On the construction of the properties of discrete space

*Sydney Ernest Grimm**

The proposed existence of relative time and the curvature of space – both combined into the concept of spacetime – influences the search for an adequate theoretical model that can describe the structure of space in an accurate way. The aim of building space is to develop a quantum theory of gravitation. This paper investigate the theoretical problems that have their origin in the concepts that are at the basis of phenomenological physics.

Introduction

"Building up" the properties of space itself from scratch isn't just fantasy. In the search for a theory of quantum gravity there are several approaches to transform the space time continuum into a discrete continuum. Well known approaches to "do the trick" are the Causal set[1] and the Causal Dynamical Triangulations approach.[2] In this paper the focus is on the Causal Dynamical Triangulations approach to simplify the explanation.

There is still no breakthrough in the field of quantum gravity despite the research during several decades. This questions the cause behind the problems to create a workable model that can describe both the curvature of space and the quantization of space.

If I examine these attempts to describe space in an accurate way it shows that increasing the accuracy of the discrete properties of curved space results in a decrease of the accuracy of the law of conservation of energy and universal constants like the speed of light. At least if we are convinced that the basic properties of the universe are not separated of each other by some kind of domain walls. Of course, it is possible to implement hypothesised properties that compensate for the problem, like the present framework of quantum chromodynamics. Nevertheless, these problems question the reliability of the theory of relativity too. Because it is the concept of spacetime that forces theoretical physicists to develop a very demanding model.

There is a clear explanation of the basic ideas behind the Causal Dynamical Triangulations approach by Renate Loll, "*Rethinking spacetime*".[3] The lecture was presented during the IAS symposium "The road to reality" and describes some theoretical properties of discrete space and the rising problems that are natural to this type of research.

References:
1. Sumati Surya (2019). "*The causal set approach to quantum gravity*".
Living Reviews in Relativity (2019) 22:5.
https://doi.org/10.1007/s41114-019-0023-1
2. J. Ambjørn, J. Jurkiewicz and R. Loll (2006).
"*Quantum Gravity, or The Art of Building Spacetime*".
Cambridge University press.
https://arxiv.org/abs/hep-th/0604212v1
3. Renate Loll (22-01-2019), "*Rethinking spacetime*".
Symposium "The road to reality", IAS, University of Amsterdam. Video of the presentation:
https://www.youtube.com/watch?v=PRyo_ee2r0U

* City of Amersfoort, the Netherlands
email: segrimm@conceptualframeworks.org
Orcid: 0000-0002-2882-420X

Discrete space

If we try to construct spacetime from scratch we need some kind of a basic idea about the structure of space. Figure 1 shows a *schematic* representation of a 3D metrical space. The notation λ_e indicates that the size of the metric is related to the minimal length scale,[4] because lambda (λ) is frequently used as a symbol for the wavelength of the

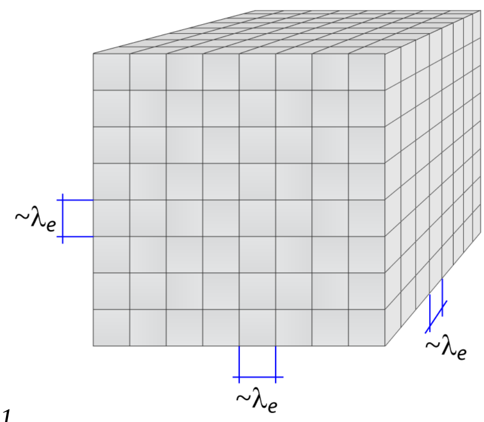

figure 1

electromagnetic waves. That means that the elements that fill the volume of our universe have a linear size (λ_e) that is directly related to the basic size of the proposed minimal length scale. Conclusion: the quantity of the volume of every element – the schematic small cubes – is invariant.

The properties of space itself seems to be homogeneous and isotropic. That means that we never pass a region in space where everything that's entering suddenly swells up like a balloon and return to its normal proportions when it leaves the region behind. Or swelling up if we change the direction of our motion. The consequence is that discrete space must be composed by elements that have the same basic properties (see the schematic figure 1).

Nevertheless, the idea that observable reality is created by the basic properties of elements that fill up the volume of our universe has consequences. Because this concept is violating our conviction that empirical evidence is the corner stone of modern science. The schematic image below shows the problem (figure 2).

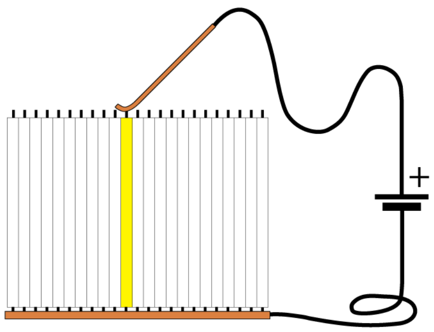

figure 2

Suppose I fill a volume with 100% transparent light tubes. There is an electric power source and at the bottom all the electric contacts are connected. At the top of the light tubes there is a free movable slider. So if I move the slider it seems that a column of light is moving inside the volume with the invisible light tubes.

The analogy with figure 1 is clear. The invisible light tubes are the elements. The power source and the slider represent the dynamical properties of discrete space – the elements – and the column of light is the creation of a phenomenon within *observable reality*. Actually a local dynamical difference in relation to the other invisible light tubes around.

