Time, by which I mean we note that, for example, the Earth takes time to pass round the Sun and in that time we can do many things, but not everything that takes us many years to

[12] Ellis (2012:27) or Baumgarten (2017:5)
[13] Aristotle ([350BCE]1923:16§2)

achieve. We do not travel from one city to another instantaneously. An action cannot occur faster than a minimum interval – but how do we recognize this? Put another way, how does a mere point convert in our experience to what we recognize as a minimum interval?

The answer must lie in the existence of a trace-point being established for every Time point. This allows comparison of sequences as the progression grows. In particular, this growth implies that a sequence of just one trace-point (for example, the first point, [1], in the progression) can exist, for which this sequence must be comparable to sequences of more than one point; it therefore should give meaning to an interval, as defined in section 4.3, albeit the necessary minimum interval. That is, it should somehow allow for an interval between two Time-points to become recordable, in human perception, even though the first *Time*-point has passed and been destroyed in the creation of the second. This means that as the trace and Time-points are both created from the same operation, the operation must provide some sort of connection between them that creates a recordable period. That is, one which humans can record and mark down.

Being minimal, but not zero, that is 'not nothing', implies points must be finite and, in this respect, have substance. The question then becomes how can a supposed volumeless trace-point be both not-finite and finite? The answer will be seen to lie in the concept of special relativity. But to see this, the concept has to emerge automatically from the foundational concept of Time. It is thus looped. But we can turn to the 'man in the sphere' to fuel our imagination. This would require, at its minimalist limit that the sphere be completely reduced to what humans would believe was zero – the man in the sphere would obviously not agree because he still has his clock and ruler with which he measures. This is obviously not mathematical or physical but should it prove incisive then it would demonstrate that something is missing from both mathematics and physics. So it has to be checked out – it requires a total knowledge of all the processes of the Universe to be proved, in as far as anything can be proved (see reality section 3.5) – an elucidation of the concept of space and volume will go a long way to understanding.

It does, however, reflect on the concept of atomism raised in section 3.5: that is, if humans can consider a continuous number line consisting of points, then they should be able to consider a continuous geometrical line consisting of a number of substantial and contiguous points all of which according to Euclid[14] have 'no part' or size. Equivalently, in the projected natural Universe, as each Time-point in a continuous progression of points generates a trace-point, the trace-points become a contiguous set of points. Then by the definition of Time and the continuity (contiguity) of the progression derived in section 3.5.2, Time-points can be considered to make a continuous Time-line, or continuous Time-lines, bearing in mind that subsequences may be possible in the progression of Time; nevertheless each point in the subsequence will still bear an exact relation between its production and the overall Time-line. That is a point, such as q_7, as an example, in any subsequence will be represented by a point, 7, on the Time-line,

[14] Cf Bell (2017), Euler also considered this concept

and for trace-points a continuous, or contiguous, set of corresponding trace-points – but these trace-points, as already stated, exist for the rest of the Universe so long as it may exist.

The first step in providing recordability and substantialness from a progression of points must thus follow from the operation $\hat{T}$ that generates the points. However, this leads to a problem in human logic as it currently stands. How can we imagine a collection of points without a space into which they are placed? Yet we cannot have a prior space into which we place a universe. So we must assume these points somehow generate what we call a space in which they exist – which is presumably the space we perceive around us.

4.4 Concepts of space and no space

Consequently, returning to the definition of Time: the first point of Time comes into existence and instantaneously disappears followed by the second which instantaneously disappears and so on. So no Time point, in the progression of Time at a given stage, exists at the same instant as any Time point in a different stage. As a result, no two points in different stages are the same point. Furthermore $\hat{T}$, on the creation and destruction of the Time point, produces a trace-point – which is not a point of Time – for every point of Time produced. Each trace-point is therefore different from every other trace point, but as they last for as long as the progression of Time, they accumulate. Even if they have no volume none of them can be the same point as any other. They therefore must be separate points. It is then even more difficult to imagine a collection of many distinct points with no space for their existence and it is here we have to pass into the transcendental and noetic areas of the proposed foundational philosophy. That is, if the universe in all its totality is to emerge from nothing, or rather a single first cause, then it seems, as stated earlier, illogical that there must have existed a prior empty space into which it can grow or be put. And without that space into what could a space to carry the trace and Time points grow? Surely it cannot just be a figment of our brain as we are presumably made of more than just trace-points. Therefore current human knowledge now has two problems, how could the space we see arise and how can the points of Time and trace-points be accommodated as these obviously, in the light of the way this theory based on Time is constructed, must be the cause of space? That is, we must expect that the fundamental generator causes our perception of space.

This brings into context the human concepts of point, 'adimensional abstractions' and zero – a problem that was considered in Tyson's conference on the subject without a definite conclusion.[15] If we place an image in our minds of a line of trace-points it would seem like a set of little dots expanding outwards, but this is pure human perception built into our brains by lifelong experiences. We cannot imagine anything concrete having an existence without space. But in trying to emerge from the prison of our perception we have to consider there may be a way round the problem of many points without a space, especially if those points are only points of Time.

[15] Tyson (2013)

This is a similar problem to that of standard mathematics concerning zero. For example, mathematics allows the equation $3 \times 0 = 0 = 2 \times 0$. If we interpret this as meaning that three lots of zero equals two lots (or any number) of zeros and still gives zero, then the connection to the Time problem becomes obvious. It is even possible to state that three lots of zero equals two totally different lots of zero meaning that it does not matter on what the lots represent – they can be the same or different. But then, we could suggest that although the outcome (the middle zero) is zero what do we actually mean by zero. As Tyson after the indecisive conference on zero, stated 'can nothing exist?' For example, if we have three trace-points with no volume on one side and two Time-points also with no volume on the other, we can say the result is no volume; but we cannot say that the two sides are the same or the objects do not exist. We cannot abstract this in terms of volume because the three trace-points will remain three trace-points on one side but the two Time-points on the other side can generate two more trace-points to give five volumeless points and so on. So there is a clear difference between the two sides but the volume remains zero. So we cannot cancel the zeros as also disallowed by mathematics. The problem is that a volume is something real and measurable in human terms and humans cannot conceive of something concrete existing without a volume. In fact, as so far presented in this article, neither Time itself, nor volume is concrete; both are ethereal or abstract but what Time produces may have in human sense some concreteness attached to it. This may then give a meaning to volume. The suggestion must be that there is something missing from our knowledge of the fundamentals of our universe. We should also understand there are more than two ways of looking at zero. The zero that means absolutely nothing, and, as above, which would include the human concept of the zero between –1 and 1 representing a number or point on the human number line including negative numbers.

Then there is the zero in the context of no space which means precisely 'no space'. It does not necessarily mean no thing. It is just a human trait to visualize, as a method of interpretation, a whole set of spaceless points *in a space*. But this is purely imagery and should not be allowed to determine our logic; rather logic suggests a collection of volumeless points with no space between them does not constitute a volume. Nobody can categorically state that spaceless points need space in which to exist because nobody knows how the universe actually exists. Therefore the concept that volumeless points can exist without a space in which to exist may be possible, however peculiar it may seem, and thus should be considered. Failure to do so could end in incorrect mathematical descriptions of our universe. The concept may also explain the question of how a universe can exist without a prior space into which it might be placed.

The problem here is a human ability to think beyond our normal concept that zero means nothing, or going one step further, absolutely nothing, for one can imagine the relative zero between say having a zero bank balance rather than an overdraft or credit balance. But when it comes to the universe, especially if it was created from nothing, as has been discussed by physicists (see Chapter 7), one assumes absolutely nothing. Therefore the concept of a collection of volumeless trace-points becomes beyond logical imagination, though Chapter 7 will bring up ideas by physicists that consider a similar concept of nothing, the zero-point energy.

At this juncture one should also consider the concept of position as this does have connotations in terms of human visualization – it is very much an intuitive word defined by human geometry allowing measurement and calculation in terms of human visual understanding of what humans see as space. It is thus a word apparently requiring the human concept of space. However, if we imagine the reduction of a space in terms of the man in the sphere being reduced to what we would see as a mere point in our view, we should be able to imagine that position and direction still have a meaning without the human view of space. That is, if in terms of the definition of the frame of reference I gave in section 3.2, the man has a 'front' then we, observing him, are at some position or direction with respect to his front. Thus what follows for a spatial system should equally well apply to the spaceless concept of the fundamental construction of the Universe being formulated.

Humans think of position in a variety of ways, for example, it can cover a small area where some object such as a building or tree might stand. In this case it has a connotation of volume and may contain a large number of points. On the other hand it can distinguish between two or more points, as for example, in a graphical coordinate system with reference to an origin and perhaps a frame of reference as previously described (section 3.2). As a mathematical system, the coordinates must define position precisely in terms of the human concept of spacetime (in the three-dimensional space system as x, y, z, plus one time dimension as read by a clock, at each xyz point, synchronized with a clock at the frame's origin thus allowing, in this case, a four dimensional space-time system).[16]

Under this principle, precision demands a specific point can only occupy one set of coordinates, that is, it cannot be at two different positions at the same time. So we again have to be careful not to confuse human imagery and mathematical descriptions being used to construct ideas that may not agree with the reality of the universe. For example, if two volumeless points of the same form were to occupy the same position they would be indistinguishable (contradicting the Time definition); therefore two different trace-points, say, s_k and s_l, cannot occupy the same position. They cannot be superimposed. According to this principle two different objects in exactly the same position is an impossibility, that is occupying the same geometrical point in mathematical terminology: if they have no volume, and are of identical form then there would be absolutely nothing to distinguish one from the other. They could not be distinct as required by the definition of Time. Therefore it is illogical under this definition that two different points could occupy exactly the same position and be different.

To make this absolutely clear, I say that no point can intersect another, which they would do if they occupied exactly the same point. Therefore again logically, we must accept that they are separate even though they occupy no space (or volume). But this condition has to be qualified by the concept of 'no

[16] cf the addendum on special relativity

volume': as they are separate (in the sense of being distinct – not in the sense of having distance between them) they have to be contiguous (touching). It is not satisfactory to claim this is illogical because we do not know how what we see as space and the universe is formed at its most basic level. Therefore we should, at least for the sake of exploration, allow that it may be possible to be both contiguous and distinct without any space being involved – that is, many points without volume can occupy no volume without the need to be superimposed. Any idea of superimposition is only a human assumption based on the human *ideas* of space, which in turn are based on what we *think* we understand after millenia of human development but not necessarily on how the universe is actually constructed. This is what has to be ascertained and requires an answer to the fundamental problem of: if a Universe is to be constructed into what is it put?

As a final thought on the concept of zero suppose a reference-point *A* (bearing in mind that a point of any sort itself has theoretically no volume or radius) moving around a point *O* is actually adjacent to (touching) *O*, then it has no radius of rotation (points have no volume). But we still have a rotation. This may be as equally a difficult concept for some people as the idea of many points occupying no volume, but then humans have been trying to decipher the fundaments of the universe for thousands of years so we have to consider ideas outside of our experience. If two points are pure points without any volume, human sapience, purely for the sake of trying to imagine why physics has failed, should be able to consider that there is nothing to stop two points from passing round each other or, speaking relatively, for one to pass round the other without the need of space to do so. In this circumstance the concepts of space and time would become extraneous to the actual idea of rotation although they become of use in *measuring* the concept. The question then is what is meant by the fundamental meaning of rotation. Do we mean what it does or what it is? I would expect the 'is' to be the definition and the 'does' to be a description – an example of what I mean in saying that mathematics needs to go further than mere calculation to understand its fundamental meaning. That is, we have to allow that points, having no volume, may exist without being superimposed, which implies they may exist in an arrangement thus giving a positional conception, without an actual volume as humans believe it to be – and to see where it takes us.

4.4.1 Rotation and units of Time

Bearing in mind that only Time has been the subject of a foundational definition, the 'period defining' connection must be caused within this foundational entity. This connection must be through the action of $\hat{T}$ that causes an interval to appear without an *a priori* interval existing – (an apparent something out of nothing?) This produces a new situation. For each 'now' the trace-point produced, being distinct from all others, takes an ordering-place relative to the others. But this relies on notability. That is, any two successive 'nows' must attain, in the inanimate or abstract sense, a representation of the ordering between them. It is not entirely satisfactory to say that trace point *A* comes first and then 'sees' trace-point *B*, and then *C* because this assumes an *a priori* interval without any cause for it. But as the definition of Time stands, the assumed cause of the universe is an action by $\hat{T}$ on the creation state, which leaves a first point (of Time). The next automatic action of the generator turns the first point of Time into a trace-point which exists for the duration of the rest of the progression. However, as no such entity as space has been considered as a fundamental cause we have to assume that $\hat{T}$ can generate Time independently of space, at the same time allowing the definition of the minimum interval, so that they are clearly recorded at different times. To maintain the ordering of the progression, this action must also include the possibility for a record of a first point and any other point with a clear difference for each and all intervening points. They must gain a sense of placement with respect to each other in the progression. What we need to consider from our vantage point of being humans is: how can this be interpreted into our perceptions?

First, one can say that as $\hat{T}$ generates Time, its action must be the most fundamental part of the foundational principle. As already stated, all points are classable as minimal intervals and sequences of such points must be comparable to each other and to single points. In other words $\hat{T}$ must generate an interval almost as if it can, using human conception, unravel the point *A*, or other point, much as a tiny ball of cotton can be unwound to produce a usable length.

This suggests that the final part, the action of generating Time, of the original assumption is a primitive cause of, in human perception and parlance, rotation which I will call **p-rotation.**[17] Then, the first point of Time, and all succeeding points of Time in the progression, since they are of identical form, would be p-rotations. This would become the fundamental action, or cause of the progression. It cannot be more fundamental than time because Time produces objects – points. P-rotation does not produce objects – it acts on objects. It is this factor within the process that allows Time to be adopted as the possible foundation of the universe rather than rotation. But p-rotation cannot be less fundamental than Time because it is the progression-generating-action. It is therefore as fundamental as, and is irrevocably linked to, Time. It cannot, then, be defined in terms of anything more fundamental. Nevertheless, its form and result *can* be determined through a series of thought experiments as follows.

First I need to return to the concept of point with the view that a point has an automatic relation to position, through its generation in the progression of Time, and size in that it has no size. I will deal with size first as it will help to build an account of the transcendental idea of p-rotation. Again lacking suitable language to deal with the concept of a fundamental spaceless natural Universe we have to think in terms of our concept of size and abstract it to what we would consider a point.

Size can be related to the general concept of rotation relative to the human idea of infinitesimal. The definitions given in section 3.5 all consider 'turning around a central point'. But this does not determine whether the central point itself is rotating. If one considers a rigid line in a rigid body from the centre

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[17] P-rotation is at this moment undefined and must be more fundamental than the standard human idea of rotation which has connotations of space whereas the Time operator $\hat{T}$ is an action arising in a volumeless circumstance. Its action is figuratively defined in the text and leads to the standard definition of rotation as humans perceive it.

outwards then the rigid line represents a series of points controlled by the central point where the central point itself rotates. Humans, especially physicists, imagine this in the same sense as a mathematical power series expansion converging to zero, to give the central point, where, as with Zeno's paradox, the expansion approaches zero ever more infinitesimally without ever reaching the limit. In this case the central point is merely a point (axis) about which the rotation takes place but without the axis rotating itself. This reduces our human view to the question of an infinitesimal with relation to the axial point. The series never actually reaches that point but all rotating points other than the axial point have a tangential velocity which itself must have a maximum *limiting* value for the particular rotation. This limit would represent a limit value corresponding to the axial point rather than to the nearest rotating point at infinitesimally small distance from the axis. So, either with a rotating axis or a non-rotating axis we arrive at a maximum tangential velocity, and via the geometrical principle 'tangential velocity = radial distance × angular velocity' an equivalent angular velocity.

Now take Zeno's paradox as the power series converges. Ever more steps can be added as the axial point is approached so in theory it is impossible to ever arrive at the axial point itself or even a closest point to the axis. Thus I would argue that mathematically a pure continuum could never arise. There would have to be, as suggested for Time, a minimal interval. As this is a minimal interval it cannot be measured by anything other than a minimal interval so it cannot be considered smaller than a minimal interval. It will therefore appear to be a point. But this would seem to lead to the possibility of two such points being partly imposed on, or intersecting each other. The fact we cannot measure them does not say they cannot intersect. Thus we need the concept that to be distinct, no points of Time or trace-points can intersect each other.

Now suppose, instead of a continuum created by taking ever smaller distances in the infinitesimal approach to the axis, a cut-off is imposed which limits the infinitesimal to a smallest radial distance from the axis, be the axis rotating or not rotating. Then a limiting tangential velocity still applies with an equivalent angular velocity value (and all steps to the limit now have a constant metric, and, as above, all steps as well as the point itself would appear as points). There would then be no difference measurably, or mathematically, between no-space and a minimal metric, as such a space would be smaller than that minimum measurement and thus unmeasurable. From this it should be possible to finally imagine that a reference-point *A* (bearing in mind that a point of any sort itself has theoretically no volume or radius) can pass around *O* and be actually adjacent to (touching) *O*, with no radius of rotation (points have no volume) – it is still rotates.

Hopefully these last paragraphs have opened up a more transcendental view of the concept of point, infinitesimal, direction, position, and our *human* view of space and size. How does this help? I need to turn back to the concept of a *spaceless* p-rotation to treat it in the form of an axial point, whatever point may be in reality.

In order for the Time generator $\hat{T}$ at the creation state, to be a p-rotation operation it must have a background (section 4.3) – which would be created if $\hat{T}$ consists of two contra-rotations of equal magnitude defined as $\boldsymbol{\theta}^-$ and $\boldsymbol{\theta}^+$, working in opposite directions. As they have the same magnitude of angular velocity their rotation over a minimal interval, as required by Time, would be identically opposite while the net result would be no *overall* rotation because $\dot{\theta}^-$ and $\dot{\theta}^+$ together, having equal magnitude, cancel each other. Nevertheless there *would* be the possibility of developing a recognizable rotation if Time is generated from one of the rotations. The other would then be a *backing* rotation removing Mach's problem of which one would be rotating. I will call this fundamental system the **null-point)**.

Suppose then that $\hat{T}$ operates on the creation state from one spin, say $\dot{\theta}^+$, to create trace-points.[18] To fathom out how this functions imagine, as an example, three trace-points, call them *A*, *B* and *C* produced by $\hat{T}$. They would consist of two equal p-rotations, now defined as $\dot{\theta}^-$ and $\dot{\theta}^+$, working in opposite directions with θ^+ being the 'observable' rotation relative to $\dot{\theta}^-$. Then, from the fundamental definition, if *A* represents the first trace-point (originating from a Time-point), *B* appears at some contiguous placement (section 3.3.2) with respect to *A* in the progression of points. (*B* cannot be superimposed on *A* (in the QM sense) because they both have, by definition, to be distinct (cannot intersect)). Furthermore as the points have no volume any number of points has no volume, as detailed above. As *B* cannot be produced where *A* was (intersection or superposition not allowed by the definition of Time), *B* must be adjoining *A* but not surrounding *A* because then *A* would be inside *B* which would be the same as intersecting *A*. The contact between *A* and *B* is written for the present as *A to B*.

Similarly, *C*, when it is generated through the action of $\hat{T}$, cannot be produced where *B* (or *A*) was, so must have connection *A to C* and *B to C* via its production, and placement in the progression. As $\hat{T}$ causes the production of *rotating* trace-points, both *B* and *C* must also rotate with respect to *A*, and with respect to each other, with the same rotational value since they are all identical. (The thought that each of *A*, *B*, *C* has both contra rotations does not affect, for example *A*'s frame of reference because $\dot{\theta}^-$ is the backing rotation which gives *A*'s rotation as the distinct, or operative, rotation so that *A* rotates relative to the other points, and vice versa. It could also be said that *B* and *C*, by not being able to appear at the same point relative to *A*, cause the 'appearance' of a rotation by *A* – or *B* revolving about *A* from *B*'s point of view – but I shall stick with the assumption that the generator of Time, $\hat{T}$, is a rotation operation. Both interpretations are equal in result).

It also needs to be said that, following the concept of zero and no volume raised above, and the evolution of a rotation, 'contiguous' needs some elaboration because, although all three points *A,B,C* are touching, the rotation shows that they are not everywhere contiguous. The rotation produces single abuttals (I hesitate to use the words 'point of contact' as it might be confusing) between them. That is, it

[18] It makes no difference which direction is defined as positive because the other will be negative.

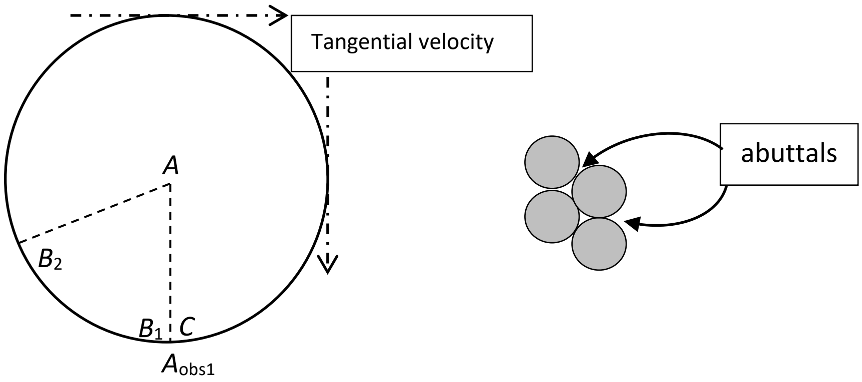
differentiates the abuttals from non-abuttals (see Figure 4.2a and b where *B* has a contact abuttal B_1, for example, in the expanded representation but abuts *A* nowhere else). Here again, abuttal must be taken in the same spirit as position, size et cetera, as mentioned above. These non-abuttals now gain relevance as not only referring to non-intersection but to not touching. Thus the fact that the points occupy no space and are themselves spaceless does not preclude that there may be gaps between their abuttals. This may run against intuitive present human perception, but then, as Tyson says, the concept of zero is an enigma. This formation of gaps will become easier to understand once the full expression of space and volume in human perception is fully explained at the end of this Chapter.

There are four following thoughts to be made here. First, the concept I have already referred to, the transcendental idea of abuttal or contact of points having no space, should not mean that the concept cannot exist. Second, such ideas automatically lead to the concept of space in the form that two points cannot be everywhere contiguous because that would lead to complete intersection, that is, superposition. Third, and more importantly, this is no immediate help to determining the concept of space, as such, because it does not explain how 'no-space' or spacelessness can become what eyed individuals understand and believe they see as space. Fourth, understanding the concept of positioning which arises automatically from the appearance of *A*, *B* and *C* introduces the nascent concept of a space. Fifth, we do not see space as such but distances between objects which we call space. So the explanation of space becomes determining how these gaps arise from the realization that two points, particularly trace-points, cannot be everywhere touching each other as that would imply super-positioning.

This first requires some method of interpreting the action of p-rotation into human language and imagination which can be done by anthropomorphizing the points as follows.

If *A* was able to observe anything in a frame of reference as described in section 3.2, he would note either a change in the position of *B* as *C* appeared, or, *B* appearing followed by *C* at a different position followed by further trace-points. Thus he would notice a difference in direction between the trace-points and himself. This is somewhat analogous to Euler's concept of infinitesimals maintaining 'shape'[19] – in the case being developed as a fundamental relative positioning with respect to each other, as the trace-points *A*, *B*, *C*, are distinct from each other. This system from our external view point can be represented for human perceptive purposes as in Figure 4.2 bearing in mind this is only an ostensive representation since, as yet, I have not yet derived the human *idea* of space. I should mention here that relativistic concepts of rotation are dealt with in the addendum on special relativity (Chapter9).

[19] Bell (2017§4)



(a) (b)

Figure 4.2a. A p-rotating point *A* blown up to make it readable, as viewed by an external observer. P-rotating point *B* is initially at the point B_1 observed by *A* at A_{obs1}. When *C* appears at B_1, *B* will have apparently, as viewed by *A*, moved (rolled round) to B_2. (b) shows that non-intersecting rotating points can abut.

In terms of the mutual connections we then have the apparent case that the connections *A to B*, *A to C* and *B to C*, written as $\overrightarrow{ab}$, $\overrightarrow{ac}$, and $\overrightarrow{bc}$, (the arrows refer to direction, not mathematical vectors) have appeared over the period of a minimum interval or unit of Time which is the Time taken between the materialization of *B* and *C*. Thus a distinct interval (of a minimal abstract nature as in section 3.3.2) has formed with clear differences between connections $\overrightarrow{ab}$, $\overrightarrow{ac}$, $\overrightarrow{bc}$ in our external ('God-given') frame of reference and distinctness of points in the natural frame.[20] The caption to the Figure mentions 'rolled round' which *A* could also imagine, thus suggesting that *A* could believe he (*A*) was fixed and that *B* was rotating around him.

In *human perception* in our universe this would be recognized as 'change in position over a period of time about a central point (*A*)' so giving the *sense* of what humans would call spatial rotation.[21] In other words the positioning of *A*, *B* and *C* has introduced what humans recognize as a spatial meaning word. However, there are essential differences between the p-rotation and the human concept of a rotation as in, for example, a rotating wheel. If *A* is given a spaceless frame of reference of the form defined in section 3.2, *A* will have a 'front' defined in terms of, say, trace-point *B* as in Figure 4.2. That is, the connection $\overrightarrow{ab}$ can be used to locate a frame of reference in order to show what p-rotation means with reference to the construction of the Universe. *A*'s p-rotation causes jumps so that *A*'s front relatively changes from position to position away from *B*. That is, p-rotation defines, in this case, a change of position over each minimal unit of Time as each new trace-point is generated. From this point of view the change of position is not continuous – it jumps. However, since these jumps are in minimal units, this discreteness will be

[20] *A* to *B*, *A* to *C*, etc. may appear quite large in the Figure but it must be remembered they represent minimum possible intervals which will later be determined in human measurement terms as 1 qul = 1.77041×10^{-15} m.
[21] This assertion may not be completely clear at this juncture but becomes perceptively meaningful as the chapter develops. See also section 4.2.

hidden below human perception (cannot be measured in terms of anything smaller) and therefore would not arise in either human perception or empirically derived physics. *B* will lie in uniform contact with *A* as *A*'s point of view is, according to the concept of p-rotation, that *B* appears to move around him (*A*) uniformly.

Thus one can state that although *A* would not necessarily know he was rotating, p-rotation would give, and is defined by, in human perceptive terms, a change of position about a central point in what humans refer to as a plane in the period between the appearance of *B* and *C*.[22] For a continuing series of generated points *A* would note a continuing change of position, and this change of position would continually repeat itself as more points were produced. He might then consider he was rotating although in this respect one has to recall the fact that it took many hundreds of years before humans realized the Earth was rotating rather than the sun traveling round the Earth. Humans would define this repetition as curved and if in a plane as being circular. Thus both the human concept of rotation and circle are formed by the action of Time generating points.

Note that this description states both what rotation is and what it does. Thus p-rotation, although too fundamental to be defined in terms of something more fundamental does define the human concept of rotation. But in the case of human perceived rotation it must be remembered that it requires a background to remove ambiguities such as shown by the Earth and Sun: from the Earth, the Sun passes round it; and vice versa from the Sun's frame of reference.

Also note that with this construction, Time, space, rotation, position and direction are all linked to each other through the single definition of Time. Rotation cannot be defined in terms of space because space and position are both derived from rotation (p-rotation) which itself is the self-generator for Time. Thus, if this structure is true to nature, then nature has given us a very simple compact basis for everything in our universe.

Since, as above, p-rotation represents, and thus defines, a minimum interval of Time, the connections $\overrightarrow{ab}$, $\overrightarrow{ac}$, $\overrightarrow{bc}$, each define minimum directed intervals. *B to C* is equal to both $\overrightarrow{ab}$ and $\overrightarrow{ac}$ (and $AB_1 = AB_2 = B_1B_2$ in Figure 4.2) – again recalling the similarity with Euler's concept of infinitesimal. These minimum directed intervals, not only clarify a minimal Time-interval, they evoke what humans would call 'spatial length'. That is, they would form the basis of our perception of space even though only in the infinitesimal sense or **natural** Universe sense.

Taking this a step further, the p-rotational action of $\hat{T}$ thus creates minimal intervals of both space and Time carried by trace-points. This will be denoted by **space-Time** with capital T to distinguish it from Minkowski (1909) spacetime which is not the same thing. It also brings up a basic concept accepted equally in human cognisance with those of time and space: that of velocity and speed as, respectively, the

[22] The change is a jump, not a continuum, so it will always appear planar in human terms.

rate of change of spatial distance over a period of time in a given direction, or just the magnitude of the change with no specific direction. As velocity (or speed) is not considered here as fundamental, it must be caused. But p-rotation, as above, generates 'a change of position over each minimal unit of Time as each new trace-point is generated'. That is, it defines a velocity which humans would recognize as orthogonal (at right-angles) to the axis of rotation – a **tangential velocity**.[23]

Additionally, in terms of the circle also derived above, the apparent production of space produces the concept of an arc and thus velocity along a line (B_2C). Consequently the concept of caused lineal velocity according to p-rotation and the definition of Time arises. Also at the same instant as the circle and an arc along it are produced, a radial distance from the rotating centre to the circle is produced, which in human thought is generated over the minimal time interval and can thus be thought of as a radial velocity. But if Figure 4.2 is shrunk to represent a rotating point, the tangential and radial velocity directions will 'lie on top of each other' and thus have no distinction between them – the tangential velocity has the same magnitude as a radial velocity and vice versa. Consequently, if *A* 'sees' the difference between *B* and *C* emerge he would equally believe a distance had opened up between him and *C*, or *B*. This 'seeing' would, of course, rely on some overlying principle that converts what is essentially no-space to an observable space; a relativistic principle.

Overall the action involved should be interpreted as saying:

Due to rotation, given two volumeless points A and B, B appears to pass around A at a unitary distance in A's frame of reference.

In other words, the fundamental action of rotation, p-rotation, causes trace-point *A* to acquire an apparent size; and *vice versa* for *B*. It will be seen over the rest of this work that this explains the principles on which Einstein raised his 'special theory of relativity' – see addendum 9A.7 on special relativity. From hereon I shall refer to this principle as **rotation-space-Time**, **RST**.

Because the action of $\hat{T}$ is identical for all trace-points, in human perception it gives a constant rate (production) of jumps defined by the minimal indivisible units, that is one unit of length per unit of Time – thus 'unitary' size, which can be considered a tangential velocity of the generated circle, with what humans would give a value *c*.[24] As by the definition of Time every such interval will be identical, *c* will be an absolute constant of the production of space-Time and thus, of a Universe created from it. Thus space and Time intervals are both representations of the same fundamental thing.

The main difference between p-rotation and human observed perceptions of rotation is then that the natural Universe has no space or Time interval as such, but p-rotation produces both the Time and space

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[23] Cf the addendum on special relativity (section 11.8) for a relativistic treatment of rotation proving that π remains constant w.r.t the centre of rotation for Time and trace-points.

[24] In human perception with units of length = units of Time, $c = 1$. But in SI units this would not be the case (see section 11A .4).

intervals from which the human idea of rotation has arisen. It is the 'is', or cause, (Ellis's philosophical question) that produces the 'does'. We also see that all the generated points keep within the null point as if they are, in human ideas, infinitesimals within an infinitesimal[25] – that is we can keep on dividing, according to mathematics, an infinitesimal into smaller infinitesimals forever. The difference between the rotations explains why humans have been unable to produce a fundamental definition (one that does not depend on physically undefined entities such as space and time). On the basis derived here space and time are generated in the human frame of reference by rotation so that the dictionary 'definitions' of rotation given in section 3.5 are 'looped'. That is, looking at them carefully they really say 'rotation is rotation'!

Furthermore, the p-rotation is an abstract item in both the Aristotelian sense of not having substance, and the human sense of not being concrete or having a material nature about it. It is ethereal. The human instinct is to interpret a point as a solid thing in space. But as Euclid said, a point is that which has no part. Its spin generates a perceived space, perceived by living things. Consequently the points it produces of space, made up of p-rotations, and Time (and time) are equally non-material. The question will then be how do we obtain our notion of solidness of anything if only these three concepts, being only abstract in the sense I have derived, are responsible for everything in the Universe?

The answer revolves around the concept of p-rotation being such that it has a rate of rotation (angular velocity in physical terminology) that gives it an automatic constant 'tangential velocity'. As a result two p-rotations, that is two p-rotating points, cannot be superimposed, where by superimposed I mean, they intersect or add together at one and the same point – though they can touch each other. For if they were superimposed, the total tangential velocity of either one would be $2c$ (due to its own angular velocity plus the angular velocity of the other), which conflicts with the fact a p-rotation has only the constant tangential rotation of c. That is, the p-rotations are points which produce the connotations of both space and Time. Thus, if p-rotation is a fundamental part of a fundamental cause everything produced from it will have the same non-intersection rules. Thus if this system should automatically lead to the production of points with coordinated rotations created out of just this space-Time, the rule will exclude them from being superimposed. This means that, if we could imagine them for the sake of explanation, moving towards each other they would be forced to change direction as if they were solid, see Chapters 5 and 6.

This first thought experiment was only to attain the general idea of a rotational basis for Time. Consequently it provides a specific condition for the three points A, B and C. Two questions need to be asked: (a) whether the outcome can apply to all future Time-points as they are added individually; and more fundamentally (b) whether the point of Time is only recognizable through trace-points. That is, two consecutive trace-points generated over the progression of Time indicate the minimum Time-interval. What is the difference that allows this? How is the generation of Time and trace-points achieved?

There are six factors that have to be considered.

[25] This is only in human conception. Infinities and infinitesimals cannot exist (see section 4.5).

(1) The p-rotation leads to a minimum interval.

(2) From the definition of Time 'all of the same form' implies that every trace-point's apparent minimal interval in our frame of reference is the same as every other.

(3) The planar form of rotation deduced creates a mutual connection between points, which implies the minimum interval must be the same for all mutual connections and relative directions*.

(4) (3) implies any space itself must also fit the minimum interval format.

(5) Are the formats of the space and mutual connections completely described?

(6) And finally from a human point of view: Does this process lead to the human perception of a space, or volume? The answer is surprisingly easy to conceive but requires Chapters 5 and 6 to rationalize it completely. However, I shall partly explain the problem in section 4.12.

* Surprisingly, direction, philosophically *qua* direction, was not tackled by Aristotle. It is a fundamental difficulty of physics, and a philosophical question for this foundational approach relating connection to direction without, as yet, a volume for reference. Although we have the concept of directed connections within the framework of infinitesimals this is only relative to the fundamental universe. For a proper explanation the concepts of a spatial plane and volume must be derived.

4.5 Three dimensions and the simple building module of space[26]

Starting with question (b) 'whether the point of Time is only recognizable through trace-points' as it will also answer (a), I shall consider this final thought experiment in two parts, equivalent to finding a representation of the above natural action in human perceptive terms. If we take a single point, it has no size or spatial connotation. But if it rotates relative to another point then its act of rotation develops a positional change as above. In this respect it develops a level of measurability which can be illustrated in human experience by reason or geometry. As above, the action/rotation of each point will create the relative condition of one point 'rolling' around the other.

In view of the absence, as yet, of space other than as a possible plane (in human language) it is necessary to consider various human perceptions that are construed as 'geometrical'. Euclid is generally considered the father of geometry through the axioms he derived in his Elements (300BCE). However, these axioms were argued by Kant (in 1781)[27] to be "synthetic", that is, only based on human intuition. For immediate purposes two of these intuitions are a straight line as being the shortest distance between two points, and a square as being a four sided figure with right-angles at each corner – right-angles being defined as given by the angles between two intersecting straight lines (thus in a plane) such that the angles between the lines are all equal. Here I shall consider these two human concepts as pure intuition as they would have been before the concept of geometry. That is, the formation of these concepts must follow from the construction of the Universe and thus precede the human idea of geometry without being

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[26] A full definition of space requires the ability of a body to 'recognize space ' derived in Chapter 5.

[27] Kant ([1781]1998:B16-17).

considered an *a priori* necessity. I have therefore to convert the natural operations above, which have been outside of, and are still beyond human perception, into humanly recognizable terms according to the human intuition of geometry. This will then provide a pointer to how and why the Time process gives humans the concept of volume. That is, we will have the how, why and what is concept, or missing definition in human terms, of volume.

The jump between points in Figure 4.2, representing the expansion of Time across a prospective rotational plane, can be imagined in Euclidean (or current human) geometry using two directions OP1 and OP2 between O and two points, **ℑ,** where each ℑ, is identical except in its separation from the other, and each ℑ represents the advance of space-Time in human perceptive terms. In keeping with the requirement of a minimum interval, the distance between these ℑs has to be the same as the distance they have jumped. This *jump* can be intuitively imagined and drawn as a straight line. Furthermore, in terms of the rotation in the human Euclidean system, and factors (2)-(4) above, a full rotation in the plane must equal an exact number of jumps. The smallest figure with equal sides that fits this requirement is what humans call a 'square' as in Figure 4.3d whereby each jump is one quarter of a complete rotation. The fourth rotation would then bring OP1 back to its starting line-up. Thus the unit has constant form in itself.

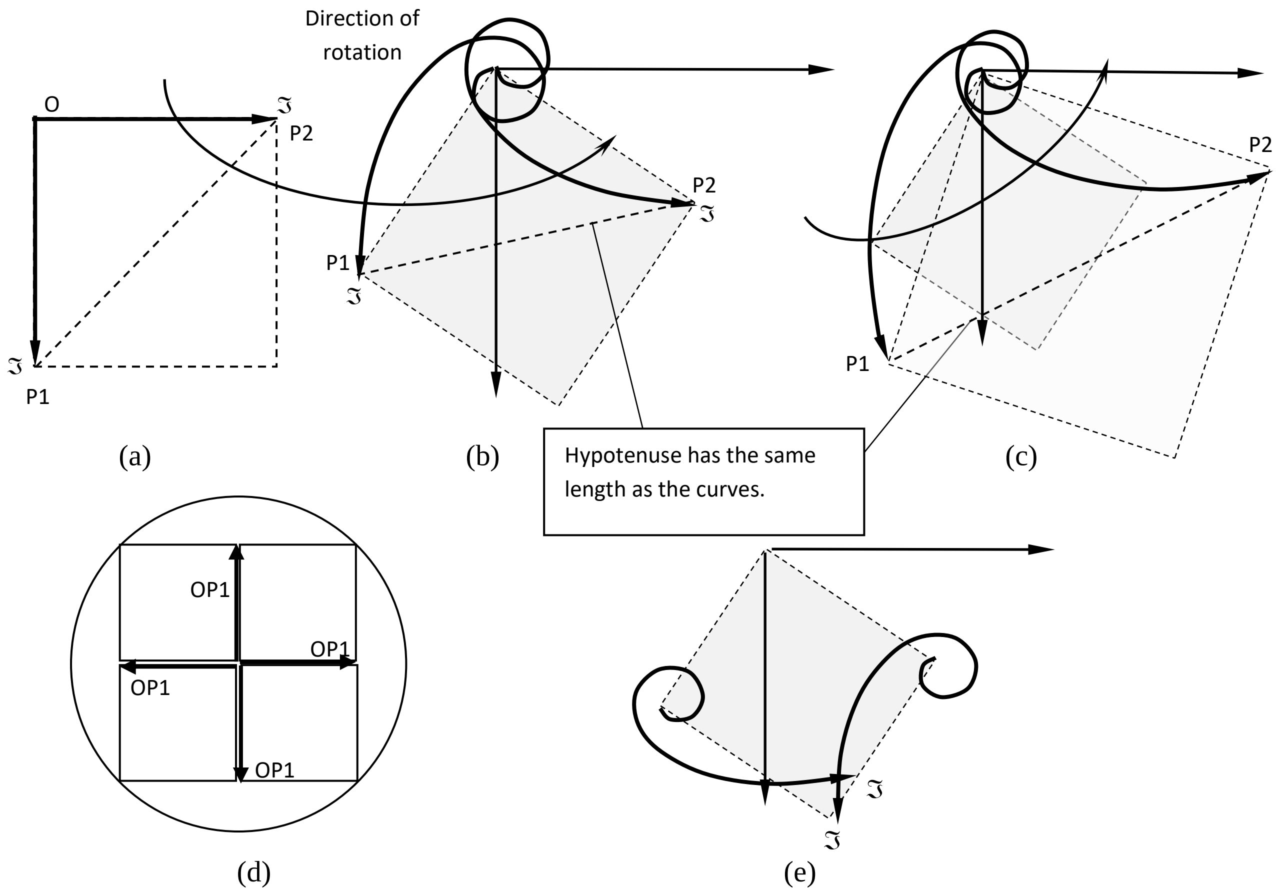

Figure 4.3. The transformation of natural space-Time generation to a Euclidean planar space-Time in the form of a rotating square using the human concept of a continuum, that is a continuous space rather than one formed from minimal units. Diagram (a) illustrates the advance of space-

Time along two sides of a non-rotating square. The heavy lines represent orthogonal axes, OP1 and OP2, along two sides of the square. The tips of the arrows and the two symbols $\Im$ indicate how far space-Time has travelled along the axes in an arbitrary time. If the square rotates, the $\Im$s follow a curve so that the distance they travel along the sides is the same as the distance along the hypotenuse, as in diagram (b). As Time progresses the arrows and $\Im$s move further from their origin and the square on which the axes lie grows ever larger as it rotates (c). The result is that the $\Im$s move around their origin, O, in spiral paths and the distance between them is always the same as the distance each has travelled along its spiral. (d) A complete rotation of the plane about O must be equivalent to an integral number of minimum intervals as otherwise a complete rotation would lead to a non-minimum interval appearing. (e) shows that extending the process to another generation would lead to the $\Im$s paths and thus the space-Time generated intersecting each other.

Figure 4.3 is then, in human expectations, equivalent to 4.2 – it is merely a different (geometrical) way of expressing the action of $\hat{T}$, in a plane over a continuous rotation suitable for transferring to human mathematical systems. In this case, although the $\Im$s actually jump in the natural system, the mathematical expression treats the action as if they pass along a continuous spiral. This would allow the use of trigonometric functions to describe the action. It also allows us to imagine the production of space-Time as a rotation, but it must always be remembered this is only a useful view and not exactly true to the underlying process. Then factor (4) is filled if each $\Im$ denotes the position to which the Time interval has expanded along OP1 and OP2 during a jump; or the rate of rotation is such that the *curved distance* (as opposed to the rectilinear distance along the axes OP1 and OP2) travelled by the $\Im$s is the same as the distance between them. If this last description also represents a direct jump during which p-rotation allows a minimum interval in human view, it is understandable how humans imagine the curved representation of the jump as a continuum. As the $\Im$s represent Time which jumps from one point to the next they are themselves points of Time.

Note that (i) this rotation has to deliver (as defined in section 4.4) a constant tangential velocity, *c*. (This appears to imply a reduction in the rotation as the representative $\Im$s jump, or progress, from O (*A* of Figure 4.2) to P1 and P2; but, due to the jump, this change of rotation does not arise; the tangential velocity is merely that at the final formation of the trace-point remembering that, despite the illusion of a space, it is still merely a point). (ii) Even though spaceless, p-rotation has the human connotation of circularity and thus tangential velocity. Then if that circularity is divided into four equal parts (Figure 4.3d), the tangential velocity at one of those parts is orthogonal to the tangential velocity at the next part (see Figure 4.2). (iii) This system does not allow for the formation of further points from P1 and P2 under the action of $\hat{T}$ as this would cause intersection. For example, repeating Figure 4.3b from each $\Im$ in the Figure, the squares formed on P1 and P2 would rotate into each other as in Figure 4.3e.

This would then seem to bring the process to a halt, or certainly it would as so far described. So it seems perfectly in line with factor 5 above to ask: is something missing? Could the subsidiary question raised following factor 3 above on the difficult concept of direction have a bearing beyond its use in raising the concept of rotation in a plane? Here again we come back to the problem of language being formed around what seem to us obvious perceptions such as volume, or in this case a word for absence of volume, that neither philosophy nor physics has ever bothered to question them. So what can we make of the concept of direction?

Let us start with the view that the fundamental definition by itself using volumeless points cannot restrict p-rotation itself to any particular direction. It is only a convenience that Figure 4.2 is shown flat on the paper. Without a volume one cannot consider the generation of the three trace-points in any specific direction, they could be vertical to the paper, but they will still form what humans would call a plane – just a vertical one. Here we should think transcendentally because we are used to planes and volumes but it should not be considered prior knowledge to question how a fourth point (*D*) fits in. And here, we have to consider another word we are so used to: dimension.

Dimension in the sense I need to use it has a definitive spatial context. But I cannot as yet describe a dimensional space other than in the human sense of a plane, here having been defined in terms of the p-rotation and three points. I now want to consider whether this is sufficient to describe a complete space without pre-allowing that there might be what humans recognize as a volume. Or worse still, there might be something that mathematicians refer to as n-dimensional space. The best I can do is to take Figure 4.3e which shows that time production would have to come to a halt at the points of intersection as this would break the fundamental rule.

This raises a further point about the strength of the Time definition. That is, *it is not an action of the form seen in human perception* – cause followed by reaction. It is of the form which humans would call proactive. The fundamental rule featured by the Time generator $\hat{T}$ automatically locks out any violation. Avoidance is thus spontaneous. Consequently the formation of new points must bi-pass this blockage thus opening up another possible direction. But this direction must also fill the other parts of the fundamental definition.

Thus, consider the generation of a trace-point from *C* to *D* with direction $\overrightarrow{cd}$. Any change in direction has to maintain the principle of the minimum interval of the Time definition so that if the change cannot lie in the (*ab*, *cd*) plane, as determined in (iii) above, it must be orthogonal to this plane, the reason being that the minimum interval has still to be met between the two directions $\overrightarrow{bc}$ and $\overrightarrow{cd}$, for exactly the same reasons as the planar case with $\overrightarrow{ab}$ or $\overrightarrow{ac}$ or $\overrightarrow{bc}$. That is, $\overrightarrow{bc}$ and $\overrightarrow{cd}$, must be representable by an identical square to O(P1)(P2) of Figure 4.3 which rotates about O in a direction other than the original plane. But it must still uphold the principle of the minimal unit with respect to both $\overrightarrow{ab}$, and $\overrightarrow{ac}$. Thus this additional direction of rotation must echo the planar description, and thus $\overrightarrow{ab}$ and $\overrightarrow{cd}$ must be orthogonal, that is, the combined system must rotate orthogonally as in Figure 4.4.[28]

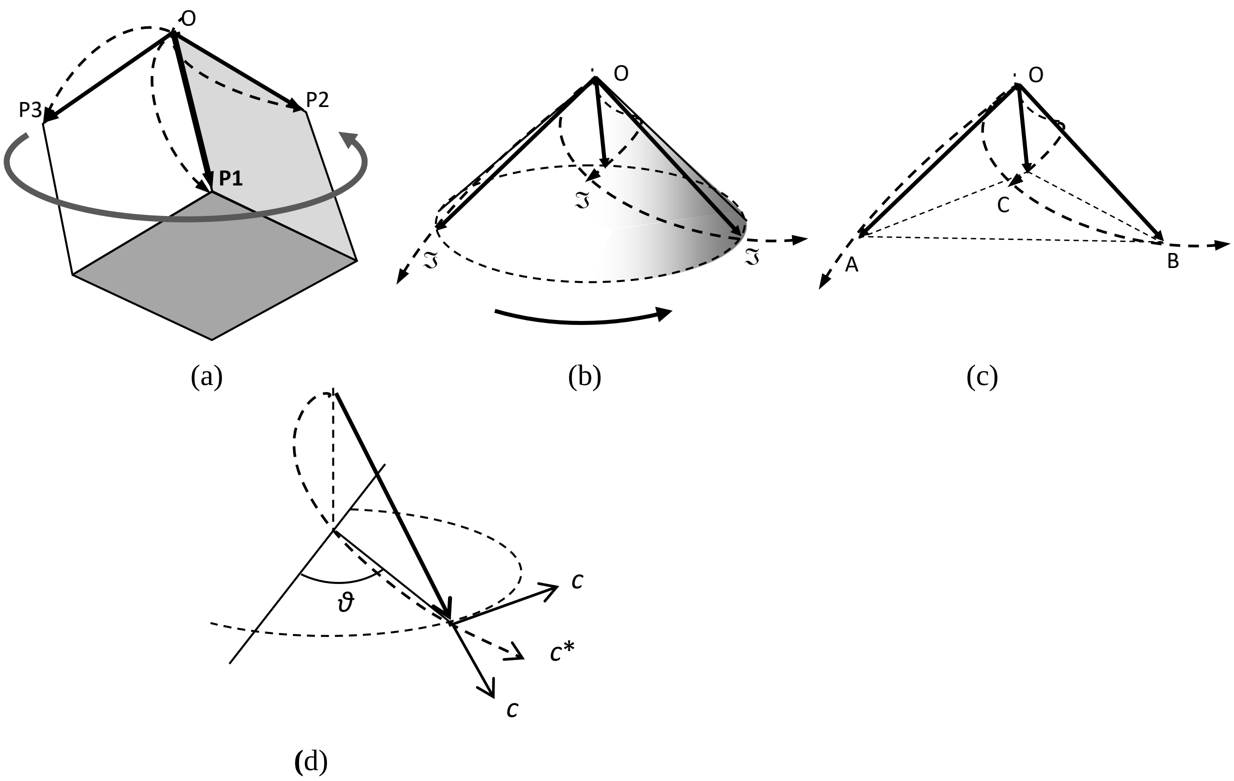

Figure 4.4. Different representations of space-Time to avoid points of Time intersecting.
Figure 4.4a represents the rotation of a cube with P1, P2, P3 arbitrarily placed on a horizontal plane. Space-Time now expands down three adjoining edges (OP1, OP2 and OP3) of the cube as it spins in the direction of the grey arrow. As in two dimensions, the route taken by each of the ℑs is a spiral (dashed lines). The triad of axes marked as P1, P2 and P3 is orthogonal. O denotes the origin of the expansion but in the Time scheme the axes do not physically intersect at this point (zero does not exist in RST). In this construction each period appears, or **materializes**, when each curve represents a space-Time unit as designated in the planar case. Diagram (b) represents the rotation of the space-Time axes as forming a hollow cone, but this is in the human view of a spiral formation rather than the straight jump of the natural production of space-Time. It would appear to produce intersection between two cones which does not occur in a straight jump. Diagram (c) represents (b) as a **right tetrahedron**, which is the most useful form for developing the principle to continuous space-Time production. Diagram (d) gives the relationship between the tangential velocity of the rotating cone and radial motion of the ℑs and resultant c^*.

Figure 4.4(c) is a relief diagram showing the volumetric arrangement of the trace-points in the form of an orthogonal triad left by the operation of $\hat{T}$ where it operated first on the 'creation space' to produce the

[28] An alternative view giving the same result: In Figure 4.3, the OP1 and OP2 axes themselves rotate as the space-Time flows expand along each axis. These axes then can be described as curved axes. Then each axis can be equally represented by two further curves and so on. Inspection shows that only one extra direction is required to completely specify the form of the space-Time interval, provided this axis is orthogonal to the original axes which it will be by the principle of the minimum unit. It might also be imagined that a volume based on an equilateral triangle producing a trihedron might work but this is easily shown to be impossible by constructing a model of a repeating volume using such objects.

first point of Time at the apex, and then operated on that to produce three ℑs. These ℑs then jumped to the three basal points P1, P2, P3 where they formed trace-points as $\hat{T}$ once again operated on them. This operation leads to a volumetric, or Euclidean interpretation for the minimum interval. Thus, although the description round Figure 4.2 was conducted by considering points produced in succession, Time generation produces a volumetric space-Time with three trace-points produced simultaneously.

The Time part will be called a **quantum unit of Time**[29] or **qut**, and the positional and eventually length, interval a **qul** (both qul and qut being along the spirals). Note that these units *must not be confused* with the Planck units of physics. From the derivation of these units it should be clear that they only have a size (of one unit) in human perceptive terms. Obviously an inanimate object cannot see the space its rotation apparently creates, where I use ‘apparently’ in the sense ‘it appears to an eyed observer’, not in the sense it may or may not exist. One qul per qut will then be a velocity denoted by $\boldsymbol{c^*}$ which, as the relativistic production of space and Time are intrinsically linked by the process derived, becomes the rate of creation of space-Time. But this velocity is purely abstract in natural terms though it has connotations with human ideas of universal expansion. It again does not have a *natural* value since it is purely in terms of units. The form of c^*, as well as its relationship to c, is determined in Figure 4.4(d)) as, in human measurability based on Euclidean space:

$$\boldsymbol{c^* = 2^{1/2}c}.$$

c being an instantaneous tangential velocity and c^* being the speed along a curve. Note that a generation of space-Time can be referred to simply as a ‘qut’ in either the natural or human interpretations of space-Time.

The quantum unit defined here, being indivisible and the smallest possible entity, cannot be measured by anything smaller since it defines the smallest unit of anything. Consequently anything with a measurable size must be at least as large. It matters not whether it has beginning and end-points; it only needs to be a qut or qul since the intervals are exactly equivalent being merely different representations of the same Time generating action. The use of a qut or qul will allow development of space-Time in more easily understood words. If this system eventually produces a Universe similar to ours it should then support the production of everything in this universe including sapient beings with similar attributes to ours. That is, they will believe in measurement and mathematics implying that these philosophical deductions, and units, must eventually become transcribable to mathematical-physics (see Addendum). So in our sapience it remains foundational philosophy until a complete description of all the fundamental processes is deduced. As these (philosophically-deduced) units are an explicit part of the foundational principle, the entire system (Universe) being produced must be formed around them. That is, again, if the system eventually produces a Universal structure then it must in entirety be centred on these units and *no*

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[29] The concept of a quantum unit for time is not new, for example Planck units. Caldirola, P. (1980) gave a value of ~ 2 x 10^{-23} to the quantum unit (chronon) which is slightly larger than my 4.1696 x 10^{-24} seconds.

others. This should not preclude comparison to human invented units such as metres and seconds or even kilograms and ohms.

Note that the last two paragraphs dealt with Euclidean space-Time formed by direct jumps of the $\Im$s under the action of $\hat{T}$. But the human representation/perception in which measurement can be applied requires the rotational form of Figures 4.3(b,c) or 4.4(a,b) which produces a curved space. Thus there are two possible systems, curved and rectilinear, for viewing space-Time both of which produce a three dimensional volume for the Universe. Furthermore, both appear to be equally valid.

In this structure, space-Time has a specific shape which humans call a triad or **right tetrahedron** in which the $\Im$s jump to their positions, the jump being in human connotation a straight line. However, if the contra-rotating spins and the complete production of space-Time over the progression of Time are both taken into account, the whole space formed by the $\dot{\theta}^{+}$ rotation can be said to rotate or spin. If this represents the Universe then the whole Universe will spin (relative to the $\dot{\theta}^{-}$ spin). Consequently I will refer to the Universe as if it is encapsulated by the $\dot{\theta}^{-}$ spin. That is, from human perception, the effect would be as if the spins operated such that one is contained within the other although a more accurate description is that it is 'backed' by the other. If we take the Universe origin as the centre of the system, it is Euclidean. An interesting point here, is that in order to pass from a curved system to rectilinear system or vice versa, instead of the highly complex Riemannian mathematics only multiplication or division by $2^{1/2}$ is required.

The curves described for space-Time in Figures 4.3 and 4.4 are equivalent to coordinate axes in curved geometry, while the heavy lines correspond to the standard (Cartesian) coordinate axes in human rectilinear representation of space. (Note (1) that as zero does not exist in the Time number system, the Time axes do not intersect at zero. This maintains the principle of non-intersection, or distinctness of points required by Time definition. (2) As the qul is curved, the rectilinear equivalent is shorter so cannot be measured; but this is not important in human measurements of straight lines as these are always longer than a qul because any measurements must involve distances of at least atomic radii in the measuring equipment. For future reference, as humans 'see' space as rectilinear, rectilinear units can be given as **qul$^{\mathbf{r}}$** which is the same as a qul divided by $2^{½}$. As $2^{½}$ is a surd, a point that has no exact position on a number line, a qul^{r} can only exist as a theoretical point between two adjacent quantum units in the set of natural numbers).

