Motion and particles

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Physics research has resulted in categories of phenomena and the present theoretical framework in physics of the microcosm, the Standard model, describes a number of fundamental building blocks: elementary particles and elementary forces. It "smells" like classic phenomenological physics so it is difficult to understand how this exhibit of phenomena can be transformed into a unified theory. But there is another way to think about motion, particles and their distinct properties.

Introduction

More than half a century ago the physics text book told me that if an unstable nucleus emits a neutron, the particle decays in about 11 minutes into a proton, an electron and an anti-neutrino. Of course, the text book described the interpretation of experiments in phenomenological physics.

The problem with phenomenological physics at the smallest scale size is that during the decay process we cannot isolate the energy of the neutron from the energy transformations of the basic quantum fields around. However, the mass of the proton and electron together is more than the mass of the neutron. An indication that the then supposed *decay* process is not well understood. So how do we solve this kind of problems?

What is motion?

Because humans have senses, motion is interpreted as the change of position of a visible phenomenon (phenomenological reality). For example the continuous change of position of a moving bicycle. Unfortunately, everything in the universe is constantly changing its variable properties although the universe itself is in rest. The consequence is that "daily reality" is the result of a underlying creating reality that exists at every point in the universe. Actually, this is the concept that the famous ancient Greek philosopher and mathematician Parmenides of Elea (about 500 BC) used to describe his ideas about the origin of motion. Parmenides' concept has – according to the paradox of Zeno of Elea about Achilles and the tortoise – a metric. So we have to conclude that Parmenides' underlying creating reality represents an unmovable structure that must be composed of indivisible dynamical units.

In modern quantum field theory (QFT) we use nearly the same concept because the *general* concept of QFT is that daily reality is a creation of basic quantum fields. A handful of fields that together form a tessellation of the volume of the universe.[1]

If motion is not a property that is generated by the phenomenon itself – for example the motion of a cyclist – phenomenological physics cannot be an explanatory model of daily reality. Because local properties don't originate from the phenomena itself. These local properties are created by the non-locality of the properties of the dynamical basic quantum fields (Noble prize physics 2022).

The consequence is that the quark/gluon hypothesis in the Standard model cannot be correct. In spite of the fact that particle theorists are convinced that the underlying framework of the Standard model is created with quantum field theory. Maybe it is a bit confusing but the quark/gluon hypothesis is a joint effort of particle physicists to create an explanatory model of the observed asymptotic freedom of accelerated colliding particles.

Colliding elementary particles in high energy particle accelerators don't split into even smaller parts. The result of the collision of the accelerated particles and the applied energy to the particles is the creation of more elementary particles and electromagnetic radiation after the collision. Probably asymptotic freedom shows us to be *the end of reductionism*. It suggests the existence of a underlying spatial structure that is composed of indivisible dynamical units that create "daily reality" (Parmenides' concept of the origin of all the dynamics in our universe).

In other words, to understand the nature of motion we have to abandon the phenomenological point of view. The latter is the conviction that local properties exist independently of all the other detectable phenomena in the universe.

Parmenides' concept of an underlying creating reality as an unmovable structure that is a composition of indivisible dynamical units, can be drawn in a schematic way as a volume tessellated by units with equal basic properties.

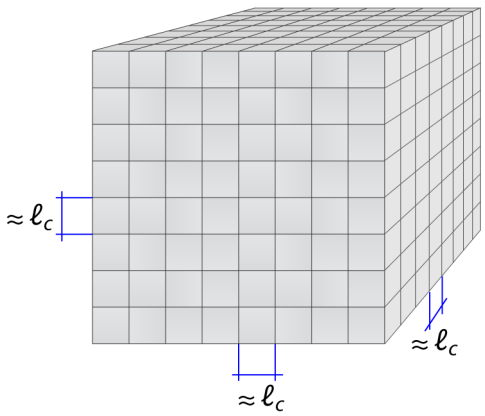

figure 1

The large cube in figure 1 is build up by smaller cubes that tessellate the volume of the large cube. So there is a metric too (ℓ_c).[2] Unfortunately, the image doesn't represent "daily reality". Figure 1 shows Parmenides' underlying creating reality in a schematic way, but that doesn't mean the creating reality is undetectable. Because Parmenides' concept must be interpreted as an explanation of the mechanism behind the motion of observable phenomena.