Unfortunately the properties of the column of light are the result of the properties of the structure of the invisible light tubes and the dynamical properties of the power source, inclusive the selection of the direction of the change by the free movable conductive slider. The column of light represents only a local difference like the observable phenomena we have explored in physics. In other words, the phenomenon is *undetermined* by itself. But that is not what the textbooks in physics have told us. The measured and observed relations between the phenomena in the universe are thought to be the *tangible* facts of reality, acquired with the help of empirical research, the scientific method.

There is only one conclusion possible, the known properties of the observed phenomena represent the mutual relations between the phenomena and not the basic properties of discrete space. Therefore it has no sense trying to hypothesize the properties of space in such a way that the model itself mimics the mutual relations between the observable phenomena. Mutual relations that are described with the help of the theory of Special and General relativity and the Standard model of elementary particles and forces.

The conclusion doesn't mean that empiric research is useless if we want to construct space from scratch. Because there are not only the discovered atoms, nuclei, planets, stars, galaxies, etc. There are also conservation laws, universal constants and universal principles. Universal properties of our universe that are directly related to the basic properties of the elements of quantized space because these universal properties exist everywhere in space.

References:

4. Sabine Hossenfelder (2013). "*Minimal length scale scenarios for quantum gravity*."
Page 5, A minimal history
Living Reviews in Relativity, January 2013.
DOI: 10.12942/lrr-2013-2.
https://arxiv.org/pdf/1203.6169.pdf

Phenomenological and absolute reality

The schematic structure of the properties of discrete space (figure 1 and 2) shows that there are 2 kinds of reality in theoretical physics. The first one is well known because it is phenomenological reality. A conceptual reference frame that is created by the observed mutual differences between corresponding properties of the local phenomena.

The theory of relativity is a clear example of a theory that describes phenomenological reality.[5] That cannot be a surprise because Albert Einstein was a phenomenological physicist, influenced by the Austrian physicist and philosopher Ernst Mach.[6] Like so many physicists at that time. Einstein created his theory of relativity with the help of *gedanken experiments* to analyse the interactions between phenomena like observers, trains, elevators, rockets, etc.

Phenomenological physics describes reality – the observable phenomena – with the help of the mutual relations between the phenomena. So I can relate the mass of a neutron to the mass of a proton and the outcome is a relation, a certain proportion. Actually phenomenological physics describes a simplified version of reality in relation to absolute reality. It doesn't describe the creating structure that is responsible for the emerging of phenomenological reality.

Absolute reality is incorporated in the theoretical frame work in physics in the form of physic laws, universal constants and universal principles. Because these spatial properties exists everywhere in the universe. Although the grand theories don't represent absolute reality. Quantum field theory is a mixture of parts of special relativity, quantum mechanics and gauge theories. But none of these theoretical models represent absolute reality. Nevertheless, the accepted general concept of quantum field theory is the idea that phenomenological reality is created by an underlying structure of basic quantum fields.[7]

Describing observable reality with the help of the underlying reality – discrete space – cannot focus entirely on one or more phenomena. Because the observable phenomena are the result of spatial transformations that are generated by the mathematical properties of the underlying geometrical structure. That means that the relations that we know from phenomenological physics are created by the basic properties of the elements of the structure of space itself. An underlying structure that is not similar to the frequently used term "spacetime".[8]

References:

5. *Francesca Vidotto (2013). "Atomism and relationalism as guiding principles for quantum gravity." Notes for the "Seminar on the foundations of quantum gravity"*, Chicago, 27-29 September 2013.
   see 5. The relational structure of quantum gravity
   https://arxiv.org/abs/1309.1403
6. Ernst Mach (1838-1916).
   https://www.britannica.com/biography/Ernst-Mach
7. 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.pd
8. Albert Einstein: transcription of a lecture at Leiden University (1920). https://www-history.mcs.st-andrews.ac.uk/Extras/Einstein_ether.html

The Planck scale

In modern physics the Planck units are thought to represent the lowest level of reality. Unfortunately, the Planck units are derived with the help of phenomenological physics.[9] In other words, the Planck units represent mutual relations between measurable phenomena, just phenomenological reality. The Planck units cannot have a direct relation with constructing a model that describes the structure of space in an accurate way, directly related to absolute reality.

The size of the Planck length – $\ell_{Pl} \approx 1.62\times10^{-35}$ m – is too small in relation to the size of the metric of the minimal length scale – $\lambda_e \approx 0{,}5\times10^{-15}$ m – to be considered as a realistic "building block" of absolute reality. Because the proposed existence of a gap of $\approx 10^{20}$ between the Planck length and the minimal length scale lacks a logical and empirical justification. The minimal length scale isn't just a hypothesized metric, it was conjectured because of the observed minimal length of electromagnetic waves and the size of sub-atomic particles.[4]

Arguments in favour of an existing pre-quark metrical structure of space are not realistic because the theoretical framework of the elementary particles originates from the measured mutual relations.[10] There is no evidence for a smaller underlying metric structure. However, the opposite – the Planck length shows the reliability of the concept of the minimal length scale – is a more significant proposition that can explain the strange gap of $\approx 10^{20}$ in magnitude between the Planck length and the smallest phenomena.