Additionally, the foundational premise with a single cause produces a first space-Time point from a rotation $\dot{\theta}^{+}$ which exactly balances the encapsulating rotation. It is only the encapsulated $\dot{\theta}^{+}$ rotational system which produces the Time points for the Universe.**[30]** The $\dot{\theta}^{-}$ remains as a controlling system purely

[30] See section 7.9. *w* is a maximal rotation which reduces every qut until it has the value *w*/*w* whereupon the spin system reverses to eventually create an antimatter universe starting at *w*.

as a boundary holding the total system to occupying no space. The space we see is therefore, as already suggested by section 4.4, an internal structure arising from the Time and trace-points. Since the $\dot{\theta}^-$ spin carries this backing role, it remains constant. Then if $\dot{\theta}^-$ is constant, the rotation of $\dot{\theta}^+$ relating to the tangential velocity of *c* must correspond in magnitude to $\dot{\theta}^-$. The value of this rotation will be called ***w***. The space-Time of section 4.4 therefore arises due to a rotation, *w,* the value of which is by assumption immaterial to the formation of the Universe. It is then only of interest to humans in their belief in measurement. This raises an important foundational point which helps explain the whole concept of measurement and its existence as only having been created by sentient-beings. *The initial rotation, w must have, in human terms, a definite value*, otherwise it can always be subject to an earlier starting point and/or different value – which makes no sense. Thus, as far as the Universe is concerned, infinities cannot exist, in which case, as *w* can in human terms have a numerical value, *w*/*w* = 1 must be the smallest value for the Universe so that infinitesimals also cannot exist except in theoretical mathematics.

Finally, turning to the most important factor (6) from those listed at the end of section 4.4: How does the human perception of a space, or volume, fit in with the necessity of an absolute constant Time-point rotation corresponding to a tangential velocity of *c*? In the above derivation of space-Time I have consistently referred to an apparent volume in the knowledge that the two contra-rotating p-rotations negate the possibility of what humans would regard as an 'obviously' existing volume (cf Chapter 7 on the macro-Universe which adds to the explanation). Based on this I will first ask an unexplored, but nevertheless important consideration in the above derived process: what triggers the completion of a trace-point and production of the next? It is quite simple. The problem of the timing (completion) of the jump only appears in human perception where a trace-point apparently expands from the human idea of zero. In the Time-reality, at its instant of creation the Time-point's three $\Im$s all have a tangential velocity *c*. The trace-point itself must also rotate at *w* to give its tangential velocity when it materializes at *c*. If the Time-point could possibly expand further the $\Im$s would attain a velocity greater than *c*. Consequently the concept never arises. The $\Im$s jump spontaneously, each to form a new Time point (and thus trace-point), with exactly the same construction as the first. Returning to the human timing problem, the expansion from zero would have to halt at *c*, that is, when the apparent radius is a qul^r. But as *will* be seen this does **not** preclude the living creature perception of (or ability to move in) a volume. On the other hand this duality of natural versus relativistic representations does answer the question of the size of the universe. It is atemporal and has no size. The size we see is purely relativistic.

Here I should mention Einstein's special theory which he derived in 1905, as that is from where I took the name 'relativistic'. Unfortunately Einstein's idea of special relativity is very much a mathematical theory so it is included in the addendum. However, I should say the mathematics itself is extremely simple. It is the interpretation that causes problems as it runs against human perceptions built over the millennia. But, it *is* less extreme than the completely fundamental form deduced in these last sections. The basis of his theory was already mentioned in section 3.2 with reference to measuring the distance between two mountain peaks; and then later, in the same section, on the transverse Doppler effect which is perhaps the clearer concept because it demonstrates the two way nature of observation. So while the light period grows longer (dilates) the frequency of the light becomes lower or less energetic (red shifted) and the wavelength, as a measure of distance units grows longer (also less energetic or red shifted).

This type of length and time alteration has been checked experimentally and is included as part of satellite location systems. If it was not included, guidance by satellite, especially of ships on open seas would quickly fail. In Einstein's derivation he assumed the speed of light was an absolute constant and that this could only be maintained for two observers travelling with respect to each other (sometimes referred to as 'co-moving') if their space and time units changed according to their relative velocities.

There is then no 'magic' in $\hat{T}$ creating a series of trace-points. It is a purely spontaneous process forced on itself by its own action. I shall call its existence[31] without any space the **natural** Universe and the human perception of this Universe, in which objects exist with apparent directions and space-Time intervals between them, the **relativistic** Universe. How it relates to humans observing and moving through a space-Time in an atemporal and sizeless Universe needs far more foundational reasoning, given in Chapter 9, despite its final simplicity.

4.6. Form of trace-points

In the above process $\hat{T}$ produces an object, or **space-Time module,** that in the human view becomes an orthogonal rotating triad of axes. Thereupon $\hat{T}$ passes on to produce the next Time point leaving behind a set of trace points. These trace-points are not points of Time and therefore do not produce triads of their own. They are merely p-rotating points. Nevertheless, as shown in section 4.7 it is this p-rotation that generates the relativistic space interval, equivalent to the minimal interval of Time taken between the forming of two successive Time points in the progression. In our perception of space (given by the relativistic representation) these trace-points are arranged according to their original formation from a Time point. That is they are arranged in a grid like structure that has the shape of a right tetrahedron as in Figure 4.4c.

However, the action forming this arrangement has a palpable difference when described in human mathematics compared to the Universe processes. The trace-point in the Time process strictly arises as a jump from no trace-point to the existence of a trace-point. The p-rotation then only has a value (of angular velocity, *w*, and equivalent tangential velocity, *c*, at the time of the jump. This constancy of rotation is obviously not possible in the human mathematical system (used only as an aid for explanation) which expands as in Figure 4.4 so that the motion[32] of each $\Im$ is always at one qul per qut = c^* along the curve.

[31] Remembering that the reason for existence itself will be discussed in Chapter 10.
[32] which is only imaginary to aid this concept being described in humanly imaginable terms.

But it is useful to have this humanised view because it can be related to measurement using human mathematics, which we now know may not agree with what actually happens. But on the other hand it does express the action in terms of a continuous system which is how everything we see appears to be arranged. And therefore it is easier to understand provided one remembers everything happens in jumps, or if you prefer, in quantum units. That is, in the natural system the space-Time at the instant before a qut has a fixed condition and at the end either the same condition or a different condition, but there is no gradual change of condition in between.

To clarify, the triad of axes (OP1-OP3) in Figure 4.4abc represents, or defines, the first point of space-Time expressed as a 3-dimensional minimal period using the human Euclidean view of the process. Space-Time, as derived in this humanistic view of the rotating-space-Time (RST) system, is therefore 3-dimensional and is formed from three space-Time flows. Note that this appearance of space-Time is specific to 'bilateral observation' (mutual observation between two observers), or 'relativistic-observation' of p-rotational objects in this thought experiment. It anthropomorphizes something purely spontaneous. This is particularly evident in the three space-Time spiraling flows which arise in adjusting the RST system to the human concept of a continuum in human mathematics. By contrast, the appearance of a space-Time period, in the strict sense of trace-point generation, only arises at the instantaneous change from a single point of Time to a trace-point. There is, therefore, no actual 'natural' flow, just the jump. Such a view shows a clear difference between human physical principles and a causal explanation for the universe. In any case, should these flows actually exist they would be undetectable as the space-Time generated by them has length one quantum unit which is the minimum measurement possible. Thus:

> *the appearance of what humans see as time (as a time interval) and space (as a volume) becomes purely due to a p-rotation producing an apparent velocity (c) between each of two touching, timeless, volumeless trace-points*.[33]

Due to the point form of each trace-point mutually observing the other, this statement will be true for any apparent direction between (connecting) the two trace-points.

However, this has only explained the first point of space-Time. The three $\Im$s produced in Figure 4.4c must, by the continuing operation of the Time generator, pass on to produce the next stage in the progression of Time. Section 4.7 develops the foundational principle, building from the philosophical point of view on Kant's[34] argument that the principle should be extended to its logical conclusion. It

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[33] Both trace-points have the same direction so that ostensibly they will have opposite rotations at the point of contact. But there are two factors to be noted. (i) Each point is a point and sees the other rotate with tangential velocity *c*. (ii) If the points are regarded in human perceptive terms then Einstein's deduction on special relativity shows that if *c* is regarded as an absolute maximum velocity his addition of velocity formula applies. In fact it will later be shown that the tangential velocity of the trace-points *c* has the same value as the speed of light. Also note that it is the $\dot{\theta}^{+}$ rotation of each point that causes the appearance of rotation inside $\dot{\theta}^{-}$.

[34] Kant (1998:134§B27)

extends the foundational principle to a Universal background structure. Before doing so, however, it might be worth summarizing the rather complicated arguments raised above.

4.7 Summary of the basic principles leading to space-Time.

(I) The foundational cause is assumed to be a single cause as otherwise it could not be fundamental but composite, in which case there would be a still more fundamental cause.

(II) The definition for Time is a foundational assumption so cannot be expressed in more fundamental terms.

(III) A Time point is a fundamental point so again cannot be described in more fundamental terms. It is a pure point although it has a dichotomous existence[35]: a) as the sum/superposition of two contra-rotations giving a point with no rotation, b) as a simple point with rotation within an outer rotating packet.

(IV) The Time generator, $\hat{T}$, is a self-generating rotation action which generates a rotating trace-point. As the generator and its action (rotation) are fundamental with Time they also cannot be described in more fundamental terms.

(V) A trace-point is a permanently rotating object but not capable of reproducing itself. It has been described as passive (section 4.3)

(VI) The minimal interval (in human geometrical view) appears as three points forming the base of a right tetrahedron, the apex of which is the original point. (It can be represented in human visual terms as a triad of axes originating from the tetrahedron apex as in Figures 4.4b,c. But in the fundamental sense it has no size). In trigonometry it would (incorrectly) be represented as a rotating cone. (The $\Im$s actually sponatenously jump so do not follow a curve).

(VII) This system is dichotomous in that the foundational cause contains two contra-rotating spins defined as $\dot{\theta}^-$ and $\dot{\theta}^+$. The Time generator operates on the first point of Time utilising one spin $\dot{\theta}^+$ inside $\dot{\theta}^-$ to create the trace-points and their intervals. Thus inside $\dot{\theta}^-$ a relativistic space emerges as described above, but the rotations together constrict this apparent volume to no volume.

(VIII) Consequent upon (VII) the Universe has two representation forms. In the total picture it is a spinning point with no volume, called the **natural representation**. The Universe which humans are used to is a **relativistic representation** with a spinning relativistically induced volume. Thus, should this reasoned Universe test positively against the universe in which we live, then this outcome solves the problems of the possible size of the universe and the problem of 'into what does the universe expand'. It has no volume; the volume humans perceive is purely relativistic due to a Universal rotation. The full meaning becomes clear in Chapter 6.

The above actions, together with the definition from which they are deduced, thus conclude the third original assumption, that of defining a fundamental cause. They can be summarized into the following single governing rule on which the philosophically derived Universe should be constructed.

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[35] Existence still to be explained: see Chapter 10.

The governing, or foundational, rule of the Universe in Euclidean terms

Space-Time is created in such a way that at a specific instant a relativistic volume is created in three rotating orthogonal directions (Cartesian axes) such that the curved distance along these axes is equal to the distance between them. The space-Time modules so generated have the form of a right-angled tetrahedron rotating about an axis through its apex orthogonal to its base. Each module must remain distinct from each other, that is, no module can intersect another; *and the space-Time along the curves is created at c*.*

Less formally from the purely human perception view: Space-Time is created in the form of rotating right-angled tetrahedra, each tetrahedron being as described in item (VI) at the beginning of section 4.7 and as described in Figure 4.4abc. None of these tetrahedra, (being space-Time modules) can intersect any other. They can however, touch. Most importantly, as in Figure 4.4d, each module has to maintain a tangential velocity of *c* (equivalent to space-Time being generated at *c**). Although humans see the result as a volume, this perception is purely due to the fundamental rotation which itself requires no volume. Therefore, a universe constructed this way needs no volume in which to exist.

Thus Ellis's belief that questions of existence cannot be solved by physics laws but need metaphysical arguments seems to have been justified.[36] And too, Aristotle can be brought to the front of modern thought through his belief in 'contraries' which sometimes adorn metaphysical arguments.[37] Here there is the single contra-rotation pertaining to the first principle. Being a foundational contra it is the only one necessary to this construction of a universe. Consequently this form of open-ended philosophical debate is only raised here just once. It gives a separation which humans recognize, and call, a spatial distance, and the rate of change in this instance is called a tangential velocity – equivalent to the man in the sphere of section 3.2 rotating and suddenly becoming larger. This solves Aristotle's problem (section 3.3.2)[38] of how to consider the gaps versus no gaps, or boundaries, between the 'nows', the 'pasts' and 'futures'.

The foundational principle is now complete in the sense the original definition has been able to produce space-Time volumetric modules, subject to observability, which could lead to a Universe. Time, space and rotation are different aspects of the same definition, originally given as just 'Time'. There is still the question of existence to finalize the principle but this will require knowledge of the entire structure and processes following from Time. As the basis for this work is philosophical it seems reasonable to expand it to account for every thing, especially as I assume the universe cannot be mathematical in construction. This must therefore be continued without mathematical 'language' as a philosophical procedure. A major benefit is that the accuracy of the deductions against human observation can then be checked by transcribing the philosophical results to mathematics, thus allowing it to be checked against known human physical observations.

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[36] Ellis (2012:27-28)
[37] Aristotle ([350BC] 1923:A5)
[38] Aristotle (1991:§218a4-222b)

Here I have to bend my self-imposed dream that we can just follow the deductions, for to make them intelligible, one needs to know what they are in aide of. That is, we need to consider the ancient Greek deduction by Leucippus that there exists some form of atom. Should this, or something similar emerge, then we need to know how these blocks of substance can joint together to form bigger objects. That is we need to see how, why and what humans know as force and energy arise. So first I deduce the attribute substantiality. Once that has been achieved I shall pass on to the idea of motion (already raised); then force and so-called electric charge, and finally energy.

CHAPTER 5

Thought experiment continued

5.1 Introduction

The rule derived in section 4.7 can be re-stated in terms of the ℑs using human conceptual terms for ease of explanation as:

> *The ℑs creating space-Time must travel along three rotating orthogonal axes such that they (ℑs) maintain the same distance from their originating point as the distance between them*; *they must travel at c**; *and remain distinct;*

where the ℑs are the 'bearers of Time'. Both statements, this and the rule in section 4.7, are completely equivalent and define the **constraints** of the RST system, that is, they define the rules that all fundamental space-Time objects in the universe has to obey. Consequently they determine what can, and cannot, follow from the original premise. The tetrahedron is only an instantaneous materialization so it has no time to rotate itself. The reason we, as humans could imagine the tetrahedron to rotate is for exactly the same principle as we imagine the sun passing around us every day because we are fixed to our place on Earth which is rotating. Using the same sun moving principle, the jump would appear to arise if the sunrise and sunset occurred during the blink of an eyelid. It is the same principle for the original point at the top of each tetrahedron or triad. It generates, in the view of that original point, the relativistic appearance of space. However, the rotating cone-shaped view is useful for imagination as well as describing the action caused by the rotation, so will be used in conjunction with the correct (instantaneous jump) RST mechanism. It also allows us to calculate the effects of this rotation mathematically to see how it pans out in relation to our need to measure things.

A few philosophical deductions have thus produced a possible first stage from an inferred foundational cause, which must now be developed, as anyone can invent a rule. It needs "exhaustive analysis" to demonstrate its worth as Immanuel Kant[1] philosophized two hundred and forty years ago. As he pointed out, this analysis should follow exclusively from the foundational base, outside of any empirical or mathematical ideas. At this stage of the argument it may not be clear that this basis differs enormously from the modern concepts of physics given by quantum mechanics, but that will become clearer in Chapter 7. Nevertheless, it should still be imagined that it lays a completely new approach to understanding the universe we live in.

This travels well with Feyerabend's principle that science should not be the "only road to truth".[2] Consequently, philosophical reasoning should not remodel nor build upon, standard theories. It should

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[1]Kant ([1781](1998:134§B27)

[2] Feyerabend (1993:6)

avoid, as far as possible, observation of our surroundings and preconceptions not derived from the above foundational rule.

But, unfortunately, while total avoidance of existing ideas would avoid the pitfalls of standard physics it would possibly lead to losing track of the plot. So some leeway must be accepted. For example, if I note that we are aware of tactile objects, the fact of having to use them to put ideas onto paper should not be too much of a leading argument. Philosophy helps in this quest because, as seen, it has a completely different view-point to mathematics. As Merali suggests,[3] a fundamental principle should be that any true laws of nature should arise from a first cause or overarching rule. Thus the first section of this Chapter, 5.2, aims to explain how the fundamental rule, or constraints, of the RST system sets up a basic structure for a Universe. The result, without any preconceived ideas, leads to the automatic creation of what humans call particles. Sections 5.3 and 5.4 investigate the nature of these particles, which again automatically leads to explaining two other human unilaterally accepted concepts, those of motion and force. Both sections will dissect the related views of fields. The results give, for the first time, an explicit view of the nature of these two actions, and in so doing show how the failure of physics to do so has led to a complete mis-understanding of the nature of our universe. Due to the complexity of describing these actions a summary is given in section 5.3.4. Section 5.6, then describes how sections 5.2-5 culminate in a visible spatial volume even though, paradoxically, the 'natural Universe' remains volumeless.

As might be expected the disclosure of how a Universe based upon the overarching rule is structured and functions, leads to conflict with some heavily entrenched human beliefs; but it is the course of philosophy to (1) contest existing views especially in the search for truth and reality, and (2) to escape from the self-imposed box of academic dogma even if only to test it. As Feyerabend says, theories change over time and therefore should always be considered suspect.[4] Although the intention is not to build on existing theories, this new approach will question undefined parts of these theories. It will therefore ignore everything physicists currently believe unless these beliefs are discovered to arise from the foundational cause. Consequently, the reader is urged to discard what he believes he knows and to reassess his surroundings in terms of what is deduced here.

5.2 Expanding space-Time

This section develops the foundational principle, building from the philosophical point of view on Kant's argument that the principle should be extended to its logical conclusion.[5] It extends the foundational principle to a Universal background structure that follows automatically from the rotational space-Time concepts so far developed. Because eyesight, or pictorial imaging, is such an important part of the human ability to understand, while word descriptions of unforeseen (noetic) deductions are difficult to visualize,

[3] Merali (2013)
[4] Feyerabend (1993:28,45)
[5] Kant [1781](1998:134§B27)

diagrams must continue to play a large role in this conceptualization – visualization from words alone only being possible if the brain has an embedded image on which it can draw. In any case, the human concept of reality demands the ability for figurative reproduction in keeping with the three-dimensional volume derived in section 4.5. (Four-dimensional spacetime cannot be drawn in a single diagram, three dimensional space-Time can, but only in relief, or as three separate two dimensional diagrams).

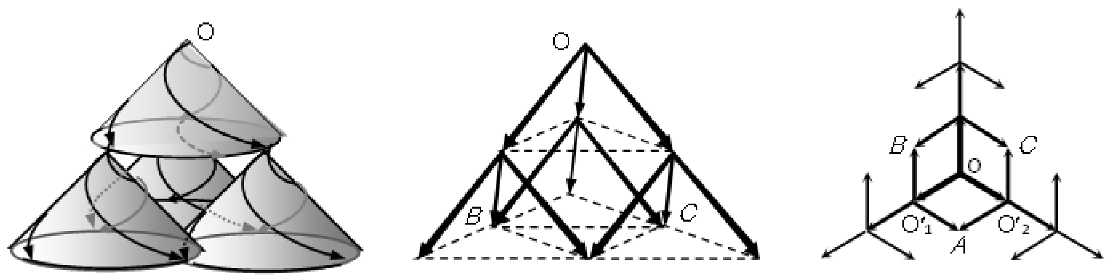
In Chapter 4 the foundation of the Universe was built around the rotation generator producing minimal intervals for each of space and Time from an as yet undefined starting point. The process was shown to automatically continue to generate further space-Time intervals from each previous interval in an ordered progression. This will lead directly to the noetic (beyond observation) principle of a network, or **lattice**, of identical trace-points built up tetragonally, the first three stages of which are drawn in three equivalent forms in Figure 5.1. Although this is drawn showing triads of axes, it must be remembered these are only imaginary for human visualization. The lattice in the *natural* representation, has no volume in the sense which we as humans would see. Nevertheless, it would have a 3-dimensionality about it in the sense that the points are arranged in lattice form but with no distance between them. Its construction leads to the explanation of a visual space in section 5.6.

For explanation simplicity the orthogonal *IJK* 3-dimensional system of axes is used for the Figures, with *K* representing vertical and *I* and *J* being horizontal. Thus *IK* and *JK* represent vertical planes orthogonal (at right-angles) to each other and *IJ* a horizontal plane. However, as space has no 'one and only' up and down direction, this is only a convenience for descriptive purposes, particularly over the concept of change of orientation of spins.

Due to the action of $\hat{T}$, every new space-Time module generated in the lattice as it develops, starts with the same conditions as every other. Consequently it avoids an 'addition of velocities' problem of a new trace-point building upon the rotation of another. That is, if the original triad of Figure 4.4c is itself rotating then one might expect that each of its three $\Im$s are moving around it at *c*, its tangential velocity. Then one might expect the new triads produced from each of the $\Im$s to start their 'life' with this velocity. However, $\hat{T}$ is identical for all generations of space-Time which means it carries both $\dot{\theta}^{+}$ and $\dot{\theta}^{-}$ spins with $\dot{\theta}^{+}$ encapsulated by $\dot{\theta}^{-}$. Thus each new $\Im$ starts its 'life' with no prior rotation as it is automatically annulled by the $\dot{\theta}^{-}$ spin carried by $\hat{T}$. Therefore each new space-Time module (triad) produced is identical to all the others.

From this situation it is easy to set up a general structure for the whole of space-Time by merely repeating the operation from the first triad to generate the next (second) stage consisting of three triads which then produce three triads each to give nine triads. This is done in Figure 5.1 using the human belief in an actual space formed by cones (5.1a) or triads (5.1b) depending on whether a continuous space-Time or jump formation is contemplated. (Either can be used as a personal choice depending on which is easier to visualize).

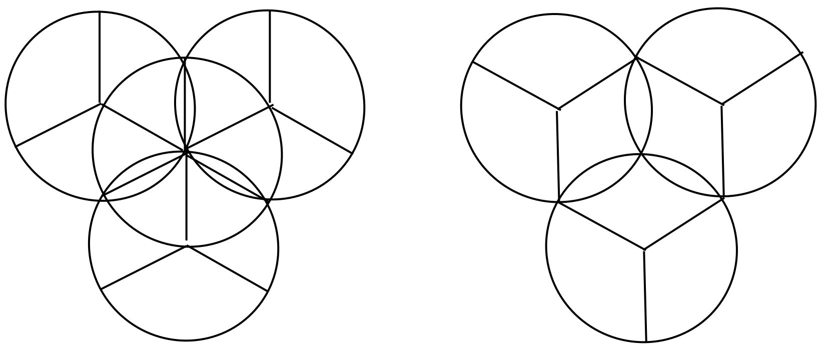
In both the natural or relativistic representation the result is the same: when the first generation (first qut) of space-Time points materializes, it is actually the ℑs that materialize. Each generates a new Time-point for the second generation in the progression leaving behind a trace-point as described in section 4.3. When these ℑs of the second generation materialize they, too, leave behind trace-points, and so on as the progression of Time advances; a third generation is shown in plan-view in Figure 5.1c. In (b) and (c) the imaginary triads of rotating axes are drawn for each generation in their final directions at the end of the space-Time expansion, which becomes the starting direction for the next qut (fourth generation). The tips of the arrows represent the positions of the ℑs at this instant, which is also the instant when the new space-Time points generated by these ℑs form. In the natural representation, as described in sections 4.3-4.4, there would be no space between the points, and no measurable time interval although the points would still be generated in the same sequence. This (no space diagram)) obviously cannot be drawn – Figure 5.1 is therefore purely to give a visual impression of how the process would appear to humans using our perception of a real space-Time.



(a) (b) (c)

Figure 5.1 Space-Time generation following from extending Figure 4.3b,c. to a second generation in diagrams (a) and (b) and adding a third generation in (c). (a) and (b) are drawn in relief and (c) in plan view starting from the first qut – heavily lined, the second – medium lined the third – light. As in Figure 5.2b,c the cones and triads are just different representative methods of drawing the process of space-Time (trace-point) formation, (a) representing the human view of the ℑs spiraling to form the trace-points and (b) jumping. The tips of the arrows represent the final positions of the triad axes at the end of each qut and thus the position of the points forming a grid or lattice. In all three diagrams the first generation produces three new triads in the second generation. The axes of these second generation triads meet at the points designated *A*, *B* and *C* which causes interference in space-Time production at these points. However, the outer three points *P*, *Q*, *R* can continue normal production of a space-Time lattice as seen in diagram (c). The lines connecting the arrow tips to the triad origins are imaginary to show the direction of motion, or jump, of the relevant ℑs in human view.

However, as can be immediately seen from the Figure, the regularity of the expansion leads to several problems. The first concerns the visual representation of the cones which, despite having said that either the jump or the continuous rotation in the form of the cones is extremely useful, might be construed as misleading. Figure 5.1a clearly shows the front two lower cones cutting into each other at their base which is against the rule that says their space-Time cannot intersect each other. To some extent this misrepresentation is useful as it shows up the difference between human mathematics, perception and what lies beneath that perception. The spiral or cone formation is purely how geometry would produce the space-Time production from rotation and thus through human education how humans would imagine it. Through the use of trigonometry mathematics would follow suit. From both these views the bases of the cones would overlap, as shown more clearly in Figure 5.2b. But this is not what actually happens. In the *natural* representation, there is no 'starting' and 'end' point – just a spontaneous jump. Therefore there is no interval. This is a difference between the p-rotation or the 'is' or 'being' of rotation. It is an instantaneous rotation. If one views the rotation as forming a cone, it stops at the instant of the ℑs reaching their materialization. Thus the ℑs never overlap. They only instantaneously meet at the point of contact when they materialize, which also happens to be the point described earlier (item (6) at the end of section 4.4) which triggers their materialization at tangential velocity *c*.



(a) (b)

Figure 5.2 (a) showing Figure 1a from above and (b) the bottom three triads in plan view. Using the human concept of rotation it looks as though these lower triads would intersect each other but as explained in the main text this is purely misunderstanding the rotation action of the natural process. The ℑs jump to the positions at which they materialize and never intersect each other. It is only our life-perceptions that imagine it as a continuous rotation.

The second obvious, and much more interesting and important problem, arises at the second generation of triads (space-Time points). At the positions labeled *A*, *B* and *C* (in Figure 5.1) the triad arms coincide creating a hexagonal 'ring' of points. Extending the process of Time formation could lead to ever larger rings appearing every few generations, though these rings are not necessarily hexagonal – for example the heart shaped ring in Figure 5.3(b). In the later stages of Universal development these rings could be enormous, millions of coincidences to a ring. These rings leave holes in the lattice (see Chapter 7 on hotspots and voids).

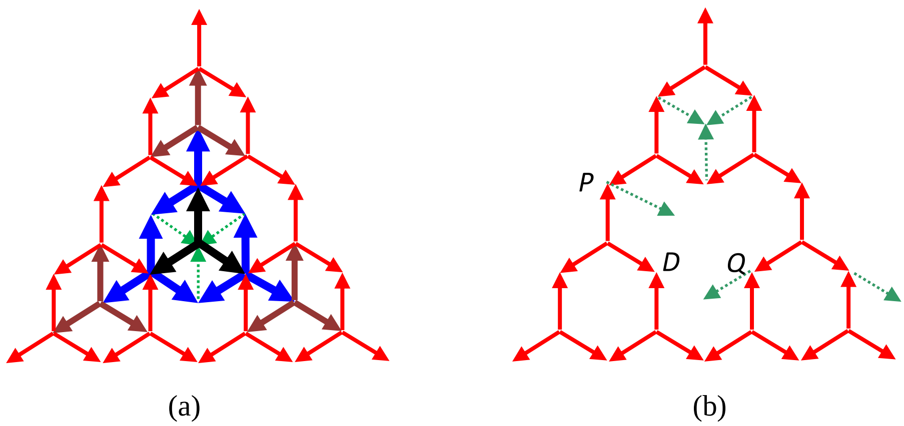


Figure 5.3a shows four generations of space-Time in plan view starting from the black triad for the first stage through to the red axes at the fourth. The blue triads create a ring of coincident points from which space-Time axes can develop in certain directions as in the main text. When any two axes meet, unstable proto-particles form. (In this particular case the single viable axes (green dotted) created by the proto-particles meet below the central black axis to form a triple triad [section 5.3.2]). As the lattice grows the outermost lowest axes are always **free**. (b) The red triads form a larger (heart-shaped) ring than the blue ring in (a). Some possible arrangements of the single axis (green dotted arrows) emerging from a coincident point are shown. P and Q can each generate new space-Time triads.

These coincidences of two points are an automatic (caused) effect of the creation of space-Time intervals, and again seemingly lead to a possible breach of the fundamental rule that no two points of Time can intersect. That is, if they were both to generate space-Time intervals from this coincidence it would seem the expansion of each point would pass into the expansion of the other as the rotation generator has a specific function to act on both instantaneously as each stage in the progression is instantaneous. They would then violate the uniqueness principle that no point can be superimposed on another, nor can its space-Time expansion intersect another point's expansion. Using a human idiom they would seem 'to invade the other's space'.

A good human view might be to say that the space-Time production interferes with itself where these coincidences occur. This situation produces an important difference between human thought processes and a fundamental principle. Humans would say, "if the basic idea is correct there must be a way round the problem". Mathematicians and physicists might go one stage further, and say, "Well our mathematics says it must happen so what can we introduce to counter the problem?" In the case of the creation of the universe these ideas smack of an intelligent 'creation' – which may be true – but as said before, I have to avoid the idea of a Divine inspiration however true it may be – and assume there can be no prior knowledge of any problem. So, therefore, if the fundamental principle is correct, that is fully fundamental, there is no 'way *around* the problem' as such. It must already be covered without any special thought of a difficulty emerging. Consequently, one has to consider purely the cause and effect, taking into account the spatial configuration as it stands when the $\Im$ makes its jump.

5.3.1 Double triads

So the Time operation has produced another apparent hiccough in our human view. The last one produced the necessity of a three dimensional volume thus explaining why our universe is three dimensional. Could this one produce something important as well?

Recall that in the Time structure there is no zero, only an endpoint – for example 1 (one) marking the closure of the first interval. Thus, using coincidence *D* in Figure 5.3b as an example, at the instant of coincidence zero does not exist, so that even though the two points coincide, neither point intersects, nor is superimposed on the other at that instant. This means that at the instant of their inception, the ℑs of each of the two coinciding points are independent of each other, and the only condition(s) affecting the ℑs, other than not intersecting, in general, is the rule that they must meet the quantum principle (and develop via $\hat{T}$ at c*). Their rotation then has no specific direction (sections 4.5-6) provided it fits these conditions.

The easiest way of understanding the principle is via the relativistic representation. Here the cones of the earlier generations of space-Time (in Figure 5.2b these are above the coincident points) will have reduced to mere points (trace-points) leaving room for a ℑ to 'expand' between them. Figure 5.3/5.4d shows this more clearly for a development covered in section 5.3.2 but the principle is the same.

Consequently the coinciding ℑs do have an expansion direction that will avoid them intersecting each other, bearing in mind that the quantum principle, as in section 4.5, requires individual ℑs' axes to be orthogonal to each other. Only the trace-points remain from the preceding triads and they are just ethereal spinning points with no volume, so there is room for a new space-Time triad to form upwards – as shown by the three green arrows between the blue dots representing the trace-points in Figure 5.4(d). Thus some of the ℑs, in order to avoid intersecting the space of other ℑs can, and will have to expand into these open lattice gaps. The simple answer might seem to be that one of the coincident triads forms the other way up but that would involve a choice for which there is no motivation in the overarching rule.

Then, since both points are blocked from developing normally by the other as neither can occupy the other's space in any form whatsoever according to the foundational definition, the choice is avoided if both work together. Figure 5.4 shows that five of the six ℑs change what would have been their original direction of development (as described in Figure 4.4), the remaining ℑ being unaffected. A change in direction of the ℑs would consequently give a human view that the triad axes had reoriented, as in diagram 5.4a to the positions shown in 5.4c – in fact, it is not the triad as such that has reoriented but the individual ℑs.

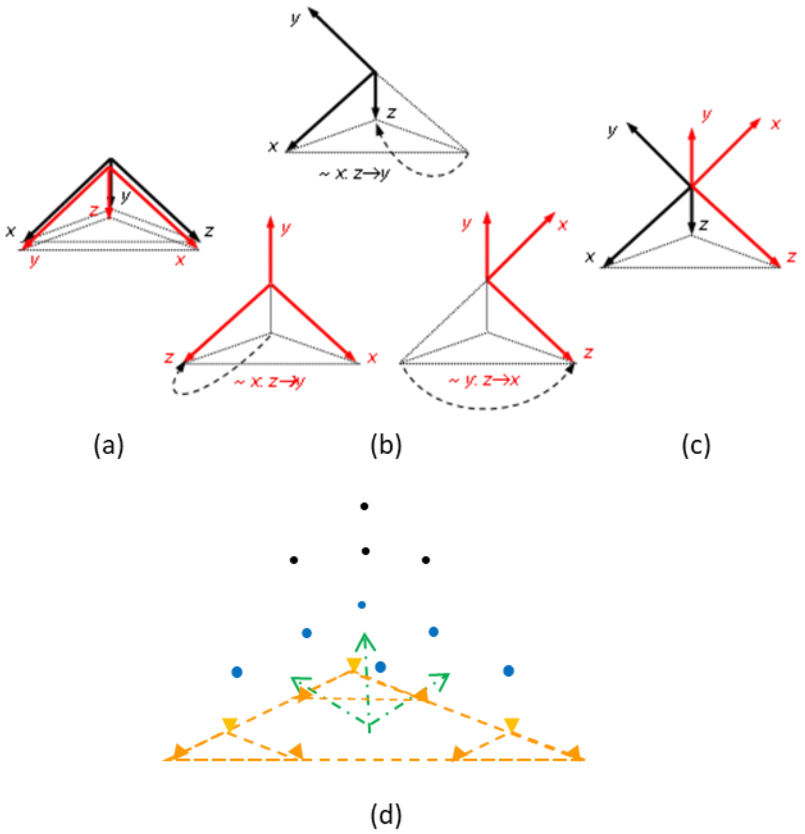


Figure 5.4. Reorientation of coincident triads from a possible uniqueness violating overlap in diagram (a) to a ‘double-triad’ in diagram (c). ~ *x*: *z*→*y* reads: rotating about the *x*-axis, the *z*-axis goes to the original *y* position as shown by the dashed arrows. In the lower two changes the first change moves the *y*-axis to the top of the triad and the second change is about this position of the *y*-axis. These changes of orientation take place as explained in the text before the axes expand to the positions shown. They can start from any axis with similar expansions so that the Figure describes the general form. (d) shows three generations of trace-points showing the empty spaces between them. In the case of the triple-triad of section 5.3.2, upwards jumping ℑs emanating from the green arrow would move into points between the blue dots (on the same plane as the blue dots but below the bottom three black dots).

The top line of the Figure shows the effect of a rotation reorienting the *zy* axes once around *x* (**reorientation rotation**) so that *z* moves into the position *y* would have occupied. In the lower line, the red diagrams represent two rotations, first about the *x*-axis and then about the new position of the *y*-axis, from the original position. The final two-coloured diagram (c) shows the form that this process gives to the combined triads after all the rotations have been made; all six axial positions have been utilized once. Thus the ℑs would still maintain their orthogonality to each other causing the end result to be the formation of two opposite space-Time triads, or **double-triad,** as in Figure 5.4c. This had to be the case because the entire action has to agree with the principles that led to the three dimensional aspect of space. In nature the complete action would be instantaneous. Similar rotations starting about any of the other axes end up with a similar result, so only the one description is needed. Before investigating the implication of this process there is another important factor in this reorientation which would have been hidden by a straight mathematical deduction.

Reason suggests that, if this reorientation, which is in the sense of a p-rotation, should take place at the same time as the ℑs develop, its addition to their natural rotation (*w*) would produce a total rotation greater than *w* which is the maximum possible rotation as specified in section 4.5. Therefore the reorientation would have to take place as an automatic instantaneous adjustment *before* the development phase; the development phase is of course a human perception, but in the natural operation it all occurs in order without the need of a time interval that humans can observe – much as in the case of the man in the sphere. He would see intervals and time orders even though an external observer might believe he was a mere point outside of time and space. In other words *it is the relativity of the situation that gives the human perception of ordering*. Actually, one could say it all takes place without any special realignment as the ℑs are blocked from developing any other way by the fact they cannot intersect.

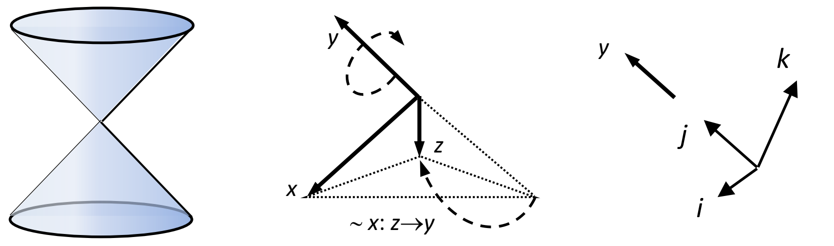
This will produce an unexpected and, as it will turn out, a very important effect which as suggested above would not be apparent from a mathematical approach. In fact there is a series of differences beyond normal human perceptions of rotation, space and Time which the reasoned philosophy uncovers.

The rotation we see is on a grand scale compared to the tiny size of the qul and qut. In human measurements rotations can be by small amounts to many decimal places of a degree. In the basic progression of Time a rotation always has to be in terms of the three-dimensional or cubic nature of the space-Time building-blocks. For example we come back to the meaning of a line in our perception. It has to be made up of a series of materially constructed points such as atoms, but if the general structure of space being developed here is correct, these atoms somehow have to be constructed of space-Time points because everything according to RST has to follow from (be caused by) these points. But no point can have a rotation faster than *w* so a line of points of even a millimetre's length cannot be rotated as one unit if *w* is the angular rotation of each point.

To see the difference between our perceptions and possible reality, let the line be fixed at one end, the point about which it is to be rotated in, say, an upwards direction. Then if the first point rotates it can only do so at *w*, which for an instantaneous rotation is a fixed amount of rotation per qut. The second point can also only react identically to the first so can only move a fixed distance upwards from its original position; the same for the third point and so on. Consequently the line would not remain straight and if there were a hundred points the final point would only move into position to make the line straight after a hundred quts. Each point along the line can, and would have to move independently of the others so that if an identical force (force-action still has to be determined) acts on each, all points on the line would rotate by the same amount, *w*. This would, however, be unobservable because the qut is so small compared to even an atto-second (see section 9A.4).

It should therefore be apparent that rotation goes far beyond the creation of new objects but also of how they function/work together, in other words the subject of communication between objects, or force. Part of the puzzle may already be apparent from the above description. As the reorientation rotation is caused by the fundamental rule, once it has appeared it cannot disappear as this would require a cause not included in the initial definition. Consequently, the reorientation rotation must become a property of the reoriented ℑs. This, in a way, is representative of part of a conservation law as proposed by Aristotle[6] or Helmholtz (in 1847) that what has been created cannot be destroyed, only changed in form. A little more reasoning will later show (Chapters 6-8) that this apparent extra rotation is also not a sudden creation of rotation from nowhere but a part of the total rotation of the Universe.

Taking the top part of Figure 5.4 as an example, the resulting rotational situation on the reoriented *y*-axis becomes, as described in the caption, an axis with a superimposed reorientation action orthogonal to it. That is, as in Figure 5.5, the additional rotation for the *y*-axis is in the *ik* plane since the *y*-axis is in the *j*-direction, shown for a straight jump. Consequently, the *y*-ℑ on materialization could not develop any axes in the *ik* plane as the resulting tangential velocity would always have an extra velocity element to be added to *w* making the tangential velocity greater than *c* for this case. In the spiral (trigonometrical form) the rotation around the spiral would always be orthogonal to the axis.



(a) (b)

Figure 5.5. Taking the top reorientation in Figure 5.4(b) the *y*-axis gains a rotation in the *ik* plane as the natural rotation takes *y* round in the next expansion thus ending with the direction shown. So the *ik* and *ij* planes are compromised leaving only the direction in the *jk* plane available for development from the *y*-axis. As the only directions in the fundamental space-Time development must be orthogonal, if the *ij* plane is tipped by a reorientation in the *ik* plane direction then it will be orthogonal to the *jk* plane direction.

Two important effects are thus described. The overall effect is that once the reorientation has been completed, the ℑs belonging to the original coinciding points can jump, or geometrically spiral in human imagination (as in Figure 5.1), to materialize at the end of the qut to form the above mentioned double-triad. The second effect described, which will become very important later, is that five of the Time points (ℑs) released from the double triad have a restricted rotation (four of them in two directions and one in all three directions).

[6] Aristotle, tacitly in (1923:K6, Λ6)

This may have seemed a complicated action from the length of the description; in fact it is simple as it is an automatic action caused by the fundamental rule.

To recap, as seen in Figure 5.4 there are five axes around which the orientation has changed and one which has had no change in orientation. Of the five axes one has undergone two changes of direction which means its $\Im$ would carry rotations in all three orthogonal directions at the same instant so that $\hat{T}$ cannot develop a new Time point from that $\Im$ at all.[7] The other four, that have reoriented just the once, carry the effect of this reorientation rotation. They would, then, under the action of $\hat{T}$ each be expected to produce three $\Im$s to form a new triad. But two of these three new (next generation) $\Im$s must, as already determined, continue to carry the reorientation rotation. This would ostensibly give them a rotation greater than *w*, or equivalently a tangential velocity greater than *c*, if they were to develop into a new triad. Consequently, these two axial directions cannot form into a spatial triad with the third (for example the *y*-axis in Figure 5.5(a,b)), and so can be said to be bound to the orthogonal (third) $\Im$ as a fixed point-like group. Thus when the reoriented $\Im$s regenerate in the next, and all subsequent quts, they can only produce a '*linear*' interval in the one direction – in the sense of a humanly observable volume. (Recall that they *jump* from one point to the next and on completion of this jump they exist for a fleeting instant before undertaking the next jump. They thus appear to be pure points with no volume). To distinguish the $\Im$ groups with this property, they will be temporarily called **trions**. They will prove to be absolutely vital to the construction of the Universe, so keep them in mind.

This means that as a result of the reorientation there will be three types of regeneration of space-Time from this system: (i) one of the axes has no change in its orientation direction (*x* in Figure 5.4c). It will be a 'free axis' from which its $\Im$ will be able to form a new three-dimensional space-Time module. (ii) the $\Im$s from four other axes, being affected by reorientation can only regenerate linearly (sections 5.3.2 onwards and Chapter 6 explain the consequences) and (iii) the necron (dead particle).

What happens to the double triad itself is unimportant here so is left to Thompson 2024a:ch10). What is important is that it has one free axis with its $\Im$ carrying no extra rotation. This leads to a further variation from the simple lattice production described at the start of section 5.2. This is the next action to be explored.

5.3.2 Triple-triad

The free axes of Figure 5.3 show several possibilities for axial directions for developing space-Time triads from coincidences so demonstrating that there is a distinct randomness in trace-point formation in the

[7] The red *z* axis in Figure 5.4. As its $\Im$ cannot develop an axis it becomes 'dead'. That is, it cannot intersect any other particle so it will merely float around any other space-Time forming $\Im$ without causing any change in the other $\Im$'s motion. The name 'necron' was proposed by Col. D.B. Emley for this 'dead particle' in a private communication.

lattice. Using the adopted layout of the figures to build on the foundational basis, the free ℑ (the ℑ that does not change its axis) emanating from the double triad will always be in one of the three downwards directions of Figure 5.3 depending on how the initiating double-triad reoriented. For example, the coincidence at *C* in Figure 5.6(a), shows three possible directions as green dotted lines. There is thus a one in three chance that the downwards axis will point into the centre of the blue ring. Similar possibilities can arise from any coincidences such as those at *P*, *Q* and *D* in Figure 5.3(b) or the special possibility *A*, *B* and *C* in diagram 5.6(b) where all the downwards axes (dark green) point inwards to meet at a point in the centre of the grey ring. Diagram (c) reproduces diagram (b) in relief view.

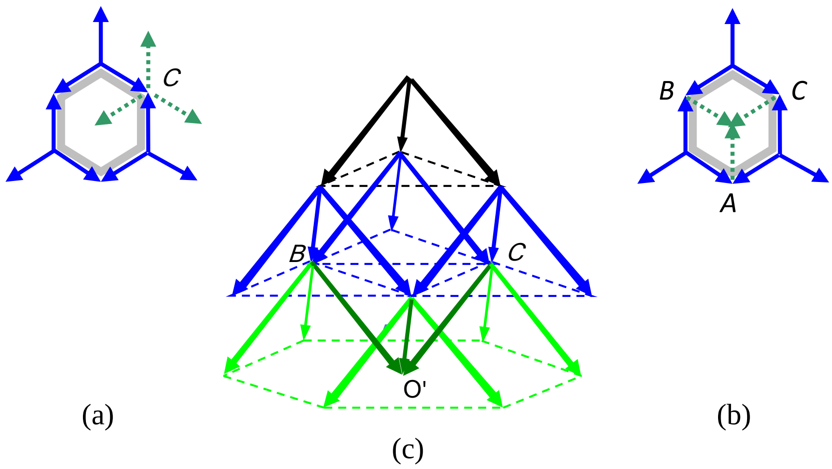


Figure 5.6 Formation of a triple coincidence.

The chance that all three free axes will meet as in diagram 5.6(b) is then 1/27. With three ℑs involved in such a coincidence, the expectation would be the formation of three space-Time cones as they regenerate, but similarly to the double-triad, these cones cannot overlap. Therefore, they must automatically reorient into a free space as with the double coincidence.

However, three cones produce a total of nine ℑs in human ideas; but even using the free space above the coincidence, the foundational rule only permits space-Time development in six orthogonal directions. (Note: for convenience of explanation I use six directions to indicate three downwards and three upwards from the origin of the three cones as in Figure 5.7 as all six directions are equally valid – mathematics would use positive and negative motions along three directions). The three space-Time operations of the rotation generator, one for each triad, would thus interfere with each other instantaneously causing each triad to reorient about one of its axes (Figure 5.7). In this case, unlike for the double triad, only one reorientation is needed for each ℑ to avoid a case of intersection. As with the double triad this instantaneous reorientation would take place without the prior need of any particular human numbering system – it takes place because the ℑs are blocked from operating any other way. It is yet another form of space-Time interfering with itself, but a more potent one as it will turn out.

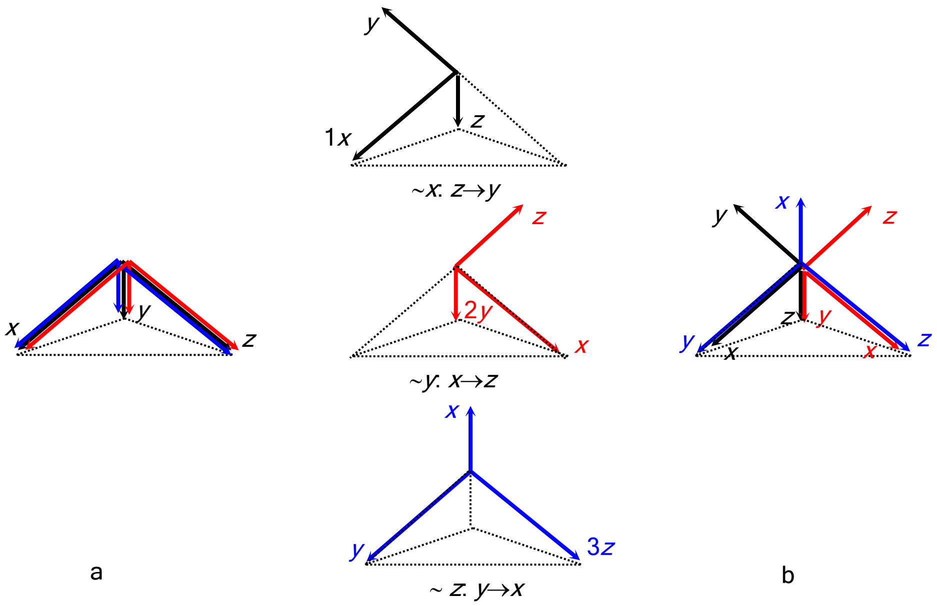


Figure 5.7. Reorientation of three coincident triads. The original directions lie superimposed on each other as in diagram (a). The rotations are made in the $\dot{\theta}^{+}$ direction (as seen from above). The central part of the Figure shows the individual triads rotated about one of their axes. The final diagram (b) shows the central parts superimposed. Note that the unchanged axes 1*x*, 2*y*, 3*z*, in diagram (b) are drawn extended for recognition purposes but they are in fact **suppressed**. They thus do not overlap the other axes.

This more direct action of just one rotation for all three triads leaves three unchanged lower axes 1*x*, 2*y* and 3*z* in the middle diagram. The ℑ of each of these (fixed) axes then has to remain at its origin because the reorientation process takes precedence to the expansion of the triads – these three ℑ's development and their axes become **suppressed**. That means the ℑs are stopped from jumping, they are stuck at their origin because the six reorienting ℑs move first. Consequently the reorienting ℑs take up all the available paths (paths being the axes along which the ℑs will travel/jump as they form the new space-Time building block). The result is shown in Figure 5.7b: all six possible directions are utilized leaving the fixed ℑs suppressed at their origin at the central point of the structure, as shown in Figure 5.8b. As the human idea of zero at the origin of the triad does not exist, the suppressed ℑs would not, in this scenario, intersect the space-Time axes or each other. The total result therefore appears as three triads so will be designated a **triple-triad** even though the apparent form is that of two overall triads. These will be called **super-triads** for ease of distinguishing between the two concepts.

This action, as with the double triad, is an automatic response to the principles involved in the rotational action of the Time generator. That is, if the first cause of the prospective Universe is as given in sections 4.4 to 4.7 – creation from rotating Time points that cannot intersect each other – the 'automatic response' (reorientation plus suppression) *must* take place.

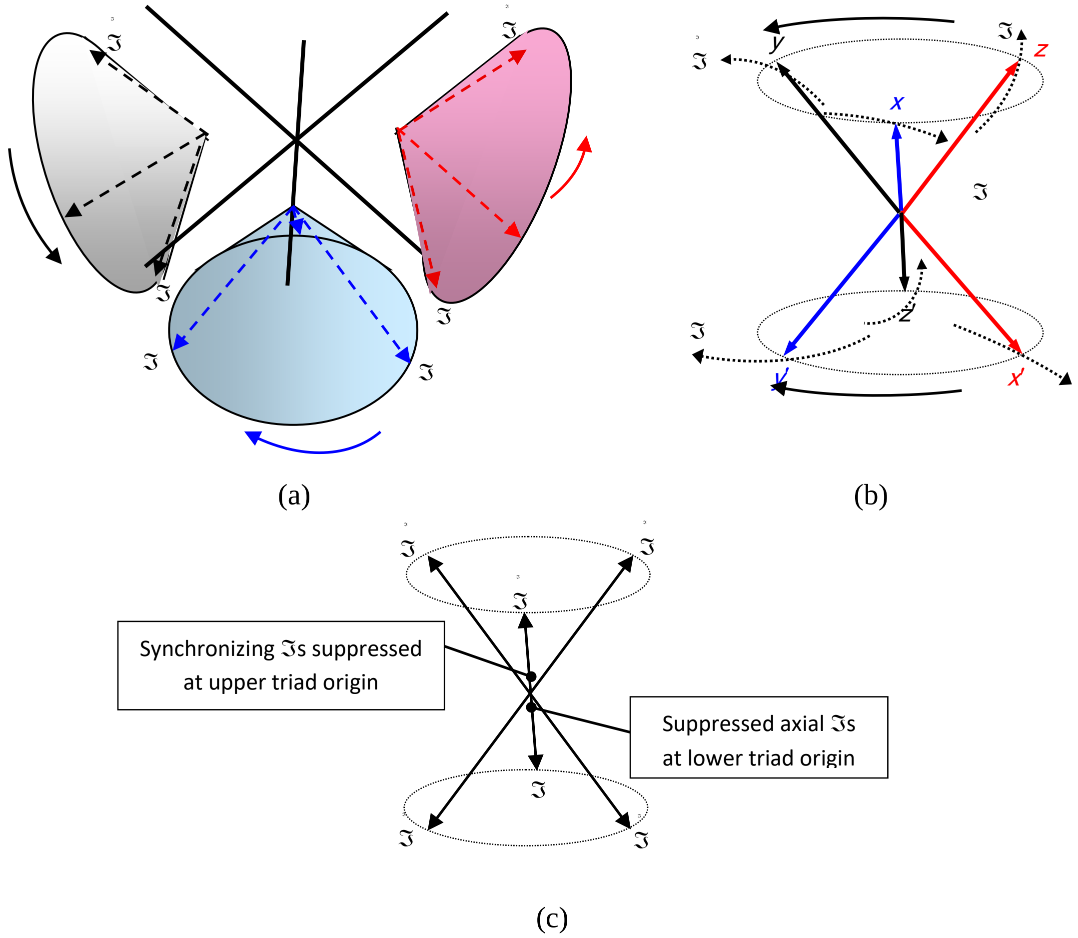


Figure 5.8 The arrangement of the triple-triad axes, shown in the exploded diagram (a) view. The initial motion of the ℑs (in human mathematical/trigonometrical imagery) is represented by the three cones with their triad axes (broken arrows) all spinning in the $\dot{\theta}^{+}$ direction (plain arrows). In (b) only the expanding ℑ's axes are given, grouped arbitrarily into 'top' and 'bottom' sets which would have to rotate according to their own $\dot{\theta}^{+}$ directions as shown. The third axes of each triad still exist, but their ℑs are trapped (suppressed) at their origin. The labels *x*, *y*, *z* and their colours are for convenience of showing action only; there is no *natural* distinction between the ℑs represented by the axes.

This leads to yet a further action: in view of three triads being involved the question of a rotational clash arises. For example, section 4.5 deduced that all pairs of neighbouring ℑs *must* meet the equidistant constraint – bearing in mind that all basic ℑs (ones not containing an additional orientation spin) are identical and thus cannot be distinguished from each other. However, Figure 5.8 shows that this equidistant requirement could only occur at the instant the triple-triad is formed. Transferring the rotations of the axes to the super-triads as in Figure 5.8b shows that the top triad would have to rotate in the opposite direction to the bottom (the arrows show the differing directions of motion). Consequently, because the jumps between each subsequent materialization do not fit a full rotation, the ℑ's relative distances would be continually changing. They would be breaking the fundamental rule that they must all be equidistant from each other in the relativistic representation. (This would be a result of the equivalent inequality of the p-rotations in the natural representation).

Once again, although the foundational principle, being simple, does not specifically foresee this problem, either the principle is sufficient to reconcile the problem or the system collapses. In fact, it does contain an automatic adjustment. This arises through the rotation generator always functioning over both the $\dot{\theta}^{+}$ and the $\dot{\theta}^{-}$ rotations. Thus suppose that the lower super-triad in Figure 5.8b has $\dot{\theta}^{+}$ rotation, then the top super-triad is rotating in the opposite direction, as seen from the lower. To match the $\dot{\theta}^{+}$ rotation of the lower axes, the final top-rotation at materialization of the ℑs must gain a *relative* rotation of double that value (*in human perception*) in the opposite direction: an apparent **synchronizing** rotation of twice the $\dot{\theta}^{-}$ spin so that the top triad rotates at the same rate as the bottom in the same direction as seen from below (or above). Then the ℑs will remain equidistant from each other.