The units of the structure in figure 1 have dynamical properties too, so every unit must be a homotopic topological space. That means a volume that can transform its shape in a continuous way under a geometrical invariance. And last but not least, during the transformation of the shapes of the units all the changes have to be synchronised, otherwise no change is possible. The invariance is the volume of every unit – in line with experimental physics – and figure 2 shows the principle of the dynamical geometry.

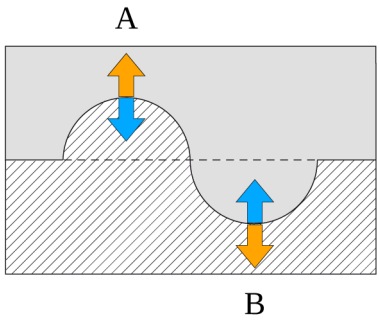

figure 2

The image shows the cross section of 2 rectangular bodies with invariant equal volumes. The joint surface area can increase or decrease its area if we deform A and B in a synchronous way (in the direction of the orange arrows or the blue arrows). Be aware that the topological deformation is only possible if the 2 bodies can transfer volume towards their boundary and visa versa.

The principle of topological deformation under invariant volume shows that change – energy – is equal to the variances of surface area between all the units of the structure (also termed *discrete space* or *quantised space*). In line with the square of c in Einstein's formula $E = m\,c^2$.

The "power" to change the shape of every unit of the structure must be a geometrical property of the unit. Because without an internal "power" it is impossible to imagine how the units can change their shape. The consequence is that motion is the propagation of topological deformation within – and by – the units of the structure. In line with the general concept of the structure of the basic quantum fields in modern quantum field theory.

In other words, it is quite obvious why Zeno of Elea rejected the then common ideas about space, time and motion in ancient Greece. Because these ideas represent the limited point of view all humans use in daily live.

Space isn't empty so we don't move *through* the universe. Our properties are created and transferred by the underlying structure. Time isn't day and night and the Earth motion around the sun. Time is the continuous sequence of transformations within the structure of the universe.

References:

1. Art Hobson (2013); "*There are no particles, there are only fields*". American journal of physics 81, 211. DOI: 10.1119/1.4789885. https://arxiv.org/ftp/arxiv/papers/1204/1204.4616.pdf
2. S.E. Grimm (2024); "*The box without walls*" PotMNoR 2024-06-10

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What is mass?

If topological deformation – energy – is locally concentrated, the process of concentration is not accidentality. Our universe is local and non-local, therefore the local process of concentration "suits" seamless within all the other processes – actually dynamical energy configurations – everywhere in the universe. In line with the universal conservation laws (energy and momentum).[3]

The linear propagation of 1 quantum of energy in vacuum space has the speed of light (c). But in quantised space every unit of the structure of the universe has an equal and

invariant volume. So all the changes of the universal electric field and its corresponding magnetic field have to be synchronised. It is the synchronisation of all the transformations that forces the universal electric field to transform in a quantised way. In other words, every unit of the structure deforms its shape with a fixed amount of topological deformation – the quantum of energy – at exactly the same moment. In between no unit of the structure can change the direction of its deformation. Be aware that the quantum of energy is a quantised topological *relation* between all the units. The transformations of the deformed part of every unit are smooth and continuous (see topology).

A highly deformed unit needs a lot of quanta transfer to return to the average topological deformation of the other units in vacuum space around. The only way to get rid of the surplus of topological deformation by a unit is to transfer the surplus of topological deformation in relation to the average energy density around to adjacent units.

If the pass on of the topological deformation is in one direction, it is like the surplus of energy "moves" in that direction. And of course, thanks to the all-inclusive synchronisation of all the changes in the universe the velocity of the propagation of the surplus of energy is far lower than the linear propagation of 1 quantum of energy (speed of light).