If the volume of space has a structure – that means that the whole volume of space is build up by basic volumes – every change of local properties in our universe is a geometrical change. Mutual interactions between these spatial units – "elements" in mathematics – are only possible if there is a fluent change of properties. The consequence is that the interactions between the elements – what we call energy – are determined by geometrical transformations with the help of a flux of infinite small amounts of volume. The gap of $\approx 10^{20}$ in magnitude between the Planck length and the minimal length scale is a realistic ratio if the Planck length is directly related to the flux of infinite small amounts of volume that represent the fluently topological changes between the elements (homeomorphism).

References:
9. M. Planck. “*Naturlische Masseinheiten*”. Der Koniglich Preussischen Akademie Der Wissenschaften, p. 479, 1899
10. K. Nakamura (2010). “*Review of particle physics*” Journal of Physics G: Nuclear and Particle Physics, Volume **37**, 075021. https://iopscience.iop.org/article/10.1088/0954-3899/37/7A/075021/pdf

Relative time

The theory of Special relativity[11] describes the observation of simultaneity between moving phenomena whereas the intermediating medium, visible light, has a constant velocity of ≈ 300.000.000 m in vacuum. In discrete space the velocity of light is a constant too and the velocity of the light is related to the basic properties of the elements.

Figure 3 shows a cross section of the metric in the schematic figure 1, the minimal length scale (λ_e). The grey coloured element transforms in such a way that its geometrical properties are transferred to the adjacent element at the right side. The transfer is a flux of infinite small amounts of change so I can conclude that there is a delay of time between the start and the end of the transfer of the geometrical properties of the grey coloured element.

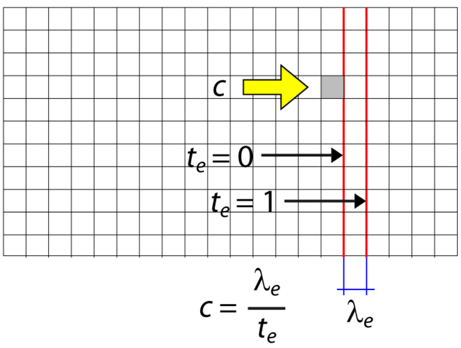

figure 3

The transferred geometrical properties represent an amount of local change and the smallest observable local change that we know is the quantum, a fixed amount of energy. That is why I can state that the linear transfer of 1 quantum over a distance of λ_e has a fixed duration because the velocity of the quantum is a constant (c) and the metric of the minimal length scale is a constant (λ_e). Therefore quantum time (t_e) is a constant too.

Conclusion: the *proposed* relativity of time in Einstein’s theory of Spacial relativity cannot be correct and must be caused by a misinterpretation of the nature of phenomenological reality.

The transfer of the geometrical properties of the grey element in the schematic figure 3 is a simplified representation of quantum reality because all the other elements around the grey coloured element transfer 1 quantum too at exactly the same time. Because it is impossible to change the geometrical properties of only 1 element if all the elements together tessellate space. Tessellation of space by smaller volumes that can change their geometrical properties is only possible if every element has an identical quantity of invariant volume. Our universe shows to be a dynamical universe so we have to conclude that the identical quantity of invariant volume of every element is deformable. The consequence is that every element of discrete space is a topological object.

Observable reality shows the existence of local concentrations of energy, matter. Concentrations of energy are created by the continuous redistribution of geometrical properties between the elements. Because of the tessellation of the volume of the universe by all the elements every transfer of a fixed amount of geometrical properties between the elements has the same duration and velocity. Therefore the velocity of a concentration of energy as an “independent phenomenon” must be directly related to the amount of transferred topological deformation by the involved local elements.

Rest mass carrying particles – matter – isn’t entirely build up by linear transferred energy like the described situation in the schematic figure 3. Because a rest mass carrying particle has a spin of itself, a rotational transfer of energy.

Figure 4 shows in a *schematic* way a hypothetical concentration of energy – a rest mass carrying particle – and the metric is the minimal length scale (λ_e).

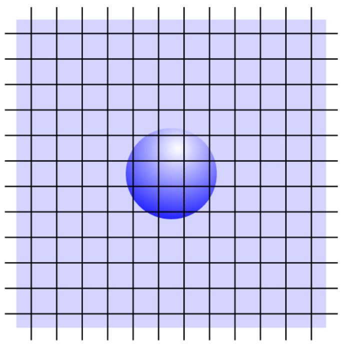

figure 4

To pass on the concentration of energy to the right every involved element “within the boundary of the particle” has to transfer a certain amount of energy. But the total amount of energy every element can transfer within 1 t_e (the constant of time) is 1 quantum of topological deformation, a fixed amount of volume.

The energy of 1 quantum – notation h_e – is the linear pass on of the amount of geometrical change over a distance of 1 λ_e during 1 t_e. All the elements together tessellate space thus every element "transfers" synchronously 1 h_e to one or more adjacent elements during 1 t_e. That is why the internal geometrical transformations of the rest mass carrying particle – like spin – will "slow down" if the velocity of the particle as a whole increases. In other words, if I exchange the rest mass carrying particle by a macroscopic clock, the clock will slow down its internal rate of change if I increase the velocity of the clock. But the internal rate of change of the clock – the velocity of the clock hands – doesn't represent the nature of time within absolute reality. Einstein's relative time is about the rate of the mutual changes between phenomena. The underlying rate of change of all these phenomena is the constant of time (t_e).