Note particularly that this is not a special remedy, but an in-built action that automatically takes place to keep within the equidistance constraint. (It is the principle rule expressed in Chapter 4 (section 4.4.1) – that the production of space-Time must be in terms of the minimal interval – that rules supreme. As a result, no remedial action is needed – the problem never arises because it is taken care of in the basic 'no volume' state. It is only us humans that think in terms of volumes and time ordering based on what nature automatically carries out.

Twice the $\dot{\theta}^{-}$ spin may also seem to conflict with the maximum allowed rotation *w*, but this is not the case as the actual rotation only arises at materialization in such a way that the top and bottom triads both rotate in the same direction at the same rate. Both will then obey the constraint that demands they must have a tangential velocity of *c*, for which its magnitude would apply with respect to each super-triad as well as the whole. (The apparent conflict again shows the fallibility of human perception and its reliance on mathematics compared to how a Universe may actually operate. Twice the $\dot{\theta}^{-}$ spin is purely a human rationalization to make mathematical sense of what the Universe does naturally and only the final result registers).

But in keeping with the foundational first cause, the synchronizing spin would have to be caused and regenerated every qut; which is equivalent to saying it must exist in space-Time, as nothing else but the original foundational cause exists – by which I mean there is no caveat that allows for cancellation of caused actions. As this synchronizing spin was caused by the fundamental rule, the only possible way in which the synchronizing spin could exist is within the ambit of this foundation. That is, it must exist in terms of the ℑs, in which case these ℑs must be part of the triple-triad itself. They would rotate in the contra-direction, that is in the $\dot{\theta}^{-}$ spin direction, at the centre of the triple-triad, suppressed similarly to the suppressed ℑs (from the reorientation) but in the opposite (upper) super-triad to the suppressed reorientation ℑs (Figure 5.9c) – otherwise there would be a clash of the relevant ℑs moving in opposite directions. But in any case, the suppressed ℑs belong to the lower super-triad and the synchronizing ℑs to the upper super-triad respectively (see Figure 5.8c). Bearing in mind that in the RST system the point jumps to an interval, the $\Im$s could only have a valid effect at materialization. At this instant the upper super-triad would appear to 'float' on a negatively rotating centre while itself rotating with a $\dot{\theta}$-spin in the opposite direction, so that the two super-triads rotate in unison. Synchronizing rotation is then really a double rotation in which the reverse spin of the synchronizing $\Im$s is *w* which floats on another reverse spin of *w*¸ the latter *w* basically balancing the positive spin of the lower super-triad. This is in keeping with the principle that *w* is a maximum spin. Mathematically, as already pointed out, humans would interpret this as the total of the two reverse spins as one synchronizing spin with magnitude 2*w*.

This action would then give six axial $\Im$s (specifically creating axes in a double or triple-triad) creating the space-Time triads so that the result would be the formation of two over-riding, or **super-**triads which, are in fact the summation of three subsidiary triads, each of the three contributing two $\Im$s to the space-Time of the triple-triad (Figure 5.8). As above this is called a **triple-triad** even though the effect is two triads formed back to back. One more question has to be asked concerning the reorientation about the specific axes used to demonstrate how the triple-triad forms. No material difference results by rotating about other axes so this description gives all possibilities for the given direction of rotation. However, reorientation in the opposite direction is equally possible and will be shown later to give rise to the Stern-Gerlach phenomenon (see section9.A.6).

5.3.3 Triple-triad stability

As with the double-triads the reorientating $\Im$s gain an additional rotation restricting their development when they materialize at the formation of the triple-triad. They become trions, and again, as with the double-triads, they jump away from the triple-triad.

The separation of the trions automatically lifts the non-intersection restriction on the three suppressed axial $\Im$s remaining at the origin, and they (the three suppressed $\Im$s) will immediately generate the next qut for this space-Time system by repeating the above process; they will each form three new $\Im$s, of which six reorient and travel along the imaginary axes. The process can be thought of as the triple-triad pulsing in at the end of every qut (following materialization) followed by pulsing out during the next qut due to the action of the three $\Im$s remaining at the origin (cf section 6.2.2 of force and motion). Triple-triads are unable to spontaneously fly apart (disintegrate) because the origin of each triad would have to travel faster than the rate of space-Time production. Consequently their regeneration continues unless some catastrophic interaction intervenes.[8] This repetitive action also maintains the formation of the synchronizing $\Im$s every qut.

[8] Jumping to Chapter 7 for example: two triple-triads being forced together due to the internal pressure inside a star.

This means that triple-triads would blink in and out of existence as successive quts are generated but, because the rate of generation is the minimum that can be measured, this blinking will be unobservable in human perception. Thus the triple-triad will seem to have a permanent existence.

I shall stop here for a short recapitulation because I have raced through a tremendous amount of details which are fundamentally completely outside of any previous human physical or philosophical thought. First I shall return to the general structure of the lattice as, though it has just one generator (the Time generator) which would seem to give it a regular structure, it actually turns out to be irregular with many possible variations caused by the formation of the double and triple-triads.

5.3.4 The general development of the lattice structure

The general form of the lattice is the background against which everything we see develops. That is, it provides what we see to be a volume in which a Universe can develop. As the Universe grows with the progression of Time, the Time points leave behind an ever growing collection of trace-points although the pattern of the lattice becomes somewhat random due to the formation of the double and triple-triads. However, since the distances are tiny and the small holes become filled in quickly (via free axes such as P, Q, D, in Figure 5.3 which then generate further Time and trace points) the randomness becomes less important. It is only when the Universe has aged, in human measurements billions of years, that the holes can be very large, and take thousands or even millions of years to fill in. In this case they become noticeable and objects of curiosity for astrophysicists – but that is for Chapter 7.

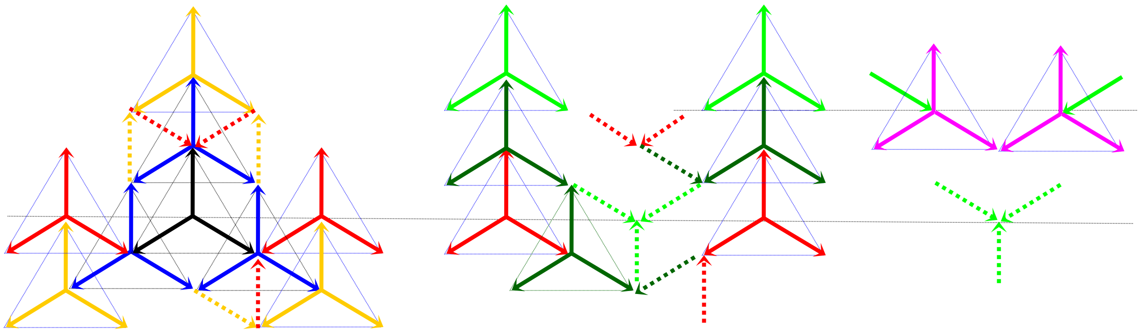
This philosophical derivation suggests that the lattice should be interpreted as a collection of RST building blocks (quantum unit-volumes). Both the natural and relativistic representations will have the same arrangement of points, but the natural representation is strictly the collection of points, trace points, double and triple-triads, and trions of various forms. These points are purely points, meaning they have no, what we call, volume; and so overall the natural representation has no volume. The relativistic representation is what we see. It has exactly the same structure and rotations as the natural representation, but in our view, remembering that we are a part of its natural structure as well, it has a space-Time volume. This is purely our view and not something extra to the natural representation. It is purely that, in common with many other living things, we have the ability to observe, whereas, although I anthropomorphized inanimate points in my original descriptions in Chapter 4, mere points obviously do not have the ability to observe and thus, via a brain, to transfer observations to an apparently spatial structure. In other words it is the brains of living creatures that see the fundamental lattice structure as a space-Time volume. Nevertheless everything in one representation exists in the other, so the two representations are absolutely identical. As I said earlier, even the diagrams drawn in this book appear in the natural representation. This will all become clearer as we pass on to see how complex objects, such as ourselves can be formed.

However, there are some clear differences between the structure I have derived from defining Time, and current human thoughts (contemporary mythologies). These, I aver, have blocked physics from finding the fundamental structure of the universe so I will briefly outline some of the differences.

In both my representations, the trace-points are ethereal, being only centres of p-rotation bearing in mind Euclid's definition of a point as "that which has no part", even though these rotating centres have a specific arrangement – the lattice in both the natural and relativistic representations. As the lattice is formed stage by stage through the points of Time, which can be represented in the form of triads of axes in the human perception of a volume, it will appear as a continuum, meaning a space with no gaps except where the holes occur. In our case on Earth, all the holes will have long ago filled in (see Chapter 7) so that, for us, the perception of volume around us would be complete. Consequently, we would have absolutely no reason to imagine that there ever had been any holes. It is what I will call 'a hidden from us' concept and we see the resulting volume as unbroken. As a result, what we call a Euclidean space is assumed to be a continuous volume, or 'continuum', in physics' language. But in fact, it would be what physicists refer to as grainy, meaning made up of contiguous Planck units,[9] or something similar as proposed here. In this case it may still not be exactly continuous, though this would make no perceivable difference to us in our immediate surrounds.

Recall that it is only Time-points that form the triads. The trace-points are merely spinning points that are timeless in the sense they are not points of Time and exist for as long as the Universe exists after their creation. The fact they are only spinning points, however, does not preclude their 'seeing' a space open between them due to their p-rotation, as described in section 4.5. Despite this rotation, in terms of Figures 5.1 and 2 the cone formation should be replaced by the stick formation in which the $\mathfrak{I}$s jump. This fills out the volume completely without any sign of overlapping. Then as Time passes on, the trace-points left behind would be merely points. They would actually occupy no 'concrete/material' space but, as just recalled, their p-rotation would still cause an apparent, or relativistic, gap to open between them. Figure 5.9 shows a possible formation of the first seven stages in the formation of the Universe displaying a number of different methods of expansion. It could equally well represent the growth from a free axis extending into a hole in an already existing Universe. Many other possible arrangements based on just the few principles of lattice formation could be devised.

[9] see for example recent articles by Regge and Williams 2000, Chiou 2000, Bahr and Dittrich 2010.



(a) (b) (c)

Figure 5.9 One of many possible formations of the space-Time lattice structure over seven stages in order black, blue, yellow, red, dark green, light green, lilac. In accordance with Figure 5.3 the arrangement is with the black closest to the viewer passing down in diagram (a) to the red triads. These are repeated in diagram (b) with the dark green being lower than the red and the light green being furthest from the top. In (*c*) the light green axes point downwards to the lilac triads at the bottom.

Because the lattice arises in three dimensions Figure 5.9 is split into three parts with the green axes in diagram (b) directly below the blue triads of diagram (a) and those in (c) below (b). The dotted lines indicate the viable axes emanating from the relevant coincident axes. The triple coincidences of light green axes represent a triple-triad. In diagram (c), a double-triad will be created from the lilac coincident axes. It would normally form in the volume occupied by the green triple triad. However, this would cause an interception of the space-Time of the newly forming double triad and the triple-triad, which is contrary to the fundamental rule governing the Universe. Consequently, one or both of the double or triple-triads would have to move apart thus introducing the concept of motion (see section 6.2 for detailed explanation) to the forming Universe. As this would have to occur within one qut, the composite triads could be expected to attain velocities of between 0.5 and 0.8*c* (*c* here still referring to the tangential velocity constant. It will be shown to be the same as the speed of light in section 6.3.2). This 'rejection' concept is caused by the expansion of each composite triad's space-*Time*. That is, it is the Time part of the expansion that causes the motion. Trace-points are merely permanent spinning points so do not cause a composite triad to move off. Once again, it can be seen that this is a quite different concept to physics where laws of conservation of energy in force creation and collision reactions are needed.

Figure 5.10 gives an alternative development to Figure 5.3a. Here, only double-triads can form and these are too widely separated to subsequently create a triple-triad; where reoriented ℑs meet unchanged axial ℑs no action follows because the reoriented ℑs can only develop in one direction and so pass on without any engagement.

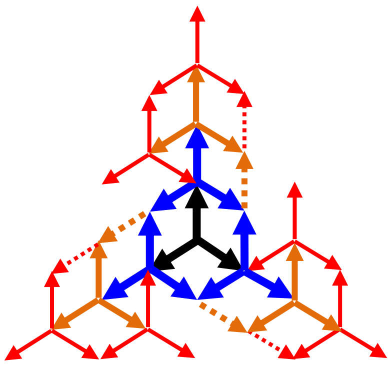


Figure 5.10. An arrangement of free axes not leading to triple-triads.

This, or similar formations, can occur not only in the first stages of the Universe but from any free axis penetrating into a large enough hole created by a ring of coincident points at later stages in the lattice formation. Such a free axis could start a new formation of space-Time modules of the form given in Figure 5.1 provided there was no interference from any other axis penetrating the hole as happens in Figure 5.9c.

Finally, it should be noted that the universe we see grows within the $\dot{\theta}^+$ spin region and no axes can pass outside this region because the $\dot{\theta}^-$ spin would preclude this.

This entire set of results is a natural, automatic consequence of the existence of Time, as defined, unaffected by any mathematical concepts. However, there can be no doubt that the lattice it establishes, lattice is a better term than field,[10] will lack regularity although every point in it is a spinning space-Time trace-point generated from Time points. This irregularity is the result of the regular tetrahedral format creating coinciding points which leave gaps or holes in the space-Time structure. As briefly explained above, these holes can be filled in if free axes pass into them to form new branches of the lattice. However, double and triple-triads have no means of forming trace-points so cannot themselves form parts of the lattice. The holes, then, remain holes in the lattice unless penetrated by free Time points to form new triple triads. The holes as such are not space-Time unless they become filled in. Consequently, the lattice should not be confused with what physicists understand as a field (the meaning of a field will be investigated in sections 5.4 and 6.2.2), nor a continuum, nor a closely knit grainy spacetime where objects can pass uninterruptedly from one place to another.

Finally, any philosophical derivation should consider how its deductions can transform to human inspired mathematics. The fundamental rule has produced two differing forms of sequence which coordinate completely and simply with each other. In mathematics the result can be interpreted in a composite (active) form of trace-points and a Time point. If we designate trace-points as *s* and Time-points as *q*, every point in the lattice can be mathematically given coordinates [*s*, *q*] meaning that a trace-

[10] Lattice is a better term than field as (1) it covers a whole range of operations and (2) it is completely described whereas field (see section 2.11.2) is unclear but is supposed to be uniform.

point maintains its position in the lattice at all 'nows' in Time after its creation; that is, each point of the lattice *s* produced at Time *q* in the progression of Time becomes a trace-point as the progression moves on in Time. Humans then have a method of referencing positions in space. But also they can, as trace-points exist continuously once created, designate a time for 'being' at a given trace-point. So, although the space-Time lattice and space-Time as such is ethereal in construction, it could be given a geometrical format if there is some way in which individual points can be determined. This, of course assumes that the structure emerging here will eventually lead to the existence of thinking beings and other objects.

We now have a structure of space and Time points together with trions, double and triple-triads to provide a basic nature of existence for a Universe based on the chosen fundamental cause and foundational principle. In particular the human concept of space is replaced by a lattice structure;[11] but we still need to understand how this affects human understanding of existence, and of the space we see around us, bearing in mind the difference between the natural and relativistic concepts of Universal existence (being). Among other things it still needs to deduce how it leads our existence. So I return to the role of the triple-triad in the nature of things and the concept of particles from which humans are formed.

5.3.5 Trions

Now we come to perhaps the most important piece of missing information in physics, the mechanics of force. It is supplied here by the actions of the trions – the axial $\Im$s emitted when the triple-triads materialize to become new points of Time. That is, they carry an additional reorientation rotation imposed on them compared to the normal $\Im$ which is purely a point of Time.

Being still points of Time, but restricted to developing in only one direction (dimension) instead of three, they must form new space-Time points which means they will disconnect from the triple-triad, as in Figure 5.5. In the relativistic representation they will appear to move away in a straight line, or series of jumps at *c*, because they can only regenerate in one direction. In the case of the natural representation of the Universe, as with the formation of trace-points, the $\Im$s leaving the triple-triad, although they are not separated by space from the triple-triad, they are separated by condition. Again it may be worth recalling the 'man in the vanishing sphere'. If everything is below microscopic view, which would represent the natural representation of the Universe, we would not see these $\Im$s moving away. But if the sphere were to be expanded enormously, which would represent the relativistic Universe, we would see a gap develop between them and the triple-triad, and continue to develop equivalent to the lattice developing as Time progressed. In both the natural and relativistic representations, because trions cannot expand laterally to their propagation they have no intersectable volume attached to them in either universal representation, and thus are pure points. However, should two, or more trions collide in the lattice they could not pass through each other, but they could, in the human sense of volume, rebound.

[11] A fundamental definition of space requires an ability to recognize space given in sections 4.5-4.7.

The question also arises whether the formation of the trions, which carry Time, requires the rotation generator to leave behind a trace-point as is the case in the normal generation of new Time points. The answer is ‘not really!’ which seems a peculiar way of putting it. The crux is that a trace-point is a fully rotating point which provides a relativistic space about it when viewed from another point. In the relativistic representation the trace-point is then a fundamental distancing location. From this view the trion, by having its relativistic expansion restricted due to the reorientation rotation, does not have the characteristics of the trace-point, nor a Time-point, In other words it does not leave behind a series of trace-points but it nevertheless has an existence. Consequently, it is yet another form of object generated not so much directly from the Time points but from the production of the double and triple-triads.

Returning to the triple-triads then, they are, taking into account their materialization and collapsing phases, permanent spinning objects formed where space-Time could be said to have interfered with itself. Furthermore, as Figure 5.9 shows they can be produced in the space-Time lattice in such a way that their space-Time would clash with another similar object. Since they are already maximally rotating in all dimensions the only way of avoiding intersection with the other object is if they jump apart. That is, they will gain what we call a motion between the trace-points making up the lattice (cf Chapter 6 on force and propagation).

At this stage it may not be clear that all the elements are now in place for the creation of the universe we see around us. So I will go back to the main problems of contemporary physics, starting with the the metaphysical problem: the nature of matter, in other words particles.

5.4 Particles

The question of what is a particle has engaged physicists and philosophers for more than a hundred years although the concept of some form of atom (from the Greek ‘that which cannot be divided into anything smaller’) first appeared in written form by Leucippus around 430BC. However, as already said, Aristotle dictated the idea of earth, air, fire and water as the fundamental constituents of matter, which held sway for many years. Even today, the major part of physics since the reinstitution of the atom in the 1800s has been the question of what we call matter. Since then physicists have concluded by experiment that atoms are made of protons, neutrons and electrons. Only one lasting theory of the constitution of this matter, quantum theory, has been put forward with much apparent success in explaining the micro-universe, and its processes, which leads to the question: if QM is as successful as made out to be, why should an alternative be suggested?

Part of the problem derives from a lack of knowledge of how the universe could have arisen in the first place. This automatically leads to the question of formation for some form of minimum building block for the objects we observe in the universe which we refer to as particles.

The nature of matter has been examined in both metaphysics, by querying the nature of its existence,[12] and physics in its structure. The ancient Greeks considered combining numbers of different fundamental objects in varying quantities but the question was still what were these made of. As already pointed out one can only guess at the fundamentals of the universe, test them and if not effective try again. In the case of quantum mechanics de Broglie took into account Planck's and Einstein's realization that light appeared to be emitted in energy quanta with what appeared to be frequencies and wavelengths. He also noted the photo-electric effect established by Hertz and Lenard that electrons could be driven out of a metal sheet with a velocity dependent upon the strength of impinging light or X-rays. In particular he thought that the stable motion of electrons in an atom, as suggested by Bohr in 1913, required whole number solutions suggestive again of frequencies. That is if the electron was a wave then its waves must exactly repeat around the atomic nucleus as otherwise they would interfere with themselves and destabilize the atom. Thus de Broglie (1923/25) was led to his equation relating momentum to frequency, and to the suggestion matter was equivalent to wave motion. Then taking the standard idea of a repeating quantum harmonic oscillation (QHO), in the form of a sine wave, he translated the QHO into a wavelength and frequency related to a particle's momentum, and thus mass. (A QHO can be described as being the quantum analogy of a frictionless spring bouncing back and forth [vibrating] without slowing down). From this he formulated a mathematical representation based on a collection of waves forming the wavepacket mentioned in section 2.5 (physics). It was left to nearly a hundred years later to connecting it to a possible origin of the universe see Chapter 7. However, there are still numerous problems which indicate the lack of clear knowledge of fundamental particle structure. Nor is there any definition for mass, electric charge, momentum or energy, of which one or more, are believed to be fundamental properties of any given particle; for example an electron is assumed to have all four, a photon energy and momentum with a query over charge. Nor is it clear how these form particle properties although there are equations that describe mathematical outcomes for mathematical inputs. So there is a fundamental problem with mathematics, not only in describing anything fundamental but in describing the space and time in which we live. Thus physics is 'hamstrung' without philosophy to clarify these absolutely fundamental problems.

But as this article is only interested in deriving a philosophical final theory, they are left to Thompson (2024a:Ch5,8-10). Instead I shall turn to the space-Time concept being developed.

5.4.1 The triple-triad as a particle

In RST the concepts of particle, force and motion are more or less synonymous. In accordance with the fundamental definition and principle, no part of one space-Time triad can be part of another. So, as described in Figure 5.9, if there is a chance of the space-Time of a double or triple-triad cutting into another, the two will be forced to move apart.

[12] Hobson (2013); Kuhlman (2018:§5.1)

This is possible in the lattice structure as described above because in the natural representation, although the trace-points are pure points they are not everywhere contiguous; they do not abut each other everywhere. The Time-points are also only points, in this representation, so that the double and triple-triads are equally points, only acquiring a *relativistic* size for the instant in which they materialize in the relativistic representation. Consequently, in the natural representation, as explained earlier, they (double and triple-triads) can pass between the trace-points through the non-abutting gaps. (These should not be confused with the holes that form within the rings of the form in Figure 5.3b. The concept of this translational motion as opposed to rotation, and the method by which changes in motion arise, are covered in Chapter 6).

So if double or triple-triads are forced to move apart by the fundamental rule of their relativistic space-Times not intersecting each other, they will give the appearance of being what humans would call solid objects. They would appear to have substance. This is more obvious if two triple-triads are moving through the lattice, (as said, the full concept of motion will be detailed shortly) directly towards each other. Then one or both would have to change direction to avoid intersecting the other. They would thus appear as solid objects much as marbles do when aimed at each other.

If we can now show that the triple-triad has the properties of what we imagine particles to have, then it would not only provide the human idea of a concrete object but it would fit the roles of human experimental observations. All it needs is to explore the effects of spin a little further.

5.4.2 Decay, formation of subsidiary particles

The triple-triad described above has a specific rotational form raising the question whether there could be other forms of rotation even though the one derived arises automatically from the fundamental action. Without proper investigation alternative rotations must be regarded as a possibility until confirmed or denied. Therefore the subject must be checked. Then the following concept arises.

Suppose that after its generation, the triple-triad receives some form of stimulus (see section 7.11. for possibilities) that causes its axes to reorient to another form of rotation. In other words it acts rather like a rotating ball which is suddenly hit by another object. An easy example is our planet with its latitude and longitude lines. It rotates about its north-south axis but if it was given a glancing blow by a heavy asteroid its rotation might be redirected so that it rotates around an east-west axis.

Thus, for example, if the triple-triad received a ‘blow’ its axes could be rotated, **or flipped**, in relation to its rotation axis as in Figure 5.12; that is, the triple-triad flips about one of its axes in such a way that (1) its spin remains fixed externally in its original *IJK* orientation while the flip changes the triple-triad axial orientation; and (2) so that in the flipped state its super-triads both *naturally* rotate in the same direction, when seen from above or below, that is along the axis of rotation without any need of the synchronizing rotation. Then there would obviously be no need of the synchronizing rotation to keep the

ℑs in synchronization; the ℑs would automatically maintain their distance apart equal to the supposed distance they had rotated in the human mathematical view without the synchronization.

Such an action is provided by a 135° flip (in human terms – the Universe does not need to know this value for the flip to occur) about the *zz′* axis in the Figure 5.12. The cause of the flip will have to wait until Chapter 7 but for the present, without wanting to prethink the answer, the thought that such a possibility could exist will have to do. It should, however, be noted that this 135° flip maintains the orthogonal conditions of the fundamental rule. The extra 45º merely twists the axes while maintaining the overall rotational axes but with the triple-triad axes in a different alignment.

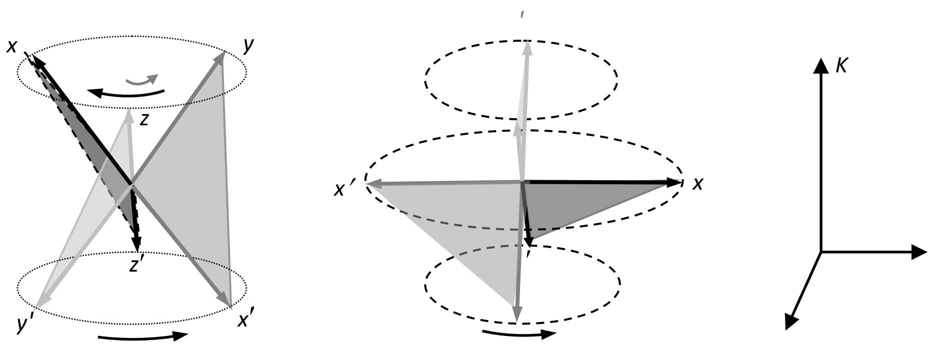
Now the important part: if the *synchronizing rotation* was to remain in place it would no longer act to synchronize the two super triads but instead it would work against them so that they no longer met the constraints. Consequently, we have to return to the fundamental rule for guidance. The first thought is that the ℑs that formed the synchronizing rotation, as with the fundamental definition, have no built in cause for their destruction. Therefore it cannot be supposed that they might cease to exist. In this case they will then be forced by the non-intersection principle to move away as a group from the flipped particle. Humans would see this as an instantaneous ejection of a group of opposite-rotating ℑs.

Through the usual space-Time expansion, these rejected ℑs would then have to instantaneously form a separate triple-triad as they would otherwise overlap (intersect) each other's space-Time. But due to their former rotational action this new triple-triad would have to have its rotation in the opposite direction to the flipped triple-triad and, in human ideas twice the magnitude. And here we have a difference in their formation compared to that of the original triple-triad formation: whereas the original triple-triad took on a synchronizing spin as it formed, the release of this additional spin was caused by the original triple-triad suddenly becoming synchronized, which means the synchronizing spin on release would automatically be synchronized itself. But, again according to the fundamental principle, the ℑs rate of production of space-Time must be c^*, and this rate can only be achieved if the particle they form has, in human terms a radius half the size of the original triple-triad as shown in human perception in Figure 5.11. That is, the tangential velocity must be c in the human relativistic expansion, which is attained in human geometric terms when the relativistic radius is half that of the original triple-triad. Human mathematics easily calculates that this radius is large enough to ensure that this new form of particle could not disintegrate within a qut. In this respect w was a value for human measurement that fitted the original human view expansion of the universe and was not therefore a constant value for the Universe; the constant value was c as the tangential velocity arising as a result of the p-rotation. That is, the p-rotation has to fit the tangential velocity c. Put another way w is the angular velocity of the $\dot{\theta}^{-}$ spin.

(The qut is unaffected; the qul, however is fundamentally a human perception, in that it derives the concept of space from a spaceless natural representation of the Universe. Therefore the concept of qul/2 does not affect the concept of a minimal interval, which correlates to Time as the fundamental cause. It may seem this triple-triad construction and appearance of the synchronizing particle suggests a violation of the human conservation law that matter can be neither created nor destroyed on the basis that the synchronization spin arose from an internal rotation problem, and then emerged as an apparent particle due to the non-intersection principle. However, any violation of this law is easily overcome as explained in Chapter 10 on the conservation of energy).

Thus, the fundamental action automatically leads to three main types of particle, the original one, the flipped version, and the synchronizing spin now in the form of a particle. This is similar to the action in standard physics of a neutron decaying into a proton, electron and anti-neutrino. This can also be constructed in the form as neutron *plus* neutrino decays into proton plus electron,[13] which will be seen to be in line with the action that would take place according to the RST basis of the Universe. The complete function of the neutrino, unknown in standard physics is explained in Chapter 7.

Note that only the 'original' form of particle follows directly from the fundamental action. The others only arise from this 'decay' process. Consequently, I shall use the terms neutron for the original particle, proton for the flipped particle and electron for the synchronizing spin particle in future. This use of standard nomenclature is, of course, only partly acceptable as these particles must also be shown to have the same properties in both the Time and standard theories, but it aids understanding what follows in Chapter 6.



a b

Figure 5.12 In (a) the bottom group of axes *x′z′y′*, rotates anti-clockwise with a spin of $\dot{\theta}+$. The upper group *xyz*, has the same spin but is upside down, so viewed from the top spins clockwise. The grey arrow at the top points in the direction of the synchronizing spin which, being upside down, has the direction and magnitude of twice $\dot{\theta}^{-}$. The net effect is that the top half spins anti-clockwise. Diagram (b) shows (a) flipped about the *zz′* axis by 135° bringing the *x′x* axis horizontal while maintaining the same $\dot{\theta}^{+}$ spin (which is the fundamental/foundational spin of the Universe) about *K*. The shaded areas represent the volumes (in the relativistic representation) of the original triads when the axes are fully developed. They are 'infinitesimally' thin due to the suppression of one $\Im$ in each triad. The whole spins in the direction of the arrow at the bottom of diagram (b).

[13] Hughes (1972:144)

The changes which this action instigates are profound so will be developed in Chapter 6.

CHAPTER 6

Force and motion

6.1 Introduction

The previous Chapter detailed the production of particles of four sorts: neutrons, protons electrons and trions (shortly to be renamed photons). This Chapter will deduce what properties rotation-space-Time causes them to have. In particular, it will reason precisely the action of force and associated motion through the lattice. Sections 6.2 to 6.5 derive an overall view of how particles undergo motion in response to a force, with sections 6.3 to 6.4 explaining how and why particle properties arise together with an overview of electron orbits about an atomic nucleus. However, the actual arrangement of the nucleus, completely unknown in standard physics, is only determined in Chapter 7, while measurement calculations are specifically mathematical so are left to the final Chapter 9 as a test of the accuracy of the RST scheme. Chapter 6 thus deduces a great deal of new knowledge unknown in standard physics such as the exact details of motion, mass, electric charge, force, and energy.

6.2 Particle interactions and force

The thought that the fundamental principle has possibly met a first test requires further reasoning to ascertain whether the three particles suggested have any relative properties and if so whether these properties agree with those observed for the neutron, proton and electron. In this respect standard physics interpretation leads to both physical and philosophical problems. Physical properties depend on interpretation of interactions. But physics does not ask why particles interact or even why they should interact in the first place. And although physics tacitly asks the question 'what is the mechanism?', it has proceeded with its equations and laws without determining the complete principle. It assumes the existence of 'virtual particles' that interact instantaneously, meaning ignoring the speed of light,[1] but without defining what constitutes these particles, or how they function. The principle is, as suggested above, probably more of a stop gap to obtain equations to predict what will happen rather than how it does happen, the latter being unimportant if the only object is to calculate the outcome for given inputs like a black box. Fox attempts to fix this oversight as merely an intermediary between mathematical calculations, as in Feynman calculus for interactions between two particles.[2] Causality (action at a distance) is overcome through the use of creation and destruction operators in field theory. Javadi mentions positive and negative virtual photons but does not describe how they differ, so this says nothing.[3]

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[1] Causality (action at a distance) is overcome through the use of creation and destruction operators in field theory (Peskin and Schroeder 1995:14,26 and29)
[2] Fox (2008); Jones (2002)
[3] Javadi (2017:1-2,7).

Physicists talk about force, but do not enter into the nature of force. They do not explain the difference between positive and negative forces (charges) other than assuming mathematics covers this difference either because, as with virtual particles, only the result is important; or, when applicable, using negative expressions to refer to negative charge and positive numbers for positive charge. But if my assumption that the universe cannot be constructed around mathematics is correct this concept immediately fails. In any case force is suggestive of motion to humans, or rather change of motion as suggested by Newton's so-called laws. So the attainment of properties not only entails interaction but motion. How and why motion (movement) should exist in the first place was raised in Figure 5.9 and section 5.4.1. It appears that this has not been a consideration in either physics or recent philosophy until Nail in 2018 in which he claimed that his article on the subject appeared to be the first in modern history. Early philosophy treated motion as a natural occurrence rather than something caused, as does Nail himself, although Aristotle certainly considered its causes and nature, and van Fraassen discussed various views including those of Leibniz and Newton relating space to motion.[4] Current philosophical concerns only seem to fit around relative motion with either other moving things, or relative to an object's surrounds.[5] Physics takes motion as a given fact and derives equations and laws (e.g. $E = ½mv^2$, or conservation of energy or momentum) for handling it but without delving into its root cause. However, the following sections explain precisely how it functions in the rotation-space-Time Universe.

6.2.1 Linear motion

The fundamental principle of motion given in section 5.4.1 only considered the avoidance of particles intersecting each other. Sections 6.2.2-6.2.5 derive the exact nature of interactive consequences and processes involved in this motion, that is, the nature of motion together with the complimentary subject of the fundamental nature of force. In this respect it passes far beyond the knowledge of standard physics which has no idea of the process of force nor how it is connected to motion other than by Newton's equation *Force equals mass multiplied by acceleration* which is not derived from a first principle and does not say why it should be so.

If a triple-triad was stable at rest in the lattice of trace-points it would be expected to have a basic rotation that would meet the fundamental constraints, that is the tangential velocity of its $\Im$s at their materialization would be c. But if the particle had a linear motion this should, by addition of velocities, affect the overall velocity of its $\Im$s at materialization. For example take the points y' and z' where the $\Im$s materialize as in Figure 5.8b. By the fundamental rule, their tangential velocity must be constant at c. But if the particle moved across the page to the left, the tip of the arrow at y' marking the position of the $\Im$ when it materializes would have an additional velocity (to c) unless it somehow changed its direction of motion so that the $\Im$s could all maintain their tangential velocity of c.

[4] Nail 2018:49, 54-58; van Fraassen (2013:124-131); Aristotle ([350BCE] 1923).
[5] Huggett and Hoefer (2015)

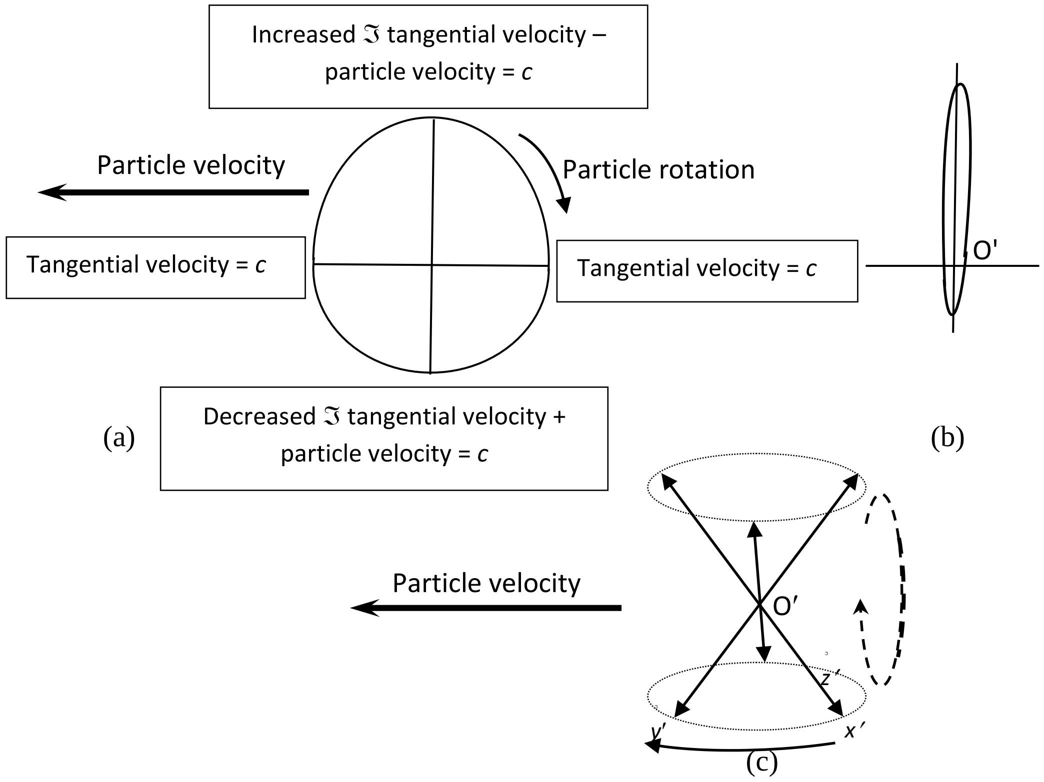

Figure 6.1. The relativistic particle according to the Time deductions. As the triple-triad particle rotates the tangential velocity of the ℑs ranges from being in the same direction as the particle's velocity (at the bottom of the diagram) to the opposite direction (at the top). This means that the spatial velocity (the velocity in the relativistic representation) of the ℑs changes depending on their positions. This is compensated by a change in their radial distances from the particle centre which increases or decreases their rotational velocities so that they always have an overall velocity of *c*. Consequently the particle's shape (in the relativistic representation) distorts to compensate for its velocity of propagation. In (b) a triple-triad travelling at 0.99*c* would have the shape shown. (c) Figure 5.8b showing the triple triad travelling to the left while rotating in the direction of the light arrow with its *x*′ and y′ axes also rotating in that direction. The two motions both have to add to the tangential velocity *c*. The z′-axis will be moving in the opposite direction because it is on the opposite side of the triple triad's axis of rotation. As the *x*′ and y′ axes rotate they will pass to the far side so their rate of rotation must speed up with a possible concomitant change of shape as in diagram (b). However, there is also the possibility as will arise in Chapter 9A.3, that the triple-triad can also rotate in the vertical direction (dotted arrow) as well as in the horizontal plane. This can make a big difference in the velocities actually attained by the axes.

Here, as earlier, the difference between human notions and the Universe is apparent. Humans would probably assume the ℑ *reacts* to the situation but in the both the natural and relativistic representations the ℑ materializes *into* a situation with its velocity automatically arranged to be *c*; similarly for the cases at *x*′ and *z*′. And as the triple-triad has to maintain its orthogonality, so do the ℑs represented by *x*, *y* and *z* in the upper super-triad. The triple-triad therefore spontaneously changes the direction of its rotation axis, or the radial distances of the ℑs from the centre of their rotation, or its rate of rotation, or a mixture of all three, so that all the ℑs obey the constraints when they materialize. That is, the direction change of the triple-triad suggested in the last paragraph depends on the motion (velocities) of all the six ℑs making up the corners of the triple-triad so that each ℑ travels with tangential velocity *c* relative to the particle centre.

There are several possible methods of balancing the velocity of the ℑs. The most obvious is the change in their relativistic radius (i.e. in human view) from the centre of rotation. For example, according to the RST principle, if a ℑ is rotating in the opposite direction to the triple-triad's motion and expands its radius, then its tangential velocity in isolation increases to compensate for its motion caused by the motion of the triple-triad itself; and vice versa for a ℑ spinning in the same direction as the triple-triad motion see Figure 6.1. This reduction or expansion of the radius will also arise in relation to the overall motion to affect the ℑ's velocity. Thirdly the direction of rotation of the entire triple-triad can alter so that the ℑ's axes can continually change direction in relation to the motion of the triple-triad. Thus, even in a geometric-mathematical representation, it should be possible to find a set of answers that agree with the general principle as well as explaining exactly why each particle has its properties. This process is expressed in measurable terms as a set of mathematical equations of motion to determine how humans would record the results in the Addendum. These results agree exactly with human observations, but more than that, they explain why the observed values occur which standard physics is unable to do. Physics only calculates what will happen, not why.

To determine the process, first imagine the axes (*i*,*j*,*k*) of the triple-triad in line with the spatial axes *I*,*J*,*K*. Then the *I*,*J*,*K* space axes also represent the initial direction of rotation of the triple-triad so that any change in the triple-triad *orientation* ($\dot{\varphi}$,*k*) can be referred to *I*,*J*,*K* using three separate angles, α, β, and ξ as in Figure 6.2 to define angles between the *i*,*j*,*k* axes of the triple-triad and the spatial axes *I*,*J*,*K* where α represents a change of axis *i* relative to *I* in the *IJ* plane about axis *K*, β a change of *j* from *J* about *I*, and ξ a change of *k* from *K* about axis *J*.

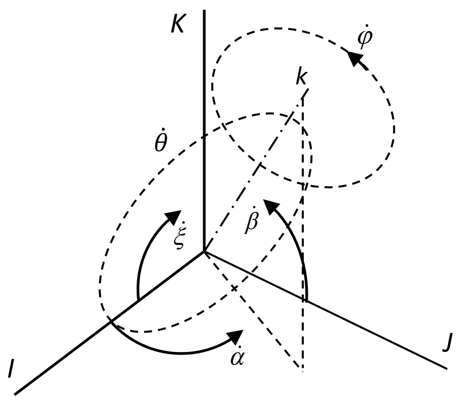

Figure 6.2 Change of rotation symbols. $\dot{\alpha}$, $\dot{\beta}$ and $\dot{\xi}$ are spin/rotation in the α, β and ξ directions. $\dot{\varphi}$ is (1) equivalent to $\dot{\theta}$, (used to avoid any confusion between the spin of the Universe and the combined rotation of $\dot{\alpha}$ and $\dot{\beta}$ which measurably would have the same value) and (2) the rotation of the particle in relation to the *k* axis.

In case figure 6.2 is not immediately clear it is repeated in Figure 6.3 with respect to a ball to place the concert in terms of human imagery.

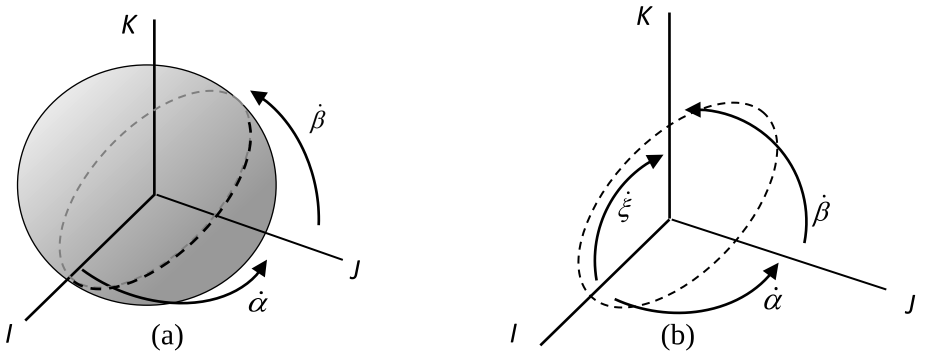

Figure 6.3 (a,b) Description of a ball rotating in the $\dot{\alpha}$ and $\dot{\beta}$ directions in the *IJ* and *JK* planes respectively with overall rotation $\dot{\theta}$ (replaced by $\dot{\varphi}$ as in Figure 6.2) along the dashed line.

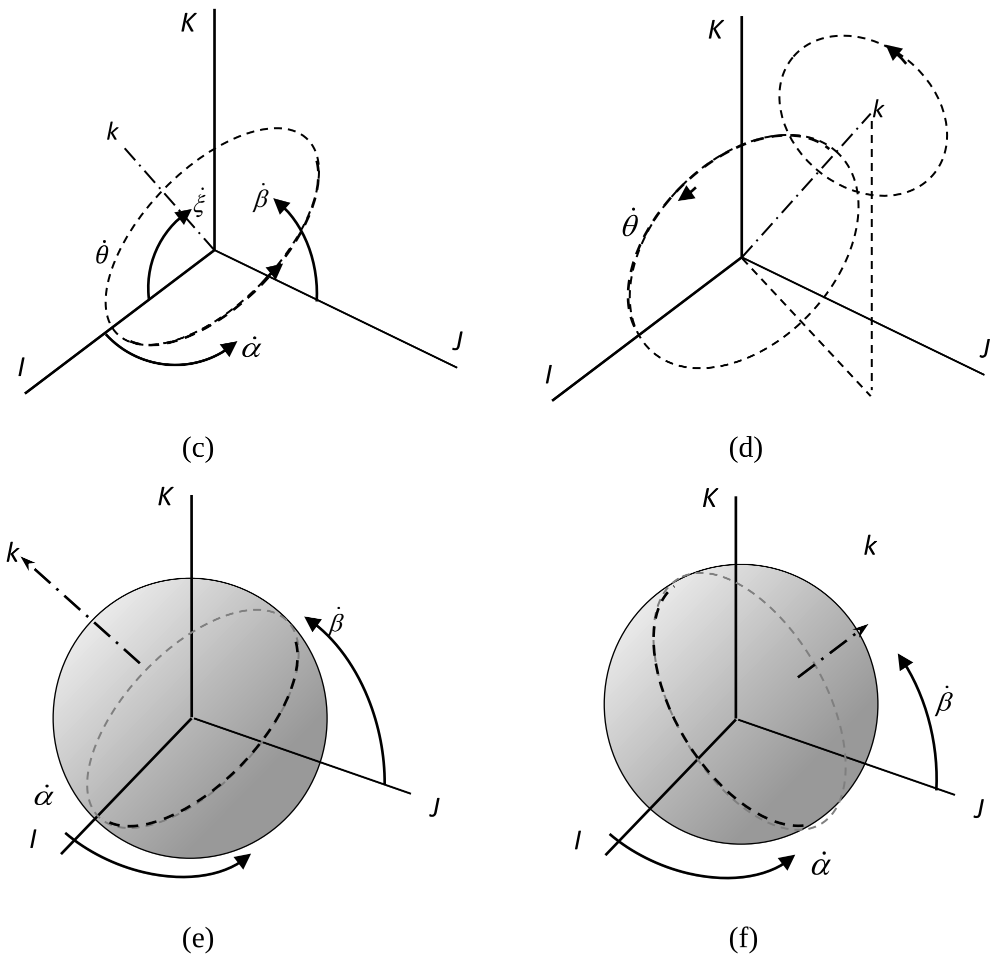

Figure 6.4 (c, d) place the $\dot{\theta}$ rotation around *k*, *k* being one of a set of three additional orthogonal axes *i*, *j*, *k*, shown again in (e,f) in ball form in human view connecting graphical representation to human visual sense.

The alternative would also be true: If the rotation of the triple-triad was somehow increased, then the rotation would create $\Im$ velocities that would break (**violate**) the constraints unless the triple-triad changed its overall motion (rotation plus linear velocity) to meet the required tangential velocity of the ℑs at *c*. The question now is how can these changes be effected?

Looking back to the original determination of a relativistic volume, a plane was defined first and transferred to 'rotation in a plane', followed by realizing that this would leave the possibility of the plane rotating orthogonally to itself. Thus the situation shown in Figures 6.2-4 appears in human graphical terms but can be exploded via the 'man in the sphere' concept to the natural representation in our minds.

The process itself may seem complicated due expressing it in human language and associated measurement. For the Universe it is spontaneous. The linkage of Time and rotation, determine the outcome, as humans might say, *before* the question. It is purely the spontaneous maintenance of the quantum units at a constant value, which is the same as maintaining the tangential velocity of the Time (and trace-points) at *c*. That is, the principle that three angles of rotation are involved derives directly from the definition of Time and rotation for the Time generator $\hat{T}$.

This use of three angles again separates the foundational principle from standard theory; this time through Euler's principle which requires only two angles to describe a rotation.[6] By removing the concept of three angles to cover three-dimensional rotation, Euler's method hides the exploratory use here of three angles which I argue is necessary to understand the principles governing motion and particle interactions at the fundamental level. The system derived allows the triple-triad to 'tumble' through space rotating in all three directions. The two angles β, and ξ are fixed according to the different particles as mentioned in section 5.4.2; α, changes independently to fit the requirements of the constraints (the ℑs' tangential velocities at materialization must be *c*). That is, the orientation of each type of triple-triad is fixed differently *in relation to its spin*. Finally the overall particle spin can change as suggested at the start of this section. It can be represented by three rates $\dot{\alpha}$, $\dot{\beta}$ and $\dot{\xi}$ which must be independent of each other thus allowing/causing the triple-triad to rotate in such a way that its ℑs always materialize within the constraints – recall that this is spontaneous not reactive. The constraints require the super-triads to remain orthogonal. Also recall that, as given in section 6.2.1, although I refer to rotation as measurable, this is only applied in human mathematics. Saying it can be recognized in the Universe means that an interaction involving trions just functions automatically without any need of 'knowing' a measurement value.

The simple motion of the triple-triads can now be expressed in complicated human terms – complicated because the natural spontaneity will be lost in geometrical and physical jargon. With this knowledge of *how* motion arises in the triple-triad – a change in the rotational aspect of the triple-triad to keep its ℑs obeying the fundamental rule – the next thought should be *what* can change the motion of the triple-triad? In physics this is known as force acting on a particle, the general rule being that a particle moves at a constant rate, which may be at rest with respect to an observer as well as moving, unless it is

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[6] See e.g Spiegel, M.R. 1987. *Theoretical Mechanics*. Singapore: McGraw-Hill Book Inc.

acted upon by a force. If acted on by a force, its motion changes with respect to the observer according to the force applied. But physics does not state what force actually is, nor how it is transferred to a particle and what causes the particle to react. This is particularly true when the force causes a particle to move for no apparent reason such as an electromagnetic force causing a compass needle to move or iron filings to arrange themselves in lines, or even the gravitational force between objects. As Ellis said, it is a question for philosophy.

To put it the other way round, physical force, in as far as it is defined, falls within the ambit of ‘strength, power, energy of action, an action which changes the state, condition or motion of a body’; these expressions being a summary of ‘definitions’ from a number of dictionaries. The common factor is that, as with time, they give no proper statement on the *nature* of force:

why or what causes it, how is it transferred and received?

Newton’s laws, for example, only give a classical interpretation of measured outcomes for given measured inputs suitable for applications in basic engineering, construction et cetera. So the *concept* of force certainly does not answer the question of how and why changes in motion occur.

6.2.2 Force and motion

Exactly the same sort of question should be automatically asked of the triple-triad without any recall to standard physics. In other words, why should there be motion in the first place and what causes it, or rather how is it caused. One point has already been raised in the observation given in Figure 5.9 that two particles can arise in such a way that their space-Time volume clashes with the other so that they are automatically forced apart in accordance with the fundamental rule. But this does not state that other particles must be forced into motion. In other words does this mean that the Universe may consist of a few particles in motion and perhaps a bigger number stationary with respect to the points where they were created?

In contemporary physical theory, such questions should fall under the headings of ‘force’ or ‘energy transfer’ in QM and QFT. These theories are based on four so-called fundamental forces: gravitational, electromagnetic, the weak and strong forces. The general principle is thought to be that force is transferred by bosons being exchanged by interacting particles; but the nature of the bosons, and how and why they should be transmitted is unknown. The mathematical formulation conceived by Feynman (1965) uses ‘virtual photons’ imagined to travel instantaneously between particles. Gravitational force is believed to be carried by gravitons, the electric force by photons (or virtual photons). The other two forces are theoretical. Their existence is said to have been confirmed by various energy emissions believed to correspond to ‘mediators’ such as W and Z particles or gluons.[7] But the actual nature of the action of

[7] (Peskin and Schroeder 1995)

force or energy transfer is unnecessary to creating or using equations that predict outcomes from inputs,[8] so it is primarily left to the philosophers to decide.[9]

The question of whether particles are fields was introduced in section 5.4 for stable particles such as protons, but not for the mediators of force. The problem is: it is all very well to talk of fields but what is a field, especially a force field? This is the same problem faced by Newton over gravity. The fact Einstein can express gravitation as a distortion from one field structure to a curved field merely emphasizes curvature but not why it should cause a movement towards the centre of curvature on a body at a distance from its field-source. Here one has to also be certain what is meant by a force-field. It can be expressed mathematically, which as a generality avoids questions of continuity, but here I am strictly considering the philosophical aspect, not what it can *do* but what it *is*.

The general description in physics seems to be a space where every point is affected by a force.[10] But nowhere have I found a clear definition that considers the field itself. The fundamental equation behind quantum field theory, the Hamiltonian, rests on the concept of a continuous set of adjacent lines that show how a particle will move between points but this motion is a comparison of its position and momentum over time. The accompanying diagram (Figure 6.5) shows changes of direction equivalent to a changing force. These curves appear because the diagram is not just a change of position over time but a change of momentum depending on the particle’s position. So again it tells us what happens but not why it happens other than saying a particle changes its state of motion if the force on it changes. It does not define exactly what a force is. Putting this another way, a force is ‘something’ that causes an object to change its state of motion. The question is what is the something? That is the important part that Newton realized needed an explanation. What he called action at a distance, how does it work? Without that knowledge a field has no actual meaning. It is merely a human idea that allows mathematics to be applied to calculate what the outcome should be.

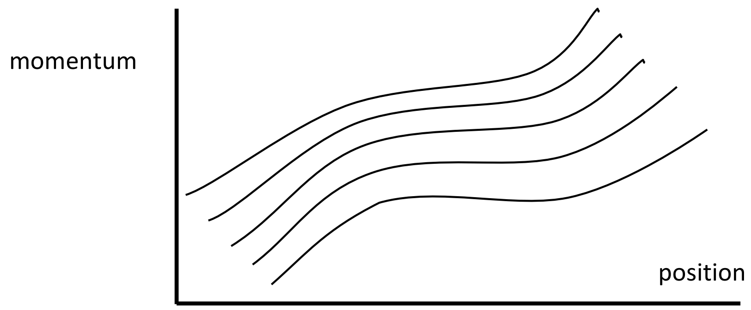
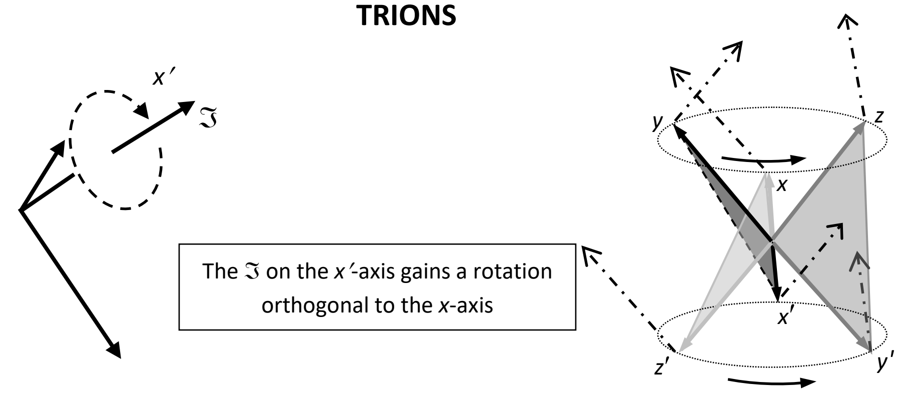


Figure 6.5 Each of the lines represents the motion of a particle through the space on the basis that a particle will tend to move along the line of least resistance. Thus the bends would be due to a

[8] (Dirac 1926:§1)
[9] (Ellis 2012:27)
[10] See e.g. Encyclopedia Britannica, World Book Dictionary, Bueche (1977:72), Synge and Griffiths (1959:63) for physical definition in terms of coordinates and (1959: 455) in terms of Hamiltonians.