So $E = m\ c^2$ is clear. To transform a local concentration of energy – an amount of topological deformation – into "free quanta" again the "locked" energy of the mass (m) – an amount of concentrated topological deformation (see figure 2) – must be redistributed over the surface area (c^2) of a large number of units around. In other words, a "free quantum of energy" is a quantum that is transferred at the moment *now*. A quantum of energy that is already "stored" in the total amount of surface area of the unit is mass (m). So every quantum of energy – and vacuum space itself – has mass. Phenomenological reality is relational reality. So we cannot observe or detect what is nearly equal everywhere in the universe. Physical reality – that's what physicists can observe and detect – represents the mutual relations between local amounts of energy and their mutual influences. We cannot measure the mass of vacuum space so its mass is undetermined.

The propagation of mass

The structure in figure 1 is a schematic impression of its existence. I can continue to draw the schematic representation, but now inclusive a particle (figure 3). Actually a local concentration of energy.

In phenomenological physics we focus on the particle. We measure it and describe its properties in relation to our system of measurement units (SI units). So we measure its motion/velocity in relation to a point of reference. We measure its mass and also its influence on the electromagnetic field around. But the particle is a creation of the underlying structure so it is impossible to isolate the particle from everything around. We can argue that the mass of the particle is enormous in relation to the energy of a single quantum of energy, so we ignore vacuum space around.

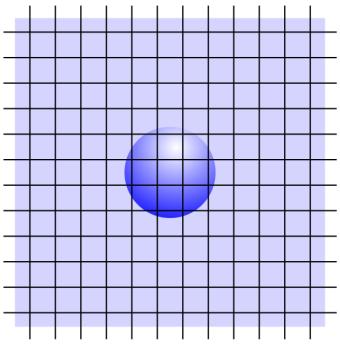

figure 3

If we observe the direction of the motion of our solar system it shows that we move in a direction perpendicular to the orbits of the planets. While the Milky Way moves in a direction perpendicular to the rotational disks of stars. In the microcosm it is impossible to observe one free moving atom. But we know that in particle accelerators a composite particle gets some kind of a disk shape perpendicular on the direction of its motion due to the Lorenz contraction.[5]

The velocity of our solar system in relation to the rest frame of the CMBR is about 371 km s^{-1}.[6] So what is the meaning of the velocity of the solar system in relation to the structure of the electromagnetic field? A structure that is a rest frame because every quantum of energy has a linear velocity in relation to the structure of the electromagnetic field that is termed *the constant speed of light* (c).

If we divide the linear trajectory of a propagating quantum of energy (299.792.458 m) during one second by the size of the unit (about $0{,}5 \times 10^{-15}$ m) we get the duration of the rate of change of 1 unit. It shows about $5{,}99 \times 10^{-23}$ second and it represents the constant of quantum time (t_q).

The size of the unit (about $0{,}5 \times 10^{-15}$ m) is obtained with the help of the diameter of the proton.[4] The proton has a loop of energy transfer (spin) and rest mass. The latter is only possible if the boundary of the proton envelopes a decreased scalar of the Higgs field. The diameter of 1 proton

shows to be about 1,46 x 10^{-15} m. Thus 1 unit of quantised space will have a diameter of ⅓ diameter proton.

If I throw an object to a target and it hits the target after exactly 1 second, the object has "travelled" a trajectory of about 371 km (the velocity of the solar system in relation to the structure of quantised space). In physics we don't mind the general velocity of 371 km s^{-1} because "everything" moves with the same velocity in relation to the rest frame. Inclusive our rest mass carrying particle in figure 3.

In the Standard model the rest mass of a particle is enabled by a boson, the Higgs boson. The lifetime of the Higgs boson is about 1,5 x 10^{-22} second. The rate of change of every unit of quantised space is one quantum of energy during ≈ 5,99 x 10^{-23} second. The consequence is that the calculated Higgs boson exists "as a particle" only during 2 consecutive changes of a unit of quantised space (the duration to pass on 2 quanta by the same unit). The velocity of the Higgs boson is zero because of its creation inside the point of collision of 2 colliding beams of protons from opposite direction. The mass of the Higgs boson is about 125 GeV/c^2.