Conclusion: the theory of Special relativity isn't about the nature of time itself. Time is quantum time and it is a universal constant like the constant speed of light.

References:
20. A. Einstein (1905). "Zur Elektrodynamik bewegter Körper". Annalen der Physik, Eingangen **30**, Juni 1905, Bern.

The curvature of space

Albert Einstein's theory of general relativity[12] predicts that the existence of matter in space creates gravity. That means that without matter, there is no force of gravity. This simple fact raises a question about the true nature of gravity because curved space cannot emerge by magic. The consequence is that without the existence of matter in our universe the mechanism that causes the curvature of space must still be present.

Einstein's famous equation $E = m\,c^2$ shows that mass and energy are equivalent. To transform the mass (m) into "free" quanta we have to redistribute the concentrated energy of the mass to the vacuum space around the mass, adding topological deformation to the elements around. Actually, an increase of surface area (c^2). After the distribution of the energy to the elements around, the energy of the mass exists in the form: $n\,h_e$ [n = integer; h_e = energy 1 quantum transferred over a distance of 1 λ_e].

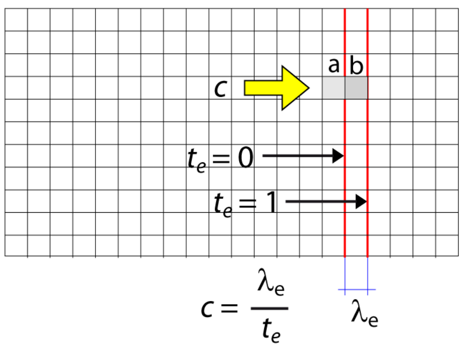

figure 5

If I transfer 1 quantum to an adjacent element (from a to b) that has a surplus of 1 h_e in relation to the source element (a) – see figure 5 – the adjacent element b represents a local concentration of energy (2 h_e). Actually, it is about an increase of the local topological deformation of element b. Theoretically this local increase of topological deformation creates Einstein's curved spacetime. But the increase of topological deformation doesn't show an emerging gravitational force because the topological deformation is limited to the electric part of the electromagnetic field.

One can argue that there is a fundamental difference between mass and matter. Matter has rest mass because the energy that creates the rest mass is supplied to the concentrated energy within the electric field if the energy of the mass exceeds a certain threshold that forces one or more local scalars of the Higgs field to decrease their magnitude. This shows that the energy of the rest mass becomes part of the local electric field. The transfer of the energy of a local decreased scalar of the Higgs field to the electric field is called the Higgs mechanism.[13][14]

But if Einstein's curved spacetime describes the topological deformation of the electromagnetic field around objects (matter), how is it possible that the theory of general relativity can predict the local gravitational field in an accurate way, confirmed by experiments?

The only reasonable clarification is that not only the gravitational field concentrate energy in space, but the electric field concentrate energy too. And both fields concentrate energy to the same local position in space. Therefore, if I implement the gravitational constant in the equations that describe the topological transformations of the electric field the calculations will mimic the gravitational field.

Anyway, how do I know for sure that Einstein's theory of general relativity isn't about Newtonian gravitation at all?

References:
12. Albert Einstein (1916). “*Relativity: The special and the general theory*”.
Berlin, ISBN 978-3-528-06059-6
13. Giovanni Organtini (2012). “*Unveiling the Higgs mechanism to students*”.
European Journal of physics **5**, Jul. p. 1397-1406
http://dx.doi.org/10.1088/0143-0807/33/5/1397
14. Jeremy Bernstein (2011). “*A question of mass*”
American Journal of Physics **79**, 25 (2011)
https://doi.org/10.1119/1.3487939

The basic quantum fields

The basic quantum fields exist everywhere in the universe and are related to each other. That is obvious because the law of conservation of energy exclude the existence of independent fields. The consequence is that the basic quantum fields have a structure because the redistribution of properties under conservation laws is impossible without a joint structure. Not a structure like the pattern of a fabric but an underlying structure that is responsible for the way basic quantum fields are displaying themselves to the observer. Basic quantum fields are thought to create the observable phenomena so the underlying structure is the subject of this paper: the properties of discrete space.

The fact that we cannot observe the underlying structure at the lowest level of reality indicates that the properties of discrete space can only be determined by reasoning. And the result of the reasoning is a mathematical description of the structure.[15]

Figure 1 shows a schematic representation of the structure of space. The figure shows that every change of a basic property of an element is impossible without the change of all the other elements in the universe because all the elements have an identical amount of volume and tessellate the volume of our universe.

The mathematical consequence of the synchronous change of all the elements in the universe is:

- The *conservation* of (observable) change.
- The *universal velocity* of (observable) change.
- The *non-locality* of (observable) change.

Actually, the list shows the 3 cornerstones of modern physics. The law of conservation of energy, the linear universal velocity of energy (c) and the consequence of entanglement[16], the existence of non-locality.

In other words, there is no doubt about whether the concept of figure 1 is a reliable schematic representation of absolute and phenomenological reality or not. It is.

Nevertheless, the theory of general relativity predicts that space itself is curved by the existence of matter in space and the influence of the curvature of space on matter is what we observe and have called “gravitational force”. However, is there any mathematical proof that the elements in figure 1 can deform in such a way that local configurations of elements can create a local collective curvature?