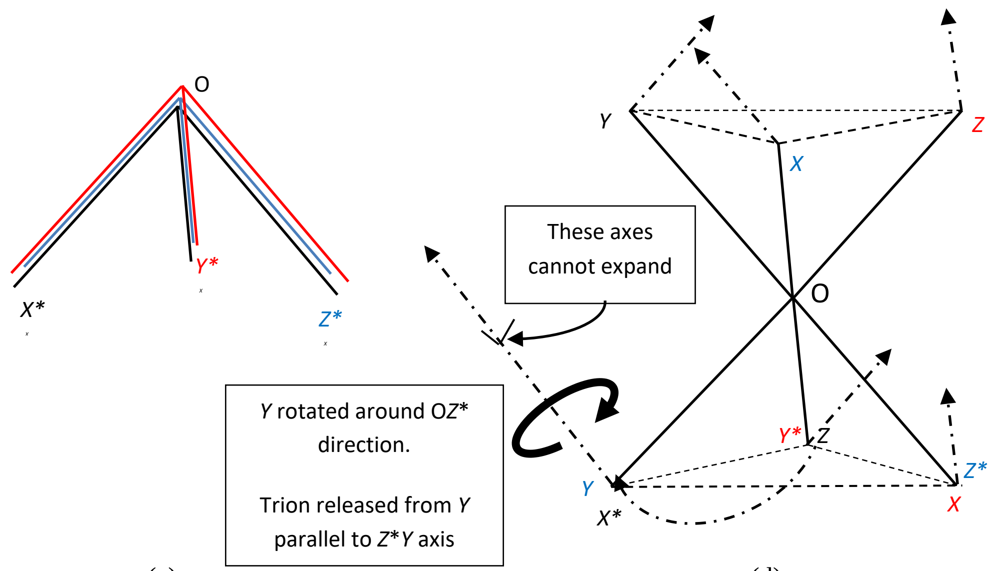
change of the force field through forces acting from different points across the lines. Since these lines represent the motion of a particle they are related to momentum and position over time from a starting position, and can be used mathematically to calculate what is likely to happen as time moves on even though time is not specifically shown in the diagram.

TRIONS



(a) (b)

Figure 6.6(a) showing rotation gained for the ℑ on the x′-axis. (b) shows the relationship between ℑs affected by the reorientation process on the axes of a triple triad. They can only jump and expand in the directions shown, which depend on how the axes reoriented as in Figure 5.6. Note that all the emission directions are upwards in terms of the diagram due to the formation process of the triple (and double) triads.



(c) (d)

(c) (d) Release directions of the trions (cf Figure 5.6). The axial colours in (d) relate to the original separate triads with their axes arrangements. It can be seen same colours have same directions.

The fact that the mathematics has provided some answers to difficult problems does not render it perfectly correct as a fundamental basis. Without having considered these objections (as far as I am aware) physicists accept a field as a continuum, or at least a continuous set of connected 'grainy' points.[11] From the foundational view, sections 5.2-5.3 have shown that the space-Time background created by a series of Time points will be highly discontinuous; moreover, this Chapter will shortly show force itself is discontinuous. Yet this discontinuity will be seen in future chapters to explain major problems facing standard physics (and astrophysics). Again I have to ask: how can a theory be accepted if it cannot answer fundamental questions? This state of a continuum, or its falsity, or knowledge of the nature of a field, might be vital points in understanding the universe.

However one cannot just chuck theories out without replacing them. In the absence of any information on the fundamental nature of interactions according to standard physical theory I shall now approach the questions of why and how interactions arise from the Time scheme. The explanations may be rather long but this is necessary as they break entirely new ground not covered by physics.

Section 5.3.3 showed that at the end of each qut the six axial $\Im$s, belonging to particles materialize to become new points of Time. Their expansion disconnects them from the triple-triad in the same way the fundamental action creates an interval between trace-points. Looking back at the process there are two important factors. Under normal circumstances all $\Im$s, on materializing, would become the progenitor of a new space-Time triad (interval). But, as in section 5.3.1, the reorientation of the $\Im$s during particle creation would cause them to gain an extra rotation in two out of the three axial directions in which they develop. The fundamental principle has no *a priori* method of countering this development. Consequently these $\Im$s carry this extra spin with them through every stage as Time progresses.

Now recall that the rate of production of space-Time is one qul per qut whereas a reoriented $\Im$ gains an additional (superimposed) rotation which is in a plane, given by the heavy curved arrow in Figure 6.6d but with value *w* (see section 4.5). This extra rotation is due to an instantaneous change which stops the $\Im$ developing space-Time *in that plane* as the $\Im$ would otherwise break the constraints by attaining a velocity greater than *c**. But on the other hand the extra rotation does not stop development in the third direction. So instead of developing into a full-grown triad when it materializes, this $\Im$ *remains a point particle actually consisting of three $\Im$s as if they are glued together*. That is, only the one $\Im$ of the group of three creates a continuation of the group. The other two remain in 'limbo' but nevertheless take part in the formation of the regenerating triad every qut.

Meanwhile, the triple-triad reproduces itself every qut from the $\Im$s which were trapped at its centre. These $\Im$s create a fleeting relativistic volume for the triple-triad before leaving it as trions. That is, the triple-triad emits trions at the rate of six per qut as in Figure 6.6b,d .

[11] Regge and Williams (2000); Chiou (2000); Bahr and Dittrich (2010)

Consequently, each trion, would (if it could be observed over single quts) appear to jump from point to point in a straight line as it materializes with the passing of every qut. In Figure 6.5, diagram (c) gives the three superimposed triads from which a particle is formed. The starred coloured axes are the suppressed axes. Trions are only emitted from the unsuppressed axes. Taking the blue *Y* axis in diagram (d) as an example, it initially points in the red *Y** direction and then reorients, as in diagram (d), into the initial position of the suppressed *X** $\Im$. This is a rotation, as given by the dash-dot line, around the *Z**O*Y* axis. Consequently, when the $\Im$ at the blue *Y* materializes, for the reasons given above, it can only regenerate as a trion in the *Z**O*Y* direction; similarly for the $\Im$s at the other five generation points according to their individual orientations. There are thus two trions travelling parallel to the *X**O*Z* direction, two parallel to the *Z**O*Y* direction and two to the *Y**O*X* direction. Of these, the trions moving parallel to the O*Y* direction carry a rotation in the sense of *X* rotating towards *Z*; that is, an $\dot{\xi}$-rotation as in Figure 6.6d. The heavy black circular arrow shows the rotation carried by the trion. This rotation limits the trion's ability to form a triad. Consequently every time it regenerates it can only continue moving in the one direction in which it left the triple-triad. The same form applies to all the other trions in the specific directions in which they are released.

All triple-triad type particles emit trions every time they materialize (every qut) which travel in straight lines away from the particle at a speed c. Now to determine the equally important result.

6.2.3 Basic trion interaction

The nature of particle interactions and 'force' can now be unlocked from a first principle rather than merely using an undefined idea as in physics. With only one direction of rotation for any given triple-triad and three axes of emission, as in Figure 6.6, the six trions are emitted in pairs every qut, one pair to each Cartesian dimension of the triple-triad. Then:

1. The emitted trions are oriented according to the orientation of the emitting particle.
2. Each pair, by being emitted according to specific axial directions, carries a different rotation to the other pairs. For example, one pair might carry rotations ($\dot{\alpha}$, $\dot{\beta}$[+]*w*, $\dot{\xi}$[+]*w*) or ($\dot{\alpha}$[+]*w*, $\dot{\beta}$, $\dot{\xi}$[+]*w*) where [+] means the rotation 'contains' both elements rather than the two being added together to make a single spin; the *w* part is the largest rotation possible so the $\dot{\beta}$ rotation cannot be added to it as shown in Figure 5.17(d).
3. The binding of two flows to the third, means that the trion's orientation is also determined in terms of its direction of travel.

Despite the problem of item 2, the set of all three rotations is, nevertheless, knowable. As already mentioned (section 6.1) Euler's method of rotation operates on two dimensions whereas RST shackles each of three dimensions to a rotation – that is, three dimensions: three rotations. The maximum rotation of each of these is *w*, but also, because *w* is a maximum value, the total spin of two or three dimensions is also *w*. (This is a p-rotational equivalent to Einstein's relativistic addition of velocities equation where adding two near light-speed velocities together does not give a speed greater than that of light.[12] Similarly in the case of *w*, as the tangential velocity of a rotating point is *c*, equivalent to a rotation of *w*, if the point had a rotation of *w* in three orthogonal directions its tangential velocity is still *c* in human view.

Note from this that the maximum value *w* automatically divides the spins into separate directions whereas if all the spins were combined as in Euler's method the total value would be greater than *w*, which would produce a tangential velocity greater than *c* – something that has remained hidden from physics until now. The reason for this has been that physics allows infinities and so does not consider that if the universe had a start it would have had to have a maximum value for everything, it neglects that you cannot have a starting value for something greater than its starting value! Standard mathematics and physics therefore misses an important factor governing the Universe.[13]

To repeat, the principle dictated by the p-rotation is that if a spin containing *w* can be separated into two or three dimensions then the dimensions and accompanying spins are independent of the whole as each has a different orientation to the others. Nevertheless, each spin cannot exceed *w* so that, according to the principle outlined in section 5.3.1, a particle carrying $\dot{\alpha}$, $\dot{\beta}$[+]*w*, $\dot{\xi}$[+]*w* could only achieve a quantum period in the $\dot{\alpha}$ direction. Consequently the $\dot{\alpha}$ rotation is distinct. Note that the $\dot{\beta}$[+]*w*, $\dot{\xi}$[+]*w* parts are transmitted and the receiving particle absorbs the entire trion, which means the recipient can orient to the $\dot{\beta}$[+]*w*, $\dot{\xi}$[+]*w* parts; it just cannot register the actual spin-values $\dot{\beta}$ and $\dot{\xi}$.

Therefore, from 1, 2 and 3, the trion emitted from a particular axis will *always bear a directional relationship* with the orientation of the emitting particle. Furthermore, the orientation of the rotations relative to the super-triad axes will depend on the particle species, their rotation direction being given as in Figure 5.12 with a change from the original particle (Figure 5.12a) to the flipped particle and the synchronizing spin particle (Figure 5.12b for both). Figure 5.12b is redrawn as 6.7 to show this orientation in the same frame of reference to the original triple-triad. The positive spin and synchronizing spin particle axes here rotate such that one axis, arbitrarily designated *xx´* moves as though in an imaginary disc which is fixed 'between' the *Y* and *Z* axes. Thus the components of rotation in *any* frame of reference, not just the particle's own frame, can be related to the ℑs. Every action is therefore a spontaneous response to the fundamental rule of section 4.7.

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[12] Einstein ([1905] 1923: 51); cf §11.10 addendum on special relativity
[13] Testing the RST scheme will demonstrate this view.

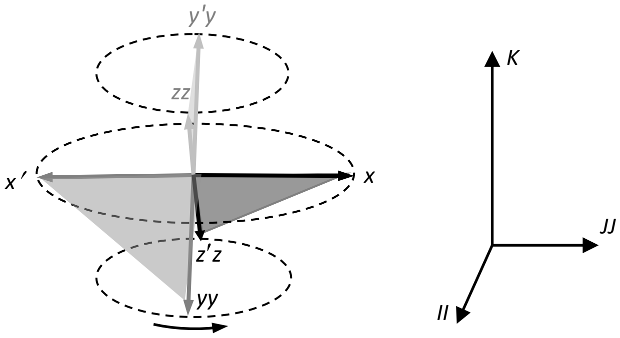
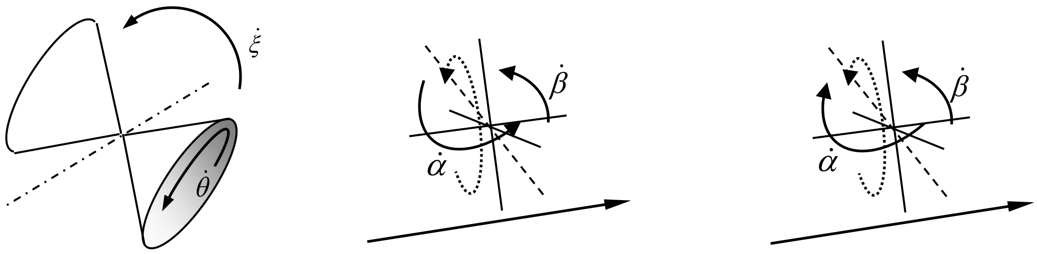


Figure 6.7 Figure 5.12b reproduced to show how the proton, or electron, triple-triad rotates in the plane of the dashed circle so that the *XX′* axis lies as if in a disc between the *YY′* and *ZZ′* axes which also rotate in the discs shown by the dotted lines.

The connection between a trion emitted from a particular axis and an emitting particle is shown in Figure 6.8 in terms of the three angles of rotation. Because the $\dot{\alpha}$, $\dot{\beta}$, and $\dot{\xi}$ rotations in diagrams (b) and (c) are distinct ('knowable') due to their values and directions they can be related to either a positive spin (diagram b) or a synchronizing spin (diagram c). A model of either can be made and whatever its orientation, its rotational form will never match the other. Diagram (a) relates the $\dot{\theta}$ rotation and $\dot{\xi}$ rotations (for a neutron); (b) and (c) represent trions, travelling in the direction of the main arrow, with an orientation given each by either a proton (for b) or electron (for c). (The same orientations are used for both for ease of comparison). The rotations will always be distinguishable from each other by a recipient of the trion as above and shown in Figure 6.8.



(a) (b) (c)

Figure 6.8. The rotation of a particle in terms of its axes.

We now have hooks on the 'deep metaphysical/transcendental questions', in section 5.4 onwards bedeviling philosophers and physicists: particularly the problem of force and energy transfer (two paragraphs below) so far conducted in standard theories according to physical laws

To finalize the problem of force, or energy transfer, envisage a trion colliding with a triple-triad. Its point-like structure would be able to pass in between the particle's space-Time triads shown in Figures 5.12 without intersecting them. But it would not be able to pass completely through them within one qut because within this time the triple-triad would contract. (Put more correctly as 'passing between' has connotations of the human view of space, the trion would change positions with trace-points or triads).

Note that this happens as equally in the natural representation as with the relativistic representation described here. The trion's ℑs will then become positioned at the recipient's origin where they will be stuck because the recipient's own ℑs must still expand, and the trion cannot, in this instant, pass through them without breaking the uniqueness constraint. Consequently, the trion will be held in the triple-triad centre so that the particle's ℑs now have to operate from this spinning centre. The rotations carried by the trion and the triple-triad will each be orientated according to their individual ℑs. These orientations may not initially match, but will need to do so if the constraints for space-Time development are to be met; that is, the $\dot{\alpha}$, $\dot{\beta}$, and $\dot{\xi}$ components of rotation of both particles (the recipient and trion) must line up – as follows:

There are three points in the alignment process under considerations. The first is that the three rotations should *not* be imagined in the sense of a rotating sphere, which Euler showed can be fully determined with only two rotation directions or even just one (see Figure 6.3). As derived in section 6.1, the rotation of a triple-triad is determined by its separate ℑs. Each ℑ, in the relativistic representation, has a definite three dimensional track relative to the other ℑ; it 'bends as it propagates'[14] depending on $\dot{\alpha}$, $\dot{\beta}$, and $\dot{\xi}$: The path that it follows, in relation to the space its rotation creates, is completely different from the other ℑs. As the trion is the spawn of a given triple-triad, the same will have to be true for its fundamental rotations, allowing for the extra *orthogonal* rotation that its two non-developing ℑs carry. Therefore the trion's rotation is specified, firstly, by the distinctive paths of the ℑs as opposed to considering them as a whole, even though they travel as a point-like bundle – reminiscent of tropes as above). Secondly, the flip of the neutron to form the proton and electron places the $\dot{\xi}$ rotation in a plane at 45° to the *Y* and *Z* axes. This distortion relative to each particle's (both triple-triad and trion) axis of rotation from three orthogonal axes, makes it impossible for the alignment of the axes of trion and recipient to be incorrect. It acts as a form of key aligning them. Thirdly, the α, β and ξ component angles of both particles will also need to match, which they would automatically do because of the distinct nature of their rotations. In fact the lining up of either the rotations or orientation angles would cause the other to be correct.

Finally RST dictates that because the trion contains two rotations with magnitude *w*, it cannot change its orientation because it cannot rotate faster than *w* (nor slower). This means that the triple-triad's ℑs will be the ones making any changes to orientate to the trion's axial directions, turning the other way up if necessary. (The fact that two of the components of the trion's rotation carry an extra rotation of *w* does not annul these rotation directions; it merely means their magnitudes cannot be transmitted). Turning the other way up does not involve any additional spin because the triple-triad is rotating anyway. In any case,

[14] This is determinable mathematically but nevertheless is a result of the foundational principle irrespective of any mathematical consequences. The $\dot{\xi}$ rotation, for example, varies between 10^{-17} and one radian per qut. A trion rotates at one radian, approximately 57.3°, per qut.

it is not a change affecting the ℑs specifically but the rate of rotation of the particle. That is, in this case, the rotation (Time) generator is not involved and thus the fundamental rule the generator governs is not violated. The particle structure is unchanged so it merely adjusts to the external rotation, see sections 6.3.2 and 6.4.1. The distinction can be seen in the relativistic representation where, when the rotation generator was involved, actions violating the constraints had to take place instantaneously, whereas in the case under review the turning upside down can take place over the whole qut.

Thus the recipient triple-triad will align itself to the trion and as a result the receiving triple-triad will be caused to react in a specific way (dictated by the trion). It could be said that, by passing from an emitting particle to a recipient, the trion can carry 'instructions' detailing how the recipient must react. It is now possible to decide exactly how changes of motion will occur in the Time scheme.

6.3 Change in motion

Sections 6.1.1-6.2.3 derived the automatic existence of interactions between particles but not the nature of any result.

In the opening paragraphs of 6.1.1 the comment was made that the foundational principle requires that the tangential velocity (of the two discs) of the triad rotation must remain constant at *c*. For a particle at rest against the space-Time lattice this would automatically be the case. But for a particle in motion, the ℑs would face an addition of velocities problem when their rotation was in the direction of particle motion and a decrease as they rotated to move against the particle motion. This condition can be related to a particle's fundamental $\dot{\alpha}$ and $\dot{\beta}$ rotations making up the $\dot{\theta}$ rotation plane (see Figures 4.3d and 6.4). Then a change in this plane's orientation coupled to a change in the particle's total rotation could maintain the Universal over-arching rule that each module has to maintain a tangential velocity of *c*. This implies that a change in velocity implies a change in rotation, and vice versa, and that the $\dot{\xi}$-rotation becomes the controlling rotation. It should be recognized that this change in rotation is purely due to the relativity of human perception and only occurs in the relativistic representation. As there is no space in the natural representation the relevant points merely change position in a spaceless-timeless environment so no velocity applies.

Although this is an implication it may appear at this stage as an assumption – there may be some other natural cause. It thus needs to be tested to see whether it is measurably verifiable. Mathematical testing shows that it produces accurate results. Thus these philosophical considerations can be formed into a subsidiary rule to the foundational premise and accompanying rule:

The velocity and total rotation of a particle have to be such that the constraints for its space-Time generation are adhered to. If this is not the case either the velocity of its origin or the rate of rotation of the particle has to adjust to compensate.

(A change in particle rotation creates a change in particle velocity or vice versa).

Then referring to Figures 6.4 and 6.8 a proton has a $\dot{\theta}$ rotation plane which itself can rotate with $\dot{\xi}$-rotation, so that $\dot{\xi}$ is the rotation that will determine the velocity required by the particle to maintain the tangential rotation of its ℑs at *c*. Consequently, the motion of a triple-triad, such as a proton or electron, is governed by its $\dot{\xi}$-rotation only. But the other two parts of the received trion are important as they form a three part system in which two of the parts automatically determine how the trion's $\dot{\xi}$-rotation fits into the triple-triad rotation. That is, the system ensures that a change in the $\dot{\xi}$-rotation is passed on if the absorbing triple-triad has a different value of that rotation to that of the trion.

In this respect, significantly, section 6.2.2 (Figure 6.6) derived that only two of the six trions emitted by a triple-triad would carry the $\dot{\xi}$-rotation. Of the others, two would carry ($\dot{\alpha}$-rotation coupled with $\dot{\beta}$, and $\dot{\xi}$, and two with $\dot{\beta}$, ($\dot{\alpha}$ and $\dot{\xi}$). As $\dot{\alpha}$ and $\dot{\beta}$, have different rates of rotation from $\dot{\xi}$ they would provide different actions to those provided by $\dot{\xi}$. This will be followed up in Chapter 7, and the concept of force related to the $\dot{\xi}$ interaction in section 6.3.2. But first the question of movement through the lattice is raised as this is strongly related to the relativistic appearance and nature of space-Time throughout the universe.

6.3.1 Motion through the lattice

In standard physical theory, space has been considered a continuum which allows propagation of particles without hindrance. But in RST space-Time has emerged as a set of distinct trace-points in the lattice which are not even necessarily regularly spaced due to the appearance of rings and particles as shown in Figure 5.9. These are pure points in both the natural and relativistic representations but in the latter they are separated by the Time factor of the space-Time that created them. And here we have to go beyond simple physics and its laws to understand the concept of their spacing. In order to bring the concept within human experience, imagine a triple-triad to be an observation point (anthropomorphizing it). Because the triple-triad's rotation always gives it a tangential velocity of *c*, it relativistically 'sees', as derived in section 4.4.1, trace-points separated from each other by the same quantum units that make up its own volume.[15] Thus it 'sees' a volume around it. This explanation perhaps makes it a little more understandable how a Universe can have a volume, yet have no volume, and have Time intervals and yet have no interval – though the solution to this paradox is still far from complete. It is the ability of particles, and combinations of them (Chapter 7), to change positions in (move through) the lattice that produces the concept of space. Between us and our surrounds there exist particles in motion changing positions, all 'seeing' a relativistic space around them.[16] Analogously, the same applies between moving

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[15] Volume as it would appear to us if we could see it. Chapter 8 will show we can only see the force field it gives off.

[16] The relativistic space they see itself varies according to their speed but this is only apparent at speeds in the region of one fifth of *c*, as explained in Chapter 11. For example, although the qul and qut arise naturally in jumps, rather

particles, their frames of reference, and the frame in which they move. (1) The particle and its surrounds interact according to the relative spins. (2) A change in the relative rotation of a particle with another at each jump determines a possible change in its position in the lattice. But, (3), this in accordance with the particle's velocity, as interpreted by humans, should be considered as the number of quts it takes to travel one qul (in curved space) or in Euclidean space the number of quts it takes to travel one qul^r.

Thus from questioning standard physical lines by using transcendental reasoning, linear motion is shown not to be a foundational entity of the universe but a consequence of the nature of Time and the controlling constant of the Universe, *c**, or equivalently the tangential velocity of the space-Time points, *c*. In particular, each particle is at the centre of its own frame of reference and Universe, and its observation of space-Time is with reference to its, and only its, Universe so that all points in its Universe are relative to it. Again recall that the actual measurement values we use only arise as a result of our wish to measure and calculate.

Having determined the nature of motion, the nature of the associated human concept of force or a change in motion of an object, can now be investigated.

6.3.2 The concept of Force - particle interactions and 'mass'.

The concept of force is intuitive to humans and, by this intuition, is causal, a problem that worried Newton (1693) with respect to his gravitational theory – action at a distance with no recognizable cause. A similar problem arose later in electromagnetics where particles react to an electromagnetic field at a distance from its source. This is now covered in standard physics by quantum field theory (QFT) where force is described mathematically as an interaction between fields mediated by bosons.[17] It has been found to predict theoretical outcomes well, but without actually knowing the nature of the background over which it works, nor the nature of these bosons, nor how, and particularly why, they interact in the first place. As Dirac (1926:§1) said in his introduction of QFT "*it is possible to build a theory without knowing anything about the dynamical variables except the algebraic laws that they are subject to*" (which gives grounds to those physicists who believe that mathematics may run the universe but it rules out the possibility that there may be conditions that mathematics and physics cannot expect).[18]

Consequently, the problem known as an ultraviolet divergence raised briefly in section 5.4 appears because, in QFT, the field at a point is the total of all the possible fields in the system, usually taken as infinite in the case of the universe.[19] This produces infinities in many calculations. For example, taking an electrostatic interaction over a tiny scale about, say an electron, a negatively charged particle

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than the spiral form used for explanation in the diagrams, the qul and qut intervals of human experience are dependent on the relative movement between frames of reference as in section11.8. To put a measurement figure on it, according to RST, (see Chapter 11 for calculations) the electron has a *minimum* velocity of approximately 7.5 × $10^{-8}c$ which translates to 22.5 ms^{-1}. However, its speed in H^1 orbit can be calculated as 0.0072973*c*.

[17] (see e.g. Peskin and Schroeder 1995;79-81 Kuhlmann 2018:§2.2end).

[18] Dirac (1926:§1)

[19] Kuhlmann (2018:§4.1)

approaching that electron very closely would require a very high momentum in relation to other negatively charged particles moving further out – the force required to move any charged particle to the centre of another similarly charged particle becomes infinite according to the inverse square of the distance rule. If it becomes included in a calculation for an experiment then it appears that the total experiment would require an infinite amount of energy to carry it out. Thus in the case of field theory as raised earlier in a different guise it should be cut out by rescaling to a larger view which would not include rare or impossible events.[20] As already stated this has been called *ad hoc* mathematics by some physicists. Thus it should be clear that the nature of force, a force field, and in particular the fundamental forces, is of paramount importance to creating physical concepts, even if these apparently work most of the time.

This problem is exacerbated by the observation that some objects are more difficult to move than others. Neglecting causes such as wind resistance, this has been related to the existence of an entity known as 'mass' via Newton's first and second laws. Once again, the question is the nature of mass which has not yet been ascertained in physics. It has been considered a fundamental property of nature and has thus never been defined on the assumption that, being fundamental, it cannot be considered in terms of more fundamental entities.[21]

The mathematical suggestion has been raised that mass may be caused by a fundamental 'Higgs particle'[22]. But as above (section 5.4), this idea still leaves open the question of the nature of a particle other than some form of mathematical entity. Is it real, or an element of the human mind, a corpuscle, wave or field? Assuming the fundamental belief of this study that the universe requires absolutely no mathematics in order to exist, the meaning of mass becomes something deeper than a physical measurement. It is somehow tied to the concept of motion and force, both of which must have something more fundamental to them than mere human observation of movement.

Physics, again in human perception, sees force only in mathematical terms and in more than one form: Newtonian force between objects as in collisions, electric force and gravity. The strong and weak forces are additional to QFT. The nature of gravity is analyzed in Chapter 7, aspects of Newtonian force in the mathematical addendum 9A.4.3,[23] leaving the electric force to section 6.4.3 The peculiarity is that the last's reality has never been challenged until now. It has been given measurable physical units such as Coulombs. Equations have been constructed to allow calculations for its use. Electricity is fundamental to human life. Yet no-one no-one has determined what it actually is. Current is conveyed by electrons but, as in section 5.4, there is argument in standard physics over whether these (electrons) are corpuscles, waves or fields. Protons have charge supposedly opposite to electrons but why do like charges repel and unlike

[20] renormalization Peskin and Schroeder (1995:211-222)
[21] Khrapko (2000:1)
[22] e.g. Peskin and Schroeder (1995:715)
[23] Derivation of $F = ma$ from first principles.

charges attract? What is the difference between the two – if there is any? And how can the particles tell whether to come together or move apart?

Thus the concept of force is far from clear in physical theories although the concept clearly does appear to exist throughout the universe. (The concept of an electric field involves conservation laws so is finalized in section 8.5).

On the other hand, section 6.3 based on the single foundational principle has at least suggested some generalization of the nature of force as follows: imagine a particle *A* moving in some arbitrary direction with speed v_a and rotation ($\dot{\theta}_a$, $\dot{\xi}_a$) where the subscript refers to the particle. (Again the measured values of these variables is immaterial as it is the process that is being investigated and measurements are of no importance to the process actually taking place. In any case as already stated, the Universe has no need of any values in order to establish its structure and processes). The rotations carried by the six trions *A* emits are specified by *A*'s rotation. Suppose a trion carrying $\dot{\xi}_a$ rotation is absorbed by a second particle, *B*, of the same species, for example two neutrons, whose rotations before absorption are ($\dot{\theta}_i$, $\dot{\xi}_i$) where the subscript *i* refers to the initial speed of particle *B*. Without the absorption, the continued existence of *B* during the next qut (and all subsequent quts) would be due to the expansion of the three $\Im$s that remained at its centre, O'_i. These $\Im$s moved with O'_i during the previous qut. Consequently when these $\Im$s are released to generate nine new $\Im$s (of which three will remain at the triple-triad's origin) the six $\Im$s that materialize at the end of the new qut will all have motions commensurate with *B*'s velocity of $\mathbf{v}_i$ (in terms of a set of *I*, *J*, *K* axes fixed at some given time (real numbers), such as the beginning of the previous qut). Without other factors, this velocity will determine the rotations at the outset of the new qut.

Now imagine the absorption occurs. Then the procedure of section 6.2.3 implies that, as the ($\dot{\theta}_i$, $\dot{\xi}_i$) rotations result from *B*'s velocity, $\mathbf{v}_i$ before absorption, *B*'s new generation of $\Im$s will be free to take on the rotations, ($\dot{\theta}_a$, $\dot{\xi}_a$) that the absorbed trion carries. As $\dot{\theta}_a$ is the combination of the rotations $\dot{\alpha}$ [+]*w*, $\dot{\beta}$ [+]*w*, it operates in orienting axes only, only $\dot{\xi}_a$ has any transferable magnitude and this will be the rotation taken on by the six $\Im$s that will generate the space-Time for *B* in its 'pulsing out' phase. The $\Im$s automatically carry the orientation angles (β, ξ) and the remaining parameters (α, $\dot{\alpha}$, $\dot{\beta}$) must adjust to meet the constraints. Therefore the recipient's origin O'_i starts the qut at its old velocity $\mathbf{v}_i$**,** but the new $\dot{\xi}$ amends this velocity to $\mathbf{v}_a$ with respect to the external *I, J, K* axes. But note there is a difference here from the intuitive addition of velocities in mathematical physics. For example, if $\dot{\xi}_a$ is greater than $\dot{\xi}_i$ then the change of rotation is from $\dot{\xi}_i$ to $\dot{\xi}_a$ and thus the change in velocity is from $\mathbf{v}_i$ to $\mathbf{v}_a$, and not a straight addition $\mathbf{v}_i+\mathbf{v}_a$.[24]

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[24] This situation refers to the rotational aspect. $\mathbf{v}_i+\mathbf{v}_a$ would produce a duplication of the spin in $\mathbf{v}_i$ and thus violate the law of conservation of energy. The usual addition of velocities in physics remains unchanged.

If the particles are of different species then their positive and negative spins cause a directional difference – see section 6.4.1. Also in standard physics terms, the concept of mass causes the conservation of momentum which means that the mass has an effect on the change in velocity. It will be seen that this leads to some unexpected hidden difficulties in standard physics which are overcome in that discipline by some unexpected misconceptions (see section 8.2.2). These are, however, easily overcome by the explanations of what actually happens based on defining clearly the actions of force and energy.

If a trion were to be absorbed carrying the same spins as the recipient, it would cause no change in rotation or speed as the $\Im$s would start with rotations that agree with the speed given them by the motion of the recipient's origin. (This does not overall affect Newton's second 'law'). However, although there is no change in the $\dot{\xi}$-rotation, the orientation angle would be superimposed on the conditions from the previous qut and so would cause a change in direction (see equation and Figure 9A.5). Thus, if two particles are temporarily at rest relative to each other, that is, moving with identical velocities, and one of them receives a trion from the other, it will change its direction of propagation. Then, although there has been no change in the *magnitude* of its velocity (no change in its speed) it has attained a velocity relative to the emitting particle. (As above, all changes in rotation refer to an individual particle's frame of reference, not a general frame).

If a particle carrying high $\dot{\xi}_i$ enters an area where its motion will be restricted through the absorption of trions from particles in the area carrying a different spin $\dot{\xi}_j$ less than $\dot{\xi}_i$, the particle will, at the instant of absorption, have an excess rotation. Reversing the first process described above, it will instantaneously emit the excess rotation in the form of a trion carrying off the change in spins which can be denoted as $(\Delta\dot{\alpha}, \Delta\dot{\beta}, \Delta\dot{\xi})$. That is, this form of trion will be a pure rotation particle.[25] For ease of reference the term **Δ-trion** will be temporarily used for this particle. If the motion is not restricted then it will continue propagating in accordance with rotation $\dot{\xi}_i$. Again this implies that the actual measurement values we use only arise as a result of our wish to measure and calculate.

The RST system implies this emission-absorption process can work both ways between particles but *not necessarily in tandem*. Triple-triads will emit $\dot{\xi}$-trions in a continual stream at the rate of two per qut, in pairs travelling parallel to each other, although only one will be absorbed by another individual triple-triad; the other will pass by but may be absorbed by yet another triple-triad. So triple-triad *A* may absorb a trion emitted by *B*, and some other time *B* might absorb one emitted by *A* but there is no specific exchange between freely moving triple-triads. This process may seem very much a hit and miss affair, which it

[25] If a Δ-trion were to be absorbed by, for example, an electron, it would have to align in such a way that the electron's final rotations would meet the constraints otherwise no interaction could take place. So, on receipt of a Δ-trion or both trion and recipient together, align (whereas in the receipt of a force photon the recipient only aligns). Then the absorbing particle shows a change in speed but not necessarily a change in direction. The change in direction depends upon the relative rotations of the two particles and their directions of travel. This form of emission is particularly important for visual reception of light.

certainly is, but if the qut is very small in relation to human SI units, as might be expected if it only appears as a point, and from the description of particles is smaller than them, it seems reasonable to suppose that many trillions of trions are issued by each particle every second, as is the case.[26] With many trillions emitted every second from a triple-triad carrying, as above, 'instructions' detailing how a recipient must react, it would appear as if each triple-triad had what we would call a force field about it.

The emission process, then, will send a narrow beam of trions diagonally away from the emitting triple-triad. Now take a hypothetical case that the emitting particle is completely free as it moves through the lattice, that is, it receives no trions from any source. Bearing in mind that a particle moving through the lattice has to rotate in accordance with the principles of section 6.4, that is, rotating through three dimensions: over a period of time, every part of the surface area of an imaginary sphere surrounding the emitter will be passed through by at least one trion over that period of time.[27] If its surface is divided into σ-sized sub-areas, then if the sphere's radius increases, the probability of each σ-sized sub-area receiving a trion reduces as the square of the distance. Should the number of trions issued by a triple-triad be very large, as projected above, these two factors would give the overall impression of a continuous force field at very small distances (nanometers in human experience) which weakens as the distance increases.[28] Furthermore, as a trion is a group of ℑs with its velocity given by only one of those ℑs, its straight-line velocity will be c so this will be the speed at which a force is transmitted from particle to particle. This fits into human perception that force travels with the speed of light,[29] especially in the case of the Δ-trion. In this case the trions fill the role, in human physics, of the 'photon' as a quantum of energy and will now be referred to as such. In this role it fills the undefined concept of a virtual photon of QFT except that it travels at the speed of light and is a definite particle even if only as a point-spin.[30]

The RST mechanism thus shows that there are at least two forms of photon: an ξ-photon which transfers electric effects (see section 6.4.3 for electromagnetism) while the Δ-photons fill the role of visible photons and other waves, such as gamma-waves, that do not respond directly to electric or magnetic fields. The reaction of an absorbing particle is due only to the rotation the photons carry. QM derives de Broglie wave lengths and frequencies for photons. These can be calculated directly from the qut and qul if these units can be expressed in equivalent human measurements, for example, SI units. This is done in Chapter9.

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[26] The question here is only whether a Universe can be constructed around the definition of Time. How this translates to numbers and measurable values depends on a measurement test (11A.2). The actual figure according to the test is almost a trillion trillion, 10^{24}, per second so that the photon field will *appear* continuous at the radius of an atom.

[27] This three dimensional rotation is demonstrated mathematically by the equations of motion in sections 11A.2-4.

[28] In terms of a particle on the surface of a sphere geometry gives the probability in proportion to $1/4\pi r^2$ thus reflecting the inverse square rule for the distance, r.

[29] (cf Einstein [1905]1923:52, Kraus 1984:383)

[30] (Fox 2008)

So, developing the foundational principle beyond the bounds of physics, as suggested by Kant's transcendental philosophy, gives the nature of fundamental processes such as force, which physical reasoning by humans has been unable to determine.[31] Mathematics gives no clue either, because mathematics only deals with outcomes of given instances according to human input so it cannot answer the deep why and 'how do' processes work. This lack of human determination is the result of human lack of clarity on the nature of fields exposed in section 6.2.2 and definitions of the fundamentals for/from which human laws and equations have been formulated. The nature of force in this Universal structure is specific. It opposes physicists' assumptions of continuity and instantaneous transmission (see section 6.2.2) by a virtual photon: γ, γ_{ξ}, γ_{Δ} for short.

So we now know exactly what a force field is, how it works and why it exists.

As described above, the RST system's force radiates out from a triple-triad much as a light beam from a lighthouse that can rotate through three dimensions rather than a plane. At very close distances from the source a possible recipient of a photon would have a much greater chance of being hit by one emitted from that source than if it was further away, the probability geometrically falling off proportionally to the square of the distance. The force around a particle in this Time scheme is therefore *not a continuum, as in physical theory, but disjointed*. However, the number of photons leaving a single triple-triad can be calculated (section 9A.4) at approximately 10^{24} every second. Thus, the force 'field' is intense within atomic distances. With these major differences, should the proposed theory being constructed meet with observational tests, there can be little surprise that mathematical physics has been unable to establish the fundamental causes of the structure it purports to describe.

Furthermore, *there is no recoil, nor equal and opposite reaction* in the emission or reception process of triple-triad type particles and photons, contrary to what is assumed in physical theory.[32] RST neither suggests nor requires automatic simultaneous exchange of photons contrary to Hawking and Mlodinov's views. Nor do photons carry 'momentum' in the standard theory sense.[33] Finally, the explicit form of this field suggests that it is the only possible form of 'force' transfer (which would include gravity – see Chapter 7). But having said so, it should be noted that three types of triple-triad type particle have so far appeared. This speedily raises the question whether each is likely to react identically to 'force'. If not why not?

6.4 Do all particles react identically?

Section 5.4.2 gave three particles, the original triple-triad or neutron with rotational properties that required a synchronizing spin in order for it to exist. Its off-shoot, the proton, had a stable rotation at the same rate as the neutron without the necessity of a synchronizing spin, while the synchronizing spin was

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[31] Kant (1998:132§a11)
[32] Bueche (1975:48); Hawking and Mlodinov (2011:134)
[33] Kuhlmann (2018:§5.1.1.2)

ejected as a particle with twice the rate of rotation of the proton but half its radius. It has become clear that the foundational principle leads to the motion of these particles in such a way that their $\dot{\xi}$-rotation determines their velocity. As always, this velocity is determined by the need that the tangential velocity of the particle's space-Time triads is maintained at *c*.

In these next paragraphs (including section 6.4.1), I specifically refer to human perception in the relativistic representation. In this perception we see a 'volumetric' space, which itself still has to be explained once the interaction problem has been sorted out. In this volume each triple-triad would have a radius, although this is too small to be measured by human instruments. However, when human volume emerges so does measurement, and thus mathematical treatment of measurement. Here there appears a difference between the natural representation and the human viewed representation by which I mean a mensuration interpretation of the relativistic representation. In the natural and relativistic representations the ℑs forming the triple-triad jump to the positions where they materialize, whereas in the mathematical interpretation their positions are determined by the spiral motion needed to express the situation mathematically, as in sections 5.2 and 9A.1-2. This is actually a result of the human view of a space-time continuum in which the rotation of the triple-triad (and, thus, its ℑs) will apparently have to adjust its (their) angular velocity as the triple-triad's radius expands from its origin (and thus distance of its ℑs from their origin) so that the tangential velocity of the ℑs remains constant.

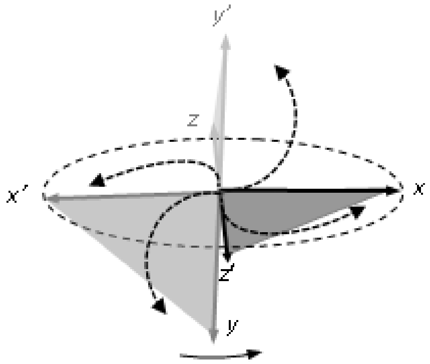

Figure 6.9 Showing four of the six ℑs creating a proton (or electron) triple-triad expanding according to the mathematical representation of human perception to give the final triple-triad at materialization. (The other two ℑs are left out for graphical clarity)

The proton and electron triple-triads are orientated in such a way that their super-triads are not lined up with the axis of rotation of their respective triple-triads as shown in Figure 5.12b. They are tilted at an angle. Consequently, the triple-triad ℑs rotating with tangential velocity *c* will vary in distance from the rotational axis of the triple-triad and thus in terms of the human interpretation would be set to violate the constant tangential velocity unless the triple-triad itself moves through the lattice so that all its ℑs keep within the constraints, as quoted in section 6.3.

This means the proton and electron will automatically have a minimum velocity through the lattice.

However, for all three triple-triad particles, proton, electron and neutron, there is one further factor: the basic triads are those of three coinciding Time-points as in Figure 5.8a for which the $\Im$s have to reorient into the two super-triads of the triple-triad. This then requires the triple-triad to undergo a change in its motion so that if it would, but for this change, have been stationary it must undergo a compensatory motion through the lattice to maintain the constraints.

Consequently, even the neutron has a minimum velocity, though this will be the smallest of the three basic particles; the other two having incurred both types of change so that they are never at true rest. *This means that they must immediately move from their formation position in the lattice and always have a relative speed with respect to their birth place*. This is clearly reflected by the equations of motion and tables 9A.1-3 derived in the section 9A.3.

Here, it must be remembered that this involves rotation in three simultaneous directions. The $\dot{\xi}$-rotation is only one of the three directions of rotation possible which suggests that, in order to maintain their tangential triad velocities at *c*, the individual triple-triads must have individual minimum velocities according to the principles already deduced.

For example, the neutron rotates with its super-triads upright with respect to their rotation as in Figures 5.8 or 5.12a; the proton rotates with its super-triads tilted at 45° to its axis of rotation, while the electron rotates also tilted at 45° but with twice the rotation of the proton but half the proton's radius. We should thus expect, in view of their different forms, that each particle will have its own minimum speed and rotation, and furthermore, any increase in its $\dot{\xi}$-rotation from this minimum level should increase its speed proportionally to its minimum rotation and rotational form – all increases arise in quts, as did its original motion.

So an electron, in view of its radius, might be expected to travel faster than a proton; and the proton, due to its form in relation to a neutron, to travel marginally faster than a neutron (these two have the same radius). And, if each receives a photon carrying the same amount of extra $\dot{\xi}$-rotation, each will change its speed upwards by differing amounts to keep their triad tangential velocities at *c*. In other words, the neutron will act in human view as though it has some restraint on increasing its velocity a little more than the proton, which will also appear to have some restraint on increasing its velocity compared to an electron. Humans call this 'resistance to motion' or 'inertia' and not knowing any better say these particles must carry some peculiar entity called inertial 'mass'.

The nature of inertia deduced above can be converted into measurement equations as in the Addendum. These give to within approximately 99.99% agreement the observed inertia (inertial mass) of each particle relative to each other. The equations will also show that the minimum $\dot{\xi}$-rotation corresponds exactly to Planck's constant.

In standard physics it is unknown why these particles have the inertias observed by experiment, nor why Planck's constant has its experimental value (thus instigating Hawking's 2002 objection to not knowing why these relative 'masses' and constant values exist – "what knowledge is there in that?"). In other words, although physical equations can be built around observations, the equations are unable to determine why the so-called masses of particles have their relative values. As a result perhaps physicists should reflect on physics inability to (a) ascertain the nature of mass, and (b) provide a proper definition for mass.

6.4.1 A question of attraction and repulsion

However, inertial differences are not the only differences. The electron and proton rotate in opposite directions with relation to their three components of rotation. What effect will this have on their motion and thus on the concept and nature of force suggested in section 6.3?

The basic space-Time spin is $\dot{\xi}$ but when dealing with the proton and the emitted synchronized spin, its components ($\dot{\alpha}$, $\dot{\beta}$) giving the theta-rotation, become the important rotations. Only one of these can change sign to give the negative synchronizing rotation, as ($-\dot{\alpha}$, $-\dot{\beta}$) would be indistinguishable from the rotation of a triple-triad downside up (in relation to its fundamental axis of rotation as in Figure 5.12b). Using the arrangement of axes in Figure 5.12, rotation from the neutron to proton orientation arises around the *z-z′* axes which brings the *x*-axis into a plane orthogonal to the *K* axis. As the *x*-axis rotates through the α-angle it would then be the $\dot{\alpha}$ component of rotation that is responsible for the electron rotation.

Now imagine an $\dot{\xi}$-photon released by a proton carrying $\dot{\alpha}$-rotation being absorbed by an electron with $-\dot{\alpha}$-rotation. In order for the two $\dot{\alpha}$ rotations (those of the photon and electron) to coordinate, and thus all the components of rotation to additively superimpose, the receiving electron may have to turn the other way up. This would reverse its rotation relative to the photon in exactly the same way as looking at a clock with a transparent face ticks clockwise when viewed from the front but anti-clockwise (and its face numbers are also anti-clockwise) when viewed from the back). (Although the diagrams are drawn a specific way, even a casual glance should be enough to note that the triple-triad type particles they represent have no true upper or lower designations; so there is no designated right and wrong way up – it all depends on the rotations of the particles. The only factor by which they orientate is their rotation – which varies according to the particle species).

In the case of turning the other way up, for a given observer, the change in direction passed on by an $\dot{\xi}$-photon would be reversed. Then, for an $\dot{\xi}$-photon passing from an emitting triple-triad to an absorbing triple-triad where the $\dot{\theta}$-rotations are opposite the recipient would change direction diagonally towards the emitter as in Figure 6.9.

Thus the so-called electric charge of human physical theory becomes nothing more than a reaction to the differing rotations of the electron and proton.

This change of direction further has the surprising effect that if, say, an electron is travelling directly towards a proton its change of direction will still take place but in a direction *away* from the proton and then the next change will start to bring it back *towards* the proton.[34] The same applies to all particles so that freely moving triple-triad type particles *can never come into contact* except under intense pressures, as, for example, in stars.

The varying values of $\dot{\xi}$ rotation would not cause 'electric charge' to be variable. Particles already 'attracted' or coordinated with each other would exchange $\dot{\xi}$-photons carrying $\dot{\xi}$ commensurate with their joint velocity and so would maintain position relative to each other. The 'electric' attraction is caused by the $\dot{\alpha}$ rotation carried by the ($\dot{\alpha}$ [+] w) component of an $\dot{\xi}$-photon in which case no change of speed (i.e. magnitude of velocity) with respect to the source of the $\dot{\alpha}$ component would take place. Nevertheless, in the frame of an external observer there would be an observed change in direction of the electron and thus an observed change in velocity. The magnetic effect can be considered in terms of Einstein's theory.[35]

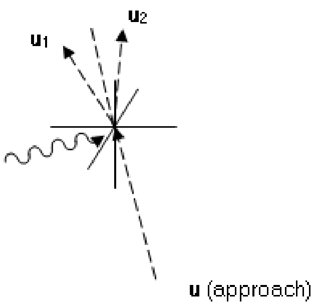

Figure 6.9. Attraction-repulsion effect. If a particle with velocity **u**(approach) is hit by an $\dot{\xi}$-photon carrying $\dot{\xi}$-rotation it would move along $\mathbf{u}_1$ if the signs of the $\dot{\alpha}$-rotation of the $\dot{\xi}$-photon and absorber are different, or $\mathbf{u}_2$ if the same.

The effect on the neutron depends through which half of the triad system the $\dot{\xi}$-photon arrives. If the signs of the $\dot{\alpha}$ component and neutron $\dot{\theta}$-rotations are the same it will move away from the emitter but the probability is that, because the neutron is rotating, the next $\dot{\xi}$-photon will arrive through the other half, which bears the opposite sign of θ (see section 6.2.3). In this case the neutron will move diagonally towards the emitter and the net effect will be an oscillation. Similarly particles near the neutron will oscillate depending on which sense of $\dot{\theta}$-spin they receive from that neutron.

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[34] The change of direction can be calculated once the Time mechanism has been tested against measurement as in section 9A.9

[35] Einstein ([1905b] 1923:52-65)

This now leaves the very tricky problem of electron orbits. First it is necessary to look at the standard atomic physics model. There are three major points to be considered and questioned, not only in the light of the foundational cause of RST, but in the light of common sense.[36] The first is Bohr's concept of the atom based on the QM wave concept. The second is the concept of potential and kinetic energy used to explain electron orbitals. The third, which will be left until Chapter 10, is the concept of energy conservation.

6.4.2 Bohr's atom

Bohr's concept derived in 1913 followed Rutherford's experiments showing that the electron appeared to revolve around a central nucleus. Bohr pointed out that this would cause a loss of energy through centripetal acceleration resulting in the electron collapsing into the nucleus within micro-seconds.[33] He assumed that electrons could remain in "stable configuration" due to laws based on Planck's constant.[33] He was then able to show that his general concept fitted Balmer's formula for the emission spectra of the H^1 atom.[37] His formula fits the standard energy formula given by, for example, Bransden and Joachain[38] in which the total energy of an electron is given by summing its potential energy and kinetic energy. The standard principle is that as the electron jumps to a higher orbital[39] it must *lose* kinetic energy in keeping with the standard physical 'inverse square law'. As the energy must obviously increase in order to produce the emission spectra when an excited electron drops to a lower orbital, the shortfall is made up by the potential energy *increase* as it is forced outwards against the inward directed Coulomb force. However, the potential for an electron to fall back to the nucleus is zero at infinite distance from the nucleus. If its potential energy is lower closer to the proton its potential energy must therefore be negative – lower than zero. Then the work required to pull it to infinity must increase so that as the electron is pulled out it loses negative potential energy – mathematically its potential energy gets closer to zero and thus increases. This, according to mathematical physics, allows the kinetic energy to decrease but, by theorizing the magnitude of the potential energy is twice that of the kinetic energy, the total energy increases by becoming less negative. Conversely, as the electron falls back to the proton it gives up positive energy by gaining negative energy. Which is all very well if you believe in a mathematical universe, but if not, one has to ask the philosophical question: what does an energy less than no energy mean? (Recall comments on zero throughout Chapters 3-5). A physicist would answer that the potential energy has a negative sign and can therefore be subtracted which shows quite clearly how mathematics can be manipulated in its own field. This is a point that appears to have avoided consideration in the philosophy of science; but perhaps should have been questioned based on the principles of measurement,

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[36] Common sense in relation to physical ideas is discussed in section 3.1.1.
[37] Bohr (1913:4,2,9)
[38] Bransden and Joachain (1983:31)
[39] I use 'orbital' rather than orbit as it makes no difference to the argument whether one regards the electron as having a continuous wave function probability distribution around the nucleus expressed as an orbital, or a distance given for a corpuscular electron in terms of 'Bohr orbits'.

particularly in terms of potential which means the capability or possibility of *providing something*. Would a negative potential energy not mean less possibility or capability of providing energy?

The next section gives an alternative and, in Chapter 8, it is shown that potential energy (PE) is really an extension of kinetic energy (KE). Then we have the odd situation that energy has to be applied in QM to *decrease* the KE and mass of the electron, and energy has to be emitted to *raise* the energy level of the electron when it drops to the ground energy level which is supposed to be its lowest energy state. This needs further consideration.

The process that follows, particularly in the concept of electron escape, revolves around interactions between single particles which is seriously different to standard dynamics based on Newton's theories ('laws').

6.4.3 Electron Orbits and force in the RST system

An accurate representation of an electron orbit would require knowledge of the position of the electron every qut as well as the position of every photon released from the proton over the orbital process. This is not possible with current computer capacity but the overall effect can be derived by reasoned deduction. Previous sections have shown that the electron will have a specific position at a given time though this is contrary to QM and QFT, see Thompson 2024a:ch8). Here, I shall only consider how RST affects the proton-electron interaction.

If the electron (and proton) has a specific position at a given Time against the space-Time lattice, irrespective of whether this can be determined, it suggests that as the electron is 'attracted' to a proton, yet can never collide with it except in extreme conditions, it will follow a path about the proton – what humans call an orbit. The reasoned approach would be that if an electron is in the region of a proton and it receives an $\dot{\xi}$ -photon from the proton it will change direction as in sections 6.3 and 6.4.1 – diagonally towards the proton. If it receives no further $\dot{\xi}$ -photons it will then continue along its trajectory until it is so far from the proton that the chance of it receiving $\dot{\xi}$ -photons on a regular basis is, for statistical purposes, non-existent. On the other hand, if it approaches the proton its chance of receiving an $\dot{\xi}$ -photon from the proton will increase with proximity until it reaches a state where it either travels directly at the proton or it travels past between receipts. If the direct approach, it will initially turn away, but in both the direct and indirect approach cases a further receipt will bring it back towards the proton. By this process it will be led into a condition where it regularly receives photons from the proton. If no external sources to this electron-proton pair are involved then the change in direction is caused by identical $\dot{\xi}$ -photons, and is thus always by a fixed amount (cf section 9A4.1). In this case, in order to receive $\dot{\xi}$ -photons on a regular basis (remembering that these do not form a continuous field but operate as a rotating beam) the electron's velocity and orbital radius must be in exactly the right proportion, thus keeping the electron at a specific distance from the proton. This appears to be a very tenuous condition but as Chapter 9A will show, the numbers of photons issued per second is so large, and the beam rotation so fast, that the electron will achieve an orbit, for which the distance, furthermore, agrees with experimental observation. Section 9A3.5 will also demonstrate that all triple-triad type particles propagate in a circular helix with a period of 18.97 qut. As a result protons and electrons can regularly receive photons from each other, thus seeming to bond together. At 10^{24} photons emitted per second it should be imagined these processes take place faster than humans could observe them.

This predicted process has the benefit that should the electron receive a photon from an external source that increases its speed it can break out of its orbit. There are then three possibilities: (1) The increase in its speed is sufficient to take it so far from the proton that further photons from the proton only marginally affect the electron's progress – it escapes completely. (2) The increase in its speed is sufficient to make it travel further out but not fast enough to avoid it receiving regular photons at a lower rate. The faster the electron travels, the further it will move between successive interactions with the proton. It will then have a larger orbit. (1) and (2) will give the appearance of the 'force of attraction' to the proton falling off with distance. (3) It only gains a small increase in speed but not enough to avoid being dragged back to its initial orbit. In (2) and (3) one would postulate that its velocity would be reduced back to its initial velocity and that it would release a Δ-photon in the process. Obviously, as this process of orbit maintenance is completely at variance with standard ideas it will need to be tested once the concept of measurement has been established. Sections 9A.9 will show that it agrees to a remarkable degree to standard calculations and observation of orbital radii though not to orbital velocities except for the lowest orbital.[40] Comments on the nature of electron orbits and emission spectra are included in these sections.

Thus philosophical examination of human ideas based on a foundational principle shows that neither electric charge nor mass actually need to exist in nature. They are purely man-made ideas to explain what humans could not otherwise explain. Their apparent cause is the same in both cases: the natural requirement that rotation must give a tangential velocity of c to space-Time points, which is the same as stating that space-Time must form at the rate of one qul per qut or c^*. In particular it shows that the avoidance of defining the basic principles of physics has led humans to misconstrue vital concepts such as force and fields.

6.5 Comments arising from chapters 1-6

This takes care of the relativistic representation/picture, but what of the natural representation where there is no space-Time. Here we enter into the problem of zero which was left unanswered by Tyson's conference. It is, as I suggested in section 4.3 and 4, only a problem because humans cannot understand the concept of no space and thus zero in this respect. But, as I suggested with the man in his shrinking sphere, and we pass into the human idea of infinitesimal (which I know I said does not exist), everything

[40] The electron speeds up in the Time based scheme, as opposed to slowing down according to mathematics.

carries on shrinking equally as the man's entire space shrinks to nothing. Consequently any gap would also shrink. But there is a philosophical, or you could even say, spiritual difference between the infinitesimal and the natural universe in that while the balancing spins cancel to nothing, the expansion starts with a definitive rotation (even in the p-rotational sense) of *w*. This was, and still is, necessary because there cannot be an initial start and then an initial start before the initial start. It makes no sense. So for the expansion there is automatically the concept of a maximum *w* which corresponds to a value for the contra-rotating universal spins. There is no difference between points with no space moving between spaceless gaps when compared to the relativistic representation. The possibility that the triple-triad axes may end up in 'contact' with a trace-point is immaterial as neither are capable of expanding into another triad format, so they will merely brush each other as they rotate without intersecting.