The consequence is that the Higgs boson cannot be a real particle. It must be a calculated imaginary "entity". In line with the opinion of the late Martinus J.G. Veltman[7] in 1986 that the Higgs field doesn't need an intermediating boson to generate rest mass.

References:

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4. G. Giacalone, G. Nijs, W. van der Schee (2023); "*Determination of the Neutron Skin of ^{208}Pb from Ultra relativistic Nuclear Collisions*". DOI: 10.1103/PhysRevLett.131.202302
5. Jeremy Darling (2022); "*The Universe is Brighter in the Direction of Our Motion: Galaxy Counts and Fluxes are Consistent with the CMB Dipole*". DOI: 10.3847/2041-8213/ac6f08 iopscience.iop.org/article/10.3847/2041-8213/ac6f08
6. T. Cai et al. (2023); "*Measurement of the axial vector form factor from antineutrino-proton scattering*" Nature 614, 48-53 (2013) https://doi.org/10.1038/s41586-022-05478-3
7. Martinus J.G. Veltman (1986); "*The Higgs boson*". Scientific American, vol. 255, Nov. 1986, 76-81, 84. DOI: 10.1038/scientificamerican1186-76

Concentration of energy

In QFT it is thought that particles are excitations of the basic quantum fields. But that is not in line with the equivalence of matter and energy ($E = m\ c^2$). Because under universal conservation laws a local concentration of energy is only possible if there is a synchronous creation of a local deficit of energy. Just set theory (mathematics).

Figure 4 shows in a schematic way a local concentration of energy (1) and its equivalent local deficit of energy (2). Both situated within the average energy density of vacuum space (3). There is a schematic diagram as an overlay too.

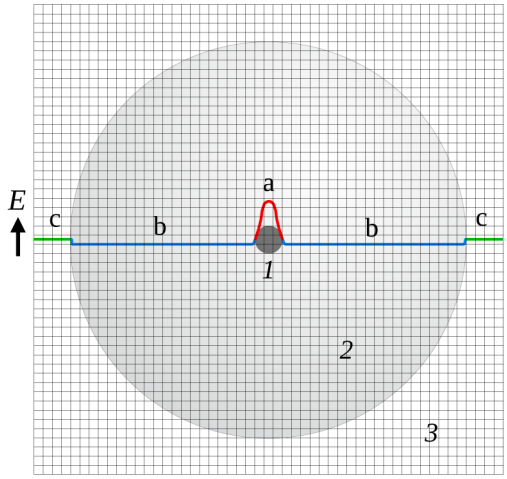

figure 4

The consequence of figure 4 is that the mechanism behind the properties of a particle cannot be described in a correct way if the corresponding deficit of energy isn't part of the description.

Figure 4 also raises the question why the local surplus of energy (1) and the local deficit of energy (2) are stable phenomena – creating a duality – that don't "annihilate" each other after some period of time. But the only known energy duality in relation to sub atomic particles is the electric charge. In the Standard model the electric charge is an conserved quantum number because the proton and electron have a conserved electric charge of respectively *+e* and *-e*. Figure 4 doesn't show any electron so why are the surplus and the corresponding deficit of energy equal to the electric charge?

There are papers about non-electron charge currents in strange metals.[8] It shows that under certain conditions the relation between the electron and the negative electric charge is not for granted. It also brings to mind the strange decay of an neutron that is emitted by an unstable nucleus. After ≈ 11 minutes the emitted neutron decays into a pro-

ton, an electron and an anti-neutrino. But the total amount of mass of the proton and the electron is more than the mass of the neutron. It suggests that the energy of the electron doesn't originate from the mass energy of the neutron. It questions the nature of the electron, proton and neutron.