Suppose that the elements can reconfigure their shape in such a way that it shows like the curvature of space. If this is possible every element must have the same dynamical property that is responsible for the creation of the joint curvature. But the basic properties of the elements are very limited. The amount of volume of every element is invariant, the shape of every element is deformable and there must be a dynamical property to “drive” the deformation of the shape of the element.

Quantum field theory has a limited number of basis fields too. The Higgs field (scalar field), the electric field (topological field) and the magnetic field (vector field). The gravitational field cannot be a basic quantum field because it emerges at the moment matter is created.[17] It is obvious that only basic quantum fields exist everywhere in the universe and during the whole history of the universe.

So I have to conclude that an element has a scalar property, a topological property (the deformation of the shape of the element) and a vector property. The scalar property is easy to insert into the model of the schematic figure 1 because to create a real scalar within the volume of an element it must have an internal mechanism that creates the geometrical shape of a sphere. Figure 6 shows one cube of the schematic figure 1 with a scalar inside. The presence of the scalar divides the volume of the element in 2 parts: the scalar itself and the deformable volume around.

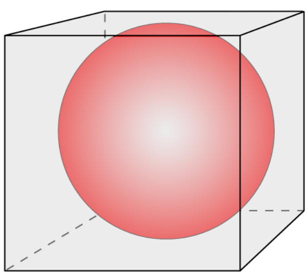

figure 6

In quantum field theory no basic quantum field has an invariant magnitude. That means that the properties of the scalar inside the element (figure 6) is not independent from the properties of the deformable volume around the scalar. Both parts of the volume of the element must have a mutual property otherwise there cannot exist any mutual influence. All the elements in the universe tessellate space therefore it is reasonable to conclude that the volume around the scalar is just what it shows to be: the deformed part of the same scalar mechanism that is responsible for the existence of the scalar. In other words, the scalar in figure 6 is the inscribed sphere of the volume of the element and represents a different spatial configuration than the deformed part of the volume of the element.

Suppose I blow op the volume of the scalar till the whole volume of the element has the shape of a true scalar. All the elements around has to adapt their shape to this element with the shape of a sphere. Now all these elements around are forced to decease the size of their scalars to transform into some kind of a local curved space. Unfortunately, every element within discrete space has the same basic properties. So how is it possible that 1 element can force a large number of elements around to decrease their scalars? That's impossible. The consequence is that discrete space (figure 1) and curved spacetime cannot be mixed into one model, like the Causal Dynamical Triangulations approach[2][18] is trying.

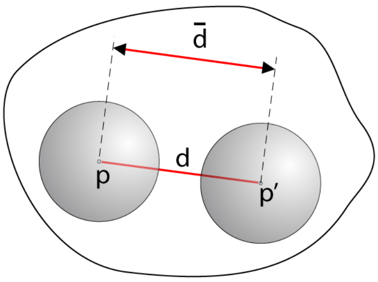

figure 7

In the causal dynamical triangulations approach there is no enveloping concept about the properties of the scalars and "space around". The model with the help of the Ricci scalar curvature in Riemannian geometry describes the curvature of space with the help of the relation between the metric d and $\bar{d}$ (see figure 7).[3][19]

The use of the Ricci scalar curvature is caused by the conviction that space itself is curved. But the theory of general relativity isn't about the underlying structure of space itself. The theory is about the mutual relations between the observable phenomena. Phenomenological reality is the moving column of light in figure 2 at page 2. Therefore, without the misinterpretation that space itself is curved discrete space is just Euclidean space. That means that I can replace the schematic figure 6 with the schematic figure 8, a discrete Euclidean space where the scalars have an identical magnitude in vacuum space. Actually, the schematic figure 8 is the cross section of the element with enclosed scalar in figure 6.

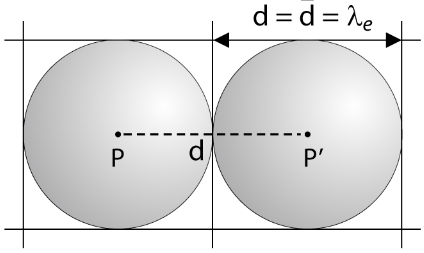

figure 8

The schematic figure 8 shows 2 basic quantum fields. The scalar field (the Higgs field) and the topological field (the electric field).[20] There is missing one basic field and that is the vector field, the magnetic field. However, vectors don't represent the transfer of energy. That means that a vector field occupies no volume in an element. Vectors influence the direction of the transfer of energy.

In other words: how do elements change their shape?

References:
15. Max Tegmark (2007), "*The mathematical universe*". DOI: 10.1007/s10701-007-9186-9 https://arxiv.org/abs/0704.0646
16. Yin, Juan et all (2013). "*Bounding the speed of 'spooky action at a distance*". *Physical Review Letters*. **110** (26): 260407. DOI: 10.1103/PhysRevLett.110.260407 https://arxiv.org/abs/1303.0614
17. E. Verlinde (2011). "*On the origin of gravity and the laws of Newton*". Journal of High Engery Physics **4**, april 2011. DOI: 10.1007/jhep04(2011)029 https://arxiv.org/abs/1001.0785
18. J. Ambjørn, J. Jurkiewicz and R. Loll (2006). "*The universe from scratch*" DOI: 10.1080/00107510600603344 https://arxiv.org/abs/hep-th/0509010
19. Marques, Fernando Codá (2012), "*Deforming three-manifolds with positive scalar curvature*", Annals of Mathematics, 176: 815–63, DOI: 10.4007/annals.2012.176.2.3, MR 2950765 https://annals.math.princeton.edu/2012/176-2/p03

20. Saša Harkai, Bryce S. Murray, Charles Rosenblatt and Samo Kralj (2019). "*Electric field driven reconfigurable multi-stable topological defect patterns*" Physical Review Research **2**, 013176 (2020).
DOI: 10.1103/PhysRevResearch.2.013176
https://https://journals.aps.org/prresearch/abstract/10.1103/PhysRevResearch.2.013176

The scalar mechanism

The hypothesis that an element is a deformed scalar with an invariant volume can be translated into a geometrical model of the element. And the geometrical model of the element makes it possible to describe an amount of elements that tessellates space.