6.5.1 The human view of volume

Chapter 4 showed that space-Time, and thus the human concept of space, follows from the definition of Time as a collection of rotating points. The only difference in definition between Time and space-Time is that Time is a self-generated ordered progression of points, while space-Time and space are a collection of non-intersecting rotating points generated by Time such that each point spontaneously acts as if a minimal interval exists.[41] The intervals arise as a result of comparative motion about a point in the absence of space – the absence producing 'the natural representation'. This spontaneous action is a difficulty in human perception which arises primarily through observation. It can now be justified based on the nature of the expansion of the lattice and formation of triple-triads and their emission of photons.

Photon emission leads to interactions with, and resultant change in motion of, the triple-triads with respect to the background lattice. The triple-triads thus interchange positions with respect to the trace-points making up the lattice at a rate given by an interchange in a number of quts (e.g. 1qul/20qut), see next paragraph. With the almost exponential increase in particles predicted by the Time scheme as the lattice size grows, one might imagine that there will be an equally rapid increase in the number of interactions between the triple-triads leading to more and more complex structures. It would thus seem likely that eventually structures could emerge that could undergo automatic and regular changes in their formation, and might even be able to repair and reproduce themselves. In this case the possibility does arise of structures capable of sight and observation. All these interactions require motion through the gaps in the lattice as described in section 5.4.1.

All the triple-triads in this case are connected to each other by photon interactions (binding forces) so that each body moves as a whole, not only in relation to the background, but in relation to each other. These rates of motion are very slow in comparison to that of a photon. On the macro-scale, once the

[41] I would like to say infinitesimal interval but this suggests infinite divisibility. Technically the interval could be taken as $1/w$ where *w* is the maximum possible rotation, as in Chapter 4 – the initial rotation of the Universe which obviously has to be fixed.

lattice has grown enough points to allow formation of separated planets and stars, the amount of Time to travel between them becomes enormous compared to the motion of a photon. Thus sighted objects, such as humans, would see (be able to measure by visual triangulation) differences and changes in position on scales far larger than the microscale triple-triads from which they are made. These complex structures float in a field of free particles – a gas, in human parlance, sometimes almost completely rarified as in the cosmological space between stars and galaxies – made of little more than trace-points. Humans would thus believe in space and volume as if it were real instead of relativistic. It is purely relative motion brought about by the progression of Time. In terms of special relativity and the transverse Doppler effect, if we measure a fast moving celestial body it shows a redshift, or lengthening of its wavelength. This is a slightly different effect because it involves composite bodies which will either not be spinning or spinning extremely slowly compared to a triple-triad or materializing Time point. The greater the red shift the faster the travel and shortening of the period, which is the same as the traveller's time unit (period is inversely proportional to frequency). Reversing this condition gives the slower the relative travel the greater the traveller's relative time unit and lowering of the relative frequency. As the qul and qut are fixed units in nature (the natural representation) the lengthening of the traveller's time unit implies a greater number of quts are covered. Thus the slowing of his relative velocity implies an increase in the number of quts for one qul of distance covered expressed as 1 qul per number of quts – remembering that these are curved units so could be converted to 'flat space' terms where $c = c^{*}/2^{1/2}$ = qul^{r} per number of qut, or remembering to inflate the number of quts by $2^{1/2}$.

However, the increase in the red shift takes the body further into the infra-red spectrum until it passes out of the visible range. Furthermore, the closer to the speed of light that a triple-triad travels the greater the chance of it breaking up as its individual parts will travel too fast to be held in place by its rotation.[42] The only particles described so far that travel at the speed of light are the photons and they do not emit subsidiary photons. (Chapter 7 will introduce another type of spin particle known to physics as a neutrino which also travels at the speed of light) so it is possible to say that we could never see or detect a triple-triad travelling near the speed of light. I mention this because it might be tempting to consider a compound object, that is, one capable of observing us, measuring light from our sun and finding its wavelength to be infinitely long. That is, by the principle I outline in the sections on special relativity, the metre ruler of an object travelling at c would have shrunk to nothing and thus our wavelength, under this circumstance would appear to him as infinitely long. However, as stated any form of composite object, including triple-triads, would have broken up before it could reach the speed of light.

The definitions of Time and space (space-Time) are:

Time is a self-generated ordered progression of recordable points all of the same form but such that each point is distinct from any other;

where point is a spaceless, timeless, object with distinction only in its position in the progression,

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[42] A double-triad as described in section 5.3.1 has no stability so could break up at any velocity.

and the generator of the progression is a formless rotation generator.

Space is a collection of rotating points generated through the progression of Time forming a lattice of distinct identical trace-points;

where a trace-point is itself volumeless but through the action of the rotation generator would, in an observer's view, be a rotating right-angled tetrahedron formed over a minimal period of Time relative to a non-rotating point; and the rotation generator takes the form of a change of position over a minimal period of Time in a plane centred about an axis orthogonal to the plane.

The similarity of the definitions thus indicates that space, space-Time, Time and rotation are all intimately linked into one causal entity: rotation-space-Time. That is, they are observed by humans as different forms of the same entity which I have called simply 'Time'.

6.5.2 Concluding comment

It is clear that all this stems from the fundamental basis of Universal existence. This, if it fits observations of our universe, surely cannot make it clearer how important the subjects of foundational philosophy, metaphysics and philosophy of physics are to understanding the structure of our universe. It shows that the nature of existence itself is fundamental to everything we see. So called human derived laws have nothing whatsoever to do with its nature. They did not and do not determine how the RST-Universe works. They have not featured in deriving this theory based on Time and rotation. They do not even give the slightest clue to why they appear to us to be laws. They are only of use to developing human living conditions (houses, cars, computers, etc) but not discovering the structure of the world around us (instrumentalism). The same can be said for mathematics. It is fundamentally nothing more than measurement even to the concept of 1,1,1 ≡ 3 being greater than 1,1 ≡ 2 and 1, and so on up the number system. The universe has no requirement for either measurement or number. It is only the human need of measurement that produces the concept of mathematics.

These are points that I believe physics needs to take into account. Through deriving a foundational principle, Chapter 5 has derived the nature of building blocks, the particles, from which a Universe can be derived, and Chapter 6 an understanding of how these blocks may interact with each other. The next step is to determine further the nature of existence of a Universe built out of these blocks and the nature of its structure

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CHAPTER 7

Macrouniverse

7.1 Introduction

Chapters 4 to 6 examined the nature of the micro-universe based on a single first cause. It is now time to bring these discoveries to bear on the macro-Universe, what we actually see and experience of our surroundings. This, in fact, is really the most important part to us because whatever lies below our vision must agree with what we actually see. Kant's writings 240 years ago, imply any foundational basis has to explain the macro-universe – including the reason for its existence. This chapter is [1]therefore aimed at logically extending the micro-principles, or fundamental cause, to the macro-universe (cosmos) from its beginning to possible end. The central problem is gravity, whether expressing the expansion of the universe, dark matter and energy, or the early formation of galaxies and their present distribution among voids. The development of gravitational theory in standard physics (section 7.4) has centred on attempts to combine Einstein's general relativity (GR) with QM, the latest concept being Loop Quantum Gravity (LQG).[1]

There are many other unanswered problems in astrophysics and the hope has been that LQG may point the way to a complete theory. These problems include details of the beginning and possible end of our universe, neither of which are firmly established in standard astrophysical theory. The physics of the early universe (up to 10^{-36} seconds) according to standard theory is unknown,[2] as is how it led to the creation of particles, and the exact mechanics of force and energy transfer. The so-called laws of physics may even break down in this period, which should not be surprising without a foundational cause for all laws.[3] Thoughts surrounding the end of the universe range from never ending (a cold universe with energy density too low for interactions to occur suggested by Goldberg and Scadron, to a 'bouncing universe' by Gielen and Turoq.[4]

As in previous chapters, I shall still argue that the prime problem, this time with astrophysics, remains the lack of definitions of the fundamentals (time, space, mass, force, et cetera) together with the lack of a foundational principle. I also question whether complicated mathematical, controversial theories, still outside a full mathematical understanding and formulation, could relate to the macro-universe, the galaxies, stars planets and living creatures.

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[1] (Vaid 2014)
[2] Guth (1981:347)
[3] Curiel (2019); Bojowald (2006); Singh (2012:1)
[4] Goldberg and Scadron(1995); Gielen and Turoq (2015)

As standard theory believes that the solution to gravity is fundamental to understanding everything else in the macro-universe, current ideas are briefly mentioned in section 7.2. Section 7.3 develops the contents of Chapters 4-6 to a background structure for a macro-Universe which, in section 7.4, automatically leads to the fundamental existence of a gravitational force. Sections 7.5 and 7.6 explain very briefly some physical aspects of the growth of the matter universe. Section 7.6 includes a major concern of existence, the beginning and ending of the Universe, in a never ending flow of contracting and expanding universes. Section 7.7 looks at a surprising gravitational prediction of the foundational principle which may already have been discovered in the question known as the ‘axis of evil’. Finally, sections 7.8 and 7.9 explain how the fundamental structure of particles readily leads to a structure for atomic nuclei, the nature of which is completely unknown in standard theory, although the standard theory entertains a range of possible ideas. A complete understanding of the role of neutrinos in the universe directly follows, which again is a mystery in standard theory other than that they are somehow involved in neutron interactions. This chapter then completes the understanding of the nature of space and our universe. Chapter 9 gives mathematical details where required.

7.2 Standard ideas of the creation

Some of the old myths concerning the creation of the universe were briefly mentioned in Chapter 2. To these can be added the modern concept, not so much a myth because at least it is based on careful observation using the latest techniques: orbiting telescopes, space craft and radio telescopes collecting information formerly obscured by the Earth’s atmosphere; plus much interpretive mathematical theory. Thus the obvious starting place seems to be first a simplified explanation of the current theoretical astrophysical background with its mathematical language turned, as far as possible, into straight English.

In 1927 Hubble discovered that certain faint patches in the night sky were much further away than the supposed size of the universe. He suggested they might be vast groups of stars, now called galaxies, with distances of as much as a million light years between them. They were also found to be Doppler red shifted indicating that they were moving away from us. Hubble concluded that the further they were from us the faster they were moving.[5] This implied the whole universe must be expanding and, if so, by working the expansion backwards in time Lemaître concluded it must have once been an infinitely small point, disparagingly called the ‘big bang’ by Hoyle as conservation of energy suggested all the matter currently in the universe must have existed then.[6] Work on Einstein's general theory of relativity also seemed to back this view. This supplanted “The Steady-State Theory of the Expanding Universe” of Bondi and Gold in which the universe would appear to be almost uniform in whichever

[5] Hubble (1929)
[6] Lemaître (1931); Hoyle (1949)

direction it was observed.[7] This would have allowed the steady creation of matter in order to keep the universe more or less uniform in structure. It would also have overcome the problems of the size of the universe, and its beginning, as it would allow the mathematical concept of infinity to explain the philosophical issues with a never-ending (unbounded) as well as never beginning universe.

I will not go into these ideas here, nor more recent concepts of zero-point energy and harmonic oscillations even though these fit well into philosophy of science discussions. But they are included at some length in Thompson 2024a:ch7. Instead I shall only deal with the formation of the universe according to RST. This will include an automatic existence of an additional force known as gravity and some unsuspected ‘hidden from us and observational physics’ concepts.

For now, I will assume a current that it was formed from Φ, that it simply ‘became’; in other words, it was formed from a sudden creation. Thevfinal results of thisvinvestigation will determine the form of Φ.

7.4 Gravity: some philosophical considerations concerning standard theory

The concept of gravity has been an enigma throughout the history of mankind. Even Newton when he introduced his laws of force understood the problem of causality:

“*That one body may act upon another at a distance through a vacuum without the mediation of anything else ... is to me so great an absurdity, that I believe no man, who has in philosophical matters a competent faculty for thinking, can ever fall into*”. (Newton 1698)

Einstein ([1916]1923) in his general theory attempted to avoid a mediator,[8] that is some particle that carries force or energy from one point to another, by considering an acceleration created by a supposed spherical deformation of space around a mass containing particle; this would be from an otherwise undefined geometry – flat, saddle or spherical in current theory. In other words a change of the shape of space can cause an apparent change of speed. For example, take the idea of an expanding balloon as sometimes quoted in television programs; two points that were stationary close together before expansion, move apart, but not only do they move apart, the surface they were on which may have been flat (before being blown up) becomes curved. So the flatness has been deformed into a curve with greater distance over the curve than there is as a straight line between the two points. If the particles were moving apart at a constant speed, then the blowing up of the balloon accompanied by the stretching of its surface causes the curved distance between the particles grows more quickly. The problem, of course here, is that there is still an action causing the change so it does not really overcome the problem of ‘action at a distance’ or transfer of a cause. Einstein also made the assumption, based on

[7] Bondi and Gold (1948)
[8] Einstein ([1916]1923)

his version of special relativity and his equivalence principle, that an accelerating (non-inertial) frame of reference is indistinguishable to human experience from a gravitational field.

For example, if one steps into a lift and it starts rising, one feels a force on one's body and particularly one's feet in a downwards direction as the lift accelerates. But once it has stopped accelerating no further force is felt. Conversely, if one steps into a lift on the top floor and it starts to descend one feels as if one is losing a bit of contact with the floor until the lift descends at a constant rate. But on the lift decelerating one feels the pressure, force on ones feet, as if one wants to carry on going downwards, until the lift finally comes to a halt.

Einstein noticed that force was only felt when a motion, or rather mass containing body, accelerated or decelerated. He further realized that in curved motion, exactly the same effect took place. For example, someone on a bicycle gradually leans into a turn to overcome the force felt at the beginning of the turn, and then stays leaning at a fixed amount feeling no force on the body in the middle of the turn, followed by the feeling of falling into the road as the turn straightens with consequent bringing the body upright again.

Consequently when motion is steady there is no force felt acting on the body and thus we on Earth are not aware of any motion the Earth might be making, nor are we aware of the so-called force of gravity acting on our bodies. It only becomes apparent if we jump up, or ascend in a lift, or aeroplane, or rocket or dive into a swimming pool, and so on. Einstein viewed change in motion as a relative effect produced by mass, equivalent to the effect he had deduced for time dilation ten years earlier (though mass is irrelevant to this latter effect).

He concluded Newton's gravity could be generated by a rotating space as each point in the space moves continuously around an origin, creating an apparent force on mass containing particles. But in such a rotation there is a change in direction which implies some form of force to stop a particle, or object, from continuing its motion in a straight line, according to Newton's first and second laws. As anyone knows through whirling a stone on a string there is a pull on the string away from the hand holding it. If the string is cut the stone flies off away from the line. So in human perception, and thus mathematics, circular motion produces an apparent force on mass containing particles. But it requires a constraining force to hold the object to a circular, or curved motion. That is fine if there is a string but what if the object is not held by a clear constraint, as for example in the gravitational attraction? So we still have Newton's problem of action at a distance.

In its original form Einstein derived a set of field equations, the most trivial solution to which was the Minkowski (1909) 4-dimensional spacetime. As in real terms there is no limit to defining an infinitesimal metric, Minkowski provides a reasonable approximation so that for the assumed curved space (manifold) of general relativity the Minkowski spatial vectors (x^i in physical theory) provide a 3-

(Euclidean) dimensional tangent space. Time is represented as a scalar serving all three space directions (dimensions). This is essentially different to the space-Time derived in Chapters 3 and 4 as this latter form requires three *vector* quantities for Time, one to each Euclidean direction.

There still seem to me, then, the fundamental questions which standard concepts have not fully tackled:

1. How and why does the rotation/acceleration required by Einstein arise?
2. Why and how could this be allied to mass? There has not as yet been an established connection between particle angular momentum and gravity although physicists have theorized the possibility.[9] Could this even be definitively answered without a definition for mass?
3. Why should there specifically be a surrounding spherical space (due to mass)?
4. The gravitational acceleration due to a supposed field around an individual particle is assumed to be a constant, *G*, ((as opposed to *g* which depends on the amount of matter present in a localized space). Why constant?

Although General relativity has been accepted, *inter alia* having met Popper's (2006) requirements of testability (falsifiability), leaving these questions aside, General Relativity, to some extent, clashes with the other main standard theory: quantum mechanics.

Quantum mechanics is a statistical theory based on the assumed wave nature of matter where one can either know the velocity of the particle but not its position, or its position but not its velocity, or an uncertain mixture of the two. It relies on superpositions of continuous waves with different phase velocities so that a coordinate system describing the quantum state of an object cannot be converted with certainty to definite spacetime coordinates, in other words a clear spatial geometry.[10] But it too, has met Popper's requirements.

Consequently both theories have to coexist in standard physical theory. However, general relativity does not take into account exactly what matter is. It merely assumes it can be represented as particles containing mass representable by a point in an undefined space. QM has been set up to explore the concept of matter in a manner that allows *predictions* for its particle interactions. But it does not recognize the possibility of a particle having a definite position at a given time.

It is thus difficult to bring the concepts of general relativity and QM together and, as suggested in several places in this book, this may stem directly from the lack of clear definitions of the fundamental universal quantities. Advances to unifying the two theories have been made through the development

[9] Unnikrishnan (2019)
[10] see Merali (2013:4)

of loop quantum gravity[11] but as yet there is no established theory,[12] only some interesting philosophical concepts mentioned below that seem to fit in very well with the RST picture being developed.

Since quantum mechanics has experienced much greater advances than general relativity, current attempts to find a happy connection between them in recent years have centred around taking the Hamiltonian of QM and attempting to apply it to general relativity; in other words to quantize general relativity. However, this introduces a new problem known as 'the problem of time'.[13] The problem arises due to Hamiltonian mathematics (section 6.2.2) being formulated around generalized coordinates centred on momentum and position observables,[14] as opposed to classical theory where time is always present and usable in calculations. The universe itself can be considered as having a wave function to describe it, in which case all systems inside that quantum space are inside a closed system. As observables only appear when measurements are made, time only arises in a system external to the measuring (of observables) device. Thus mathematically, time cannot be realized within the quantum formalism. But as Page and Wootters point out (cf Thompson 2024a§8.4) going over to a gravitational theory means going over to a total energy state of the universe. This must be 'stationary', that is, it must obey the law of conservation of energy and cannot change with time. In any case, time is not a physical interaction between observed and observer according to QM, and therefore not a QM 'observable'. Time only arises in QM at the point of measurement and is specific to a human frame of reference. It is thus not surprising that time until now has not been considered with any real importance as *the* fundamental entity of the universe.

The Hamiltonian being independent of specific coordinates can be applied directly to a curved or a 'flat' space or any of the other possibilities. Furthermore, being independent of time, it has no effect on the gravitational constant, *G*.[42] Therefore standard theory believes *G* can be treated outside of time even though time is a part of Einstein's original formulation where spacetime is a purely geometrical-mathematical object. The failure of GR and QM to marry up has led to a new idea, Loop Quantum Gravity (LQG).

7.5. Loop quantum gravity

QM depends on discrete energy quantities so it seems logical that QG, particularly the version known as LQG, should have a discrete quantity attached to it. Early steps in QG using Regge Calculus[15] developed through the concept of simplexes (simplices), the idea being to construct a spacetime built

[11] e.g., Smolin 2016, Chiou 2014. Bahr and Dittrich, 2010, Dittrich and Thiemann, 2009, Regge and Williams, 2000,

[12] Weinstein and Rickles (2015:§4.1, §5.1)

[13] see e.g. Kauffman and Smolin (1997)

[14] Observables are defined as a Hermitian operator with a complete set of Eigenfunctions (Merzbacher 1961:148). Basically, it is an action related to a measurable physical quantity such as position or momentum.

[15] (Regge and Williams 2000)

upon triangles (the simplest spatial figure for two dimensions) placed adjacently to form a two dimensional continuum (space) which can be shaped by angling the triangles against each other to form curved surfaces. Regge and Williams adopted the principle to a volume for which the simplest figure is a tetrahedron with the intention of turning 3-dimensional space into a discrete collection of such tetrahedra in order to allow general relativity to be similarly discretized, in which case it could be adapted to fit quantum mechanics. Although this leads to new ingenious mathematical concepts in order to accommodate discretization of space, it still holds to the concept of the standard geometrical idea of volume, such as spherical and flat or Euclidean as opposed to the tetrahedral space demanded by Time. It is also interesting that the RST tetrahedral form relies on the cube as the smallest reproducible form that fits the quantum principle of minimal intervals raised in section 4.5 – the result leading to the tetrahedral form of space. This is in analogy with the simplexes just mentioned.

The LQG problem arises because if a collection of regular tetrahedrons were ‘glued together’ along any of their sides to form a volume, there would always be gaps between some of them (as can be easily shown by gluing five regular tetrahedrons together – they will form a decahedron with a gap in it). The conclusion should perhaps have been drawn that the tetrahedra should meet the concept of quanta in terms of the standard concept of Planck measurements in such a way that they could form a continuous regular structure. This can be done in the form created in section 4.5: as triads of orthogonal axes forming a continuous space-Time lattice of discrete structures measuring a multiple of quantum units along its developing axes. This allows for the curvature of space created by the various spins in order for the natural representation of Time to appear as a universal structure in the relativistic representation.

It seems possible, then, that with a little further thought along the Regge lines, the quantization of general relativity would have arrived at the same form, but not necessarily the same quantum units, as the space-Time concept so far developed.

Consequently I return to the fundamental cause of Chapter 3 to relate it to the construction of a macro-Universe.

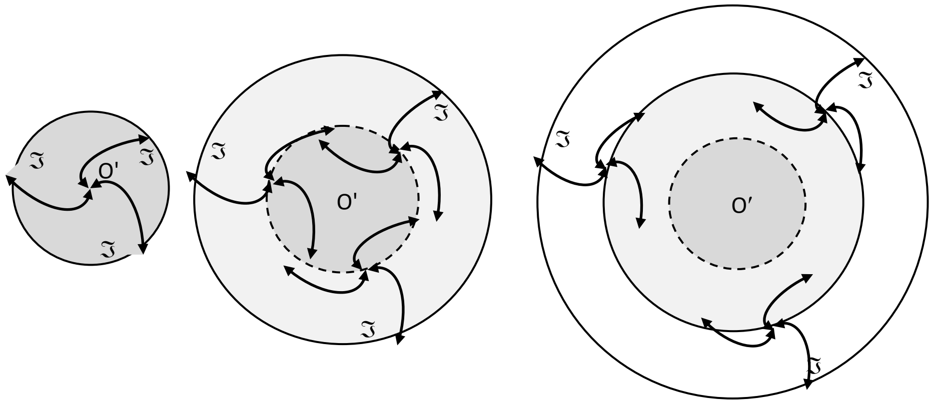
7.6 Development of macrospace

The previous chapters have argued that the space-Time of the foundationally based Universe expands, generating particles, on an approximately regular format so that the number of particles produced grows with the size of the Universe – at complete variance with the standard idea of the big bang, though not Bondi and Gold’s steady-state expanding universe. All three concepts of the universe expand, the standard driven by a hypothetical dark energy, introduced following the observation that the expansion of the universe is accelerating.[16] The nature and mechanics of this dark energy is completely unknown, if it even exists.

Expansion of the foundational Universe, as explained in Chapters 4 and 5, is within a spaceless, timeless, rotating **null point.** It gains an apparent, or relativistic volume due to an inner contra-rotation exactly balancing that of the null point. This gives a constant rate of formation of an apparent, or relativistic space-Time driven by the Time generator in the form of a lattice of trace-points. Each trace-point is generated identically with a constant maximal spin w and is distinct from of all the other points. The age of the macro-Universe, denoted by T_A, will correspond to each stage (Aristotle's 'nows') in the progression of Time; the relativistic Universal radius will correspond exactly to its age. In human cognizance the Universal age in quts would run through the human-made concept of the natural numbers.

As in Chapter 4 the lattice is contained in a packet known as the null-point consisting of two rotations. An outer rotation, $\dot{\theta}^-$, although only a point spin, is treated as a packet (null point) with a surface – **null surface** – and the inner rotation $\dot{\theta}^+$ is a packet rotating inside the null surface. As the universe ages the null point spin, $\dot{\theta}^-$, remains constant and the tangential velocity of its 'null surface' (bearing in mind it is a point) is c. Consequently, the surface velocity of the inner packet is also c – these velocities being relative between any two positions (so-called observers) one on each sphere, see section 4.4.1. These concepts lead to two obvious problems. The first arises from the human view that if the inner packet spins and produces points that also spin, there should be an 'addition of (tangential) velocities' affecting the trace and Time points. The second problem is that, again from the human point of view, if the universe develops as projected by the foundational principle, how can a relativistically expanding inner packet maintain its tangential velocity at c and its angular rotation at w (the maximal value of the $\dot{\theta}^+$ spin) in an apparently expanding Universe? That is, how can it balance the constant null point rotation of the $\dot{\theta}^-$ spin which must have constant value w^- (meaning same magnitude but opposite direction to w). These are two very important problems, the answers of which explain a great deal about what we perceive of the universe around us.

[16] Rubin and Hayden (2016)



a b c (not to same scale)

Figure 7.1. The *expansion* of space-Time as given in Figure 2.1 seen from both inside and, imaginatively, outside the universe.

The first problem is answered by looking from the relativistic observational point of view that created the space-Time in the first place. An 'observer' inside the relativistic space can treat the spin as if the background is fixed and he is spinning or that he is fixed and the background is spinning. Figure 7.1 shows the generation of the first three sets of building blocks according to the latter condition. An 'observer' on the null surface (of the null point) would see space develop inwards due to the spin, starting with the first qut, somewhat equivalently to the measurable concept given in section 4.4.1. Then the second generation of building blocks would appear next to the null surface and so on, each set increasing the relativistic size of the universe as viewed by him.

But an observer (an eyed one as opposed to Chapter 4's anthropomorphized one) would not see the Universe spin relative to his origin as, although both $\dot{\theta}^+$ and the counteracting spin $\dot{\theta}^-$ exist, $\dot{\theta}^-$ only exists as an invisible containing surface. Section 4.5 derived that the relativistic intervals of space-Time points arise within the inner packet and are due to their rotation within this packet. As this space-Time is produced identically for each point from a maximal spin *w* in isolation of all the other points, every point is unaffected by the external rotation $\dot{\theta}^-$. Thus the observer would believe the Universe expands outwards, and without the knowledge acquired in the last two chapters he would imagine, as nearly everyone does on this planet in our universe, that his Universe is expanding into some vast unfathomable volume. For this reason the curves are drawn with arrows at each end; it depends on who is viewing as to which way space-Time *appears* to develop, a consequence of the reciprocality of observations in relativity.

The first problem is thus only a problem of human physical interpretation of observation, and not one that occurs in the foundation of the Universe. The second, on the contrary, is one that does not occur in human interpretation of observation, but one that is implicit in the relativistic nature of the foundational principle, as follows.

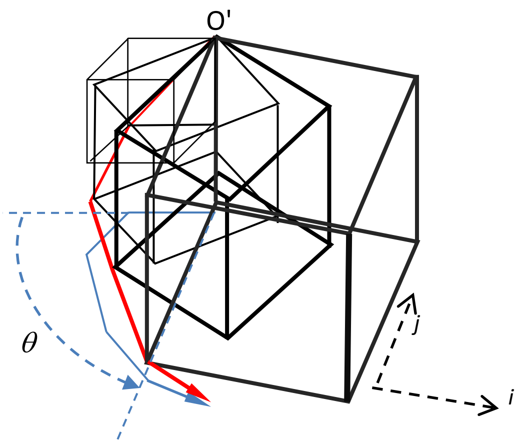


Figure 7.2. 3-Cartesian dimensional representation of space-Time volume production over four quts, starting from the first qut at the origin of the Universe, as seen from an O' plane of reference in which rotation is only observed in the *ij* plane.

In the natural creation of space-Time one of the points would observe the other to move around it (at *c*) and vice versa, both giving the same result as viewed in the contra-rotating system. From this view, the continued construction of space-Time modules, as appears from the origin in a Universal frame of reference,[17] will appear to follow a spiral. For example, there is always a free axis at the basal apexes of the tetrahedron so that the tracking of any one apex can be represented over a period greater than a single qut using a series of cubes, as in section 4.5 and Figure 4.4. In human figurative terms this spiral can be projected onto an (rectilinear) *ij* plane as shown by the blue arrow in which case each change of direction is related to the total angle turned through, theta. This gives the structure as shown in Figures 4.2-3. Rotation in the other planes need not be considered as the whole figure can be rotated taking the spiral projection with it.

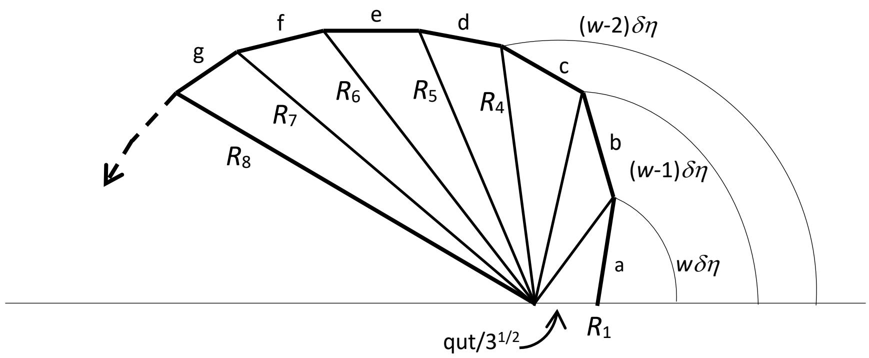


Figure 7.3 The projection of Figure 7.2 onto the *ij* plane in detail. η is used in place of θ and $\delta\eta$ means a smallest change in η, in this case a quantum unit.

This reasoning suggests that the macro-Universe can be described in both volumetric and planar terms as might have been supposed from the basic construction of Chapter 4. Then the relativistic

[17]Frame of reference still as described in chapter 1 without geometrical connections.

Universe would expand at a constant rate *c* while maintaining the tangential velocity of its surface at *c*.[18] Therefore, if the relativistic radius of the Universe (inner packet) increases, the apparent rotation of its surface around its origin must decrease in proportion. Imagine a given point on the edge of that Universe. From human view it would travel around the Universe origin O' at *c*. Then *as its distance from O' increases, its angular rotation must reduce reciprocally* (recall Figure 5.11). Because this change of spin is due to the relativistic expansion of space it would appear only in the relativistic representation of the Universe (which we would see but the change would be very small now because of the huge distance of fourteen thousand million light years from the origin to the edge of space [section 7.7])[19] But any change in angular rotation in our mathematicalview would seem to destroy the balance between $\dot{\theta}^+$ and $\dot{\theta}^-$ that arose in the first qut.

This would produce a difference with the natural structure of the Universe, which is the actual structure of the Universe, the relativistic structure being precisely the Universe we 'see' around us and therefore not necessarily a 'truthful' view based on the fundamental cause. The difference is that the natural Universe does not occupy any volume so that the spin of the null surface remains constant and the trace-points do not have any linear velocity. Accordingly, the natural system would have no 'addition of spin or velocity' problems (another expression of the condition stated earlier in this section) and forms up with the same basic structure as the lattice described in Chapter 5 – but in point form only. As it is deemed the true format of the Universe, a human viewed relativistic representation must agree with it rather than the other way round.

As with the proactive nature of the fundamental definition there is an automatic correction which we do not see. The $\dot{\theta}$ spin in Chapter 4 (and 5) is the rotation of each space-Time triad during the formation of the space-Time building blocks; to distinguish the difference between this aspect and the rotation of the expanding universe, the rotation of the expanding macro-space will be called the ***η***-spin, η replacing θ for clarity of expression, as the age, T_A, of the Universe increases. Then, as the age increases, the η-spin must reduce from *w* at the beginning (T_A =1) of the Universe with the passing of every qut. As in section 4.5 this value *w* must have a finite value as the original spin cannot be greater than itself.

This reduction in rotation, if uncompensated, would, as seen above, destroy the equivalence of the spin of the relativistic space and the constant spin $\dot{\theta}^-$ of the null surface. As the latter is constant, the compensation must arise in the relativistic representation of the Universe. The fundamental rule then demands that a **balancing spin** must arise, one which we would not see because it operates *between* the

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[18] In mathematical terms: resolving *c** by splitting the three-dimensional representation into planes as in Figure 4.4d.

[19] There have been suggestions, and refutations, of measurements of a universe spin (Longo 2011).

imaginary null surface of the Universe, that is, the inner packet, and the outer packet, $\dot{\theta}^-$ spin. Thus the relativistic form of the Universe would be maintained by the balancing spin increasing as the η-spin decreases so that the two together agree with the $\dot{\theta}^-$ spin which always has the magnitude *w*. These conditions would then apply to every space-Time origin as if it is the centre of its own universe. In particular, they would ensure that at the end of every qut the formation of new space-Time in our system commences with exactly the same motion as in the very first qut that started the universe. So again, with no difficulty, the foundational cause leads to a balanced expansion of the Universe that meets its fundamental rule. As it turns out, a factor that will answer many astrophysical questions.

In view of this being a new concept arising from a new reasoned formulation there would be no reason in standard physics to expect this process. It is, therefore, what I call a 'hidden from us' concept, though we might expect there exists some consequence which we *have* seen.

7.7 The consequence

If the spins of the previous section exist outside our knowledge but have an effect on creating the space we see around us, as suggested by the foundational principle, we might expect the result would be mysterious. Consequently we might have difficulty in interpreting it, especially in our physical system based on elements such as mass and electric charge which Chapter 5 suggested might only be man-made ideas. Again I return to the nature of the basic construction as in sections 4.5-6 to explore the possible outcome.

Each set of building blocks pertaining to a particular stage in the RST system must be generated in jumps exactly analogous to the expansion in Figure 4.3. The expansion of space-Time can then be imagined as a series of concentric bands, as in Figure 7.1, one band being added every qut. As in Figures 5.1, 5.3, 5.6 the space-Time building blocks will interfere with each other and particles will be created at a measurable distance from the universal origin O′ in a corresponding band. Then any particles in that band will have an intrinsic angular motion relative to the origin of the universe, O′ in Figure 7.1. But due to the relativistic nature of this construction every particle may consider its own origin as the centre, O*, with bands R* surrounding it (as appears with the two bands in 7.1b and three bands in 7.1c.[20] As the appearance of space is due to the relativity of observation, every particle is placed within – and is at the centre of – its own measurable Universe. But it *will* receive, irrespective of its position in the Universe, a reduction in its rotation relative to the Universal spin $\dot{\theta}^-$ at the passing of every qut as the Universe relativistically expands. This means a particle's relativistic rotational value must be reciprocal to the age of the Universe (recall that this is a feature of the relativistic representation giving us our view of space but has no effect on the natural representation and thus the

[20] Recall the relativistic construction of space-time as seen by every point and particle.

particle's spin). The age of the Universe has the same value as the Universal radius or number of imaginary rings, in quts and quls.[21]

As this reduction depends upon the age of the Universe, every particle will be subject to the same reduction irrespective of its position. But, if every particle received this reduction it would neither be noticeable nor measurable as such, even though an observer might recognize an equivalent increase in the size of his Universe over a period of time. It is not unreasonable, then, to suggest that without the RST explanation there would be no stimulus for humans to associate the size of their Universe to a particle's rotation. (The size of each particle's observed Universe als o still depends on its relative speed through the lattice as in section 6.3.1). Nor would humans deduce from standard physical 'laws' that this is the basic nature of existence of a macro-Universe from which various consequences emerge.

On the other hand, such a reduction in rotation affecting all triple-triad type particles should produce some more concrete property, one that fits human observation. Indeed another consequence can be deduced. A photon transferred between particles will be created at the *end* of a qut and it will carry the spin it is given at that instant for one complete unit of time. In this case, the difference arises in the $\dot{\theta}$-spin plane; the η-spin merely extends the $\dot{\theta}$-spin beyond the first Time stage (t = 1). Consequently it will not be passed on by the $\dot{\xi}$-photons. However, section 6.2.3 reasoned that six photons are issued by every triple-triad each qut in pairs, as drawn in Figure 6.5. This means the spin transfer must be carried by photons for which either the $\dot{\alpha}$-rotation or $\dot{\beta}$-rotation gives a tangential velocity of c (see section 6.2.3). But as in Figure 6.7, the $\dot{\alpha}$-rotation is responsible for the direction of the $\dot{\theta}$-spin, and thus the difference between the electron and proton rotations, so the reduction of the universal spin must be carried by ' $\dot{\beta}$-photons' (from the $\dot{\beta}$-rotation) , designated from now on as **G-**photons.

As a G-photon propagates, being generated, like everything else in our observed Universe out of space-Time, it must be subject to the change in the universal spin. But, as the G-photon carries the original spin given it by its emitter for one qut, its spin always lags behind the change in the Universal spin by one change in rotation, when it is absorbed by another particle. Accordingly, the $\dot{\beta}$-spin (for the Universe at large I shall refer to the rotation as spin) passed on increases in the triple-triad's spin (in the β direction with a compensating change in the other directions to maintain the tangential velocity at c) by an equal amount. The spatial bands around the triple-triad then reduce by one ring (of radius $3^{-1/2}$ qul). More pithily: *if a particle is hit by (absorbs) a G-photon thus taking on its slightly higher spin, the relativistic space about the particle reduces*.

[21] Mathematically the Universal radius multiplied by the η spin = c.

Because a particle emitting a G-photon, is at the centre of its universe, the absorbing particle will appear to move towards the emitter against a background of not-hit particles (far enough from the source that their probability of being hit at the same Time is low). As with the $\dot{\xi}$-photons, approximately 10^{24} (see addendum 3A.4) are issued every second and, due to the rotation of the emitting particle, they appear to create a field around the emitter obeying the inverse square rule. That is, the chance of a particle being hit by, and thus absorbing, an $\dot{\xi}$-photon reduces with increasing distance.

Overall an observer would see an apparent acceleration of an absorbing particle towards the source emitting the G-photons. Furthermore, this acceleration is the same, at a given age of the universe, for every triple-triad type particle irrespective of its distance from the carrying photon's source. Because the relevant spin is the inverse of the radius of the Universe, the smaller the radius the greater the change in spin; and thus the greater the change/difference in velocity between an absorbing particle and the same particle if it had not absorbed a G-photon. So when the Universe was very young this acceleration would have been very large, but now is very small and growing smaller with the passing of every qut. Humans are well aware of such an acceleration which we call gravity. The G-photons can then be called **gravitons** in tone with standard theory language. If the deductions made so far are valid, the equations of motion should provide a connection between the value of this acceleration as measured by human experiment and the age of the universe.

Comparing the change in velocity due to the time lag of one graviton, to the change in velocity due to the minimum $\dot{\xi}$-photon gives the comparative strength of the gravitational constant, *G*, as 1.24×10^{-35} that of the electromagnetic force (10^{-39} using proton-electron masses), and *G* becomes $G = 6.57329 \times 10^{-43}$ qul qut^{-2} (6.6738×10^{-11} kg^{-1}m^{3}s^{-2}). These figures agree with CODATA. The age of the universe is then by calculation 1.0484×10^{41} qut, or about 13.786×10^9 years old[22]. Thus the Time scheme not only agrees with experimental results but explains exactly why these figures occur (see addendum 9A.5.1 for calculations).

Two points need to be noted. The first is that *G*, according to the RST system, is dependent on the age of the Universe so changes everywhere instantaneously,[23] but the effect is transferred between particles at *c*. These gravitons are continuously emitted from their source particle, so another particle will pass into a gravitational field without having to wait for a graviton from a particular particle to recognize it has arrived – that is, Hawking and Mlodinov's idea that particles must exchange mediators for action (a 'chicken and egg' situation) is, according to the logic of the RST system, false.[24] The second is that although gravitons are responsible for the effect, their numbers in a localized volume

[22] I calculated this result about 21 years ago, long before the latest calculations by astrophysicists following the Planck satellite information which do suggest this value. It therefore has a predictive test quality.
[23] cf Eaves (2014)
[24] Hawking and Mlodinov (2011:103)

depend on the number of triple-triads, with their associated imaginary concentric bands, present in that volume. There will then be a proportional reduction in the relativistic radius about the recipient. Consequently, a strong field in which the recipient receives many gravitons within a short time will have the same accelerating effect on that recipient as a field with an equivalently smaller radius, that is, with a number of bands corresponding to the number in a younger universe. In other words, the strength of the field will give it an apparent curvature of space-Time surrounding the source of the field. With this point of view, the result is similar to Einstein's general theory. However, there is one major difference. Einstein's theory requires the difficult Riemannian mathematics to evaluate it whereas the Time based theory requires nothing more than multiplication by $2^{-1/2}$ to pass from curved space coordinates to rectilinear and vice versa. The simplification of this logically deduced case is so great it need hardly be commented on.

Einstein's theory of gravity showed that the planet mercury should have an abnormal precession. It also predicted that light should be affected, bent by gravity. Both of these effects are observed, though the latter is extremely small but has been seen from deep space photographs showing light from extremely remote galaxies can be bent as it passes large galaxies closer to us. It should be clear from this section and section 6.1. that they should be expected in the Time Universe, so I am not going to say anything more on the subject.

7.8 Development of the Universe

There are many unknowns about the *early* universe (Dayal 2018:12-15 or Smeenk & Ellis 2017). To save space these will not be discussed here. Instead a *brief* and superficial summary will be made of certain aspects deducible from this and previous chapters. This summary is purely to show that RST does allow for all major human observations.

7.8.1 The beginning

Chapter 5 reasons that instead of a 'big bang' the chosen first principle leads to a regular increase in particle numbers. The gravitational principle of section 7.7 then argues that when the age of the universe was less than 10^8 qut, or 10^{-16} secs, G was greater than the 'electric force'. Calculations based on section 9A.5.3 show that after two seconds about 10^{48} particles would have been created. However, in the early universe, holes would occupy much of the tetrahedral volume.[25] Then, bearing in mind, that electrons need a minimum of 10^5 qul (Thompson 2024a§11A.9) distance from a proton, the available space for neutron decay would be reduced – thus creating a high probability of a heavily neutron dominated universe, as opposed to standard ideas where hydrogen was expected to predominate.[26] After about 380 000 years G would have been 8.75×10^{27} times stronger than now.[27]

[25] These holes would be spaceless-Timeless gaps in the relativistic 'fabric' of space.
[26] Dayal (2018:12)

This is the estimated age of the cosmic microwave background radiation (CMBR) when photons from the nascent universe were first released.[28] Since it is impossible to know the exact division of space-Time to holes in the space-Time lattice I can only assume that at this point in the Universe sufficient protons, electrons and neutrinos (see section 9A.5.4) had formed to overcome the retarding effect of super-gravity – which only acts in the space-Time parts of the lattice, not the holes.

Furthermore, where the lattice holes appear, there will be no connecting space for particles, particularly gravitons, to move through. Consequently, instead of 'ultra-high *G*' leading to a single solid mass of particles, a number of conglomeration points would have arisen. Then, when the neutrons decayed, particles with a wide range of velocities up to 0.8*c* would have appeared (section 5.3.4.) resulting in strong rotational motion. Instead of just neutrons, each conglomeration would have drawn in increasing numbers of protons and electrons. Under the great pressure (see next section) these would have fused (recombined to form neutrons)[29] together more rapidly than in today's universe. Consequently any stars formed would have been unstable and very short lived. Recent observations seem to fit this possibility.[30]

7.8.2 Black holes, pulsars, et cetera [31]

The combination of super-gravity and pressure exerted by the fusion process would have caused the central particles of these first stars to be crushed together until they were in complete contact, further contraction being excluded by the uniqueness constraint. Such an accumulation could have contained billions or trillions of nucleons. Some of these conglomerations or star-cores may have been destroyed as the stars exploded, but the explosion itself and the super-gravity may have held some of these dense cores together. Then, by the principles outlined in sections 6.7 and particularly 6.11.2, their internal gravitational field would be strong enough for them to remain stable as *G* fell. Their external gravitational field today would be 10^{16} times stronger than a piece of Earth of the same size. This is strong enough to fit the standard concept of a black hole.

Sections 5.3.3 and 7.11.2 Figure 6.6b suggest the nucleons could be arranged in such a way that their $\dot{\xi}$ -photons (the ones responsible for both velocity changes and the human idea of electric charge) pass out in either direction along one axis. Then the nuclear gravitons are produced and travel orthogonally to this direction. If the core rotates about an axis that runs through the polarized beam of $\dot{\xi}$ -photons they will not tend to interfere with the nucleons making up the core. Nor will the gravitons, or surrounding strongly curved space, interfere with the $\dot{\xi}$ -photons as they pass directly outwards; it is only photons travelling towards or closely past the core that would be bent into it. So the polarized

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[27] 380 000 years ≈ 1.2×10^{13} qut. Using this value in equation (3.1) gives $G(1.2\times10^{13}) \approx 5.5\times10^{17}$.
[28] Weinstein (2004:6)
[29] See e.g. Goldberg and Scadron (1995:174)
[30] Smit (2018)
[31] Cf Goldberg and Scadron (1995:257-284)

beam doesn't have to remain in a fixed direction; it could sweep through space like a lighthouse. The energy of the beam would depend upon the rate of rotation of the core and the gravitational force holding the core together. The equations of motion suggest that a proton absorbing a photon close to the beam's source could attain an energy in the region of 10^{22} eV travelling at the speed of light. Such objects have been recorded.[32]

7.8.3 Particle creation

According to RST the number of nucleons created is proportional to the square of the Universe radius (see section 9A.5.3) but they are only produced from areas where new space-Time is generating.

Creation of particles would not be observable on or around Earth because first, the ratio of the number of particles created, currently about 10^{41} per qut (10^{65} per second), compared to the volume of the universe, 10^{123} cubic quls (10^{70} cubic kilometers), is about one particle per million cubic metres per year. But, secondly, the creation of particles requires the formation of rings, or gaps in space-Time (Figures 5.1, 5.3 and 5.10). Where the universe is densely packed with particles, around planets and stars, all such gaps would have long been filled in, so creation of matter in our immediate vicinity is likely to be non-existent. Although in terms of the total universe volume the creation of matter would be tiny, in terms of the creation of *new* space-Time the creation of matter would be much larger: about 10^{22} particles per cc per second. Production points would be observable because particles would often be produced with relativistic speeds attached to them so that they would radiate high frequency photons. If these should appear from otherwise apparently empty, or diffusely populated space, they would indicate areas of particle creation. The greatest production of these particles can be expected around the perimeters of the Universe and
galaxies. A rough calculation of particle numbers is given in addendum 9A.5.3.

7.8.4 Big bang, horizon and flatness problems, and accelerating universe

Three major problems associated with the big bang are rendered unnecessary in the Time scheme, but need, for the sake of completeness to be raised. The first two are the horizon and flatness problems referred to by Guth.

The horizon problem has already been mentioned. It arises from the apparently almost universally uniform cosmic microwave background radiation, CMBR[33] which is thought to have been emitted approximately 380 000 years after the big bang and yet is reaching us now from every part of the universe *including the edges* thus considerably increasing the distance it could have travelled in that time. In the RST universe light from the edges is created from the formation of new particles at the edges which fits observations from the earth orbiting telescopes. That is, the light comes directly to us

[32] Linsley, J. (1963).
[33] (Penzias and Wilson, 1965, Dayal 2018:7:10, Kashlinsky 2008)

but we can only see as far the light takes to travel. As the Universe ages its edge becomes further away from us so there would be a limit to how far we can see at any given time. The more powerful telescopes merely allow us to see much more diffuse light from deep space rather than an increase in distance.

The 'flatness' problem concerns the energy density of the universe. To find the universe in an almost perfect homogeneous and isotropic state 13.786 billion years after it started to grow seems extraordinary considering all the possible variations in force which must have taken place during and after a hypothetical big bang. In the RST universe everything obeys the causal rule so there should be no surprise that space is homogeneous (allowing for its holes), and isotropic.

The third problem, acceleration, arises as a result of observations made by Perlmutter et al. in1998, Guzzo, Rubin and Hayden (2016) and disputed by Nielsen et al:[34] the universe is believed to be expanding at an increasing rate. This might seem to conflict with RST in which the radius of the universe increases at a constant rate, *c*, while the bulk of matter is created at the edges of the universe as it ages. In the early universe, when *G* was very large, creation of new stars would have been pulled closer, due to the gravitational attraction, to the main body than now. As *G* fell, so the gravitational attraction towards the centre would reduce. Consequently, new formation of gas clouds would have taken place at relatively further distances per unit of time from the main body until the rate of visual increase approached the rate of universe expansion, *c*, giving the false impression that the relativistic spatial radius is increasing at an accelerating rate. This formation of new stars and galaxies as the Universe expands also allows a reasonably standard CMBR as new particles are produced – there is one major exception, see section 7.10. Thereore none of these problems arise in the Time evolution of the universe as derived, and thus Guth's inflation theory is inconsequential here. Furthermore, the Time explanations may be considered a partial test for the correctness of the Time scheme.

7.9 Contraction and Expansion epochs

According to the previous sections, the existence of Time requires the existence of counteracting spins, $\dot{\theta}^+$ replaced by $\dot{\varphi}$ for the macro-Universe, and the balancing spin, with maximum rotation *w*. $\dot{\varphi}$ places new lattice points, and particles produced, at an increasing distance from a given origin in the relativistic representation as the universe grows. As in section 4.4.1, *R*, the Universe radius, multiplied by $\dot{\varphi}$ to give the tangential rate of rotation, must remain constant at *c*. If *w* is the maximum spin of the universe and $\dot{\varphi}$ reduces every qut, there will be an age of the universe T_w when $\dot{\varphi}$ = *w*/*w* = minimum (it cannot pass to *w*/(*w*+1) because *w* is the largest possible number of quts if $\dot{\varphi}$ reduces every qut. Then the balancing spin must start from one and increase until it reaches the value *w*. Humans would

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[34] Guzzo (2008), Perlmutter et al. (1998), Rubin and Hayden (2016) and disputed by Nielsen et al. (2016)

give the balancing spin at any given Time the mathematical value '$w - \dot{\varphi}_A$' (A being the value of $\dot{\varphi}$ at a given age of the Universe) keeping the natural representation volumeless. An observer at the origin only notices the $\dot{\varphi}$ spin so that the space-Time lattice appears to build along spiral paths.

As there is no macro-universe spin smaller than w/w, $\dot{\varphi}$ and T_A must reverse themselves when $\dot{\varphi}$ is a minimum = w/w. Then T_A runs backwards towards 1 starting a contraction epoch. The $\dot{\theta}$ spins must also reverse direction and as a result the internal spin produces anti-space-Time. As the $\Im$s materialize their rotation additively annihilates with the rotation of the old expansion epoch so that the space-Time lattice disappears. Even though space-Time is contracting it can still produce particles. In this new epoch all their rotations are reversed so that not only will the old epoch neutrons, protons and electrons annihilate with their new epoch equivalents but so too will the photons, neutrinos and everything else when they meet their nemeses. When η has returned to w the universal *relativistic* radius will be 'zero' and there will be nothing left other than the counteracting spins of the null point. A new expansion epoch then begins, still with the $\dot{\theta}$ spins reversed (and also the balancing spin) so that an antimatter universe results until T_w is reached; and so on *ad infinitum* producing a succession of matter and antimatter universes between contractions. T_A is thus periodic but computer capacity at present is not large enough to calculate T_w, and thus w. As the only 'set of rules' are those given in the previous sections all these expansion epochs have the same constants and form, the only difference being whether they consist of matter or antimatter.

Gravity also varies: as the end of the expansion epoch approaches, gravity reduces to zero. When $\dot{\varphi}$ increases after T_w, gravity reverses direction. This will not destroy the annihilation process because the apparent volume of the universe decreases and, as multi-atom objects will no longer exist, the anti-graviton distribution will be approximately uniform. Consequently anti-gravitons will cause particles and anti-particles to collide with each other as much as separate.

Note that natural causes do not require a predetermined value of w. As zero does not exist in the RST system there is no measuring scale corresponding to the invented concept of $T = 0$. The scale only commences when $T = t = 1$ and continues increasing until $T = T_w$ qut which can then be used to give a 'value' to w. The value itself only arises in terms of the human concept of natural numbers and is only of use in human calculations.

7.10 Is there an 'Axis of evil'?

According to RST the Universe develops in the form of a cone which gradually fills in. New triple-triad type particles can only be formed in the lower reaches and obviously cannot be formed above this cone. Drawing this cone as in Figure 6.4 with the pinnacle arbitrarily at the top, the cone expands downwards and outwards at the speed of light. As photons, ξ-photons, Δ-photons and gravitons or neutrinos can travel in any direction,[35] those that travel at more than 45° below the horizontal plane will never reach the edge of space as they cannot travel faster than its expansion. But if the photon travels outwards above this 45° line upwards, it travels towards a fixed side which it *can* reach. However, it can collide with other photons which may deflect it downwards as well as upwards.

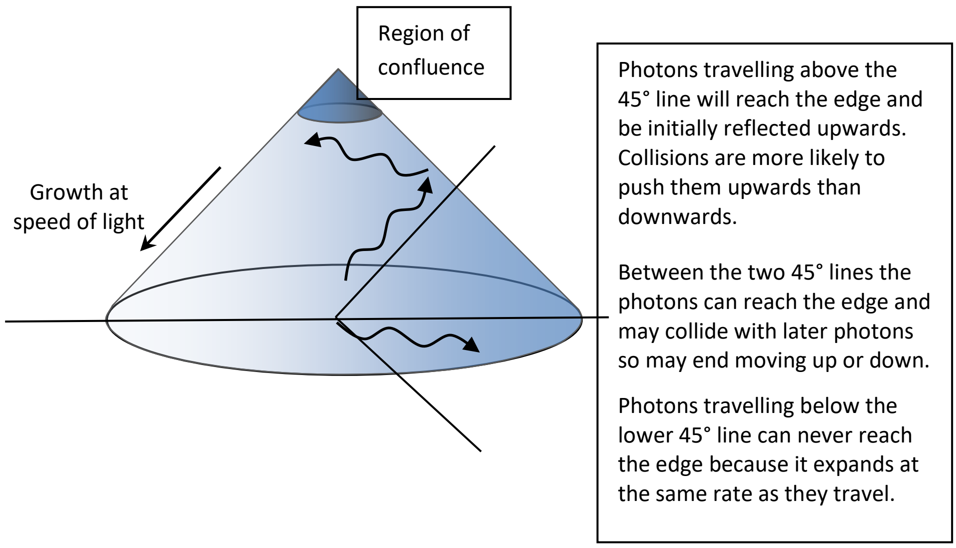

Figure 7.4. The Universe expands downwards (for convenience of expression only) in the shape of a cone which fills-in in the centre over time.

The triple-triad density should be marginally denser higher up the cone as the coincidence rings will have been mostly filled in compared to the formation of new rings lower down. Against this the density of upwards moving photons from the much greater volume of the lower reaches increases. Diagram 7.4 shows that, although there will be a tendency of the upwards moving photons to be reflected downwards, should they have a second reflection off the cone edge, the increasing number of upwards moving photons may reverse these reflections so that there is a gradual increase in the upper parts of the tetrahedron.

The further upwards a photon travels the more likely these collisions will reinforce its motion towards the pinnacle. Should the photon reach the edge, it cannot pass through it because there is no natural (and thus relativistic) space the other side. As there are fewer triple-triad type particles higher up the cone to absorb the rising photons, while the space becomes more contracted, the upper parts, or '**region of confluence**' will become chaotic under the pressure of the rising photons.

In this region of confluence, the field should be approximately electrically neutral because there will be statistically as many positively spinning photons as negative. It should also contain a gas of free triple-triads, single atoms and molecules driven upwards as the photon flow intensified. The number of internal collisions will increase dramatically as the cone fills up. One might therefore expect an

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[35] Triple-triad particles can also travel upwards but need a force applied to them to give them such a motion.

increasing probability of collision between $\dot{\xi}$-photons of the same species, that is two negatively or two high rotational positively spinning photons to create positron-electron pairs;[36] with on average 10^{41} photons (see 9A.5.3) in the Universe for every triple-triad this would not be an unlikely event. These would each emit gravitons, even if only for a few nanoseconds before they revert to photons, in this time emitting perhaps 10^{12} gravitons. The expectation would then be, due to increasing pressure at the pinnacle, many photons, in particular gravitons, would be returned to the lower parts of the universe (despite a large number of collisions with the upwards moving photons) thus creating an incongruous gravitational attraction in the direction of the upper part of the space-Time cone.