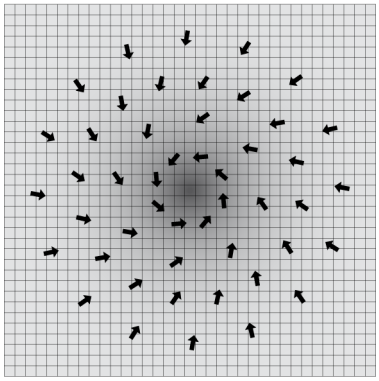

figure 5

Every unit of the structure of quantised space has the same "power" to change the shape of its boundary. A unit is actually a deformed scalar (sphere). The geometrical relation between the inscribed sphere (scalar) and the deformed part of the unit has no equilibrium thus the unit tries continuously to minimise the surface area of its boundary.[9] However, the boundary of every unit is the joint surface area with 12 adjacent units. The consequence is that no unit is independent from the shapes of its adjacent units.

Figure 5 shows vacuum space and thanks to the instability of all the units some units get more deformed than other units. A more deformed unit needs more time (t_q) to get rid of its surplus of deformation. In other words, an increasing amount of deformation "moves" slower in relation to all the other transformations in vacuum space around. But every unit shares its boundary with its adjacent units thus the result is a kind of circular pass on of energy (topological deformation) around the centre of the concentration.

Above a certain threshold of energy density a scalar in the centre of the energy concentration is forced by all the other units that are involved in the process of concentration to decrease its radius. The reduced scalar facilitates a further increase of the energy concentration.

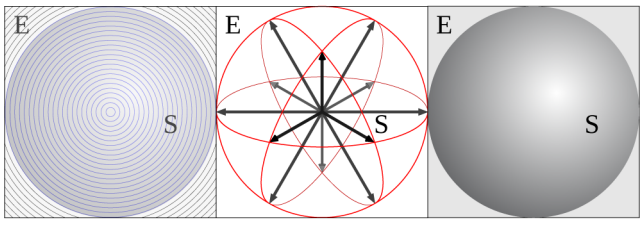

figure 6

The 3 images in figure 6 show in a schematic way different interpretations of the basic properties of every unit. Image I shows the scalar (S) of the Higgs field and the deformed volume around the scalar (E = the electric field in QFT). Image III shows a schematic representation of the internal scalar mechanism with the help of concentric shells. In other words, the scalar is the inscribed sphere of the unit. Image II shows the influence of the adjacent scalars because of the 12 points of contact. In other words, the size of the scalar of every unit is limited by the other scalars around because of the points of contact. So the vectors in image II represent the influence of the internal "power" of every unit of quantised space on the other units around.[9]

If the scalar in image II decreases its radius the points of contact of the scalar with the 12 adjacent scalars around are disconnected. It means a new vectorisation of the flat Higgs field around in the direction of the decreased scalar.

Vectors influence the quanta transfer of the universal electric field, the deformed part (E) of the units in figure 6. The result is the creation of a stable particle because the vectors will not vanish.[3] Therefore the stable particle – actually a proton – is a dynamical creation by the universal electric field and its corresponding magnetic field.

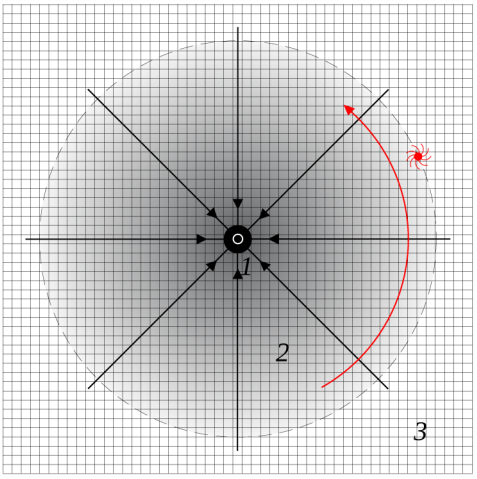

figure 7

Vectors that point continuously in the direction of the particle influence also the direction of the topological deformations of all the units around the particle in vacuum space. See reference [10]. So there is an increasing energy density gradient towards the particle and there is a resultant circular transfer of deformation around (see figure 5, 7).

The deficit of energy (2) in figure 4 and 7 will transform into some kind of an "accretion disk" of free energy, because it is vacuum space. At the boundary of its volume

are the units of vacuum space with an average deformed shape that are no part of the “rotation”. The result is a swirl (vortex; eddy) with spin ½ at the edge of the volume with a deficit of energy (2) that is stable under these conditions.