Figure 9 shows a diagram of the scalar mechanism of an element. The centre of the scalar is m, the radius of the scalar is r_{is} (inscribed sphere) and Sm is the resistance against deforming of the scalar mechanism.

In vacuum space every scalar of the scalar field has the same magnitude. Nearly everywhere in the universe local space is vacuum space so it is reasonable to chose r_{is} = 1,0 for the radius of the scalars in vacuum space. The hypothetical element that is a full sphere has a radius r_{is} = 1,105.

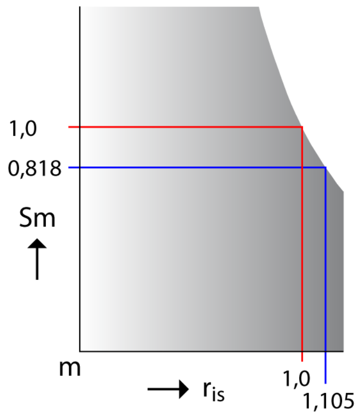

figure 9

The diagram shows that increasing the deformation of an element will increase the resistance against the deforming by the scalar mechanism. The deformation of the scalar mechanism of an element is only possible with the help of a transfer of volume within the boundary of the element. Change is energy so we have to conclude that the energy of every element is infinite.

I can simulate the scalar mechanism in a drawing of the cross section of an element with the help of concentric circles (figure 10). If element M1 transfers 1 quantum to the joint plane with element M2 it can only influence element M2 at the point of contact between both scalars. A deformation of the joint plane at A or B isn't reasonable because the concentric circles at the point of contact between both scalars are the first shell that can increase the radius r_{is} of element M1. The consequence is that elements transform their shape – actually the shape of the deformed part of the element – at the points of contact with the scalars of the other elements around.

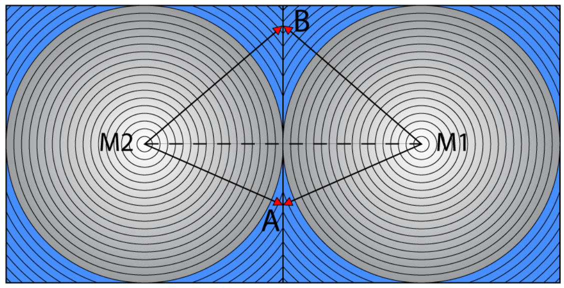

figure 10

The dynamical power of the scalar mechanism of every element in the universe is identical otherwise our universe cannot change continuously its internal configuration. That means that the cause behind the invariant volume of every element is the equality of the dynamical power of the scalar mechanism.

The consequence is that the undistorted parts of the scalar mechanism – the inscribed spheres – are responsible for the configuration of the elements in space. A mathematical configuration that is similar to Kepler's conjecture.[21] Figure 11 shows the configuration of the scalars in vacuum space by a number of identical spheres. The volume of a scalar in vacuum space is about 74% of the volume of the whole element.[22]

The scalars in figure 11 have their maximum radius in relation to the lattice "around". Nevertheless, the scalar mechanism of every element tries to transform into a full sphere.

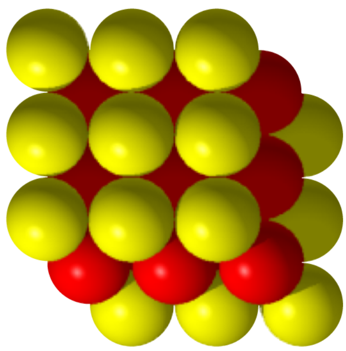

figure 11

Every scalar is limited by the 12 points of contact with the 12 scalars of the elements around so we have to conclude that figure 11 shows a configuration under pressure. An internal pressure of the undistorted scalar mechanism that is restricted to the 12 points of contact of every scalar.

It is possible to visualize the pressure of a scalar of an element that is part of the lattice of scalars in figure 11.

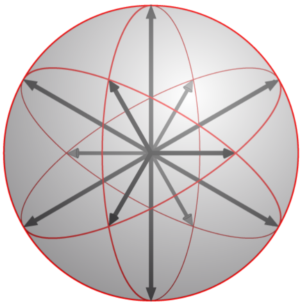

figure 12

The points of contact between the scalars in vacuum space results in point-like pressures inside the sphere of the scalar. Because of the shape of a sphere the point-like pressures within a scalar act like vectors. The scalar in figure 12 is drawn partly transparent to show the structure of the 12 vectors inside the scalar.[21]

The consequence is that the identical scalars within vacuum space are forming together a primary vector field. However, every scalar has an identical radius thus there are no local resulting vectors in figure 11. The situation changes if I incorporate the influence of the quanta transfer within the topological part of the volume of the elements on the existing primary scalar vectors in vacuum space. An influence that is explained with the help of figure 10.