RST, then, does not seem to give a nice spherical Universe that is the same in every direction, although it is really only a small part of the total universe that is 'anisotropic'. The basal disc expands to produce a universe very much as we see it.

This confluence would appear to fit in with the concept of the 'Great Attractor', a point in Centaurus to which the Milky Way galaxy appears to be moving at about 370 km s^{-1}.[37] However, recent research has shown the Great Attractor to be a cluster of galaxies which itself is being pulled towards an even bigger super-cluster of galaxies, the Shapley cluster.[38] In turn this appears to be pulled towards bigger super-clusters about 2.5 billion light years distant from Earth. Reporting on this phenomenon, known now as 'dark flow', Kashlinsky et al. state:[39] *"…Our findings imply that the Universe has a surprisingly coherent bulk motion* [at a rate of about] 600-1000km/sec . .. *Such a motion is difficult to account for by gravitational instability within the framework of* [standard cosmology]*"*.

Kashlinsky's observation at first appeared a possibility following mappings of the cosmic microwave background radiation (CMBR) discovered by Penzias and Wilson in 1964. This is assumed to be a regular constant radiation from all parts of the universe emitted approximately 380 000 years after the initial 'explosion'. The first maps were created from the NASA Explorer mission WMAP followed by the Planck satellite scan for anisotropies.[40] The early results suggested that anomalies might exist, one of which was named the 'Axis of Evil' because it led to difficulties in measuring the mass of the superclusters.[41] Along this axis it appears that light may be more polarized than elsewhere. It also appears there may be a slight difference in energy (heat) from one side to the other which seems to me to be indicative of a universal rotation about this axis. However, by far the most significant point was that, as pointed out by Raychaudhury, the Shapley and other associated superclusters appear to be moving directly towards the top (warm) pole of the axis, although these superclusters being much later in construction would not have even begun to exist when the afterglow of the universe became

[36] see e.g., Golding and Scadron (1995:2)
[37] Proust (2006)
[38] Raychaudhury (1989)
[39] Kashlinsky et al. (2008:2)
[40] Clements (2017)
[41] see Sowinski (2014)

observable. Nevertheless, the pinnacle, or region of confluence, of the RST cone is fixed in relation to the Universe expansion and the motion of these superclusters appears to be exactly towards RST's expected enormous gravitational field that should now exist there. It also appears that there is a huge void in Eridanus according to Kovács and García-Bellido[42] which could correspond with the RST universe being increasingly hollow closer to its base, as suggested by section 5.2. This void would then correspond to the lower end of the axis. Note that though the Shapley and associated clusters and the supervoids are much more recent, the general shape of the Time scheme Universe would have been well formed by 380 000 years after its birth.

However, the latest Planck scans (Planck Collaboration 2018)[43] claim that there is no evidence to support Kashlinsky et al's hypothesis. But as the Planck measurements are interpreted in terms of standard theory, and in view of the comments made elsewhere in this thesis, particularly in Chapter 5, this matter should be held open on the premise that there are always alternative explanations to any given hypothesis.

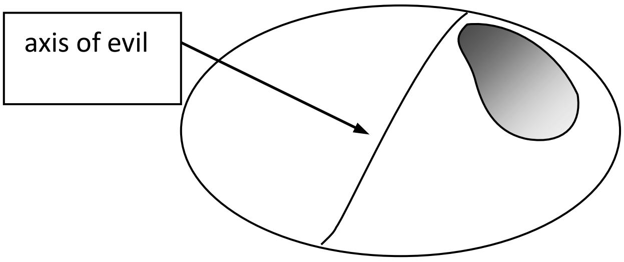

Figure 7.5 an artistic reproduction of general view of WMAP axis of evil based on NASA release https://www.nasa.gov/centers/goddard/news/releases/2010/10-023.html retrieved 15th July 2016. The dark patch represents the position of the galaxy clusters.

This gives a brief, but general description of how the RST system would see the Universe. To complete the foundational formulation it is necessary to consider its role in the formation of atoms, molecules and the fundamentals of chemistry

7.11 Nuclear structure

Very little is known of nuclear structure [44] – "*Nature has guarded her secret recipes as vigilantly as the Coca-Cola Company*".[45] And it is not a subject that appears to have interested philosophers, which is surprising considering how little is known about it. Mostly, it is viewed in terms of bags, shell and liquid drop physics.[46] However, sections 7.11.2-3 lead directly to a formulation for the structure of atomic nuclei and also to significant thoughts concerning chemical reactions. These tend to be very

[42] Kovács and García-Bellido (2016)
[43] Planck (2018:42)
[44] Nazarewicz (2016:3)
[45] NRC (1999:29)
[46] as for example given by Hartmann (1999); Ragnarson and Nilsson (1995: 29-53; (Jelley (1990)

simple but surprising. The subject of creating structures for all 92 naturally existing elements according to the RST system is far too large for this treatise; even running through the few elements covered, hydrogen through to nitrogen and then phosphorus, is enormous so these will only be *briefly* dealt with except for carbon which will be treated as an example. The reason for this inclusion is twofold: to give an overview for further work, and to show RST can answer the problems of nuclear and atomic structure (which was one of the first concerns I checked in formulating RST).

7.11.1 According to the standard theory:

One of the principle naïve difficulties in standard theory is that of charge. It dictates that the nuclei should fly apart, as repulsion of like charges in nuclear radii terms would be extremely high, it having assumed that the Coulomb field is continuous about particles.[47] For example, consider an electron. To be an electron it must have a 'negative' electromagnetic field. Then the continuity itself causes a problem because, if an electron gives off a continuous field, the field itself has a Poynting vector denoting energy transfer.[48] Under the continuity concept it must then be generating energy, but from what? It cannot be from velocity because this varies, whereas the field is defined as constant, falling off only according to the inverse distance law. If it is assumed that an electron gains enough energy from surrounding fields to replace its own emissions the following problem emerges. Consider an electron in an empty space. Suppose that another electron passes into its vicinity, then the two particles depend on receiving energy from the other before they can emit their own field.[49] They will then have no mutual repulsion. This question must be equally true of protons. How, for example, does a single proton hold an electron in orbit except by a Coulomb force? How does this relate to the negative field of an electron?

It should be clear that (1) understanding the nature of the Coulomb force and the cause of repulsion and attraction, supposedly due to electric charge, is necessary to ascertain how nuclei can be constructed, and (2) these need answers to the fundamental nature of matter, and perhaps of existence, that governs the nature of matter.

A further naïve concept has been that neutrons intervene between protons in the nucleus as a shield against charge, or, closer to contemporary ideas, that protons and neutrons form constantly interchanging nuclear pairs. It has also been suggested that nuclear particles constantly alternate between pions and themselves. However, the latest hypothesis, originating from Zweig (1964) and Gell-Mann (1964) believes that protons and neutrons are formed around a generation of quarks, the *u* and *d* quarks. The exact nature of how they might operate is unknown for certain, but it is assumed that the proton consists of three quarks *uud* and the neutron of *ddu*. These are assigned 'colour' to

[47] see Bueche (1977:369)
[48] Krauss (1984:465)
[49] cf Frisch (2009:10 asymmetry of fields); also Hawking and Mlodinov (2011:103)

codify the flow of force (strong force) between them (Greenberg 1964). The force is mediated by gluons in such a way that it strengthens the further apart the quarks might be pulled with the result that the quarks are confined, so explaining why no single quarks have been seen on experimental credibility).[50] This does have some affinity with the foundational principle of Time as follows.

The quark system relates to the Time scheme via the standard physics concept of charge, where +2/3 is assigned to the *u* quark and –1/3 to the *d* in standard theory. Recalling that charge is equivalent to rotation in RST, if two of the three sail-like triads of the proton in Figure 5.12 are arbitrarily assigned a value +2/3 and the third –1/3, the scheme falls exactly in line with the quark system: If the proton changes into a neutron one corner of each of the sails has to reverse its spin direction so that the two 2/3s become –1/3 and the –1/3 becomes 2/3. This is compensated by the absorption of an electron thus leaving a neutral particle, as it should. Note that the rotation arrangement of the 'sails' does not allow a triple-triad particle to exist equivalent to a mixture of quarks and antiquarks, confirming the principle established in standard group theory.

Finally the mesons: The structure of the double-triad is inherently unstable. It could only survive for more than a few qut (see Thompson 2024a:§10.3.1) as a particle if it incorporated a synchronizing spin similar to that of the neutron. In this case the double-triad can only exist in a form corresponding to a quark-antiquark pair. Because of its structure, it would have to decay into leptons and/or photons, as is found with mesons in experiment. So the RST and the standard theory arrive at the same *natural* results. They are just from completely different basic positions.

7.11.2 Nuclei according to the Time scheme:

As in section 5.4.2, the Time scheme provides protons and neutrons with definitive structures which emit photons in specific directions with respect to their orientation. Unlike the expected repulsion of nuclear protons in standard theory, the fundamental formation of the $\dot{\xi}$-photon field raised in Chapter 5 would allow protons and neutrons to rest in contact with each other without electrically interacting. It should then be possible to arrange their orientation so that their $\dot{\xi}$-photons do not intercept another proton in their grouping.

I am only going to consider the formation of atoms in the early Universe where the gravitational constant was very high. I do not feel RST is likely to change current thoughts of the formation of stars and galaxies as given in the literature, for example, in Goldberg and Scadron,[51] so I shall not go into this subject although I shall have to describe the current concepts of atom formation in stars later in this section.

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[50] Peskin and Schroeder (1995:548) see also Fox (2009:180-182)

[51] Goldberg and Scadron 1995

RST construction in the early Universe expects an exceptionally strong gravitational field so causing particles to be pulled together as described in section 7.7. The field is further enforced due to the increasing number of particles in a small volume. This means that the number of gravitons pulling nucleons together increases the nucleon velocities (and their $\dot{\xi}$ rotation) towards each other sufficiently to overcome the repulsive ξ-photon (Coulomb) flow in the opposite direction. In standard terms, the nucleons are under sufficient pressure to be forced together. Under these circumstances the 'pressure' would ensure that the nucleons combined into the smallest possible volume without intersecting each other.

As a consequence of the directed photon emission of force by particles (section 6.2.3) which dictates exactly how nuclear particles must combine together, models or graphics can be easily set up to give possible structures. The result suggests that, apart from hydrogen, the helium nucleus, being the most symmetrical and simplest composite formation, is the most stable and forms a basis for more complex nuclei – as expected by standard theory. Taking into account the enormous pressure of formation, the triple-triads must arrange themselves into the smallest possible volume without intersecting each other at any stage of their rotation. The models/graphics then determine that the neutrons form a central single ring structure up to fluorine, and double (closed 'figure of 8') rings up to chlorine. This allows gravity to hold the neutrons in place with the protons bound to them also gravitationally, so that, taking into account the directed emission processes described in section 6.2.3, the ξ-photons pass without obstruction from the nucleus. The action of gravity described in section 7.7 is particularly suited to this arrangement as it causes the immediate receipt, each qut, of gravitons between the neutrons. Similarly, the protons can be orientated to exchange gravitons with the neutrons each qut. Then as the nucleus itself rotates, an *apparently* continuous $\dot{\xi}$-photon field would be created about it where electrons may be captured. Surprisingly the models show that protons must bind to the neutron at 19.18° (the β-orientation angle of the proton). This, quite simply, provides the general nature of nucleon combination to form nuclei.

The structure of a few simple atoms will now be described within this context. To detail every atom would be beyond the aim of this work, so this section is only superficially explained with just carbon being given a diagrammatical treatment as it gives the general idea behind the neutron-proton arrangements. Section 7.11.3 will then investigate major considerations that arise from building these nuclei throwing new light on the role of neutrinos.

Because hydrogen (^{1}H) is a single proton nucleus its method of bonding to an electron will be different to all other elements. The Time concept shows that in atoms such as lithium, the proton has to adopt a specific orientation so that its $\dot{\xi}$-photon emissions do not interfere with the other nucleons. This means that the outer electron would not orbit around the nucleus but would always orbit to one side. In the hydrogen atom the processes outlining electron orbits (Thompson 2024a§9A.9) would cause the electron to pass around the nucleus. This special hydrogen orbit has further implications. For example, if two oxygen atoms bond, the shared electrons would orbit in a plane that lies between them. But for hydrogen, if another atom gains a share of its electron, the motion of the hydrogen nucleus would change so that the electron still passes around it. Only hydrogen would react in this way because its nucleus consists (usually) of a single proton. As a result it would easily form and release bonds, and in particular, whereas other atoms would only be able to bond on the side in which their electrons orbit, hydrogen can bond in any direction. In general, a chemical bond is formed simply by an electron oscillating between two atoms. The form of the oscillation would depend on the structure of the relevant nuclei which may be either electron donors or recipients.

After hydrogen, the Time scheme places helium as the most symmetrical, and efficient, arrangement of any nucleus. Its two neutrons conjoin diagonally with the protons filling opposite corners, see Figure 7.6b. This structure would be gravitationally extremely ‘strong’ as all the neutrons are in complete contact with each other. As a result, in nuclear synthesis new elements would be forged as near as possible around this basic design. Because of its symmetrical arrangement, all four nucleons will have similar radii of rotation as the nucleus itself rotates. This gives helium the lowest possible average nucleon rotation (lowest average value for the $\dot{\xi}$ rotation, or in standard terms, lowest energy (see Addendum)) of all the elements apart from hydrogen. The result would be that the electrons could pass around the nucleus without losing contact making an exceptionally strong connection.

In the lithium nucleus, the helium base remains intact and its associated electrons would still be strongly connected. Models show that two additional neutrons would be required forming a ring against which two of the protons bind to the neutrons as close to inside the ring in helium formation as possible. The third proton has to bind externally. The third proton’s greater rotation radius, as the nucleus rotates, means that it travels faster than the inner protons and thus its $\dot{\xi}$-photon emissions would carry a higher $\dot{\xi}$-spin. Its associated electron therefore travels faster with a larger orbital radius (Thompson 2024a§9A.9) and is always to the proton’s side of the nucleus allowing it to be more easily torn away.

Beryllium would require another variation. Its atom has four protons suggesting that it should be the combination of two helium groups giving it four neutrons as well. However, this does not form a stable arrangement as two of the protons would be conjoining (thus interacting); while the helium nuclei can be brought together in a star, as soon as the pressure is removed, they will tend to disintegrate unless the extra neutron is included. The result is that the five neutrons of beryllium form a pentagon with two protons inside the ring and two outside. This is more symmetrical than lithium with the two outer protons being attached more closely to the centre of nuclear revolution than the single external proton in lithium. Consequently, the radius of the outer two (valence) electrons will be less than that of the lithium atom and will be more tightly held. Additionally, the two valence electrons, being symmetrically arranged can be held by either proton. As a result, the theoretical size of the lithium atom should be larger than that of the beryllium atom and the latter should be less reactive – as observed in experiment.

Oxygen is an interesting example of an atom that mainly gains electrons. It shows that according to the new theory this trait in any electron acceptor is due to the nuclear structure rather than the standard shell theory, which is only incidental. It is also one of the most densely packed nuclei. As the number of *outer* protons increases (see shielding effect later), the number of positive spinning $\dot{\xi}$-photons passing out of the nucleus increases compared to just the one outer stream (i.e. ignoring the inner protons), say, in the lithium atom. Only very few of these photons will be absorbed by the orbiting electrons leaving a large number free to be absorbed by other nearby electrons; so if a donor atom is nearby its electron may be 'attracted'. The oxygen model is a direct combination of four helium nuclei producing an octagonal neutron ring with four protons inside it and four outside. This can be achieved with minimum volume only if the outer proton pairs have an angle of 104.5° between them. Then the simplest bonds (with hydrogen to give water) will be set at this angle as found in experiment.[52] The Time structure of carbon and nitrogen nuclei also corroborate with bond angles observed in experiment.

Oxygen is an oddity as, of all the atoms, this one possible arrangement places its outer protons in the plane of rotation of the nucleus. This means they have to be positioned in pairs on alternating sides of the neutron ring. Their associated electrons will thus orbit in pairs with only a very small separation of just six quls between the electrons in each pair. This separation is too narrow to allow more than one helix path of an orbiting hydrogen nucleus. As a result, although there are four external electrons, only one electron from each pair can bond with a hydrogen atom. This can be either of the two electrons per pair so that the bonds between oxygen and other atoms are much stronger than would otherwise be the case. Of the four protons inside the ring there are two that stick out slightly above and below. These create two separate electron orbits corresponding to standard theory's lone pair. See for example, Voet and Voet for detailed description of oxygen-hydrogen bonding which fits the RST atomic structure.[53]

Nitrogen and phosphorus: Models show that nitrogen being the next element after carbon, has a similar structure. The main difference is that the neutron ring contains an extra member making it a heptagon. This gives room for the additional proton to reside *inside* it. A similar case applies in phosphorus except that two heptagons form a double ring joined by two extra neutrons. Both these cases create the tetragonal arrangement of the valence electrons also found in carbon (as in Figure 7.6). The arrangement suggests that the extra internal proton could create many of the biochemical properties special to these elements. This RST model concept would be more pronounced in

[52] Engel and Reid (2006:555)
[53] Voet and Voet (2004:39-43)

phosphorus than nitrogen. In the latter it fails to create a fifth bond because, as the model shows, the associated electron would travel well within the orbits of the outer electrons and is shielded by them. Nevertheless, this inside proton, and associated electron, may activate amino acids to form proteins. The important radical is ammonia and in essence this is attached to a carbon chain when an amino acid is formed. This arrangement suggests that when two amino groups join to form a peptide the reactive parts use nitrogen's inner electron to create a nitrogen-carbon bond. The outer electron it replaces becomes redundant because these two electrons essentially have the same orientation in relation to the nucleus, so they cannot both connect to atoms at the same time without a collision. On the other hand the outer electron becomes a 'prison gate' so that the carbon-nitrogen is a short strong bond as seen in experiment.

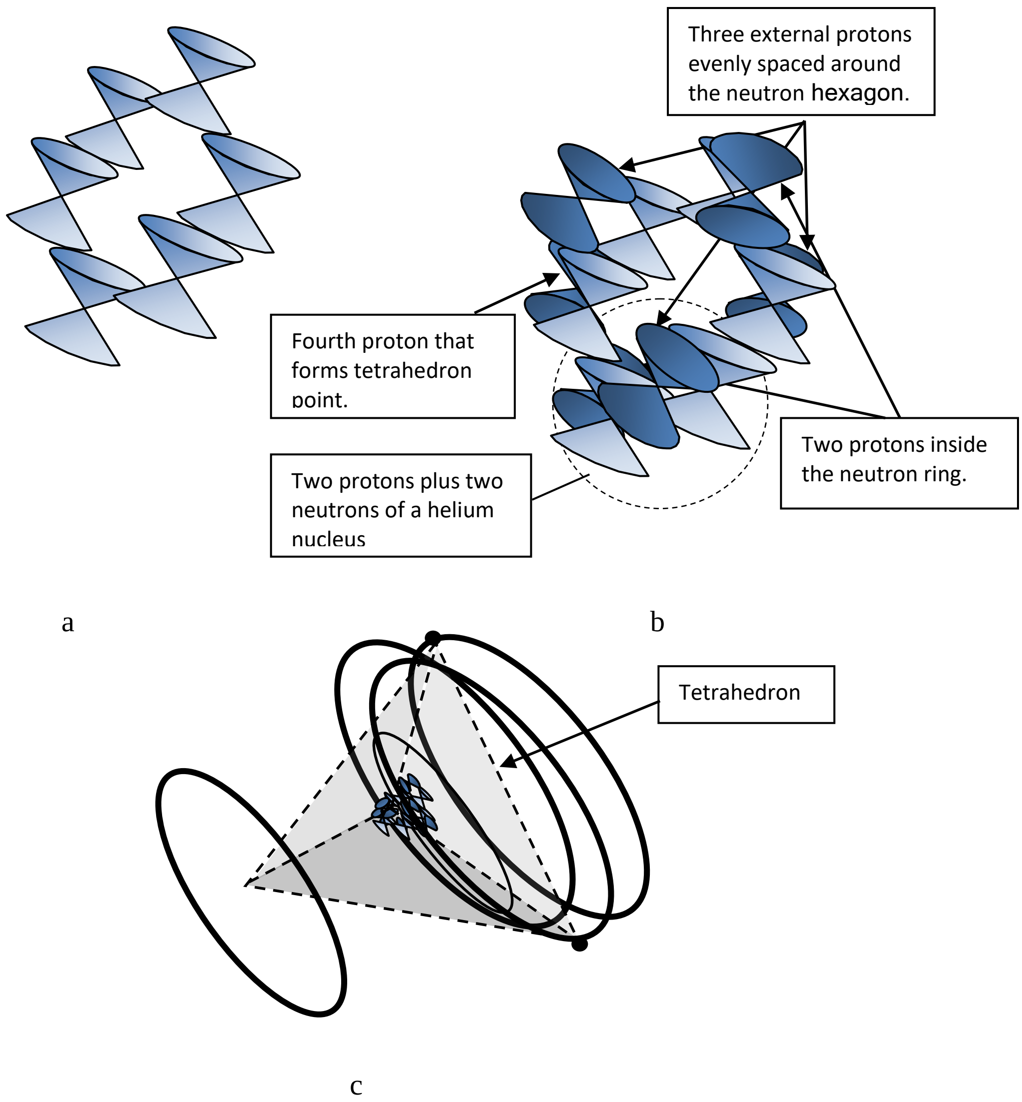

Figure 7.6. The Time structure of the Carbon nucleus as determined by modeling and graphics. The nucleus consists of six neutrons, pale grey, and six protons, dark grey. The neutrons form a hexagon as in diagram (a). The arrangement of the helium building blocks is clearly visible in diagram (b) as each consists of two protons and two neutrons. Two protons lie fully inside the hexagonal ring of neutrons and a third is partly inside. The other three stick out around the

outside. The nucleus is held together by gravity and rotates as a unit about the centre of the hexagon, which means that the outer protons have to travel further and faster than those inside the hexagon. Unlike in standard theory, the corresponding electrons then also rotate faster than those associated with the inner protons. Their orbits are shown by the rings in diagram (c) (not to scale). The thin ring represents the orbits of the electrons belonging to the two innermost protons; these will be shielded by the outer electrons. The other rings at the top of the tetrahedron represent the orbits of electrons belonging to the outside protons. The fourth heavy ring at the point of the tetrahedron belongs to the electron of the remaining proton. Only the four outer electrons can form bonds, the positions of which are determined by the protons forming the corners of a tetrahedron.

Carbon consists of six protons and six neutrons. These numbers are exactly equivalent to three helium groups and, perhaps unsurprisingly, this is how the models based on the Time concept arrange the carbon nucleus. This makes it one of the most symmetric elements. Nevertheless, this symmetry provides a wonderful variety of possible bonds with other atoms. The structure given by the Time mechanism is unique because it is the only one to contain six neutrons arranged in a hexagonal ring, and its six protons arranged symmetrically, so that three fall evenly spaced outside the ring and two inside as shown in Figure 7.6 a and b. The two internal protons are much closer to the axis of rotation of the nucleus; thus their electrons have a much smaller orbital radius than the others and are both shielded from bonding as well as being more tightly held to their protons. The sixth proton is attached between two of the three symmetrically placed outer protons but, whereas they radiate their photons upwards in the figure, the sixth proton radiates downwards thus placing its electron in an orbit at the point of the tetrahedron.

Organic bond structures and equivalent chemistry fill an entire discipline so will not be considered here. But a look at the projected electron orbits in Figure 7.6 seems to suggest that they may fit closely the angles and radii found in experiment. Instead a much more important subject is raised in conjunction with these composite atoms which solves one of the greatest mysteries of current physics (and astrophysics).

First, the Time scheme deduces that the orbits of the electrons always have to be in the same direction as the rotation of the protons. Second, the protons all have to rotate in the same direction in the nucleus so that they don't interfere electrically with each other. In any case they are all bound to the neutron rings. This at first sight may seem to indicate that no photons can be emitted downwards to form the peak of the tetrahedron. However, recall how the basic particle, the neutron is created. The $\mathfrak{I}$s that form it had to reorient and, (see Thompson 2024a:§9 A.5.5) this can take place in one of two directions giving the Stern-Gerlach effect. This means that for half the particles created, the photons can and must be emitted in the **up** direction, shown by the pair of axes in Figure 6.6b, while for the other half they can and must be emitted in the opposite **down** direction.

The impact is seen in the projected formation of nuclei. The process, according to standard theory, starts when the internal pressure of a star, such as the sun, causes a proton and electron to form a neutron.[54] This neutron subsequently binds with other protons to form, first, a deuteron and then a ‘light’ helium nucleus. The latter has just one neutron which means that only one of the protons can have a gravitational binding to it resulting in an unstable combination. Consequently two of these light helium nuclei have to combine to give the usual two neutron–two proton formation (leaving two protons over). This process is given two twists in the Time scheme – both completely unexpected in standard theory: the first is that the protons can only adhere (gravitationally) to the neutrons provided one of the two is an ‘up’ nucleon and the other ‘down’ (in the Stern-Gerlach sense as in the previous paragraph). In the case of more complex atoms similar states arise so that, for example, carbon has three up protons and three down and similarly for the neutrons. Solving the second twist requires new information not yet uncovered.

7.11.3 The role of neutrinos

To see the second twist it is necessary to look at the equations of motion (9A.4). Solving these by trial and error was useful as it became apparent that a change in the $\dot{\beta}$ and ξ orientations gave significant differences in the corresponding velocities. These angles are fixed for the neutron, proton and electron but it was apparent that if the $\dot{\beta}$-angle of the electron were to be increased by 90 or 180 degrees, particles with reduced velocities might be created. The first gives a particle with u-velocity reduced by 207.74 times and the second a reduction of 3486.109 times (Table 9A.8). These are so close to the accepted ‘masses’ of the muon and tau particles that the concept can be assumed to account for their existence. They, according to the Time structure, have a helix path with cycles of approximately 10.5 and 8 qut respectively reflecting the greater ‘energy’ ‘stored’ in the $\dot{\beta}$-orientation component. The process appears to be that if a photon or ‘other particle’ carrying sufficient rotation/energy (for example an energetic cosmic ray in the high atmosphere) is absorbed by an electron, it would cause deformation of the electron in the form shown in Figure 2.1 to such an extent that the particle could not meet any constraints. But if the particle orientation changes, the high rotation (energy) is ‘siphoned off’ to maintain the orientation with a corresponding reduction in velocity.

The reverse is attained if the muon or tau absorbs less ‘energetic’ (lower rotation) photons and emits the excess angle in the form of a rotational particle. Similar types of particles can be found for the proton.[55] Standard physics has noted the emission of neutrinos in the electron-muon and tau processes which are filled by the neutrino in the above RST processes (cf Hughes 1985: 94-98).[56] Considering that the increase in electron orientation (relative to its spin) to produce a muon, or

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[54] see e.g. Goldberg and Scadron (1995:177-187)

[55] E.g. Higgs boson 3/2 generation proton. 2nd generation proton (cosmic ray) with energy 10^{21}eV (2024:§10.3.3)

[56] (cf Hughes 1985: 94-98)

discharge from a muon as it returns to an electron, has to be carried by some sort of particle, it would seem the standard theory's neutrino would be the RST carrier. That is, the neutrino carries 90 or 180º rotations in the β- orientation direction (i.e., higher $\dot{\beta}$). The same process occurs in the interaction when a neutron is converted to a proton plus electron and antineutrino, or vice versa[57] – a particle must be released to take away the excess spin (energy), or vice versa, with an antineutrino.

As an example of nucleus formation according to the Time scheme, should the nuclear protons in Figure 7.6 all rotate in the same direction, their $\dot{\xi}$-photons would only be emitted in one direction relative to the nucleus. Then all the electrons would be held on one side of the nucleus only. However, the formation of complex nuclei in stars would, according to the Time scheme, require specific gravitational binding directions of the nucleons: half must transmit photons 'upwards' and half 'downwards' in relation to their rotation. The necessary variation is provided by the Stern-Gerlach mechanism, which also applies to both the $\dot{\xi}$-photon and graviton fields. However, the correct number of 'up' and 'down' nucleons may not be present in a specific nuclear fusion cell, that is, a small volume created by stellar pressure where nuclei are created. Imbalances can be overcome if the relevant nucleons undergo a Stern-Gerlach change in orientation. This would be provided by neutrinos/antineutrinos operating on nucleon orientation angles by the 90 or 180º angle change as required (Thompson 2024a:§9A.5.4). This is not dependent on immediate availability as any imbalance can be corrected by the absorption or emission of one or more neutrinos *or* antineutrinos to give the required numbers of up and down nucleons. The required change in angle is 180º from 'up' to 'down' whereas different neutrinos give different angle changes so that the formation of helium, or more complex nuclei, may end up absorbing electron-neutrinos and giving off muon or tau neutrinos carrying rotational effects of 90 or 180º respectively in the RST model).

Specifically, therefore, when three heliums are forced together to create a carbon nucleus there must be three protons emitting photons in one direction and three in the reverse. This would be required to give the protons the correct binding directions so that their gravitons pass into the neutrons. The nucleus will split apart otherwise as soon it leaves the stellar pressure that created it – thus allowing a randomness in construction. In Figure 7.6 the lower inner proton obviously emits downwards. The other inner proton also does so, as there is plenty of room for its photons to bypass the other nucleons – all the nucleons rotate as a whole so that the emission directions in relation to each other are fixed fixed for the existence of the atom.. The fourth external proton originally belonged to the helium nucleus opposite so that it emits downwards while the other three external protons emit upwards. This means that as a result of the protons binding to the neutrons, their ξ-photons are dispatched in directions that will fit the orbits given in Figure 7.6. The same principle applies to all atomic nuclei.

[57] In physical language $n^0 \leftrightarrow p + e \pm \nu$ during the change of neutron (nº) to proton (p), e electron ν neutrino)

This process answers a current problem of observations of neutrinos on Earth not apparently fitting expectations of solar emissions based on current theory;[58] the number of electron-neutrinos is not as expected but if the mu and tau neutrinos are added in, then the total agrees with expectation. The current standard suggestion is that somehow the electron neutrinos change to mu and tau neutrinos before reaching Earth.[59] Thus, the standard theory sees two problems, the first being why should the neutrinos not all be electron-neutrinos; the second why and how do they change species during their travels?

The Time mechanism has answered the first problem and initially suggested the structure of a neutrinos allowed an irregular helical path which would give a varying straight line velocity which is what experiments measure. But this requires experimental research outside the scope of this article.

7.12 Chemical reactions

This brief section mentions in passing two important off-shoots of RST, one of which fits in with chemical investigations, but the second should perhaps before now have been considered in the philosophy of science concerning particle interactions and observations.

First, RST implies the electric field about a proton consists of a pair of $\dot{\xi}$-photons radiating out every qut in a single beam creating a discontinuous field. The proton rotates about 10^{16} times and emits about 10^{23} $\dot{\xi}$-photon pairs every second.[60] This mechanism creates specific bonding points and allows them to be broken. A broken bond is not reconstituted immediately because time is needed for a proton to pass a new photon to the electron. This can take several thousand qut, sufficient time for molecules in a reaction to reorganize. The strength and apparent type of bonding, and the possibility of protons attracting electrons from outside the atom is explained by the nuclear structure rather than by group quantum rules. While the structure builds up from element to element in an ordered way to give a general group system very close to that of standard chemistry, each structure has differences that explain variations from the group.

Atomic neutrality is statistically attained when the number of $\dot{\xi}$-photons emitted by a nucleus is balanced by the number of $\dot{\xi}$-photons emitted by the electrons. Because of the single emission direction of photons, the emission from orbiting electrons is polarized relative to their motion so that electrons from the same atom do not interfere with each other. Moreover, this directional emission also applies to protons, allowing the proton and electron to keep in touch. This leads to the second point.

It is only via these emissions that particles can be detected. Standard physics seems to have the idea that the particles themselves can be recorded; for example the concept of electron density in

[58] Goldberg and Scadron (1995:185)
[59] Bachall (2004)
[60] The rotation depends on the u velocity which on Earth moving through the expanding cosmos is probably in the relativistically affected measurement range. At c $\dot{\xi}$ will be approximately 10^{17}qulqut^{-1}

physical chemistry, which in the Time scheme would be interpreted as $\dot{\xi}$-photon field density.[61] This detection may be by direct response of a sensor to a particle's photon emissions or by interactions when a probe bounces off the particle's photon (discontinuous) 'field'. If the probe should hit the particle it will be absorbed, not reflected, with a change in the state of the particle. Triple-triad particles cannot come into contact with each other except in high pressure conditions such as in stars. Images taken of interacting molecules by noncontact atomic force microscopy appear to fit this concept.[62] The images show strong fields in the carbon rings and lesser fields where the directed fields are breaking down, in accordance with the principle that the photon count is unaffected by whether the photons have positive or negative rotation. The dark and light areas suggest, respectively, absence of field, and a background field of photons which would exist around any collection of particles.

7.13 Entropy

No mention has been made of entropy as it has no place in RST. RST's Universe has the same basic order throughout; stars may be created and burn out, galaxies may collide, but photon interactions ensure that out of death and destruction, new stars, galaxies and life, come into existence while the regular expansion creates entirely new formations until the Universe reaches its age limit. Then it contracts to start a new Universal expansion with the same constants and constructional form as all the others. Time itself is dependent upon rotation of a single entity (the outer rotating packet) giving rise to the relativistic formation of space-Time within that single entity. But externally all that exists is a single volumeless point outside of any Time interval.

7.14 Further explanation of our view of space-Time

Taking the above factors into account, the fundamental premise leads to a background which enables a Universe and all its fundamental structures to exist. In particular, the nature of this background which explains the existence of this Universe now appears complete. As this relativistic concept is beyond human perception I summarize it as follows. Rotation of a volumeless point leads to a progression of trace-points forming a volumeless (in the natural representation) lattice. The formation of this lattice causes the concept of direction and produces mobile points (particles) at specific places in the lattice. These mobile points can exchange position with the lattice points, and each other, to form groups of particles which can also move through the lattice (exchange position). Thus to an 'observer' at a particular point in the lattice, particles appear to move with respect to him. Their rate of motion depends on the rate at which they exchange position. The act of interchanging particle positions via trace-points fixed in the Universal lattice, due to rotation, gives this 'observer' a unitary concept which he *interprets* as a unit of space for every unit in Time. A change of one unit of space over a large number of units of Time gives the impression of large distances. Thus the macro-universe containing

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[61] (see e.g. Engel and Reid 2006:634)
[62] (Oteyza 2013:340)

10^{123} or more (9A.5.3), lattice points appears very large to us although in natural terms it has no volume.

Furthermore, each particle is at the centre of its own Universe, and on the larger scale each fixed group of particles and each observer is at the centre of its own Universe. Thus their quantum units for all particles at rest in their Universe are absolute, meaning that all particles in their frames of reference relatively at rest to each other all blink in and out of existence at the same instant – the instant being dictated by the progression of Time in quantum units relative to their frames of reference. The same goes for larger 'observers'.

Hopefully this explains how the universe around us could be built from a totally relativistic Universe which in reality (natural representation) occupies no volume. The next Chapter, 8,) deals with some outstanding philosophical issues concerning energy. Then in view of the original idea including the possibility of testing the outcome in the different discipline of mathematics, a shortened version of the test follows in Chapter 9 to show that explaining by philosophical methods has its benefits.

CHAPTER 8

Energy

8.1 Introduction

The previous chapters derived a final theory based on assumptions that the universe could not be mathematical in construction and that it would therefore require a philosophical set of arguments to explain the structure and processes which could be Popper-tested by introducing the concept of measurement. This addendum derives that test.

The preceding chapters were constructed philosophically with the intention that their contents would be Popper-tested for compliance with human observation through the introduction of measurement. Sections 9A.1.1 – 3A.3 derive a fundamental equation of motion for the particles derived in Chapter 5. The results of this equation are then compared to established observations (sections 9A.3.4 – 3.5). Conversion constants for calculating measurements are given in section 9A.4

Chapter 9 then moves on to various aspects referred to in the main text, but left for explanation in this addendum: gravitational calculations including (as far as I am aware) the first derivation from first principles of the fine structure constant, section 9A.5. A calculation of particle numbers in the Universe appears in section 9A.5.3. Notes on Special Relativity pertaining to RST and Einstein follows (9A.10).

In particular, in all arguments the concept of 'analytical precision' of deductions as suggested in section 9.4.1 should be kept in mind.

8.2 Conservation of energy

The law of conservation of energy is fundamental to the standard theory, but as it is not deduced from a fundamental principle it should not be considered as absolute. There are several ramifications in the standard theory which could be said to cast doubt on this principle even down to the generation of time itself as seen in section 8.2.3 (the creation of energy in the big bang and the energy requirements of continuous waves creating particle wave packets) with clarification of the subjects of kinetic and potential energy being left to this chapter. A definition based on mathematics is also given in Thompson (2024a§9.8).

8.2.1 Kinetic energy

According to standard theory the electric charge quantum is a constant.[1] Therefore all protons and electrons must emit the same strength of force field irrespective of their situation. This implies that

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[1] Bueche (1977:365)

energy is transmitted by the field, the Poynting vector.[2] The nature of this field can be tested by considering a particle in 'outer' space. Quantum theory, as expressed by, for example Hawking and Mlodinov,[3] demands that humans must interact with what they observe in order to observe. Then the same must be true for particles. The problem is that this is a chicken and egg situation thus making any interaction impossible. For example if we use a radar wave to detect an aeroplane we do not know whether a plane exists in the area searched until we detect it and the plane does not know we are sending the wave until it arrives. Equivalently, a particle cannot know an electron is in its vicinity unless the electron emits a field, and the electron can only know another charged particle is in the vicinity if the other particle is independently emitting a field. So an isolated 'charged' particle in 'outer' space, as understood in standard theory, must emit a field.

But even if it was to receive photons from the surrounding space, because this space is expanding, in standard theory the number of photons emitted by the electron must exceed the number received. Either the particle's energy runs down – very rapidly – or it has some mechanism by which it can continually produce photons as, for example, given by the Time scheme. In this scheme there is no 'running down' of internal 'charge'. But this does not imply a build-up of energy because in any localized non-isolated neighbourhood of a particle, molecule or multi-particle object: the photons stream out at c so, unless absorbed, quickly leave the neighbourhood. Statistically there is no increase in the neighbourhood's energy. Furthermore the continual release of photons does not promote the possibility of perpetual motion machines as the preceding sections make it clear that the Poynting vector depends not on the number of photons released, but the rotation they contain; once a particle has absorbed such a photon, successive absorptions have no effect on its energy (section 6.3.1). Thus the law would appear to hold true except in observations to date beyond experiment, and that is why it has remained a corner stone of standard theory. As, see section 9A.5.3, the number of photons issued over the age of the universe depends on R^3 (R being the Universe radius), the overall energy density of the Universe remains constant. But, as the relativistic rotation of the Universe reduces as the Universe expands, the *total* energy of the Universe itself, which consists of the reducing Universal rotation, $\dot{\theta}^+$, plus the energy of all the photons released, remains approximately constant. The fact that some photons are absorbed without changing the speed of a particle, and thus its kinetic energy, will be insignificant in terms of an apparent energy loss as the total number of particles at the present age of the universe is approximately only 10^{81} compared to the total number of 10^{123} photons issued. The $\dot{\theta}^-$ rotation of the Universe is by definition constant so that all universes have the same potential to produce photons. To clarify: the law of conservation of energy holds for the total energy of the Universe, the total energy being given by the Universe rate of rotation, $\dot{\theta}^+$ (which reduces with age) plus the energy of all the

[2] See e.g. Kraus (1984:465)
[3] Hawking and Mlodinov (2011:103)

photons released (which increases with age); as the number of photons released depends on the relativistic size of the Universe, the energy *density* correspondingly is constant.

8.2.2 Lowest energy state

There are two main considerations for the standard idea that particles fall to the lowest energy state allowable. First, in Figure 6.1a the distorted egg-shape represents the distortion from a sphere for a particle centred on O' travelling at close to relativistic speeds. In the far more extreme diagram 6.1b there are two possible outcomes: either the $\Im$ remains stuck to its origin, or some of the particle's spin can be ejected in the form of a photon. The latter will result in a reduced velocity allowing everything to rotate more easily. Thus a particle travelling close to *c* would be expected to radiate away some of its energy unless it was forced to maintain its speed by some external source. This is a tendency and therefore not a rule, but it will take place rapidly. When followed it gives the impression of the principle that a particle will drop to a lower energy if it can.

Secondly, due to the photon processes described, all particles in a system, including multi-particle objects, will over time exchange photons with each other so that they will attain a state representing the average energy between them. As all particles are at the centre of their own frame of reference by the principles of section 6.3.1, they all have specific rotations; but, as this is dependent on their own velocity against myriads of other velocities, no particle can have knowledge of another particle's rotation. Consequently there can be no complete knowledge of which particle, or set of particles, has the lowest energy level so any such belief will depend on the observer and surrounding circumstances.

8.2.3 Potential energy

So far there has been little definitive description of the standard concept of potential energy in the Time mechanisms, by which I mean the concept of potential energy defined as the work done in changing the energy of a body in a conservative system. Questions have already arisen over the use of a negative potential energy, especially in Chapter 7 as well as its, what to me, is a peculiar use in the standard theory of emission spectra as detailed in section 6.4.2. It will also be raised again specifically in the deduction of the Schrödinger equation in Thompson (2024a:§9.7) where it is shown to have no role, contrary to Schrödinger's expectation. As already made clear it is a fundamental concept of energy based equations/theory in standard physics.

In Chapter 10 questions whether the concept of PE actually hides some important factors. For example, an applied force in a conservative system (meaning the method in which the change in energy is overall the same for any path taken) changes the energy of a body if it causes a change of distance from the field source. Here, from RST theory point of view the application of the force has to be considered. For example, an electron being pulled from a nucleus requires an applied external photon (electric) source. This produces an apparent acceleration as follows: Assuming the external force to be constant (that is, it is mediated by photons with constant rotation value) against a lesser constant source value, the electron moves according to the photons it receives: the external photons cause an outwards motion. As the process continues the number of external photons becomes greater than the number of proton photons received per unit time. Consequently the electron takes an increasing number of steps outwards as time progresses and fewer steps back towards the source. In observational terms it accelerates, or gains kinetic energy until it is only receiving external photons whereupon its velocity remains constant (Because the external force is constant its photons all carry the same rotation so that when the electron only receives these external photons it maintains its speed as in section 6.3.2). No artificial potential energy is involved. Should the electron at any stage in this process attain an apparent stationary position relative to the proton then the photons it receives from the proton and external force will balance each other so that the electron has a mean oscillation between the two, that is, it has a kinetic energy varying between outwards and inwards motions. The same applies to any similar action such as a bucket of water being hauled up a hill except that here many particles are undergoing the process, and they only have to receive sufficient energy to overcome the force of gravity.

Thus this form of potential energy, according to the Time scheme, is merely a form of kinetic energy and therefore potential energy as such is a human misnomer. This, of course, does not apply to the human terms ‘potential difference’ as in batteries or being ‘potentially able’ to produce hydro-electric power from storage dams although in both cases the actual storage is governed by kinetic energy in creating and holding the storage as just described.

Consequently, as suggested in sections 6.4.2 and 7.3, there is in fact no such thing as potential energy in the natural world. It is merely a man-made idea to help him explain various mathematical ideas to fit his, or perhaps his mathematical, perceptions.

8.4 The existence of Time, Humans and Earth

Taking everything written in this treatise it is now possible to wrap up the most questioned philosophical problems: those of why the Earth exists, why humans exist and most of all why anything exists. I shall take these in reverse order starting with Time and here I shall refer first to its associated rotation.

As seen in section 4.4.1 the concept of rotation, or kinetic energy, is absolutely fundamental to the Time Universe. To such an extent is this true that it could be considered more fundamental than Time, since observed space could not appear without rotation. It is the action of rotation that creates the Time intervals which signify space. But it was Time that led to the concept of rotation and thus RST. However, in our psyche we cannot define rotation without the concept of Time. Therefore Time had to come first and it was the deductive process that eventually led to the realization that energy or rotation is the fundamental requirement for a *spatial* universe to exist.

Why anything exists (in the case of this treatise, Time) is the biggest philosophical question of human existence. The first consideration is somewhat anthropic because humans are used to beginnings and endings and indeed each Universe in a series begins and ends. The question then becomes whether a series of Universes can begin and end:

Suppose there is a state of absolute nothingness and a starting point from which a particular universe springs. Then there must be a separation, that is, a limit between nothing and the start of Time, a boundary point that is neither Time nor nothing. Such a point cannot be a point in a state of nothingness because nothingness cannot contain a point. Then either the point cannot exist, in which case there is no boundary to the start of Time; or if the boundary does exist it must exist as a preceding point p to the start of the given Universe, that is, it must exist timeously. But then the same problem reoccurs between a state of nothingness and p. Induction then implies there would have to be a never ending set of *p*s, of Time, before the given Universe.

A similar proposition must hold for the end of the given Universe. Therefore it is possible to state that:

If Time exists at any single point then it must exist forever into the past and into the future.

Therefore the question of why anything exists, or why Time exists is only a question of the human mind and not of the Universe. This suggests another argument. Why should we believe that just because everything we know begins and ends, that existence of anything itself begins and ends? Our minds are made that way and need the concept of ending to protect ourselves – the fight or flight syndrome built into us through survival of the fittest. Rather ask why should there *not* be a continual existence? Arguments on this basis must by their nature contain a fundamental perception of beginnings and endings. Consequently people with religious beliefs may be better off because the idea of God creating himself is absurd, he would have to have existed in order to do so, and so on *ad infinitum*. So his existence must be non-finite. Then why cannot the existence of anything not be non-finite?

This produces an even more fundamental argument similar to that of Page and Wootters. Time is only measurable in relativistic terms, not in natural terms. It therefore only applies as a set of time units in a relativistic universe – the same as space.

Accordingly, as in section 7.9, each universe begins and ends so neither N′ nor N is infinite although the number of Universes into the past or future is without limit. It is now clear that the creation state of section 4.4.1 is the last instant of the contraction phase of the Universe previous to ours (see section 7.9).

Now for the existence of a human species on Earth. Biochemists[4] have achieved much success in establishing that life could easily have begun on Earth, and any other similar planet, as an automatic result of particular conditions during a planet's history. Many of the fundamental chemicals required exist in space through interactions arising from supernovae, destruction, or burning out of stars. Starting with the probability of a planet existing: the number of photons given out over the age of the universe, as calculated in section 9A.5.3 is of the order 10^{123} with Δ-photons a little less, so that the number of possible interactions that could have taken place over the history of our Universe is of the same order. By the probable time of formation of the first galaxy, the number of photons would have been of the order 10^{117}. It is unlikely that all of these could have been involved in interactions, so if we divide by a guess of 10^{18}, 10^{99} interactions could have been involved creating approximately 10^{10} stars. The total number of photons produced up to the creation of Earth is approximately 10^{120} and the number of interactions needed to produce earthlike planets maybe a maximum of 10^{75}. 10^{75} is so far below the number of possible interactions that could have taken place that the probability of an earthlike planet *not* existing somewhere in the universe, and *not* existing at a suitable life-supporting distance around a sunlike star is to all practical purposes zero. Then, since conditions on Earth are undoubtedly suitable for life, and thus for life to come into existence, the chances of life existing here, and thus anywhere in the universe, are close to the existence of the Earth itself. To be safe, say, at least 10^{60} to 1 on – almost an absolute certainty for our universe and all others in a progression of universes. This, of course, is absolute guesswork based on the huge numbers involved, but it does give an idea of the certainty of life-bearing planets and sapient beings existing; and even if out by a factor of 10^{24} is still almost a certainty.

10.7 Finale

These speculations taken together thus lead me to conclude that quantum mechanics as agreed by de Broglie, Heisenberg, Bohr, Schrödinger, and others is indeed missing something – definitions for time and space which coupled with rotation provide a different basis to quantum theory, that is, one which formulates a universe on rotation. It also replaces standard field theory as although both are relativistic, there is a subtle difference between the two. QFT being a mathematical theory uses a special relativistic matrix to apply it to standard quantum mechanics. In RST, relativity is covered completely by its rotational aspect with no need of any extra application. It automatically produces the quantum measurements of space-Time thus producing the volume we are so well aware of. A volume which has allowed, and one could say produced, the sub-atomic particles and atoms made therefrom. In so doing it has explained all the problems standard physics theory has been unable to solve. This includes the demonstration in Chapter 9 that Time explains the reason for the values found by experiment for all the natural constants – those which Hawking (2002) complained about standard

[4] E.g., Merrifield (1963), Hodgson and Pannamperuma (1967), Huber and Wachterhäuser (1998), Powner, Gerland and Sutherland (2009), Zhu and Szostak (2009), Lincoln and Joyce (2009), Gibson et al. (2010)

physics' inability to explain. (Boltzman's constant excluded because, being directly related to human-invented electric charge, it is not a natural component of nature).

RST is also causal, unlike standard QM. That is, it agrees with Aristotle's belief that there must be a fundamental cause, for not only everything we see to happen, but for the existence of anything in the first place.

I now leave it to the reader to decide for himself which seems the more likely to be a correct theory of the universe: the quantum theory deduced in this work, or the quantum theory based on Heisenberg's uncertainty principle, bearing in mind there might be still another even better explanation than either of these two. So the fun behind trying to ascertain exactly how the universe is constructed is still available.

Finally, and very importantly, Something rather more ethereal. I would not like this exposition to be taken as excluding what is so important to many people: the existence of God. My own view is that the essence of religion is the faith in a Divinity whose existence cannot be proved. Then, if the Time scheme was to prove the existence of God, it would do as much harm to religion, if not more, than to prove conclusively that there is no such being. God being all seeing would have known when creating the universe that a thinking being would eventually decipher how it must work. Thus God would have created the universe in such a way that it could arise without any apparent need of Himself. So whether the Time scheme, or any other, is correct the absence of a Divine influence in it should not be surprising and can never be used to prove either God's existence, or the opposite.

CHAPTER 9
ADDENDUM

9A.1 Introduction

The previous chapters derived a final theory based on assumptions that the universe could not be mathematical in construction and that it would therefore require a philosophical set of arguments to explain the structure and processes which could be Popper-tested by introducing the concept of measurement. This addendum derives that test. Sections 9A.1.1 – 3 explain how to convert RST of section 4.4 equation of motion for the particles derived in Chapter 5. The results of this equation are then compared to established observations (sections 9A.3.4 – 3.5). Conversion constants for calculating measurements are given in section 9A.4. Gravity follows in 9A.5 with, as far as I am aware, the first calculated derivation of the fine structure constant. A calculation of particle numbers in the Universe appears in section 9A.5.3.

9A.2 Real number system

Humans have developed equations and systems such as trigonometry needing rational numbers and irrationals such as π or the square root of 2 to solve them. Consequently, this number system has to be used for deriving measurements from the Time-based theory using the concept of the quls and quts derived in Chapter 2. Although the Universe structures and processes derived are not mathematical, the use of real number mathematics in place of quantum units has no effect on the efficacy of the tests as the quantum units mentioned are many orders smaller than the values attained using Excel. In any case human measurements cannot be considered perfect as they rely on the sophistication of the equipment producing them.

As in Chapter 4, space-Time jumps instantaneously from its origin at the point of the space-Time triads to the three base points. To create measurability, the effect of this action has to be represented in mathematical terms, which requires a representative equation. This requires the real number system just mentioned which gives the spiral representation of Figure 5.1a. This representation is easier to assimilate in human perception than the natural jump as it enables graphical production of the factors involved. But it must be borne in mind this continuum type of progression is not how the natural universe actually functions – the universe is discrete; every change is by an instantaneous jump.

In the following calculations accuracy is limited by the number of decimal places attainable by Excel. Nevertheless, although the natural values cannot be determined exactly, it can be seen these calculations agree to a very high degree of accuracy with experimental physical results. For example the fine structure constant (calculated from first principles in section 9A.5) has the value 0.00729603 compared to the experimental result 0.00729735. I have tended to use the latter in calculations in this addendum as human observations are relativistically modified by our velocity with respect to the actual creation point of the Universe, this point being the basis of the equations of motion (cf§9A.3). The 'rest' value of the electron 'mass' is 9.11×10^{-31} kg according to experiments. The electron, however, has a minimum velocity of 22.5 ms^{-1} in the relativistic representation, so does not have a rest mass. My calculated 'mass' from SRT principles is 9.119×10^{-31} kg which I have used in electron orbital calculations.

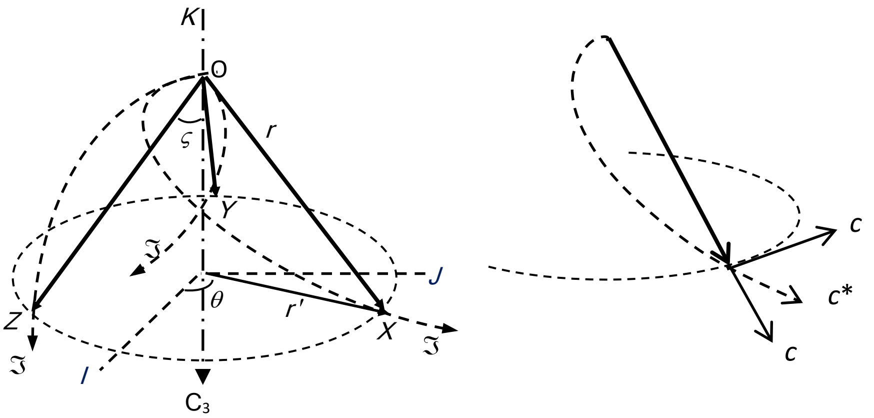
9A.2.1 Equation of motion

It has already been pointed out that mass and electric charge are not fundamental requirements of a Universe; all that is required are rotation and Time which jointly produce rotating space-Time objects that propagate through a rotational space-Time lattice as outlined in chapters 5 and 6. It should therefore be expected that this motion is entirely responsible for human measurements and thus all that is needed to attain measured values is to ascertain an equation of motion. This will be done in two parts: the first, 9A.2.2, develops a basic rotation equation and the second in 9A.2.3 expands on this to give measured values for human perception of linear motion through the space-Time lattice.

9A.2.2 Basic equation

Figure 4.4b,d of section 4.5 can be extended to accommodate real numbered trigonometric equations as in Figure 9A.1. The vertical and horizontal lines introduced in section 4.5 become *K*, *I* and *J* axes taken at a convenient instant. Figure 9A.1 is arranged with the α and β axial ℑs[1] in the *IJ* plane so that their rotation direction can be expressed two-dimensionally by θ (angle of the *X*-axis with respect to *I* in the *IJ* plane and in Figure 9A.2 the angle of the *X*-axis in the *ij* plane) and $\dot{\theta}$, its rate of rotation. θ and $\dot{\theta}$ are arbitrarily defined as positive in the anti-clockwise sense for the generation of the space-Time triads. The contra-rotation $\dot{\theta}^{-}$ mentioned in section 4.6.3(VII) will then be clockwise but is not required for the construction of a fundamental equation which operates only in the inner rotational space. The axes, as stated in Chapter 4, are labeled completely arbitrarily in order to describe human-derived geometry; none of the ℑs to which the axes refer have any natural distinction other than their directions. The operation $\hat{T}(\Phi)$ determines the form of the first triad; all following space-Time triads will have the same geometrical structure.

[1] (ℑs emerging at angles α and β in the *IJ* plane)



(a) (b)

Figure 9A.1. (a) Space-Time expansion in the relativistic representation. In the real mathematics system the ℑs start from O at t_o and develop in the direction of the three orthogonal axes *X*, *Y*, *Z*. These rotate about *K* so that each ℑ travels along a spiral. These axes are drawn so that their tips mark the position of the ℑs at a given instant. *I*, *J*, *K* are direction axes fixed in space arbitrarily arranged with *K* vertical and *X* coinciding with *I* at t_o. θ is the angle turned through by the *X*-axis in the *IJ* plane from its starting position at t_o. ζ is the angle subtended by any of the three axes with the rotation axis of the cone. Diagram (b) shows the connection between radial and tangential velocities *c* and motion of the ℑ at *c** for the *X*-axis with similar for the *Y* and *Z* axes. Resolving *c** gives the connection $c = 2^{-1/2} c^*$.