References:
8. Liyang Cheng et al (2023); “*Shot noise in a strange metal*” Science, Vol 382, Issue 6673, p 907-911 DOI: 10.1126/science.abq6100 https://arxiv.org/abs/2206.00673
9. S.E. Grimm (2020); “*On the construction of the properties of discrete space*”. https://zenodo.org/record/3909268
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Rest mass carrying particles

Although figure 3 shows an approximation of the size of a proton in relation to the metric (ℓ_c) of quantised space, the image doesn’t show how the quanta propagate inside the boundary of the particle.

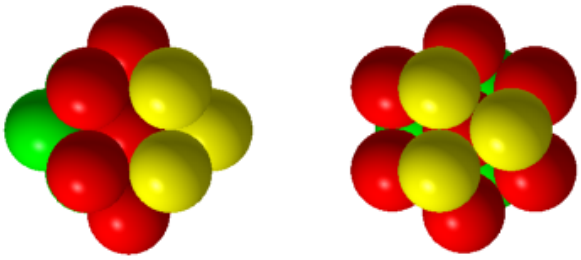

figure 7

If I rotate the left image a bit to the left, I get the image at the right side of figure 7. The different colours represent the distinct layers of the lattice of the scalars of the Higgs field.[9] Suppose the red scalar in the centre is the decreased scalar of a rest mass carrying particle. The vectors that point towards the decreased scalar force the adjacent units (not drawn) to transfer their topological deformation in one or more “loops” if we use the image as point of reference.

Figure 7 – right image – shows 4 possible loops of quanta transfer (transfer of topological deformation to adjacent units) and figure 8 shows the 4 positions in relation to de decreased scalar in the centre (black, lilac, blue, green).

Observable/detectable reality is relational reality. In other words, we cannot observe the scalars of the Higgs field and the shapes of the deformed parts of the units. We are only aware of the influences of the mutual differences on matter (our measurement instruments). So the question is if there exists some similarity between the description of the proton (and neutron) in the Standard model and the schematic representation of the internal energy configuration of the proton in figure 8.

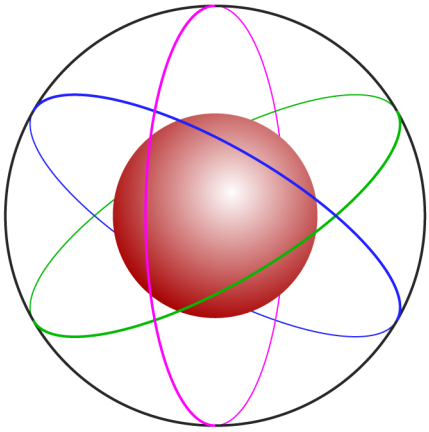

figure 8

If the proton is accelerated in a particle collider at nearly the speed of light, most of the internal quanta transfer is in the direction of the motion of the proton. After the interaction of the collision the proton resonates into a particle with a complicated dynamical energy configuration. If the black loop is perpendicular to the direction of the proton in the accelerator, there are 3 hypothetical loops left. Somehow these 3 loops have to transfer at least half the energy of the mass of the proton. So it is reasonable to expect that these 3 loops will influence the transformations of the energy of the collision.

The Standard model predicts 3 quarks for the proton (uud) and 3 quarks for the neutron (ddu). But figure 8 shows that there are 6 “crossings” where energy transfer is redistributed between these 3 loops. The unit in the centre is also part of all the energy transfer. So it is difficult to state that the hypothetical quarks in the Standard model are similar with the loops in figure 8.

However, in the Standard model the mass of the proton is not “covered” by the mass of the 3 quarks (uud). It is thought that the missing mass is generated by the strong force. This is in line with the model of quantised space, so maybe there are more similarities between both models. The problem is that the Standard model is derived with the help of high energy particle collisions. That is why the model is not suited to describe and calculate low-energy particles. It raises the question if there is no better approach to determine the properties of the electron, proton and neutron with the existing data.