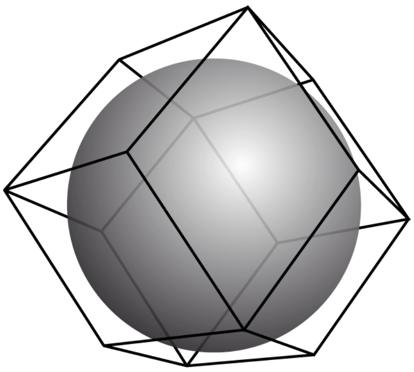

figure 13

To determine the average shape of an element I can construct a static symmetrical element with the help of Kepler's conjecture. The result is a rhombic dodecahedron (see figure 13). Therefore, the transfer of 1 quantum of an element to one of more adjacent elements is the transfer of a fixed amount of volume within the boundary of the element to the joint plane(s) with the adjacent element(s). Actually, a topological transformation of the shape of the element. However, the volume of an element – the scalar mechanism – is invariant. Therefore, there must be a compensating volume transfer to one or more planes of the element. The transfer of the quantum to adjacent elements is V_{output}. The transfer of 1 quantum *to* the element is V_{input}, so $V_{input} = V_{output}$. Figure 19 shows the schematic distribution.

Figure 14 shows the cross section of 2 adjacent elements, inclusive the deformed rhombic face of the element at the right side. The dark blue part of the deformed volumes is in all probability involved in the transfer of the quanta. The cross section shows that the element at the right side has pushed away volume of the adjacent element. Now the transferred quanta by the element at the right side are pushing against the scalar of the adjacent element. The push is super positioned on the primary scalar vector of the scalar.

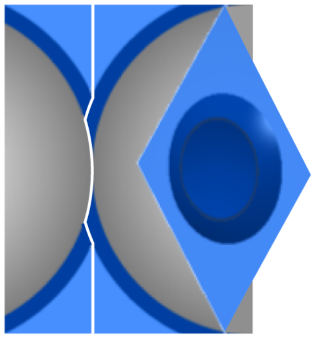

figure 14

The transfer of quanta within the electric field – the topological part of the elements – results in the creation of differences in the magnitudes of the primary scalar vectors. The created differences between the scalar vectors is similar to the amount of quanta transfer. Now it is without doubt that the changed magnitudes of the scalar vectors within vacuum space are similar to *the magnetic field* in physics.

In other words, the transfer of a quantum generates corresponding scalar vectors. But the scalar vectors generate the distribution of the volume transfer within the boundaries of the elements. Because the V_{output} of an element will be created in the adjacent planes where the scalar vectors have a larger magnitude than the entering scalar vectors from the scalars of the elements around.

So I have to conclude that, without the use of the proposed curvature of space itself in the theory of general relativity, the construction of discrete space leads to the confirmation of the existence of the basic quantum fields. Basic fields that emerge from the geometrical properties of discrete space, visualized in the schematic figure 1.

References:
21. Kepler, Johannes (1611), "*Strena seu de nive sexangula*" (The six-cornered snowflake), ISBN 978-1-58988-053-5, MR 0927925
22. Hales, Thomas C.; Ferguson, Samuel P. (2006), *"A formulation of the Kepler conjecture", Discrete & Computational Geometry, **36** (1): 21–69,* https://arxiv.org/abs/math/9811078

Gravitation
Newtonian gravity is thought to be an attracting force. But shielding the force of gravity with the help of a sheet of light shows that Newtonian gravity is a push force. That means that the gravitational field pushes matter in the direction of other objects.[23][24] This in accordance with the properties of the scalar mechanism of every element. Every element is a deformed scalar thus every element tries to restore the shape of a sphere by "pushing" the adjacent elements around.

If there is no matter in the universe, there is no Newtonian gravity. Einstein's gravitational force is caused by the curvature of space but – like Newtonian gravity – if there is no matter in the universe spacetime is also flat.[8] In other words, we cannot understand the force of gravitation if we don't examine the creation of matter.

Figure 15 shows the concentration of energy in space. I have added the schematic structure of discrete space to underscore the tessellation of space by the elements.

Matter and energy are equivalent ($E = m\ c^2$) so we have to conclude that the concentration of energy is a concentration of quanta. Every element in the universe transfers 1 quantum synchronous with all the other elements in the universe. Therefore it is impossible to understand the concentration of quanta if we compare the elements with a group of persons where every person throws a ball at exactly the same moment.

The deformation of the topological part of an element is always a number of quanta ($n\ h_e$). That's the consequence of tessellation. Moreover, every element tries constantly to restore the shape of a sphere by "pushing" the adjacent elements around. That is why deformation will accumulate itself because a couple of elements cannot force a large number of elements to increase their amount of deformation. The only exception is the synchronous pass on of the whole configuration of the concentrated quanta in relation to the structure of space.