For a ℑ on the *X* axis of Figure 9A.1 with x' measured along the *I* axis, y' along *J* and z' along *K*

$$x' = r\sin\zeta\cos\theta$$

$$y' = r\sin\zeta\sin\theta$$

$$z' = r\cos\zeta$$

The constraints (sections 5.1-2) imply that $\dot{x}'^2 + \dot{y}'^2 + \dot{z}'^2 = 1$ (qul/qut), $r = 2^{-1/2}t$, $\dot{r} = 2^{-1/2}$ and $r\dot{\theta} = c$ (section 4.6 and Figure 4.4d) so that

$$\dot{\theta} = \sqrt{\frac{3}{2}}\frac{1}{t}\ , \qquad \theta = \sqrt{\frac{3}{2}}\ln t \quad ;\, t \neq 0 \qquad\qquad (9A.1a,b)$$

and similarly for the other axes. The ℑs then move along spiral paths.

The result can be represented either as a cone or a triad. However, an important factor must now be noted. The quantum intervals have both been created in a minimum unit of time so the only possible *recordable* solutions to equation (9A.1a,b) would be at 0 and $t = 1$. 0 does not feature in the Time scheme so the only natural solution is at $t = 1$.[2] As in section 9A.2.2, the ℑ jumps directly to an interval and does not 'grow continuously' as is expressed for trigonometric reasons by equations (9A.1a,b) – but the human perception in the relativistic representation is palpable.

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[2] Though as in Chapter 2, the real number system allows intervals to be expressed in the human familiar form by using the invented number, 0, to write [0,1], [[0,1] +[0,1]], …. ≡ [0,1], [0(2),2] ….

3A.2.2 Equation of motion for the triple-triad

This simple system can be reformulated for a triple-triad. Returning to section 4.6 the Cartesian structure of Figure 4.4 was developed in Figure 5.9 to two super-triads, one represented by axes *X*, *Y*, *Z*, and the other by axes –*X*, –*Y*, –*Z*; (thus breaking with traditional geometrical usage in which an axis runs from –*X* through 0 to +*X*. Nevertheless the positive and negative directions do form a straight line only broken at 0. Consequently these two different usages of axes may be applied inter-changeably, as utilising + and – axes simultaneously means the two super-triads can be examined conveniently either as a unit or separately).

The (*X*,–*X*) axes are placed in a disc so that the change from neutron to proton, as in Figure 5.12b, is represented by orientating the disc to pass between the *Y* and *Z* axes. The disc is assigned axes *ijk* with *ij* in the plane of the disc and *k* orthogonal to *i* and *j*. To set up equations of motion in the human viewed relativistic space an arbitrary set of Cartesian space axes, *IJK*, is placed in a Euclidean three-dimensional space as an initial reference background with origin O' as in Figure 9A.2. The *ijk* axes are then arranged so that at a convenient Time, t_0, they coincide with *IJK*. This gives a completely general arrangement of axes in which any form of motion and orientation can be ascribed while maintaining the correct motion of the ℑs relative to their origin, O'. The ℑs of both sets of axes have to simultaneously meet the constraints. That is both super-triads have to meet the constraints while maintaining orthogonality.

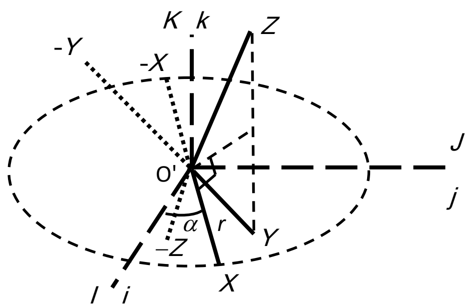

Figure 9A.2. The triads with axes *X*,*Y*,*Z* and –*X*,–*Y*,–*Z* represent the super-triads of Figure 5.9b. The *X*,*Y*,*Z* axes are fixed to a disc to fit the proton orientation of Figure 5.12b. The *X*-axis is in the plane of the disc and the other two set at 45° below and above the disc. *I*,*J*,*K* are orthogonal axes arbitrarily set in space with disc axes *i*,*j*,*k* coinciding with them at t_0.

The position of points *x*, *y* and *z* moving with the space-Time expansion along the *X*, *Y* and *Z* axes respectively are given in terms of the *ijk* axes by

$$\mathbf{x} = r\cos\alpha\,\mathbf{i} + r\sin\alpha\,\mathbf{j} \qquad (9A.2a)$$

$$\mathbf{y} = -2^{-1/2}\,r\sin\alpha\,\mathbf{i} + 2^{-1/2}\,r\cos\alpha\,\mathbf{j} - 2^{-1/2}\,r\,\mathbf{k} \qquad (9A.2b)$$

$$\mathbf{z} = -2^{-1/2}\,r\sin\alpha\,\mathbf{i} + 2^{-1/2}\,r\cos\alpha\,\mathbf{j} + 2^{-1/2}\,r\,\mathbf{k}. \qquad (9A.2c)$$

where *r* is the radial distance from O' to *x*, *y* or *z*, and **i**, **j**, **k** are unit vectors along the *i*, *j*, *k* directions. Similar equations can be found for points *x′*, *y′*, *z′* in the –*X*, –*Y*, –*Z*, directions.

These equations are not simultaneously solvable for both x, y, z, and x', y', z' in terms of the parameters so far employed, and in particular the rotation given by $\dot{\theta}$ around the k axis. However, they do become solvable if a set of velocity parameters is included to allow for the propagation of O', and a third rotation parameter is added. In this case the equation becomes generalized to the system given in Figure 9A.3 taking into account the $-X$, $-Y$, $-Z$ axes which have been left out for clarity in the diagram (they are included in Figure 9A.2b, dotted lines). The equation then has the maximum number of degrees of freedom based on the only available variables in the system, that is, rotation, orientation and motion (velocity). These must fit the constraints to give the principle behind motion through the lattice (section 6.2.1):

The velocity and total rotation of a particle have to be such that the constraints for its space-Time creation are adhered to. If this is not the case the particle will undergo a change in velocity or rotation so that the constraints are met.

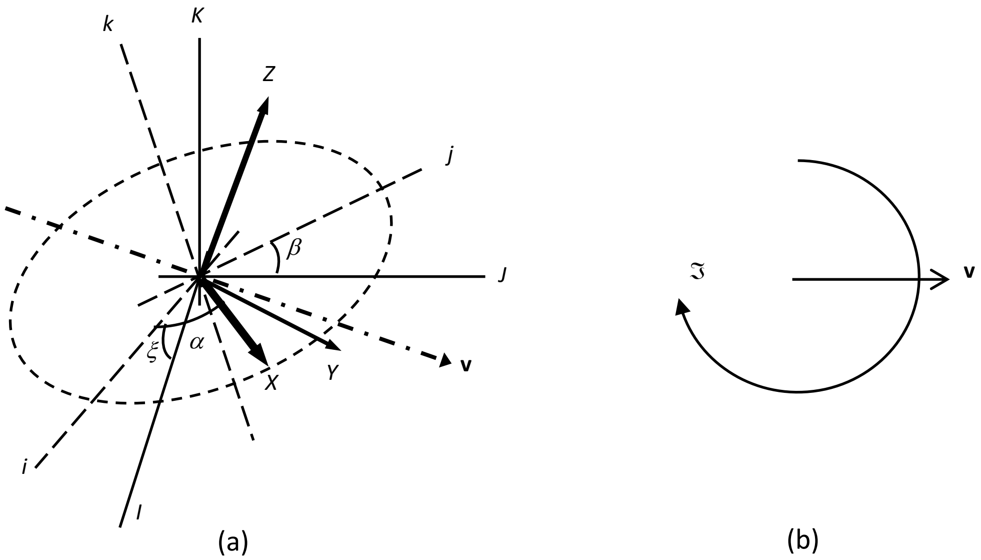

Figure 9A.3. (a) Relationship between angles and axes for the equation of motion. The direction of **v** in this diagram is arbitrary. The *XYZ* triad is arranged to agree with the flipped triple-triad (proton) of Figure 5.12b. The $-X$ $-Y$ $-Z$ triad is omitted for clarity but is included in Figure 9A.2 (dotted axes). (b) Direction of motion of ℑ in relation to the particle velocity **v**.

This principle is then expressed in the human real number system by the basic equation (9A.1) via a set of *ten* independent variables:

(1) Three orientation angles α, β, ξ arranged such that when α, β, ξ are all zero i, j, k coincide with I, J, K.

(2) The subsequent rotation of the X, Y, Z axes as the ℑs travel along their spiral paths is given by three components of rotation $\dot{\alpha}$, $\dot{\beta}$, and $\dot{\xi}$ around the k, I and J directions. These variables depend on the absorption of rotation delivered by the process described in section 6.2.1 and are therefore independent of the orientation angles.

(3) Three velocity components v_I, v_J, v_K.

(4) Plus an essential relativistic addition/amendment, κ, described in section 9A.3.

The resulting equation will allow for the triple-triad to rotate at $\dot{\theta}$ while simultaneously rotating at an angle relative to $\dot{\theta}$, that is, the k axis can rotate about K so that the triple-triad 'tumbles' through space-Time. Section 9A.3 develops these results to produce equations which fit the constraints and conditions raised in Chapters 2 and 3 to give unique/consistent results for the motion of each particle species.

9A.3 Particle motion and equations of motion

The results of this section follow directly from the existence of Time and motion. They do *not* dictate the fundamental origin by which our universe came into existence.

Notes (1) - (3) above give the variables required, orientation of the triple-triad, rotation, and velocity. To these must be added (4), attained as follows:

When **v** is not zero, as the ℑs rotate about O', their rotational velocity will vary from being in the same direction as **v** to being normal to **v** to being against **v** (Figure 9A.4). This means that if the total velocity of each individual ℑ is to be c^* its individual radius of expansion, r, at t = 1 will relativistically adjust according to its direction of motion relative to **v**. The square root adjustment must be zero when **v** is normal to the motion of the ℑs, and a maximum when **v** is parallel to the motion of the ℑs. This is implemented by the κ expression (9A.3) et seq. (with form $(1 - v^2/c^2)^{1/2}$ to take into account relativistic contraction/expansion depending on the changing velocities of the ℑs).

$$\kappa\sqrt{1-\left[\frac{(\mathrm{c}\alpha\mathrm{c}\xi-\mathrm{s}\alpha\mathrm{s}\beta\mathrm{s}\xi)v_{\mathrm{I}}+\mathrm{s}\alpha\mathrm{c}\beta v_{\mathrm{J}}+(\mathrm{c}\alpha\mathrm{s}\xi+\mathrm{s}\alpha\mathrm{s}\beta\mathrm{c}\xi)v_{\mathrm{K}}}{\sqrt{\left\{(\mathrm{c}\alpha\mathrm{c}\xi-\mathrm{s}\alpha\mathrm{s}\beta\mathrm{s}\xi)^2+(\mathrm{s}\alpha\mathrm{c}\beta)^2+(\mathrm{c}\alpha\mathrm{s}\xi+\mathrm{s}\alpha\mathrm{s}\beta\mathrm{c}\xi)^2\right\}}\sqrt{(v_{\mathrm{I}}{}^2+v_{\mathrm{J}}{}^2+v_{\mathrm{K}}{}^2}}\right]^2} \qquad (9A.3a)$$

and for the Y axis (with a similar one for Z) (3A.3b).

$$\kappa\sqrt{1-\left[\frac{2^{-1/2}\left\{(-\mathrm{s}\alpha\mathrm{c}\xi-\mathrm{c}\alpha\mathrm{s}\beta\mathrm{s}\xi+\mathrm{c}\beta\mathrm{s}\xi)v_{\mathrm{I}}+(\mathrm{c}\alpha\mathrm{c}\beta+\mathrm{s}\beta)v_{\mathrm{J}}+(-\mathrm{s}\alpha\mathrm{s}\xi+\mathrm{c}\alpha\mathrm{s}\beta\mathrm{c}\xi-\mathrm{c}\beta\mathrm{c}\xi)v_{\mathrm{K}}\right\}}{\sqrt{1/2\left\{(-\mathrm{s}\alpha\mathrm{c}\xi-\mathrm{c}\alpha\mathrm{s}\beta\mathrm{s}\xi+\mathrm{c}\beta\mathrm{s}\xi)^2+(\mathrm{c}\alpha\mathrm{c}\beta+\mathrm{s}\beta)^2+(-\mathrm{s}\alpha\mathrm{s}\xi+\mathrm{c}\alpha\mathrm{s}\beta\mathrm{c}\xi-\mathrm{c}\beta\mathrm{c}\xi)^2\right\}}\sqrt{v_{\mathrm{I}}{}^2+v_{\mathrm{J}}{}^2+v_{\mathrm{K}}{}^2}}\right]^2}$$

where sα is used for *sin*(α) and cξ for *cos*(ξ), etc, for brevity. Expression (9A.3a) is a relativistic restriction on the allowed values of the variables thus theoretically making the system of equations over-determined. This can be overcome by allowing κ to vary so that it balances the total spatial motion in the relativistic representation against the volumeless, timelessness of the natural universe. That is, r is multiplied by $(1 - k')$ where k' is given by expressions (9A.3a,b). Then an object's volume reduces towards zero, as its speed tends to c. Note: expression (9A.3) was originally taken as a single independent approximation (it should be three-dimensional rather than one; the error being minimal e.g. about $2 \times 10^{-10}c$ at $0.0075c$). κ can thus increase or decrease the effect of (9A.3) on the radii of the six axes. Table 9A.1 shows that κ decreases the relativistic effect, which is in line with the concept that a change in the axial orientation balances out the difference between the increase and decrease in the ℑ's relative velocities. Thus κ brings the equations in line with what nature automatically achieves (cf §9.A.3.2) – a hidden from observation effect (cf last paragraph in section 4.4.1).[3] Figure 6.1 describing the changes in shape of fast moving triple-triads may be recalled here.

The parameters only take values that give paths for the ℑs that meet the constraints for the development of space-Time. The final result is a set of nine independent variables from which an apparently consistent set of equations of motion can be obtained by using the rotation matrix:

$$\begin{bmatrix} i \\ j \\ k \end{bmatrix} = \begin{bmatrix} \cos\xi & 0 & \sin\xi \\ -\sin\beta\sin\xi & \cos\beta & \sin\beta\cos\xi \\ -\cos\beta\sin\xi & -\sin\beta & \cos\beta\cos\xi \end{bmatrix} \begin{bmatrix} I \\ J \\ K \end{bmatrix}$$

on equations (9A.2 a,b,c) to give, after differentiating and squaring, $\dot{x}^2, \dot{y}^2, \dot{z}^2$. Individually

$$\begin{aligned} \dot{x}^2 &= \dot{r}^2 + r^2\dot{\alpha}^2 + r^2\dot{\beta}^2 \mathrm{s}^2\alpha + r^2\dot{\xi}^2(\mathrm{c}^2\alpha + \mathrm{s}^2\alpha \mathrm{s}^2\beta) + v_\mathrm{I}{}^2 + v_\mathrm{J}{}^2 + v_\mathrm{K}{}^2 \\ &+ 2r^2\dot{\xi}\dot{\beta}\mathrm{s}\alpha\mathrm{c}\alpha\mathrm{c}\beta + 2r^2\dot{\alpha}\dot{\xi}\mathrm{s}\beta + 2v_\mathrm{I}\dot{x}_\mathrm{I} + 2v_\mathrm{J}\dot{x}_\mathrm{J} + 2v_\mathrm{K}\dot{x}_\mathrm{K} \end{aligned} \qquad \text{(9A.4a)}$$

where $\dot{x}_\mathrm{I}$, $\dot{x}_\mathrm{J}$ and $\dot{x}_\mathrm{K}$ are the components of $\dot{x}$ in the *I*, *J* and *K* directions, that is, the last three terms are cross multiplication terms involving velocity; and again where sα and cα again represent *sin*(α) and *cos*(α) etc. The equations 9A.4b and 9A.4c for *Y* and *Z* respectively are:

$$\begin{aligned} \dot{y}^2 &= 1/2[2\dot{r}^2 + r^2\dot{\alpha}^2 + r^2\dot{\beta}^2(1+\mathrm{c}^2\alpha) + r^2\dot{\xi}^2(\mathrm{c}^2\alpha\mathrm{s}^2\beta + \mathrm{c}^2\beta + s^2\alpha - 2\mathrm{c}\alpha\mathrm{c}\beta\mathrm{s}\beta)] + v_\mathrm{I}{}^2 + v_\mathrm{J}{}^2 + v_\mathrm{K}{}^2 \\ &- r^2\dot{\alpha}\dot{\beta}\mathrm{s}\alpha\text{-}r^2\dot{\alpha}\dot{\xi}(\mathrm{c}\alpha\mathrm{c}\beta - \mathrm{s}\beta) - r^2\dot{\beta}\dot{\xi}\mathrm{s}\alpha(\mathrm{c}\alpha\mathrm{c}\beta - \mathrm{s}\beta) + \sqrt{2}[v_\mathrm{I}\dot{y}_\mathrm{I} + v_\mathrm{J}\dot{y}_\mathrm{J} + v_\mathrm{K}\dot{y}_\mathrm{K}] \end{aligned}$$

$$\begin{aligned} \dot{z}^2 &= 1/2[2\dot{r}^2 + r^2\dot{\alpha}^2 + r^2\dot{\beta}^2(1+\mathrm{c}^2\alpha) + r^2\dot{\xi}^2(\mathrm{c}^2\alpha\mathrm{s}^2\beta + \mathrm{c}^2\beta + \mathrm{s}^2\alpha + 2\mathrm{c}\alpha\mathrm{c}\beta\mathrm{s}\beta)] + v_\mathrm{I}{}^2 + v_\mathrm{J}{}^2 + v_\mathrm{K}{}^2 \\ &+ r^2\dot{\alpha}\dot{\beta}\mathrm{s}\alpha + r^2\dot{\alpha}\dot{\xi}(\mathrm{c}\alpha\mathrm{c}\beta + \mathrm{s}\beta) - r^2\dot{\beta}\dot{\xi}\mathrm{s}\alpha(\mathrm{c}\alpha\mathrm{c}\beta - \mathrm{s}\beta) + \sqrt{2}[v_\mathrm{I}\dot{z}_\mathrm{I} + v_\mathrm{J}\dot{z}_\mathrm{J} + v_\mathrm{K}\dot{z}_\mathrm{K}] \end{aligned}$$

To fit the constraints it is necessary that $\dot{x}^2 = \dot{y}^2 = \dot{z}^2 = 1$;[4] also $\dot{r} = 2^{-1/2}$ and $r = 2^{-1/2} \rightarrow r' = (1 - k')r$.

The motion of a triad type particle is determined by finding values for κ, α, β, ξ, $\dot{\alpha}$, $\dot{\beta}$, $\dot{\xi}$, v_I, v_J and v_K such that the constraints will be met. This is achieved by simultaneously solving for all six ℑs (i.e. *x*, *y*, *z*, *x*′, *y*′, *z*′).

There is no analytical method for solving these equations.[5] Furthermore the available numerical methods using algorithms also provided no solutions. Consequently the equations were solved by trial

[3] That is, an effect that humans would not expect, or observe, from their observation of the universe about us.
[4] i.e. gives $c = 1$

and error (see section 9A.3.1). Some valid results are given in the following tables (Tables 9A.1-9A.3) for the electron, proton and neutron.

Table 9A.1 Parameter variations for a negatively spinning particle (electron).

κ	α (radians)	β (radians)	ξ (rdns)	$\Delta\dot{\alpha}$ (rdns/qut)	$\Delta\dot{\beta}$ (rdns/qut)	$\dot{\xi}$ (rdns/qut)	v_x (c)	v_y (c)	v_z (c)
-0.007422	1.4 E-05	0.3348054	-0.05574	-5.412 E-4	-2.595 E-4	1.2533 E-6	-1.61295 E-2	1.171 E-3	-6.35 E-3
-0.003456*	1.1422 E-5	0.3348054	-0.05574	-1.040 E-4	-7.19E-5	1.742 E-7	-7.56212E-3	5.38744E-4	-3.06845E-3
-0.003480#	1.1422 E-5	0.3348054	-0.05574	-1.1 E-4	-7.30 E-5	1.745 E-7	-7.5901E-3	5.404E-4	-3.069E-3
-0.003566	1.155 E-5	0.3348054	-0.05574	-1.159 E-4	-7.804 E-5	1.8202 E-7	-7.768853E-3	5.538187 E-4	-3.0799381E-3
0.0035660	**1.155 E-5**	**0.3348054**	**-0.05574**	**-1.159 E-4**	**-7.804 E-5**	**-1.8202E-7**	**7.768853E-3**	**-5.538187 E-4**	**3.0799381E-3**
-3.565990E-5	1.145 E-9	0.3348054	-0.05574	-1.159 E-8	-7.805 E-9	1.82 E-11	-7.7693927E-5	5.5375383E-6	-3.0802797E-5
-3.565989E-7	1.1545E-13	0.3348054	-0.05574	-1.116E-12	-7.7 E-13	1.82 E-15	-7.7693926E-7	5.5375383E-8	-3.0802797E-7
-3.565989E-8	2.06 E-15	0.3348054	-0.05574	-1.04 E-14	-7.3 E-15	1.82 E-17	-7.7693925E-8	5.5375378E-9	-3.0802797E-8
0	0	0.3348054	-0.05574	0	0	0	0	0	0

*electron velocity 0.007297351c
#electron velocity 0.007324813c

Table 9A.2 Parameter variations for a positively spinning particle (proton)

κ	α (radians)	β (radians)	ξ (rdns)	$\Delta\dot{\alpha}$ (rdns/qut)	$\Delta\dot{\beta}$ (rdns/qut)	$\dot{\xi}$ (rdns/qut)	v_x (c)	v_y (c)	v_z (c)
-2.161 E-5	-2.442 E-7	0.3348054	-0.055745	-6.003 E-8	-1.015E-9	1.82 E-7	-2.250710E-6	-1.3795809E-5	-1.5263934E-5
-2.161 E-7	-2.44E-11	0.3348054	-0.055745	-6.00 E-12	-1E-13	1.82 E-11	-2.2507081E-8	-1.3795810E-7	-1.5263936E-7
-2.161 E-9	-2.4E-15	0.3348054	-0.055745	-1 E-16	-1 E-16	1.82 E-15	-2.250708E-10	-1.3795810E-9	-1.5263939E-9
+2.161 E-9	**+2.4E-15**	**0.3348054**	**-0.055745**	**+1 E-16**	**+1 E-16**	**-1.82 E-15**	**+2.250708E-10**	**+1.379581E-9**	**+1.5263939E-9**
-2.161 E-10	0	0.3348054	-0.055745	0	0	1.82 E-17	-2.250675E-11	-1.379598E-10	-1.526394E-10
0	0	0.3348054	-0.055745	0	0	0	0	0	0

Table 9A.3 Parameter variations for a meta-stable particle (neutron)

κ	α (radians)	β (radians)	ξ (rdns)	$\Delta\dot{\alpha}$ (rdns/qut)	$\Delta\dot{\beta}$ (rdns/qut)	$\dot{\xi}$ (rdns/qut)	v_x (c)	v_y (c)	v_z (c)
-4.1231248 E-7	-2.57 3E-9	0	0	-2.4 E-14	-3.66 E-13	1.82 E-9	-4.1118285 E-9	-3.7653708 E-7	-1.5518202 E-7
-4.1231253 E-8	-2.568E-11	0	0	-1 E-16	-1 E-16	1.82 E-11	-4.11189 E-10	-3.7653709 E-8	-1.5518203 E-8
-4.123126 E-9	-2.568 E-13	0	0	0 (< E-16)	0 (< E-16)	1.82 E-13	-4.11195 E-11	-3.765371 E-9	-1.5518217 E-9
-4.123126 E-10	-2.5 E-15	0	0	0 (< E-16)	0 (< E-16)	1.82 E-15	-4.11198 E-12	-3.765371 E-10	-1.551822 E-10
-4.123136 E-11	0	0	0	0	0	1.82 E-17	-4.11198 E-13	-3.765371 E-11	-1.551822 E-11
-4.123136 E-12	0	0	0	+1 E-16	0	1.82 E-19	-4.11198 E-14	-3.775371 E-12	-1.551822 E-12
0	0	0	0	0	0	0	0	0	0

Note: Solving by trial and error is closer to natural processes than analytically as the Universe, by not being mathematical, could only act in a non-mathematical way to derive its processes. Furthermore analytical processes could only work if we know our exact speed with respect to the original founding point Φ. This is primarily why the factor κ has to be included. It fundamentally allows for the fundamental speed of the Earth to be included although there is no way we could determine this speed by any observations we could make as all particles and structures have their own speeds with respect to Φ which are not necessarily the same as ours. These speeds then reflect the fact that it is then impossible to determine the point Φ by observation.

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[5] At least there were none available in 1996-1997 when the tables were originally constructed. As they give a good idea of the accuracy of the reasoned arguments on which this thesis is based there was no necessity to look for new methods. In any case solving by trial and error showed certain hidden from human observation aspects.

In view of the complex nature of these equations and of arranging them on the spread sheets a summary of the columns is given below. Columns O to Q represent the solution values of the equations of motion for the *X*,*Y*,*Z* axes which have to equal unity but to which –1 has been added to bring the total requirement to 0 as this increases the available decimal places from 14 to 15. Columns R to T are the same but for the other triad –*X*,–*Y*,–*Z* axes. Columns AP to AX refer to the *X*,*Y*,*Z* axes (super-triad) and BC to BK to the –*X*,–*Y*,–*Z* axes (super-triad), e.g., AP gives the expression for variations in the $(\dot{x}_i)^2$ term; BC for variations in the equivalent term for the negative axis in the other super-triad.

Table 9A.4. Program columns showing arrangement of parameters in the spread sheet.

B	C	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
$\dot{r}$	r'	κ	α	β	ξ	$\dot{\alpha}$	$\dot{\beta}$	$\dot{\xi}$	AY -1	AZ -1	BA -1	BL -1	BM -1	BN -1	v_I	v_J	v_K	**V**

AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA
$(\dot{x}_i)^2$	$(\dot{x}_j)^2$	$(\dot{x}_k)^2$	$(\dot{y}_i)^2$	$(\dot{y}_j)^2$	$(\dot{y}_k)^2$	$(\dot{z}_i)^2$	$(\dot{z}_j)^2$	$(\dot{z}_k)^2$	AP+ AQ+ AR	AS+ AT+ AU	AV+ AW+ AX

BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN
$(\dot{\bar{x}}_i)^2$	$(\dot{\bar{x}}_j)^2$	$(\dot{\bar{x}}_k)^2$	$(\dot{\bar{y}}_i)^2$	$(\dot{\bar{y}}_j)^2$	$(\dot{\bar{y}}_k)^2$	$(\dot{\bar{z}}_i)^2$	$(\dot{\bar{z}}_j)^2$	$(\dot{\bar{z}}_k)^2$	BC+ BD+ BE	BF+ BG+ BH	BI+ BJ+ BK

9A.3.1 Comments on correlating human mathematics to the Time scheme

As stated above the only method of solving the equations was by trial and error. Even this produced a major problem as columns within O-T often ‘jammed’ meaning that whatever small variations were applied to the parameters no sustainable progress could be made to reducing all the OT values to zero. However, by increasing the size of the variations sufficiently it became possible to jump over the jam. A second problem arose as the velocities were increased. Up to 100 times, the minimum velocity found maintained the O-T columns at 0 but the numbers of 0s behind the decimal point gradually fell away at higher velocities due to the relativistic correction being approximated. I did not feel it was worth correcting this defect as the concept behind the equations was obviously established, and there was, according to Excel, no program giving a larger number of significant figures so that, in any case, absolute accuracy would be impossible. The jamming of O-T is of significance in the orientation angles. There appears to be a narrow band of solutions for these angles, meaning that all values of O-T were reduced to a minimum. In the immediate neighbourhood outside this there was considerable variation. This raised an interesting point concerning natural causes’ ability to obtain a working universe.[6]

[6]As in Chapters 4-6, Universal processes function spontaneously so that difficulties in human mathematics are totally irrelevant to the Universe which is only subject to its overarching rule.

When I originally set out to check the equations I chose completely random values to the parameters with the intention of determining solely whether they could ever give any result. Despite learning how to overcome ‘O-T jamming’ as mentioned in the last paragraph, finding any result was difficult until I came very close to the values of β and ξ used in the tables. At this juncture a set of solutions was quite easily obtainable. This seemed to suggest that the universe forms upon the easiest (most expedient) route, which again suggested the absence of any need of number evaluation in Universal processes. However, perhaps this is a misunderstanding of the situation. That is, the tendency is to accept taught beliefs that mathematics allows certain combinations of parameters. Chapters 4-6 imply that while the process of manipulation of numbers may work more easily under some combination of parameters than others, this is a misrepresentation of the facts according to RST where all fundamental Time-points (as opposed to particles) have identical form. Everything in the Universe is formed from these Time-points so that only certain balances and thus combinations of the parameters between individual (RST) formations are possible. It is these that determine the outcome of the equations of motion. That is the process of forming solutions becomes easier when the equation parameters and variables close in on representing the true rotation-space-Time balances. *It is not that the natural actions fit the mathematics. It is the other way round*. It must be remembered the equations of motion are in terms of a curved trigonometric rotation not a jump, as in nature, which overcomes the difficulties of sines and cosines passing through zero. Thus there are even ‘hidden-from-mathematics’ concepts such as the factor κ (section 9A.3.2), or the differences between the proton and electron calculation methods as seen by observers on different sides of the motion (the heavy lines in tables 9A 1 and 2).

Consequently mathematics becomes over-complicated as it requires a set of ten variables for each of three space-Time dimensions to reproduce in measurement form what natural causes do as a matter of course. Even then it cannot give perfect solutions because it relies on human misconception of the existence of infinitesimals and thus continuous ‘cuts’ of numbers *ad infinitum*. This can be overcome by cutting off decimal places to match the size of a qut or maybe a minimum angle of rotation equivalent to *w*/*w* if a measurement in human terms could be obtained for *w* (i.e. *w* changes over the initial *w* rotation at one change per qut to give the unit/angle of rotation). This is not attempted here as it presumably has to follow from a reiterative procedure over at least 10^{50} iterations. At the time of finalizing this addendum, this was not within software abilities.

In making the connection between measurement and the Universal structure, the first possible solutions that I discovered were a set for which the columns O-T had the form 0.000001*xx*... which I call ‘5 zeros 1’. The lowest velocities ran to approximately 10 zeros before finally jamming at this lowest value (i.e. decreasing zeros if I tried to refine further). I noticed that the $\dot{\xi}$ value was close to 2.6×10^{-17}, which I quickly realized was very close to the square root value of Planck’s constant. Thereupon I inserted the actual root value and immediately found that the 10 zeros became 15 zeros and faster velocities lowered to 14 zeros progressively growing less accurate as velocities increased. I assumed that this was the correct interpretation of $\dot{\xi}$ but on calculating the de Broglie wavelengths ascertained that these were correct for the lowest value but not for higher values by a factor of 2 – the denominator 2 reflecting the difference between c and c^* ($c^*=2^{1/2}c$). Consequently I substituted the value of $(h/2)^{1/2}$ for $\dot{\xi}$ and found that the O-T values for the higher velocities all increased the number of zeros (i.e became more accurate). Also the equation of motion results now agreed with the de Broglie QM calculations.

A further problem with all the calculations is the limit of 15 decimal places, which means that the parameter values cannot be given accurately enough to find exact values (15 zeros for O-T) for the velocity values; similarly for the calculations leading to the electron orbital results. Even so the solutions achieved appear to be accurate enough to imply the correctness of the approach adopted and implications derived. It should be made clear that especially at high speeds (above $c \times 10^{-5}$) it became extremely difficult to obtain accurate values so the higher values are only indicative to check that RST is highly likely to agree with observations even in these regions, e.g. for electron orbitals.

9A.3.2 The orientation angles and κ

Column κ, as explained above, contains a relativistic factor which, as shown in Figure 6.1, controls the radius of a freely moving (not influenced by another particle) triple-triad so that its tangential velocity remains constant at c. Again here there is a difference between the mathematical and non-mathematical universes. The latter proactively overcomes the problem that the equations constructed around both positive and negative arms (axes) of the triple-triad do not lead to a zero balance, yet these must balance for the particle to remain intact. If, however the particle's arms are relatively altered in accordance with Einstein's mathematical SR theory a mathematical balance can be achieved. In this sense κ directly depends on the u-velocity (straight-line velocity)[7] of the particle, as it should if the u-velocity is affected by the Earth's, or where satellites are used, speed with respect to Φ.

The orientation angles have a role in determining the velocity **v** of a triple-triad as they change the angle of the *ijk* axes with respect to *IJK*. This affects the velocity of the $\Im$s with respect to **v**, which causes **v** to adjust (spontaneously) to fit the constraints. As in Figure 5.12, these angles have a specific value determined by the flip of the neutron to proton, electron (and neutrino). The values β = 0.3348053540001 radians and ξ = –0.055744970 radians were originally the results of numerically obtaining unique solutions to given velocities, but can also be calculated directly from flip considerations briefly mentioned in (Thompson 2024a:§9A.5.5). This calculation was carried out but is highly complicated and adds nothing of value to this work so has been left out for space reasons. It merely confirms the values just given. These are the values used in the tables.

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[7] See table 9A.6 and description

9A.3.3 Rotation and velocity parameters

By using different sets of parameters, particularly to orientation parameters, the equations can be applied to all triple-triad type particles to give details of their specific motions depending on the values of the ten parameters.

The magnitudes of the rotation parameters were found by the same trial and error method as the above parameters. The values of the rotation parameters increase with increasing velocity. In particular, $\dot{\xi}$ increases proportionally to the square of the velocity, **v**, allowing for relativity (only multiples of 10 are shown in the tables but the proportional increase applies to any integral value). For reasons to be given later (§ 9A.3.4) $\dot{\xi}$ has a **minimum value** $\dot{\xi}_e$ = 1.82019 × 10^{-17} rad qut^{-1}. To save space in the tables, the values in the $\dot{\alpha}$ and $\dot{\beta}$ columns show only the variations from base values. In the case of the proton and neutron the base values are 1 and $2^{-1/2}$ respectively corresponding to the value of $\dot{\theta} = (\dot{\alpha} + \dot{\beta}^2)^{1/2}$ = $(3/2)^{1/2}$ at t = 1 from equation (9A.2a). The neutron entries start with α = 0 which determines its other variables.

The base values for the electron arise differently. According to the construction of particles, all electrons are created by neutron decay. In order for the space-Time constraints to be met the electron's velocity on emission from a neutron must be in equilibrium with its rotation, which is directly related to its $\dot{\xi}$ rotation. If a neutron rotating with $\dot{\xi} = \dot{\xi}_e$ = 1.82×10^{-17} decays, the electron will have ($\dot{\alpha}$, $\dot{\beta}$) = (2, $2^{1/2}$) at the instant of emission so that the four values β, ξ, $\dot{\alpha}$ and $\dot{\beta}$ are fixed. Entering these values into the equations of motion, the other parameter values can be uniquely determined as in Table 9A.5. Whereas the velocity and associated parameters for the proton and neutron can be calculated from an original ($\dot{\alpha}, \dot{\beta}, \dot{\xi}$) = (1, $2^{-1/2}$, 1.82 × 10^{-17}) by working upwards from a minimum value, this is not the case for an electron. Instead, the equivalent ($\dot{\alpha}, \dot{\beta}$) = (2, $2^{1/2}$) give an electron a speed $u \approx 0.5501074c$ (see section 9A.3.5 for meaning of u) on emergence from a decaying neutron having rotation $\dot{\xi}_e$. (This is of the correct order, allowing for neutron velocity (Burgy et al. 1960)). The equivalent $\dot{\xi}$ value is 0.001 (radians per qut). To conform to the base values for the neutron and proton, the value of $\dot{\xi}_e$ = 1.82 × 10^{-17} for the electron is obtained when $\dot{\alpha}$ and $\dot{\beta}$ have the values 2+0.64575131106459, and √2 + 0.456615131013875 respectively.

Table 9A.5. Emission parameter values for the electron

κ	α	β	ξ	$\dot{\alpha}$	$\dot{\beta}$	$\dot{\xi}$	v_x	v_y	v_z
-0.42235	0.1684	0.334805354	-0.05574497	2	√2	0.001	-0.5653	0.1215	-0.1900

The orientation angles for the neutron with $\dot{\xi} = \dot{\xi}_e$ are $\alpha = \beta = \xi = 0$. As the electron and proton are created from the same operation, the angles (β, ξ) = (0.334805354, –0.05574497) apply to both and remain fixed for all **v** for these particles – they change for the muon and tau, and the so-called Higgs.

It should also be noted that observers, on either side of the particle origin should see the velocity magnitude from the point of origin to be the same, implying **v** should have opposite coordinate signs from the point of origin to fit in with mathematical vector notation, see heavy lines in tables 9A1 and 2. In the case of the proton, $\Delta\dot{\alpha}, \Delta\dot{\beta}, \dot{\xi}$ and κ change signs with its velocity. But the electron is different because its formation velocity is at $\dot{\xi}$ = 0.001. Below this only $\dot{\xi}$, κ and the velocities change sign; at $\dot{\xi}$ = 0.001 and above, which implies κ must also function as a vector.

9A.3.4 Minimum velocities

The equations are derived from the relativistic creation of space-Time so that the velocities are taken relative to a triple-triad's creation point. They refer to each triple-triad as the centre of its own universe and the parameters operate from the triple-triad's origin in terms of change in velocity, **v**. Thus **v** = 0 would imply the triple-triad remains at its creation place – which is not possible because the existence of rotation incurs a minimum triple-triad velocity to meet the constraints. (This obviously does not include two particles moving at the same speed parallel to each other, where their relative velocity is zero).

Due to the quantum nature of space-Time all increases in **v** are incremental, which means that increases in $\dot{\xi}$ are also incremental, in the form of multiples of $\dot{\xi}_e$. But, for a given triple-triad, over even a small part of a second, the velocity measured would not necessarily correspond to a multiple of $\dot{\xi}_e$; a qut is of the order 10^{-24} second so that, with many changes in velocity over a relatively short time, average SI velocities can be measured which do not apparently reflect multiples of $\dot{\xi}_e$. As mentioned above, solutions can also be found for velocities in the reverse direction as shown by the heavy line in Table 9A.2. In this case $\dot{\xi}$ becomes negative (in direction).

Finally, returning to the table values for **v** = 0: the table for the neutron shows a turning point where $\Delta\dot{\alpha}$ and $\Delta\dot{\beta}$ are both zero. Above this point $\dot{\alpha}$ and $\dot{\beta}$ reduce from their base values while below it they increase. As $\dot{\alpha}$ and $\dot{\beta}$ are components of $\dot{\theta}$ an increase would make $\dot{\theta}$ greater than $(3/2)^{1/2}$. So, although values of $\dot{\xi}$ and corresponding velocities can be calculated, such a magnitude of spin can only arise in the 'middle' of the space-Time development (in human real number terms – in Time terms it would be during the 'jump' of the $\Im$). (This shows a difference between what can occur in the Universe and what human mathematics erroneously would believe could occur). Neutrons and protons can only have a minimum velocity corresponding to ($\dot{\alpha}, \dot{\beta}$) = (1, $2^{-1/2}$). At this point $\dot{\xi}$ has the value $\dot{\xi}_e$ = 1.82019 × 10^{-17} and similarly this is a minimum attainable value.

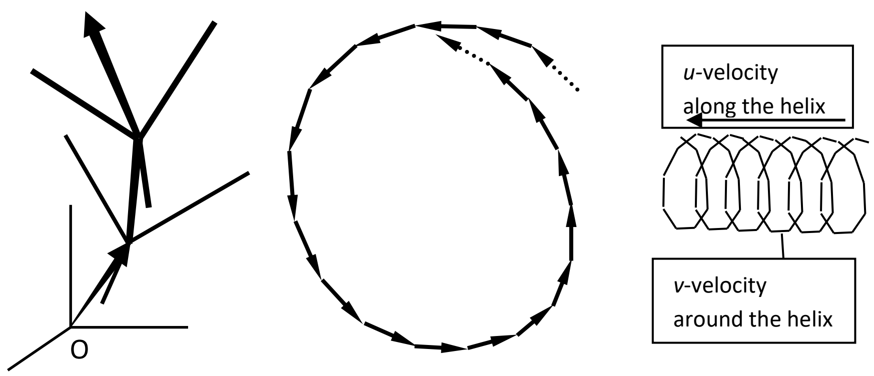
A similar case holds for the electron. Its velocity relative to its creation point is more than ½*c* and on reducing to its minimum rotation it would still have a rotation of $\dot{\xi}_e$ = 1.82 × 10^{-17} as well as $\dot{\theta}$ = $2(3/2)^{1/2}$ giving it a non-zero minimum velocity. A lower calculation can be made but as above a spin lower than $\dot{\xi}_e$ could only occur during the natural 'jump' and thus there cannot be a corresponding lower velocity.

9A.3.5 Wave motion of particles and inertia

As in section 9A.2.2 the equations of motion are based on *I*, *J* and *K* being fixed at the start of each individual qut. The values shown in the tables refer to the angle, spin and velocity components at the end of the qut. If no change in rotation has occurred compared to the end of the previous qut, these values will be the parameter values and orientations at the start of the next qut when *I*, *J* and *K* will be reset. Representing the change of angle by a rotation matrix, *M*, and linear transformation by (v_1, v_2, v_3), the position and corresponding velocity V_n at the end of the *n*th qut is given by (see Figure 9A.5)

$$V_n = M^n \begin{bmatrix} v_1 \\ v_2 \\ v_3 \end{bmatrix} + V_{n-1} \qquad (9A.5)$$

This means that the proton and electron will propagate along a helix, the pitch of which is equivalent to a velocity (**u-velocity**) see Table 9A.6. Calculations (from equation (9A.5) and table 9.7) show that it takes approximately 18.511 qut, depending on the particle, for a complete cycle of the path round the helix. As changes in direction and quts are integral, the nearest whole number of changes, being nineteen, is slightly greater than a 360 ° cycle and consequently the emission direction of the photons does not repeat itself exactly.



a b c

Figure 9A.5. v-velocity and wave motion from equation (9A.5). Diagram (a) shows the motion (in relief) of a free particle over three quts receiving no photons from any source. It starts each qut with the same diagonal motion with respect to its orientation and travels (jumps) in straight lines to materialize at the end of the qut to repeat the process over the next qut. One complete cycle is shown in diagram (b). A number of cycles is shown in diagram (c).

A particle therefore has two velocities **v** and **u,** as in Table 9A.6. Only **u** (or *u*) is measured in experiments where ***u*** is the typical 'straight-line velocity' measured between two points (showing why the concept of $c^* = 2^{1/2}c$ has not been discovered in standard experiments). In table 9A.6 the minimum velocities only are given as the ratio remains constant (allowing for relativistic effects as **v** increases) for higher **v**.

Table 9A.6. The relationships between *u*-velocities and *v*-velocities for the neutron, proton and electron for $\dot{\xi} = \dot{\xi}_e$ (hence slight difference with CODATA values based on rest-masses proton/electron 1836.15267343(11), neutron/electron 1838.68366173(89), neutron/proton 1.001378419). Also the conversion factors, given in section 9A.4, are dependent upon the 'charge radius' of the proton which has not been fully established by experiment. $\mathbf{u}_e$ is minimum straight line velocity of the electron.

	v (*c*)	**u** (*c*)	$\mathbf{u}_e/\mathbf{u}$	$\mathbf{u}_p/\mathbf{u}_n$	$\dot{\xi}$
Neutron	4.07407 E-11	4.07280 E-11	1838.70457		1.82×10^{-17}
Proton	2.06974 E-10	4.0783878-11	1836.18537	1.00137198	1.82×10^{-17}
Electron		7.48867599E-8	1		1.82×10^{-17}

9A.4 Conversion factors, Planck's constant, Planck-de Broglie relationships and mass

Comparing the structure of the triple-triads to the space-Time building block in the relativistic representation from which the qul (and qut) is defined, allows a human interpretation of the qul to be rendered in SI (or imperial) values.[8] That is, as the natural particles are given their size in human perception by the qul, while human experiments measure nucleons in terms of SI units, a comparison should be possible. However, the radius of nucleons is a matter of conjecture. The Zemach[9] radius (Distler 2011) was historically determined as 1.040(16) fm and has since been redetermined both up and down: The CODATA *charge radius* of the proton is given as 0.8775(51) fm but a report by the Jefferson Lab (Distler 2011) shows several values at 0.88 to 0.89 fm. RST gives a ratio of the radial distance of a photon at the time of emission (equivalent to the charge radius) compared to the radius of rotation of the proton as 0.5:0.7071 so that the radius of the proton is in the region of 1.240-1.259 fm. As there is variation I have taken a value based on the best fit for conversion factors taking into account all calculations using them. Taking the nucleon radius as 1.25187×10^{-15} m (equivalent to a charge radius of 0.87882 fm) at the minimum $\dot{\xi}_e = 1.82019 \times 10^{-17}$ radians qut^{-1} gives the qul conversion factor as $2^{1/2} \times 1.25187 \times 10^{-15}$ giving 1 qul = 1.77041×10^{-15} m. Dividing by c^* ($= 2^{1/2}c$)

[8] SI units are used throughout because they are unitary in the sense of one kg being related to litres, etc.
[9] the charge radius relationship with the magnetic moment.

gives the qut as 4.175785 × 10^{-24} s or 1 second = 2.39475795 × 10^{23} qut. These are the conversion factors used in the rest of this work.[10]

Using these conversion factors the frequencies and wavelengths of particles can be compared between the Time and standard theories. For the electron, $\dot{\xi}_e$ = 1.82 × 10^{-17} radians qut^{-1}, converts to a frequency of 6.937 × 10^5 cs^{-1} or 1.44155 × 10^{-6} s $cycle^{-1}$. The *u*-velocity at this rotation for an electron is 7.48867 × 10^{-8} *c*. In 1.44155 × 10^{-6} s the electron travels 3.2384 × 10^{-5} m which is its apparent wavelength according to the Time scheme. The de Broglie calculations for an electron moving at 22.45 ms^{-1} are 6.93 × 10^5 cycles s^{-1} and 3.2397 × 10^{-5} m respectively (very slow because this refers to an electron moving with minimum velocity). Similar calculations incorporating relativistic correction can be used for higher velocities.

Table 9A.6 provides the first clear test of the efficacy of the Time scheme against observation; in this case, the so-called relative masses of the main particles. The third column $\mathbf{u}_e/\mathbf{u}$ compares the minimum *u*-velocities of the electron compared to the neutron and proton for the same rotational value of $\dot{\xi}$; that is if the same force is applied to each particle the electron will travel 1838.70457 times faster than the neutron and 1836.18537 times faster than the proton. These figures are based on the minimum possible velocities of the particles and allowing for relativistic factors remain constant ratios. The CODATA rest mass ratios are 1838. 68366 and 1836.15267 – a little lower because the Time-based values are for a minimum velocity, not stationary. Another important prediction is the so-called rest masses of the particles.

These rest masses can be calculated by using frequency $f = u/\lambda$, de Broglie's relationship which gives $h = (m/f)u^2$. Tables 9A.1-9A.3 show that **u** is related to $\dot{\xi}$ by

$$\mathbf{u} = n\mathbf{u}_e \propto n^2 \dot{\xi}_e \qquad (9A.6)$$

where $\mathbf{u}_e$ is, as above, the minimum velocity of the electron. Because all increases in velocity must be attained through multiple increases in this value, $\dot{\xi}_e$ fills a similar role in the new model to that of *h* (Planck's constant) in standard physics. In Planck's energy relation, $\Delta E = hf$. If the frequency is in cycles s^{-1}, the right hand side of the energy relation is in units common to all systems. Then the left hand side can be converted to SI units using suitable conversion factors, $2(\dot{\xi}_e)^2$ = 6.626183 × 10^{-34} (number, see next paragraph) compared to CODATA 6.62618 × 10^{-34} (Js); the factor 2 in $2(\dot{\xi}_e)^2$ arises

[10] Since writing this thesis the CODATA (2021) charge radius has been reduced to 8.14 × 10^{-16} m (±0.017). However, the new results involve muonic rather than electronic hydrogen atoms which may have an affect (not considered here due to the recent nature of the experiments) on the proton spin and velocity so no changes in the charge radius or conversion factors adopted above is considered. The proton spin used above was the minimum.

because $h \sim c$ and rotation ~ qulqut^{-1} = c^*. Then only m in de Broglie's equation is a man-made term. It can be expressed in natural units and the result compared to classical physics:

$$m_{e-} = \frac{h}{\lambda^2 f} = \frac{h\dot{\xi}_e}{\pi u_{e-}^2} = 0.068449 \times 10^{-35} \text{ qul}^{-2}\text{qut} \qquad (9A.7)$$

where h = Planck's constant = $2(\dot{\xi}_e)^2$ and m_{e-} and u_{e-} = 7.488676 × $10^{-8}c$ are the 'mass' and minimum velocity of the electron.

Using the qul and qut conversion factors gives m_{e-} = 9.119357 × 10^{-31} kg in SI units of $m^{-2}s$ compared to the SI electron rest mass of 9.1094 × 10^{-31} kg[11]. Thus mass can be expressed in SI units of length and time to give $M = L^{-2}T$ in the theory of dimensions. In standard physics h has units J s = ML^2T^{-1} so that in the RST system $h = L^{-2}T \times L^2T^{-1} = 1$ that is, h becomes a dimensionless constant, or number. Its value is the same in SI standard theory and the RST model due to the unitary nature of both – and also due to the proposition, derived in section 4.3. or 5.2, that the Universal processes have no need of any values to operate. Consequently the measurement values are determined by the human system of measurement units in comparison to the concept of the use of quls and quts as measuring units. And, rather than mass determining the relative speeds of particles, it is their minimum speeds that determine what humans call their relative masses.

It thus appears that the mathematics of measurement based on the foundational cause explains the previously unknown nature of the human concept of mass (as being purely inertial), and in particular explains the values of the inertial ratios which have so far only been determined by experiment. From now on the word mass will be dropped from 'inertial mass' to fit in with the RST concept. We should say they have a different apparent resistance to motion, that is, **relative inertia** between them. However, 'mass' is a useful term and can be defined as a comparison of inertia between a given object and a standard such as the platinum-iridium block held at the International Bureau of Weights and Measures in France or as redefined at BIPM (2018)[12]. Furthermore, the question in standard physics over the slight difference in the 'inertial masses' of the proton and neutron is solved as relating to the difference in orientation and thus rotation characteristics of the two particles.

The relative inertias of the muon and tau are given in section 9A.4 as it seemed more appropriate to deal with the existence of those particles there, as well as the associated neutrinos.

9A.4.1 Change of direction

It is particularly important, and surprising, that the change in direction caused by the absorption of a ξ-photon is always a constant angle, 9.1153° in the case of an electron and 15.039° for a proton (allowing

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[11] The ease of conversion to SI is due to the unitary system. Imperial units need an extra conversion factor.
[12] Bipm conference on mass see www/bipm.org/en/the~si/

for relativity as **v** increases), see Table 9A.7. Section 6.4.3 shows that this is fundamental to understanding electron orbitals, and leads to evaluating the Bohr hydrogen orbits (section 9A.9). If no ξ-photon is received by a given triple-triad type particle, the particle's propagation continues at $\mathbf{v}_i$ and progresses as given by equation (9A.5).

Table 9A.7. The relevant v and u components of the velocity are given for the lowest velocity set of solutions from Tables 9A.1-9A.3. These remain fundamentally constant for all $\dot{\xi}$. In experiment, it is the u-velocity (**u**) that is observed. The significant differences between the v and u-velocities are because the former change direction on themselves to create the wave while the latter is a straight line connecting two points of the wave having the same period. The change in signs may seem surprising but the $v_{(IJK)}$ represent the motions of the positions held by the tips of the axes when the super-triad materializes. The position of the origin moves with respect to the orientation of these axes and consequently may move in a different direction to the $v_{(IJK)}$ axes. Overall, as seen in Table 9A.1 the electron motion increases are consistently constant (allowing for special relativity).
Trigonometry shows that the recipient's u-velocity changes direction by: e^- 9.1153° p^+ 15.039° every time the recipient absorbs a ξ-photon.

electron (c)			Proton (c)		
v_I	v_J	v_K	v_I	v_J	v_K
-7.7694×10^{-8}	5.537537×10^{-9}	-3.08027×10^{-9}	-2.2507×10^{-11}	-1.3796×10^{-10}	-1.5264×10^{-10}
u_I	u_J	u_K	u_I	u_J	u_K
-7.3941×10^{-8}	-1.1180×10^{-8}	1.17876×10^{-9}	-3.9388×10^{-11}	-1.0278×10^{-11}	-2.521×10^{-12}

9A.5 Mathematics tests: Gravity and Fine Structure constant

The explanation of gravity has already been given in Chapter 7. Various constants arise as a result of gravitational acceleration. In standard physics there is no calculation from first principles, only measurement achieved by experiment. Calculations based on the RST system produce the following results from first principles.

9A.5.1 Gravitational constant

The universe does not need to know the value of G for the process to take place, but it can be determined in human cognizance. The change in radius giving an apparent centripetal acceleration, A, is associated only with the passing of Time as the universe ages each qut. A is thus independent of a particle's inertia (defined in terms of particle relative velocities) and has a standard value at a given instant for every triple-triad type particle irrespective of its position in the universe. $A = \dot{\varphi}^2 R'$ where $\dot{\varphi}$ has the value[13] $(3/2)^{1/2}/T_A$, and $R' = r\sin\zeta = 3^{-1/2}T_A$ where T_A is the corresponding age of the universe. Taking into account the probability of a hit and using conversion factors qul-metres, qut-seconds, the gravitational constant $G \propto 1/T_A$ and can be calculated from the current age of the universe, or vice-

[13] See equations (9A.1a,b).

versa to give the figurative value of G as 6.67384 × 10^{-11} (CODATA 2010) and $T_{current}$ = 1.04843 × 10^{41} qut = 13.786 × 10^{9} years.[14]

$$G = 6.6738 \times 10^{-11} = \frac{\sqrt{3/4} \times 1.7704 \times 10^{-15}}{1.04843 \times 10^{41} \times (4.175785 \times 10^{-24})^2 \times 2 \times 2\pi} \qquad (9A.8)$$

The Time dimensions are $T^{-1}(LT^{-2})$ which is fundamentally an acceleration and compares in dimensional theory to centripetal acceleration. In standard theory the dimensions are $L^3M^{-1}T^{-2}$ but from equation section 3A.4 $M = L^{-2}T$ which gives $G = L^5T^{-3}$. However, this cannot be satisfactorily compared with the Time dimensions because the latter depends on the age of the universe whereas the former gives a constant G over all time.

In RST G is a natural 'constant' in the sense it has the same value everywhere *at a given instant* with natural value $G(T)$ = 6.57329 × 10^{-43} qul/qut² where $T \approx$ 1.04843 × 10^{41} qut and increases every qut.

This overcomes problems concerning the dimensional formulation, 'fine tuning' and especially the strength of gravity.[15] Comparing this value to the change in velocity of an electron (with $\dot{\xi} = \dot{\xi}_e$) of 5.3 × 10^{-8} qulqut^{-1} over one qut, gives the ratio G : e⁻ = 1.24 × 10^{-35} which is the natural value at $T_A \approx$ 1.04843 × 10^{41}. As the change of velocity of an electron receiving $\dot{\xi}_e$ is a true constant the gravitational strength ratio changes with time. In standard theory the strength of G is arbitrarily expressed using the proton-electron masses, in which case division by 1836 gives a non-dimensionless strength of 6.75 × 10^{-39}. The value of the fine structure constant follows from the above results.

Note that this gravitational change in rotation is so small that it has no effect on the equations of motion. Nor does a change of $\dot{\varphi}$ affect $\dot{\theta}_{t=1}$= $(3/2)^{1/2}$ rads qut^{-1} used in the equations of motion because, if $\dot{\varphi}$ was added to the base $\dot{\alpha}$ and $\dot{\beta}$ parameters, it would immediately be compensated for by $\Delta\dot{\alpha}$ and $\Delta\dot{\beta}$ (as in tables 9A.1-3) to maintain the constraints, analogous to the effect of $\dot{\psi}$ in maintaining $\dot{\theta}$ = $(3/2)^{1/2}$ rads qut^{-1} as the basic space-Time rotation for any value of T.

9A.5.2 Fine structure constant

One of the major unknowns in standard physics is a calculation evaluating the fine structure constant from first principles: "*It has been a notably elusive task to find a remotely sensible ansatz for a calculation of Sommerfeld's electrodynamic fine structure constant alpha … based on first principles*",

---

[14] I deduced (ppredicted) this Figure in 2000 ACE when astrophysical estimates were 'between 13 -15 × 10^9 years'.

[15] see Eaves (2014)

Jentschura and Nandori corroborated by Penrose.[16] This constant arises in many equations. However, in the Time based theory its existence is easily foreseen and as a result is calculable.

According to the principles of the scheme electrons are created with a minimum speed relative to their source of approximately 0.5501074*c* (section 9A.3.2). In the early Universe the average speed of all inertial particles is of an equivalent order so that the vast majority of photons will carry large values of $\dot{\xi}$. On the other hand *G*, being very large when T_A is very small, has a retarding effect between triple-triads. Inertial particles slowed by this force will then emit photons carrying correspondingly lower $\dot{\xi}$ values. As a result of both the lower $\dot{\xi}$ and high *G*, an electron will absorb photons reducing its initial $\dot{\xi}$, and thus speed, to the local average.

The expected velocity $\bar{u}$, at a given age T_A and distance *R*, is given by (the initial velocity, u_i) × (the probability of a hit) × (the retarding effect of *G* at *T*) × (the effect of the probable average of $\dot{\xi}$ on $\bar{u}$).

The probability of an electron being hit by a photon from a single proton depends on its distance from the proton and the effective cross section of the electron compared to the proton. As the proton releases two G-photons and two ξ-photons each qut and the actual cross section of an electron is ¼ that of a proton the probability of a hit is

$$P(h) = \frac{\sigma}{4\pi R^2} = \frac{1}{4{T_A}^2} \qquad \text{(9A.9)}$$

where σ is the effective cross sectional capture area of the electron = $\pi/2$, $R = 2^{-1/2}T_A$ where *R* is the distance of the electron from the emitting proton.

The number of photons arriving at the electron depends on the number of particles created, and the distance to the electron at a given age T_A. This means the number of photons arriving at a surface of distance *R* from the proton is given by

$$\int_1^T {T_A}^2 dT_A \qquad \text{(9A.10)}$$

The first particle at distance *R* supplies one photon, the 2^2 (see 9.A.5.3) particles at distance $R - 1$ supply 4, and so on, where only one photon per particle is included as otherwise this will lead to duplication when equation (9A.10) is applied to $P(h)$; dT_A is used as (after only a few parts of a second T_A is very large in qut) the qut can be approximated by an infinitesimal. The ξ-photon has a value of $\dot{\xi}$ that depends on the original u_i (0.5501074*c*) less the retardation in u_i due to *G*. Then the average value

[16] Jentschura and Nandori I. (2014:abstract); Penrose (2004:870)

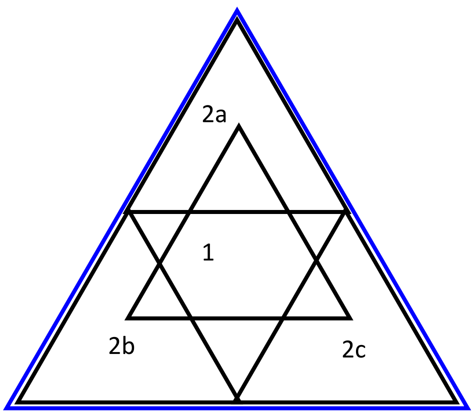
of $\dot{\xi}$, $\dot{\xi}_m$, depends on T_A, so the correction factor on u_i due to changes in $\dot{\xi}$ is proportional to equation (9A.10). When T_A is very small, $\dot{\xi}_m$ is almost exactly equal to the initial value of $\dot{\xi}$ equivalent to u_i. Then, using the retarding effect of G from equation (9A.8), $1/2\pi T_A$, with equations (9A.9) and (9A.10) the prospective $\bar{u}$ equation becomes

$$\bar{u} = 0.5501074c \times \frac{1}{4T_A^{\,2}} \times \frac{1}{2\pi T_A} \times \frac{T_A^{\,3}}{3} = 0.00729603c. \qquad (9.A.11)$$

$\bar{u}$ is thus independent of T_A (and G) and, as a result, the $\dot{\xi}$ factor does not have to be corrected for each increase in T_A. $0.00729603c$ is then the average speed at any T_A which electrons have (based on no ‘addition of velocity’ from the original neutron) when interacting with a proton so that their orbit should reflect this speed. The experimentally determined CODATA value of the fine structure constant is 0.00729735257. The reason for the slight lower velocity attained by the Time calculation is that a neutron on Earth is not ‘at rest’ before emitting an electron; to obtain an equivalent value the neutron’s velocity should have been taken into account instead of using a ‘bare’ electron velocity for the calculation. Hence I have used the human recorded value for calculations of other human measurements.

9A.5.3 Nucleon numbers in the Universe

Calculating the number of nucleons produced in the Universe to date is an impossible calculation as it involves random creation of both double and triple-triads in an ever increasing lattice over 10^{41} stages. However it can be approximated by assuming the production of double and triple-triads is regular. Even this over 10^{41} stages is an impossible task for a computer. However, if Figure 5.3a is expanded over a number of quts, triangles can be placed such that their apexes coincide with the outermost free axes.



n		N
8	Δ1	63
16	Δ = 4 ×Δ1 =	252

n = number qut's N = number of double triads formed in n qut's.

Figure 9A.6. Particle calculations. The black triangle 1 represents the triads created in the first 8 qut's. At this stage all the axes except the three apical axes are coincident with their neighbours. It thus forms a convenient counting block. Triangles 2a, 2b, 2c represent a further eight qut's based on one each of the free apical axes of triangle 1. They join at their apexes and thus form a new block where only the three apical axes are free.

These triangles can be used for number building as in Figure 9A.5.3, and this process can be continued to give triangles with $N = 4^2 \times 63 = 1008$, $4^3 \times 63 = 4032$, … as the increase seems to be approximately linear. For $T_A = 1.04843 \times 10^{41}$ qut $n = 2^{136.2673}$. The N value is then obtained by cancelling out 2^3 to give approximately $4^{133.2673} \times 63 = 1.0821 \times 10^{82}$ double coincidences. But this does not include filling in the empty rings. These rings have the greatest additional effect in the early stages of the universe and much less at the end. Consequently it is possible to obtain a reasonable estimate by starting from $n = 2^{129.2673}$ giving $N = 4^{129.2673} \times 63 = 4.2268 \times 10^{79}$, and then calculating this forward to the present age of the Universe. Ratios from the first stages of Figure 5.7 suggest a multiplication by 6667 to give approximately $4.2268 \times 6667/27 \approx 1.05 \times 10^{82}$ triple-triads which is slightly below T_A^2 but close enough to believe the number of nucleons is the square of the age of the universe.

Next the photon production: If every nucleon and electron emits two $\dot{\xi}$-photons every qut then the total number produced as the number of triple-triads increases is an integral of the number of triple-triads. Consequently, if the number of triple-triads is approximately proportional to the square of the radius at a given age, the number of $\dot{\xi}$-photons produced must be approximately proportional to the cube of the age. (Some of these $\dot{\xi}$-photons will be absorbed by triple-triads as described in Chapter 6, but this number will be very much closer to 10^{80} which is insignificant compared to 10^{123}. Under this regime the energy (cf section 10.2) of the universe would be proportional to the volume of the universe so that the energy density, not the total energy would be (statistically) constant throughout Time. Thus the continuous production of $\dot{\xi}$-photons is balanced by the Universal expansion.

9.10 Special relativity

Chapters 2 and 3 mentioned entrenchment and group psyche. This now comes to a focus here, in combination with the concept of zero again, particularly with the development of a volumetric space as the forerunner of Einstein's recognition of the constant value of the speed of light. This connection now needs to be demonstrated and in doing so I shall point to the problem that there are two distinct parts to the special theory of which only one has been recognized in mathematical physics. This requires some revision of the theory as currently accepted to bring it in line with the foundational aspects just derived. As a result relativity theory should become easier to assimilate.

Einstein is said to have complained:[17] "*since the mathematicians have invaded the theory of relativity, I do not understand it myself.*" In order to show that this comment may be a valid criticism I shall take it first as the treatment below does not depend on the fundamental elements described in the previous chapters. Einstein's overall deductions are however connected to the first cause just derived as I shall demonstrate in sections 9.10.7-9.10.9.

In sections 9.10.1 and 9.10.2 I assume the reader is conversant with the general derivation of Special Relativity as taught at most, if not all, universities and written in most textbooks[18]. What is not so well known are Einstein's original thoughts in his 1905 paper. I argue that there are flaws in the deductions used by universities and textbooks in general, and that these methods do not agree with the concept as presented by Einstein in his original paper, particularly with the comments he raised in his introduction ([1905] 1923:39-43). This section focuses on what RST shows up to be flaws, and then details a methodology that should be adopted.

For these sections the frame of reference given in section 3.2 is used but with an *xyz* spatial coordinate system attached with *x*-coordinate lying in the direction of the observers 'front' and, in general with the relative velocity between two observers lying along this axis.

9.10.1 Considerations arising from Einstein's special theory (1905)

In the introduction to his special theory Einstein ([1905] 1923:39-43) made the following points: (a) given two separated frames of reference, A and B, it is not possible for an observer in either to know with absolute certainty the spatio-temporal conditions in the other. To overcome this problem he assumed the speed of light might be constant and (b) then defined what he meant by common time between the two frames of reference as follows: If a ray of light leaves A at time t_A and arrives at B at B's time t_B from where it is instantaneously reflected to A to arrive at A's time t_A' then the two clocks would be synchronized

"if $t_B - t_A = t_A' - t_B$." ([1905] (1923):40)

i.e. the time taken for the light to travel out is equal to the time taken for it to return. In this case

$$\frac{2AB}{t'_A - t_A} = c \qquad \text{SR(1)}$$

as the light travels both out from and back to A. This defines time for "stationary clocks in a stationary system". It is therefore necessary to consider the situation for a moving system.

For a rod moving with respect to a stationary frame of reference Figure 11.10 gives:

[17] in Paul A. Schilpp (ed.) *Albert Einstein, Philosopher-Scientist*, Evanston, 1949. Footnote in a contribution to Albert Einstein: Philosopher-Scientist p 683-684 see (Stanford Howard 2004).
[18] E.g. Møller 1962, Rosser 1968, Resnick 1967, Heading 1964, Synge and Griffith 1959, Tolansky 1956.

For the outwards motion of light: $AB' = l + vt_{out} = ct_{out}$ or $t_{out} = l/(c-v)$ SR(2a)

and for the return: $ct_{back} = l - vt_{back}$ or $t_{back} = l/(c+v)$ SR(2b)

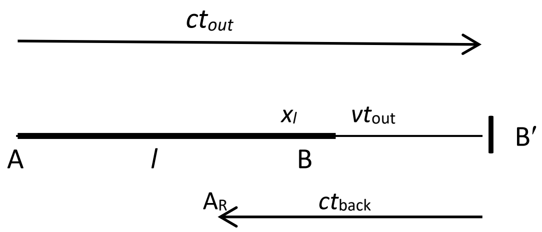


Figure 9.10 The motion of a light-wave travelling along a moving rod length *l*. The wave leaves an observer A at the origin end of the rod at t_o and travels to a mirror at the end B of the rod. In this time the far end of the rod B moves at constant velocity to B′ where the light is reflected back to the wave source which has now travelled to A_R and is received at time t_b .

Consequently:[19]

(i) Equation SR(1) only defines what is meant by "stationary clocks" in a motionless system. That is, looking at Figure 11.10 equation SR(1) is exactly the same as the length not moving, that is, B′ coincides identically with B.

The question of stationary is a major problem in special relativity which Einstein overcame but without complete clarity. The problem is the concept of motion, as is well known for example, the Earth travels around the Sun which travels around the centre of the galaxy which moves through space relative to other galaxies, and so on. Consequently there is no measure of 'being stationary'. But he did derive equation (1). Therefore I shall take it in the following concept.

Returning to Figure 9.10, the light (in the form of a photon, say) travels from A. If A remained at exactly the same point then B would not change position and the reflecting mirror would remain at B and the light would return to A. But if A travels, this does not change the speed of light, *c*, on the assumption the speed of light is constant; then A has a velocity in the direction of the light. There are two problems. (1) the photon has a velocity with respect to A and vice versa. (2) The speed of light is measured according to A's units of measurement which Einstein showed can vary according to his speed. It is here we run into the problem of what do we mean by his speed or velocity? That is, what does it refer to? He could only use another observer. According to this observer, A's units would be altered in relation to his motion. Hence the difficulty in interpreting the concept in terms of which observer (frame of reference) is travelling and which is stationary. (It will be seen in the form of relativity that follows from RST that this problem is removed as it depends only on who is observing

[19] While (ii), (iii) and (iv) may appear repetitious they all represent slightly different concepts.

whom). It is not really even possible to consider the forming point of the universe on the assumption it started from a single point.

We could, of course, make an assumption that there could be a point at absolute rest in which case a continuous circular wave of light would emanate in all directions such that any point on that circle was the same distance from A as every other point. Then A would have no velocity in any given direction. In this case Einstein's equation (1) would hold and could then be defined as the concept of 'being stationary'. Then equations SR2a and 2b can be used to determine how a moving point A will vary its measuring units so that it always measures the speed of light as a constant *c*.

If we turn to the concept derived in Chapter 4 based on Time, we do have a fundamental point at absolute rest in that it is at the centre of two contra-rotating spins which are the Universe itself. As in their natural representation they have no volume, this centre has no motion with respect to that Universe. Thus Einstein's equation SR(1) automatically holds to that condition and as the Universe develops, the space that eyed creatures see relativistically develops allowing for the possibility of motion whereupon equations SR2a and 2b come into effect. Thus equation SR(1) defines the concept of being absolutely stationary and SR2a and 2b allow us to determine (define) how and why we measure the speed of light to be constant if we are moving through the Universe. (A similar concept cannot be made for the universe we see around us as, even if it had a single starting point [about which we have no idea], we would have no reason to assume it was stationary. Nevertheless the concept of absolutely stationary can still be rendered by the fundamental provision of equations SR(2a,b)).

**Note: It may mistakenly be thought, at this preliminary stage, that because the time on a clock travelling with the rod records length/*c* that this overcomes the concept of time out not equaling the time back for all cases on the principle it is the clock in the so-called stationary frame of reference. This cannot be the case.[20] Because, as will shortly be derived, the clocks are moving with the rod they suffer the same length and time dilation as the rod. Special relativity is not about how we see our own frame of reference. Special relativity is about the actual time and length modifications as described in the remainder of this and the following three sections. Consequently the fact that our clocks give us the so-called proper length in our frame of reference does not mean that we are stationary in the absolute sense. We could be moving close to the speed of light with respect to another observer.

The rest of this section covers the standard derivation of SR with some clarifications to overcome flaws I perceive in it. The second, section 9.10.2, refers to the Michelson-Morley experiment with an interferometer and the FitzGerald contraction. The third (section 9.10.3) is the two-way comparison between frames of reference/observers. To see how these fit together I will first deal with length/time in both directions: even our eyesight in both directions will be moving with our frame of reference so

[20] Cf end of this section for further clarification.

we will always think we are seeing the same length/time in both directions. In any case in practice our velocity is so low compared to relativistic velocities that we would never notice any difference.

Moving to the derivation of the Lorentz equations: If the system shown in Figure 9.10 moves, equations SR(2a,b) imply the time taken for the outwards motion of light is not the same as that for its return: $t_B - t_A \neq t_A' - t_B$ as found by Einstein ([1905b] 1923:42). That is, a simple comparison shows that the time observed is different for an observer travelling in that moving frame compared to the stationary frame (equation (1)). As Einstein ([1905] 1923:42) pointed out: if two different observers travelling with respect to each other believed their clocks to accurately record the times taken for the light to travel to the mirror and return, the clocks of the two observers would no longer be synchronized.

(ii) All A can know is the time the wave, or photon, of light left him and the time it returned. He can*not* be certain when it arrived at B because he has no method of knowing whether he is stationary or moving, that is he cannot be sure whether it is he, or any external objects he sees, that are moving. He can only say that he is stationary with respect to his frame of reference AB.

(iii) So whilst any observer A records the speed of light as c in his moving frame of reference (that is, a frame of reference as defined by Einstein – for which the time for the light to travel out is not the same as the time for it to return) A's length and time units of measurement have changed in relation to his velocity. It is this change that produces his measured speed of light in his frame of reference as c, despite the fact he is moving with or against the light (see section 9.10.2).

(iv) The same applies to all frames of reference. The problem is no observer in his frame of reference knows, or has any means of determining, an absolute velocity because he has no reference against which to judge it. He can only relate his velocity to another co-moving object (observer) – depending on which one he picks from all the different objects he might observe.

For the purpose of giving a general derivation of Einstein's theory it is assumed the *relative* motions of two observers, A and B, can be taken in the same direction with both observer's x-axes lined up with the direction of *relative* motion. Here it must be understood that relative motion states nothing more than the fact of relative motion between the two observers. It is possible both objects are moving in the same direction at different speeds which if *relatively* in the + x-direction could be either B moving faster than A both in the + x-direction, or A traveling faster than B both in the $-x$-direction) or one travelling + x and the other – x depending on their relative speeds.

The Lorentz equations of space-time are derived in the literature and most university courses along the following lines (see references in footnote 28). If a wave of light emanates from origins A and O′, as in Figure 9.11, respectively in the frames of reference of an observer at each origin at a common time $t = t' = 0$ it propagates as $x^2 + y^2 + z^2 = c^2t^2$ and $x'^2 + y'^2 + z'^2 = c^2t'^2$ according to each observer respectively. If the observers move relative to each other at a velocity v in a common direction taken arbitrarily as along the X-axis, the equations can be reduced to $x^2 = c^2t^2$ and $x'^2 = c^2t'^2$ where x is the distance traveled by a photon of light in time t and similarly for x' and t'. By a variety of methods these two equations can be combined to give (see e.g. Møller 1962:35-39)

$$x^2 - c^2t^2 = x'^2 - c^2t'^2. \qquad \text{SR(3)}$$

Assuming, as suggested by Einstein, that there is a linear connection between the observers in terms of the time and length parameters, points in one frame of reference can be expressed in terms of the other to obtain

$$x' = ax + bt \qquad \text{SR(4)}$$

$$t' = gx + ht, \qquad \text{SR(5)}$$

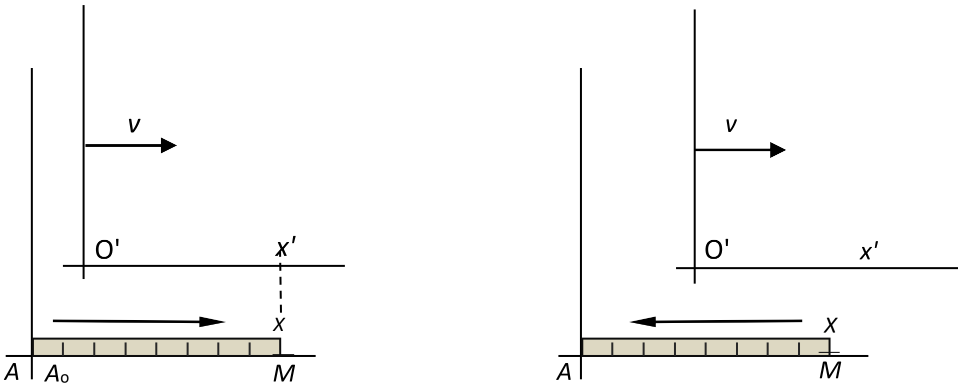
where a, b, g, h, are constants if v is constant during the expansion of the light wave. The first procedure is to ascertain two of these constants (b,h) by taking transformations between the frames of reference.

But that is only a transformation between the frames. The centre of Einstein's theory is the travelling of a wave of light in both frames of reference. This is clearly given by the condition that in one frame $x = ct$ and in the other $x' = ct'$. The other two constants (a,g) are removed using this condition. It is therefore a condition of the Lorentz equations which Møller subsequently derived after removing all four constants. It refers to the wave of light. Looking carefully at diagrams 9.11-9.13 it is clear that it is the wave of light that matters. Therefore I repeat $x = ct$ and $x' = ct'$ are conditions of the Lorentz equations and cannot be removed or replaced.

Constants a and g are determined using equation SR(3) to give $a^2 = (1-v^2/c^2)$ and $g = -av/c^2$. This result requires the square root to be taken for a which is $\pm (1 - v^2/c^2)^{1/2}$. Figure 9.11a shows that only the + square root applies for the *drawn condition*. The transformation equations (4) and (5) then become

$$x' = \gamma(x - vt), \qquad t' = \gamma(t - vx/c^2) \quad ; \quad \gamma = (1-v^2/c^2)^{-1/2} \qquad \text{SR(6a,b)}$$

known as the Lorentz coordinate transformations. I will not call them Lorentz-FitzGerald equations, as is sometimes done, for reasons that will become obvious. (The Lorentz-FitzGerald equations will be raised as a subsidiary equation applicable to a specialized condition).



(a) (b)

Figure 9.11 Given two observers A and O′ at the origins A_O and O′ of their respective frames of reference *A* and O′, a metre rule (or rod) of length *x* is placed along the *x*-axis of the *A* frame with one end at A_O. A photon of light (lower arrow) is dispatched from *A* at time t_o to a mirror *M* and reflected back to A. O′ moves with velocity *v* to the right in relation to *A*. In the right hand diagram (b) the wave reflects off *M* and returns to *A*.

Now the crux: To obtain the length and time modifications we *must* take into account that the Lorentz equations SR(6a,b) were derived under the strict condition that $x^2 - c^2t^2 = x'^2 - c^2t'^2$ (equation SR3) **where *x* is the distance travelled by a wave of light in the *A* frame so that $x = ct$.** Correspondingly, $x' = ct'$ in the O′ frame. Therefore for the wave travelling out:

$$x' = \frac{x(1-v/c)}{(1-v^2/c^2)^{1/2}} \quad \text{and} \quad t' = \frac{t(1-v/c)}{(1-v^2/c^2)^{1/2}} \qquad \text{SR(7a,b)}$$

(From this we should note that $x'/t' = x/t = c$ as it should).

But this is only for the outwards motion of the photon before reflection. As both *A* and *B* have *no* idea who is moving, or not, they have *no* idea of, *nor can they calculate*, when the light arrives at the mirror *M* in the Figure 11.10. If either is to know anything each can only gain such knowledge when the light has returned to *A*. *As stated by Einstein the return time* ([1905b]1923:42 and equation 2a,b)) *is* **not** *the same as the time out! Therefore we have to calculate this time of return to determine what A would record on his clock.* ***Only in this way can we make a proper determination of the relativistic effect***. The two way calculation is possible because although the time is different, the magnitude of *v* (and of course *c*) is the same for both ways.

It is often said, for example, see Synge and Griffith 1959:512 Fig 180, that given two frames of reference/observers *A* and O′ moving such that *A* moving to the left (say) with O′ stationary is relatively equivalent to O′ moving to the right with *A* stationary. This may be correct if *A* and O′ are exactly equivalent but most certainly it is not correct in terms of special relativity as demonstrated in

Figure 9.11a and b. They are not the same. In one the wave of light is moving in the same direction as the travelling frame. In the other it is moving in the opposite direction. Therefore the two have to be treated separately and as proved in equation SR(2) the time for the light to travel out is not the same as to travel back. Therefore both the time out and the time back must be calculated. They are not the same unless the stationary frame is absolutely stationary in terms of note (i) above.

The return can be calculated by a number of ways, (a) by noting the difference in the arrow directions of Figures 9.11a and 9.11b so that we can keep v as $+v$ as in equation SR(2b) and c becomes $-c$ for the return, or vice versa; (b) we can recalculate the standard method of e.g. Møller for the difference in motion bearing in mind that the return wave of light travels in the opposite direction to motion of B (see Figure 11.11b);[21] or (c) equations SR(2a,b) show that both $(c + v)$ and $(c - v)$ arise for the time measurement suggesting that when the square root is taken to obtain equations (6a,b) the negative square root indicates the opposite motion to that which gave (6a,b). All three methods give (using $x\wedge$ to distinguish from x' for the return),

$$x\wedge = \gamma(x + vt), \quad t\wedge = \gamma(t + vx/c^2) \quad ; \quad \gamma = (1-v^2/c^2)^{-1/2} \qquad \text{SR(8a,b)}$$

which gives

$$x\wedge = \frac{x(1+v/c)}{(1-v^2/c^2)^{1/2}} \quad \text{and} \quad t\wedge = \frac{t(1+v/c)}{(1-v^2/c^2)^{1/2}} \qquad \text{SR(9a,b)}$$

with again $x\wedge/t\wedge = x/t = c$ as it should.

Adding (7a,b) to (9a,b) and dividing by 2, as specified by Einstein, then gives

$$x^* = \frac{x}{(1-v^2/c^2)^{1/2}} \quad \text{and} \quad t^* = \frac{t}{(1-v^2/c^2)^{1/2}} \qquad \text{SR(10a,b)}$$

where * replaces ^ to signify the total photon travel time and consequent distance out and back.

Note particularly that equations (10a,b) agree with the transverse (relativistic) Doppler red shift described in section 3.2 and therefore agree with what humans observe in nature for fast moving objects. That is, in nature time dilation and length dilation work together in the same frame of reference.

I will now return to the problem of length/c = t, Figure 9.10 applies. It is impossible to determine that any frame of reference has no velocity because in recording the speed of light it is impossible to determine the time when a mirror is actually struck by the outwards moving wave of light (we are not

[21] In which case it will be found that this is equivalent to taking the negative square root of equation (3) thus agreeing with the general mathematical principle that *the square root of a number has both positive and negative roots*. It must be recalled that as Einstein pointed out (1923:40-42) the time for the wave to travel out from the observer is **not** the same as for it to return to him after reflection. This is covered by the difference between the positive and negative roots. *If the time was the same for both time out and time back then, as defined by Einstein (1923:42), the rod being measured is stationary, that is, not moving!* – see section 9.10.1.

at the mirror). So even if we had a clock at the mirror which triggered when the light arrived, it would not tell us the true situation unless we were absolutely stationary – and then stationary with respect to what? The origin of the universe which may not in any case be absolutely stationary? So here we have a clear cut difference between mathematics and fact. We can make mathematical calculations based on *assumptions* of our velocity with respect to another object but it is impossible to test those results (measurements) to be certain of the true situation. But that 'true' situation is essential for understanding the universe.

To problematize this issue, our clocks run at a rate such that the speed of light measures the same in all directions. This even applies to the Michelson-Morley interferometer experiment (see section 11.10.2) where the interferometer is adjusted so that the wavelengths of the light travelling up one arm coincides (on reflection) with the wavelength travelling up the other; the reason is because one does not know for certain whether it is the thousandth wave length (say) on each or maybe the one thousandth on one and 987th on the other that coincide. (One may for example very precisely check the measurements of the interferometer arms to be exact but there is no way of being absolutely sure the waves of light 'see it this way' for a travelling interferometer).

I will leave the very important consideration of exactly what this length and time variation means to section 11.10.4. For now, I will turn to the Lorentz-FitzGerald contraction and its derivation.

9.10.2 FitzGerald contraction

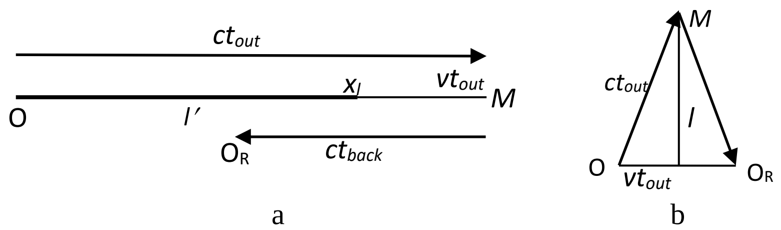


Figure 9.12. The motion of a light wave travelling along a moving rod or interferometer arm. The wave leaves O in its frame of reference at t_o and travels to a mirror at the end x_l of the rod length l'. In this time the far end of the rod moves at constant velocity to *M* where the light is reflected back to the wave source which has now travelled to O_R. In Michelson's experiment the interferometer is rotated through all directions so that there will be a result where one arm (diagram a) is lined up with the Earth's motion while the other arm is normal to the motion as in diagram b.

The result for Figure 9.12a was calculated in section 9.10.1 as

$$t_{out} + t_{back} = l/(c-v) + l/(c+v)$$

but if $v = 0$ then $t_{out} + t_{back} = 2l/c$ so that if v is not 0 the length of the rod changes or the time or a mixture of both changes with velocity. From the Michelson-Morley experiments it is the rod's length that reduces[22]. Call this length l' and the time taken as T' then as with Tolansky (1956:417-418) we get:

$$T' = t'_{out} + t'_{back} = 2cl'/(c^2 - v^2)$$

From Figure 9.12b, being an isosceles triangle, Pythagoras theorem gives

$$T = t_{out} + t_{back} = 2l/(c^2 - v^2)^{1/2}$$

If we find these two times are equal as was suggested by the case of the Michelson-Morley interferometer then

$$l' = cl/(c^2 - v^2)^{1/2} = l/(1 - v^2/c^2)$$

where l' is the contracted (FitzGerald) length.

Equations SR(10a,b) are a general form of Einstein's equations between *two* observers. The Lorentz-FitzGerald contraction is found in the specific case of an interferometer as in the Michelson-Morley experiments where one arm of the interferometer appears contracted in relation to time dilation, see for example Tolansky (1956:410-416). It therefore describes how and why an observer A, for example us, measures the speed of light in his frame of reference to be constant. The conditions between observers in two different frames of reference and a single observer in his frame of reference are thus totally different and must not be mixed up. However, in order to ascertain what A sees, a comparison to something is needed and, as with Tolansky (1956), this is usually taken to be an external observer, but it must be clearly understood this is an observer external to the total system and completely isolated from it. The standard university methods apply to this situation ***but not*** to the general length and time comparison between two observers, for which a clearer account is described in section 9.10.4. First it is important to consider the often quoted concept of simultaneity.

9.10.3 Spatially separated simultaneity

The idea that two spatially separated events simultaneous in one frame are not simultaneous in another co-moving frame is one of the mainstays of special relativity as taught and used in contemporary physics. The concept is obtained as follows (verbatim from Rosser (1967:45-46):

> "Let two events occur at two separated points x_1 and x_2 in the inertial frame Σ. Let them be measured to occur at the same time t in Σ. According to the Lorentz transformations these would be recorded at the times t'_1 and t'_2 by clocks at rest in Σ', where t'_1 and t'_2 are given by

$$t'_1 = \gamma\left[t - \frac{v}{c^2}x_1\right] \quad \text{and} \quad t'_2 = \gamma\left[t - \frac{v}{c^2}x_2\right] \qquad \text{SR(11)}$$

[22] The rod in the Michelson-Morley experiment would be the arm moving in the direction of motion of the Earth.

Since x_1 is not equal to x_2, t'_1 cannot be equal to t'_2, so that if the Lorentz transformations are correct, then two spatially separated events which are simultaneous in Σ (A frame in Figure 9.11) are not measured to be simultaneous in Σ' [O′ frame in Figure 2]"

Equations SR(11) are clearly Lorentz equations dealing with emitted waves of light which require the condition $x = ct$. Then if t is the same for both parts of SR(11), then $x_1 = x_2$ so that $t'_1 = t'_2$. This gives $t'_2 - t'_1 = t - t$) i.e. a '0 = 0 equation' – which does ***not*** allow the deduction that what happens at two different places simultaneously in the 'stationary' frame of reference occurs at two different times in the 'moving' frame – see next section for the general principle of two-way observation. What such derivations forget is that in the Lorentz equations t_1 is the time taken for the light to travel from the Σ observer (in Rosser's case) to x_1 and similarly for t_2, that being the time taken to travel to x_2 so if $t_1 = t_2$, $x_1 = x_2$. The meaning of these symbols cannot be arbitrarily changed in order to obtain a desired effect.

Yet this idea is perhaps the most often quoted sentence, and probably the most deeply rooted argument, in contemporary theory. It allows the reversal of time sequences which has become an accepted part of special relativity. For example, consider the following for which, despite many discussions, I have been unable to obtain a satisfactory standard physical answer. Suppose I get out of bed in the morning, get dressed, have a cup of coffee, go outside for a run, have a heart attack and fall down dead on the road. According to standard theory it is perfectly logical that in another frame of reference: I can be lying on the road dead, get up, have my heart attack, run backwards to my house, undrink my coffee, get undressed and go back to bed! After that bit of nonsense let's have a less jocular look at the situation.

First of all I will just briefly give a rationale to this problem, one often used by lecturers. For example, if two explosions occur at the same instant in one frame of reference, but I am closer to one than the other, then I will hear the one before the other and I may then assume it took place before the other. Now suppose the one takes place earlier than the other and I am sufficiently close to the other so that I hear the other first, then I may assume the other took place first even though the other actually took place after the one. Relook at the 'proof' of equation SR(11). Has its assumptions gone a 'step too far'?

If one considers that every observer has a frame of reference then these frames of reference must all extend to infinity, or at least the edge of the universe. Even if observations are apparently bounded by, say, a wall, the frame of reference still carries to the edge of the universe. Thus what happens at a given time in any frame of reference happens at that instant[23] in all frames of reference (whether they can observe it or not). It is (see next section) the observer's units of measurement that are different to

[23] I use instant meaning simultaneously without considering a specific time as recorded on a clock because two observers holding their own clocks may not agree on their specific times nor on their units of time. For example one clock may run faster than the other.

another's depending on their relative velocity. As above, it is an observer's *units of measurement* that always give the constant speed of light that relates all frames of reference to each other.

Suppose I bang both fists on a table together. As above, it happens in all frames of reference throughout the entire universe whether their observers are looking or not because all frames of reference extend to the edge of the universe. Even if they are bounded in a box (or well) as in QM or QFT to limit them to a specific volume for mathematical purposes, they still extend beyond that imposed boundary. However, suppose we only take those frames of reference that observe me banging my fists on the table. Those frames of reference overlap because they all extend to the edge of the universe, and they specifically overlap where my fists are. My banging the table therefore happens in all frames of reference at the instant I hit the table. Note I use the word instant, not time, because time refers to a clock in this case. How do the other observers see my action? By the wave of light that leaves my fists as they hit the table. It travels at the speed of light in all those frames of reference.

This can be formalized as a general physical principle for comparing observations made of an object by two different observers. To make the measurement principle clear, I take the object to be measured as a metre rule. It is assumed, as is usual for special relativity that all clocks and units of measurement in all frames of reference when at rest with each other are identical. It should be apparent it fits completely the general deductions made by Einstein in his 1905 paper.

9.10.4 General principle of two-way observation between two observers

Take two frames of reference A and B orientated as in Figure 9.12 and take the unit of measurement as a metre rule, with endpoints x_1 and x_2 in A. Initially imagine a perfect frictionless contact between the rule and a photographic film attached to B's x-axis as the two frames travel past each other.[24] Then if A transmits a photograph of his metre rule, the two endpoints of A's rule x_1 and x_2 must be marked simultaneously onto B's photographic film at x'_1 and x'_2 according to clocks carried in the A frame and placed at each end of the metre rule (taking into account the fact just quoted that all frames of reference overlap and an event in one frame occurs at that position and instant in both frames simultaneously). Note (1) The simultaneity of transmission is essential otherwise B will have moved during the period of transmission (as expressed in all university courses). Note (2) A single photon from each point could make the mark but these photons must not be confused with those used by A and B to measure the length of the metre rule or its photographic image respectively. Note (3) If the frame of reference is homogeneous then the clocks at x_1 and x_2 will be synchronous with a clock placed at A's origin A_o as required by Einstein.

Then at the precise *instant* that the marker in A's frame is emitted from x_1 it is recorded at x'_1 on the film at time t'_1 as recorded by a clock in B's frame at x'_1. Similarly, at the precise instant when

[24] Suggested by Douglas Gough FRS during a conversation on the principles of special relativity.

the marker is emitted from x_2 it is recorded on B's film at x'_2 at time t'_2 as recorded by a clock in B's frame at x'_2. Since these clocks are stationary with respect to B's origin $B_{O'}$ they must each be synchronous with a clock carried by B at his origin $B_{O'}$ as required by Einstein. From the definitions of x_1 and x'_1 and x_2 and x'_2, if the markers are emitted at the same time in A's frame then t'_1 is identical to t'_2 in B's frame. But note that here t'_1 and t'_2 are the times when x_1 and x_2 are recorded on B's frame (at x'_1 and x'_2).

In case this is not clear due to differences with standard methods as explained above, I will further expand on the condition of the event. The frames of reference of both A and B overlap so that an event in A occurs simultaneously in B because the event is a singular operation that occurs in both frames at the same instant and local placement[25] of the event. In this case I have placed the event specifically on the *x*-axes of both observers. I will later take this condition out but will still use the *fact* that a single event occurring in overlapping frames of reference occurs simultaneously in both frames. However, despite this event occurring simultaneously in both frames of reference, it does not mean that both observers measure the outcome in identical terms. The event is recorded by each observer in terms of his coordinate system (arranged as above). How each observer views it, depends on their units of measurement. Note that this action of recording the event simultaneously is ***not*** part of the Lorentz transformation. It is a purely a simple action of an event occurring in all frames of reference – nothing more. Hence the given use here of t'_1 and t'_2.

This completely simultaneous transmission is necessary as otherwise A and B would have travelled relatively during the transmission of signals thus giving spurious results. This does not mean that A's clocks will be synchronised with B's (they will not because the two observers are not at relative rest) nor does it mean that B will physically see light from the marking system at x'_1 and x'_2 at the same time by his clock at $B_{O'}$. Should light have been instantaneously emitted from x'_1 and x'_2 when they appear on his photographic film it still does not tell him anything other than their arrival because he has no way of telling from exactly how far away the light has travelled to him from x'_1 and x'_2 until he measures the distance with his metre rule. He merely measures their time of arrival at the clock at his origin but he does not know for certain that they arrived at the same time by his clocks at the arrival points. Even if he is midway between the arrival points he cannot tell because he is travelling so in that condition the two flashes sent to him will arrive at different times. If the flashes from each point arrive at the same time from exactly opposite directions, then, because he is travelling he must have been closer to one than the other.

[25] I have already stated instant is irrespective of the time on a clock and here I have used 'local placement' to mean w.r.t. the event itself as opposed to a 'position' in a given frame of reference which is usually taken physically to mean according to a set of coordinates carried by the frame of reference. The 'placement' of the event can then be recorded at a 'position' according to the relevant frames of reference. It is here that relativistic principles become apparent when the observer in that frame determines the 'position' according to his measuring units.

But B, in his frame of reference, can at his leisure carry out the measurements of the distances of x'_1 and x'_2 from $B_{O'}$ according to Einstein's principle of photon out–photon back if the clocks at x'_1 and x'_2 each have mirrors; or by using his metre rule against the photographic image. There are two ways of looking at B's rule. (I) If A's motion creates dilation of his unit in B's frame (as in the relativistic Doppler effect) for a given wavelength when both A and B are at rest w.r.t. each other, then B's unit of measurement must be shorter than A's; or (II), consider the Lorentz-FitzGerald 'contraction' as in section 9.10.2.

Either way he will believe A's wavelength and (time) period to be dilated as in natural red shift observations. Note that because c is constant the same results can be obtained if B's x'-axis travels parallel to, but some distance away from A's x-axis.

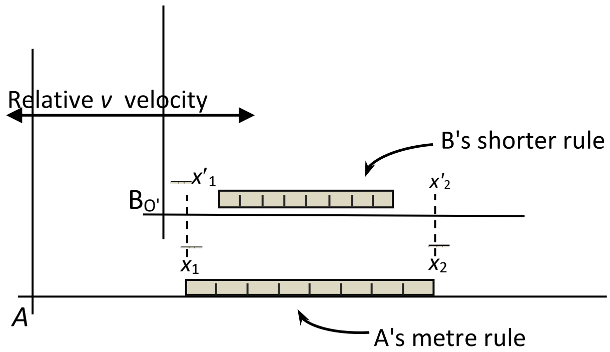


Figure 9.13. B takes a photograph of A's metre rule. Due to the relative motion, B's metre rule will be shorter than A's metre rule. In terms of his rule he therefore measures $\Delta x' > \Delta x$. The inverse condition with A travelling past B and photographing a metre rule placed on B's X-axis would show the equivalence of the two frames for this physical action.

The principle can also be applied if A and B's x- and x'-axes are lined up some distance apart because light from the end points of A's rule will travel in parallel lines to B's x'-axis at c. In either form the emphasis is shifted away from Einstein's principle of 'moving' and 'stationary' frames to the principle of determining the origin from which the transformation is being made irrespective of whom is moving.

Furthermore, according to this principle, length alteration is real as follows. For example according to Einstein ([1905] 1923:40-42) the shortest time interval is attained when a clock is stationary in a motionless system, that is, $t_B - t_A = t_A' - t_B$ (see section 4.8.1). Consequently, imagine a strand of atoms along the length of a metre rule. These are held apart by electromagnetic forces. If the ruler travels in its length direction then these forces, mediated by photons, take longer to move to the next atom and back than if the ruler is stationary. Therefore the metre rule would expand in its direction of travel. If the metre rule is held orthogonally to its direction of travel then the time taken to travel between the atoms along its length will *not* be affected but those across its width will be.

However, this is where we have to be very careful. We do not know whether we are stationary or not because our rulers adjust to our motion as above so that we always measure the speed of light as c. *It is not who is moving and who is stationary that matters, it is who is observing and who is being observed.* If B observes A as in Figure 9.13 then, as A is moving relative to him, A's transmissions are dilated, just as for the transverse Doppler red-shift of section 4.8.1 and equations SR(10a,b). Then B's ruler is shorter than A's dilated ruler and he measures A's so-called proper length projected onto his frame of reference as dilated.

Returning, now, to my fists hitting the table with a slightly different example:

I hit the table with my left fist a little before, at a small distance from, my right fist. Again that happens in all frames of reference at exactly the instants the two hits (events) occur in my frame of reference. I shall now add one refinement which can also apply to the example in section 4.8.3. Imagine that what happens in my frame of reference is recorded on a photographic sheet by the observer in his frame of reference. The waves of light from my fists hitting the table travel to this photographic sheet carried by the observer along his x'-axis which moves as usual in SR descriptions parallel to my x-axis and my fists land at different times along my x-axis. First consider the simple case that his x'-axis runs alongside and touching my x-axis. As his frame of reference overlaps mine, what happens on my x-axis (the banging of my fists) happens at exactly the same instants on his x'-axis. That is, the time order has not changed. *It is how he measures those times and positions that matters* which as in section 4.8.4 depends on the rate of running of his clocks and the length of his ruler.

Next consider his x'-axis running parallel to my x-axis but some distance away. The waves, or better still single photons, from each of my fists travel at exactly c from the events on my x-axis and therefore arrive *at* his frame of reference at exactly the same distance apart as they left my frame of reference. That is purely a geometric fact following from the constancy of the speed of light as shown in Figure 9.13 for a ruler. Furthermore the interval between hitting the table with my left fist and hitting it with my right (for which both instants occur in his frame at the identical instants they occur in mine) remains fixed as the light from both events has to travel identically to his x-axis at c. But, of course, the delay between the two waves of light arriving at his x'-axis means B will have travelled by the time both beams of light have been recorded on B's axis. Again it is how he measures the receipt of the events that matters. As it is recorded on a photographic sheet he can measure at any time he likes using his clocks and rulers which run at a rate depending on *his* velocity.

Consequently the *order* of the events in my frame of reference is preserved in his frame of reference though *his clocks* may not agree with mine in the length of time between my two fists landing on the table, nor the distance between them (because he moved between my two blows).

It should be clear from this that the concept of the explosions is different to the fists banging the table. In that explosion case there is no method of knowing which one took place first so one cannot draw any concrete conclusions about their timing and it was falsely assumed the ‘other’ took place before the ‘one’. In the second case there is a clear connection between the events. So here we can see how reliance on perception can lead to false conclusions and furthermore placing such concepts into a generalized equation (equation SR(11)) is dangerous even if it appears logical. Furthermore changing the original concept of t being the time taken for a photon of light to travel a distance x or vice versa used to construct the Lorentz equations to one where $x = vt$ as in equation SR(11) leads to spurious results.

9.10.5 Muon lifetime

Due to the muon’s ability to transfer from the upper atmosphere to the earth’s surface despite its very short lifespan, it is commonly used to uphold Einstein’s theory. It is easily explained using the above interpretation of Einstein’s paper. For example, the muon's rest lifetime is about 2×10^{-6} s. If a muon was to travel for 2×10^{-6} s it could travel about 600 m at $0.998c$. We observe light from the muon so we are the B frame and the muon, by transmitting its form to us, is the A frame. So its lifetime in its frame is Δt. $\Delta t'$ is what we measure and $\Delta t' = \gamma\Delta t$. If the muon travels at $0.998c$ the equation says that we measure its life time to be about 31.6×10^{-6} s. In this time it could travel about 9460 m. Alternatively if it has a wavelength λ and decays after n cycles we would find its wavelength increased according to $\Delta x' = \gamma\Delta x$ in which case the maximum distance it could travel in n cycles at $0.998c$ would be inflated by 15.8 times. $15.8 \times 0.998 \times 600$ m = 9460 m. Thus special relativity as detailed in section 4.8.4 explains very simply why a muon travelling at close to the speed of light with a very short life time can travel from the upper atmosphere to Earth and be observed here before it decays. Note that this short life-time and corresponding high speed of the muon will agree exactly with the causal generation of space and space-Time raised in sections 4.6-4.7, once it has been established how this generation fits into human perception of space and time intervals in section 4.9.

9.10.6 Minkowski 4-dimensional spacetime

It is assumed that the four dimensions consist of three space dimensions and one time dimension in which time is assumed to be a scalar quantity. Since Einstein deduced that time is dilated in the direction in which the frame of reference (observer) is travelling, but not in any other direction, time must obviously be treated as a vector quantity as in the Time scheme.

Simple mathematics shows that if calculations are carried out similarly to those used for the Lorentz-FitzGerald contraction as in for example Tolansky 1956:417-419, treating the dilated time to apply to both directions of the Michelson interferometer will not give the expected results. The time along the line of motion has to be dilated and that along the other orthogonal shaft of the interferometer has to be taken as undilated to obtain the hoped for result. As it is an obvious and simple calculation (see Figure 9.12) I shall not detail it here to save space.

Note that provided Minkowski space-time is used in only two dimensions such as (x^1, t) as in quantum field theory, the mistake of treating time along all axes as being dilated due to motion along one of them should have no adverse effect – provided, of course, that t is in the same direction as the moving length axis.

9.10.7 Relativistic dynamics and rotation

Dynamics can be expressed quite simply by inserting the relativity factor $\mathbf{R} = (1-v^2/c^2)^{1/2}$ to each space and time term. Thus $v' = (x/\mathrm{R})/(t/\mathrm{R}) = x/t = v$ as would be expected from Einstein's formulation of relativity, $A' = (x/\mathrm{R})/(t^2/\mathrm{R}^2) = \mathrm{R}A$ so that acceleration is relativistically affected. This gives $F' = m'a' = F$ (which in QFT automatically gives $\phi'(x') = \phi(x)$). From these terms it is easy to see that the value of π is unaffected by relative motion as follows.

If an observer *A* at the origin of a rotating frame of reference, were to consider a disc fixed to his frame of reference and thus rotating with it, any measurements he made of the disc would pertain to his frame of reference, and thus would be subject to the Lorentz-FitzGerald contraction. Let the plane of the disc be in his *x* and *y* directions and let him lay a rod as suggested by Einstein ([1916] 1923:116) with its length tangential to the disc circumference at *x*. It will thus be orthogonal to his *x*-coordinate direction. It is, of course, the infinitesimal approximation at point of contact of the rod to the disc that is of importance but, as Einstein pointed out, this would be affected by a Lorentz-Fitzgerald (section 4.8.2) contraction. As the disc rotates in the *xy* plane, the rod's length goes with the disc through to the *y* direction. That is, a point on the disc circumference not only has a tangential velocity but a centripetal acceleration so that the radius of the disc contracts equally as the rod.

Taking one step further: In the view of an external (isolated from the system as in section 4.8.2) observer, a rotating disc with tangential velocity *c* would have no apparent radius, circumference, or size. Consequently, recall the man in the contracting sphere, and, to put the ideas into context let his sphere have a rotation, of which he is unaware because he cannot see outside it. Then if this rotation starts slowly and speeds up towards a tangential velocity of *c*, the sphere, according to an outside observer, will appear to shrink. But because the man in the sphere's rod is affected by this rotation as just described, the man will be none the wiser that he has shrunk.[26] This is merely the reciprocal of the situation described in section 4.4 where I suggested that *A* would imagine he had gained a space if he was rotating. That is, if he had started out with no rotation and suddenly gained a rotation he would suddenly see a unit disc, or rather a disc which he would consider to be of unitary size. Since the Time jump gives the trace-point an instantaneous tangential velocity of *c*, *A* automatically believes he has a

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[26] Einstein's addition of velocities applies

space around him. Similarly, for trace-point *B* and all other trace-points. Then when they jointly observe each other, the general Lorentz equation (as determined in section 4.8.1) applies so that each observes the other to have unitary volumes. Thus, whichever method one uses π remains constant – it does not change with rotational velocity.

9.10.8 Simultaneity revisited

The simultaneity between two co-moving observers was explained in sections 4.8.3 and 4.8.4. This section covers a more general concept. If we receive signals from different sources we have no idea when, or from exactly where, they were originated unless we have *a priori* knowledge of the position in our frame of reference of their dispatch. There is no way we can determine such knowledge, nor the source position or time of transmission because we do not know either our or the transmitting object's exact motion; nor, if we send a signal to the object for immediate return, do we know exactly when the signal arrived because we do not know our nor the source's exact velocity (i.e., taking into account relative direction of motion even after several transmissions, as the relative motions can always change). We can only say the signal arrived at our position from a specific direction according to our frame of reference at the time of the signal's reception. Even if we receive regular transverse red-shifted signals from the object we only obtain a relative red-shift for our velocity relative to the transmitting object. As is done in astrophysics we can estimate the distance according to known brightnesses of distant objects (Perlmutter 2003). Or we can for closer objects use Einstein's system of time out – time back. Then when we say a star or solar planet is 'such and such' a distance, that is only according to our units of measurement which depend on our velocity with respect to the speed of light. (Einstein assumed this speed to be constant, but in terms of the fundamental cause of Chapter 4 the speed of light is an *absolute* constant; and it will become clear in Chapter 5 that this determines the existence of our perceived space). It thus seems a general form of simultaneity is irrelevant to the form of special relativity derived here.

I shall now relate these remarks on special relativity to the construction of the Universe according to the definition of Time and associated rotation and space. Note that here *c*, the speed of light, is taken as having exactly the same value as *c*, the tangential velocity of the fundamental rotation.

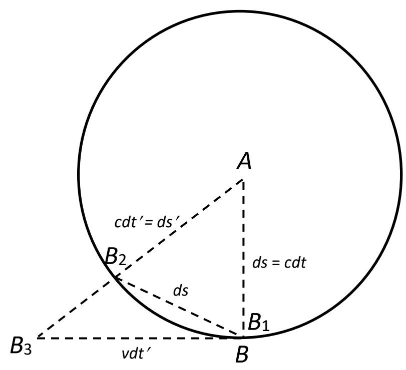

Figure 9.14 Determination of Einstein's special relativity

Let *A* be a point as in Figure 4.1 and 10.14 which in nature has no measurement but in the human interpretation due to its rotation provides what I, as a human, call a minimal interval in a similar vein to the concept of a man in a sphere, which has no volume according to an external observer. Then we can interpret the distances in human mathematics as giving

$$dt^2 = \frac{(c^2 - v^2)}{c^2} dt'^2 \qquad \text{SR(12)}$$

If we interpret equation SR(12) as a ratio equation with $v = c$, as it would be if *A* is only a point with 'no part', then

$$\frac{dt^2}{dt'^2} = \frac{(c^2 - v^2)}{c^2} = \frac{0}{1}$$

where $ds = cdt = 0$ becomes a unit interval dt'. That is, what appears to *A* as zero (no distance or Time interval) appears to an outside observer as a unitary interval: qut = 1 or qul = 1 ($ds' = cdt'$).

Einstein's special theory automatically follows. (For ease of expression I will refer to *A* (unsigned symbols) as 'he' and *B* (signed) as 'it'). Let *A*, as he rotates, see *B* and instantaneously marks *B*'s position on the surface of his unit (shown in the figure as a circle) at B_1 as he (*A*) rotates. Because *ds* is a minimal interval B_1 moves to B_2 in time *dt*. If *B* is stationary with respect to *A* then $v = 0$ and $dt' = dt$. But if *B* was to move at velocity *c* it would be at B_3 when *A* had rotated for time *dt*. Thus *A* would not see any angle subtended between the original position of *B* and B_3. But for *A*, *dt* is unitary = 1 (given) and as he sees no angle subtended ($\theta = 0$) so that his view of $ds' = cdt' = 0$, in which case equation (1) becomes (and vice versa)

$$0 = \frac{c^2 - c^2}{c^2} dt\,.$$

On the other hand, if *B* travels slower than the speed of light *A*, *will* notice a difference in position between *B* and B_3 based on equation (1). Now take the same process with another point *C* close to *B* where *C* and *B* can be solid points of some sort. Exactly the same conditions will apply. Then the same conditions will apply to any points between *B* and *C*. Consequently, the length between *B* and *C* will depend on equation SR(12) as well. Then, as with the contraction of the interferometer arm in the Michelson-Morley experiment, the length between *B* and *C* contracts as *v* increases. This is as observed in human experiments and predicted by Einstein's special theory. Time in the form of rotation ($\hat{T}$) can thus be seen as providing a causal reason for Einstein's discovery.

There is one further important concept raised by Einstein (1905 [1923]:50-51); his addition of velocities. As it is easy to establish, I will just merely mention that if an object moves through a space with a given velocity and another object moves in the same direction on that particle, it does not matter how fast the particles move, their total velocity will limit to (can never be faster than) the speed of light. For example, if two Time-points rotate next to each other both with rotation $\dot{\theta}^{+}$ and tangential velocity c their relative velocity at their point of contact will not be $2c$ but c; i.e.

$$V = \frac{c + c}{1 + \frac{c \times c}{c^2}} \ .$$

9.10.9 Final note

Note that these comments agree exactly with, and follow directly from, the principles raised in Sections 4.5-4.7. In particular it also explains a concept which is currently outside of human understanding but logically fits within Einstein's concept of special relativity; that is, the concept of $\dot{\theta}^{+}$ being encapsulated rather than backed by $\dot{\theta}^{-}$. A natural deduction from the above concept of length contraction, as found in the Lorentz-FitzGerald contraction, is that as an object approaches c its length reduces towards zero. Consequently, imagine two balls one larger than the other, with the smaller inside the bigger. Now imagine that both balls rotate with tangential velocity of each tending towards c then, as in 4.8.7 and taking into account Einstein's addition of velocities, each ball will have a tangential velocity of c and thus will be contracted to no size, but both will still be spinning points, one within the other. Conversely, a point rotating such that its tangential velocity is c, will according to sections 4.8.4 and 4.4 gain a surrounding relativistic space when observed by an observer outside of it. (cf section 4.4). This again shows the importance of what is observed and by whom. It demonstrates how an object can have no volume and yet *be seen* to have a volume.

The problem of *a priori* or *posteriori* mathematics raised at end of section 3.1.1 is also clarified. Points with no size and thus measurement produce measurable distances through the concept of rotation, thus settling the problem of Platonism in that mathematics of number and measurement arises as a result of universal structure.

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