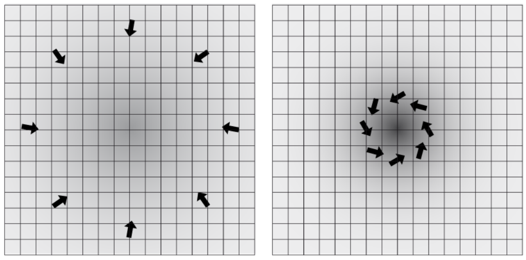

figure 15

If an element has a surplus of deformation – 100 quanta – it will take 100 t_e (constant of quantum time) to transfer the deformation to the adjacent elements. That is why the velocity of a local concentration of quanta cannot have the speed of light. Nevertheless, the concentration of quanta – just fixed amounts of topological deformation – is a redistribution of topological deformation. So if there is a concentration of deformation somewhere in vacuum space there is also a large volume with elements that has a deficit of topological deformation.

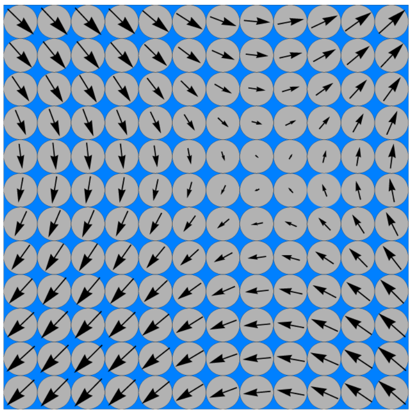

figure 16

Suppose I take a pair of tweezers to pick up the deformation at the centre of the configuration. Now the situation is fundamentally changed because everywhere around the elements with a deficit of deformation are elements with an average amount of deformation. The latter represent the majority thus both volumes will immediately mix together.

Without my pair of tweezers the elements within the concentration have to transfer the quanta in a circular way because of the lower velocity of the centre of the concentration. But if the deformation of an elements becomes part of a loop there is hardly any transfer of quanta to the outside of the centre of the concentration. The result is that the elements around can continue to transfer quanta to the centre. Figure 15 shows the described process of concentration, inclusive the resultant vectors of the magnetic field (the drawn arrows). Resultant vectors we are familiar with because of the resultant vectors of the electromagnetic field. Figure 16 shows a number of scalars within vacuum space and the well known resultant vectors of the magnetic field.

The accumulation of more and more deformation by the centre of the configuration of concentration will force one or more scalars of the Higgs field to decrease their magnitude. The released volume of the scalar becomes part of the electric field and the result is an increase of the topological deformation at the centre of the configuration.

The cause behind the further increase of deformation is geometrical. If a scalar decreases its radius the resistance against deforming by the *topological part* of the adjacent elements changes in relation to the situation before the radius of the scalar decreased. It is less than 1% but the effect is that the centre of the concentration becomes a stable spatial configuration.

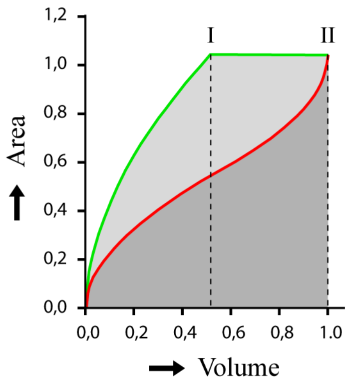

figure 17

The diagram above (17) shows the supply of quanta to a joint plane between 2 elements, like the 2 elements in figure 14. A flat joint plane between both elements has the value 0,0. The topological deformation in figure 14 corresponds with the vertical dotted line (I). It is not for certain that the supply of more volume to the joint plane at point I will result in the decrease of the radius of the scalar. But if the scalar decreases its radius and the transferred volume increases further the surface area of the increasing amount of transferred volume is decreasing. The green line between point I and point II isn't horizontal; point II represents a slightly lower amount of surface area than point I.

The decrease of a scalar by a local concentration of energy is called the Higgs mechanism.[13][14] Rest mass is the mass that remains if the energy of the velocity is subtracted of the whole energy of the mass. Actually, rest mass is another term for stable mass so I can to conclude that rest mass originates from the decrease of one or more scalars within vacuum space. And last but not least, Newtonian gravity only affects the rest mass of an object.

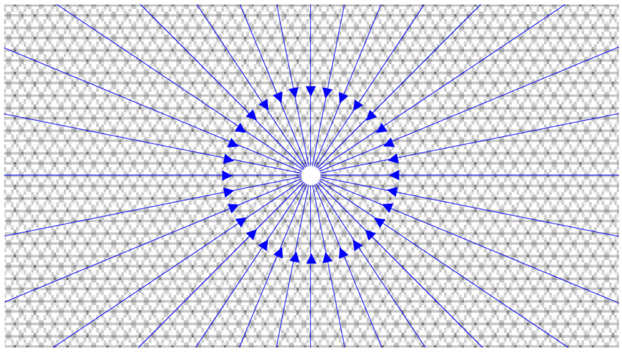

figure 18

If Newtonian gravity emerges at the moment that one or more scalars within vacuum space decrease their radius we can conclude that Newtonian gravity represents the vectorisation of the primary scalar vectors within vacuum space (the vectors in figure 12 without the influence of the transfer of quanta by the magnetic field). A decreased scalar within vacuum space is like a hole in the network of primary scalar vectors (figure 18). The result of the created unbalance within the network of primary scalar vectors is the creation of resultant vectors that are pointing to the decreased scalar(s).

References:

23. Chungpin Hovering Liao (2019), “*Microwave-caused influence on gravitational constant G in Newton’s gravitational law*”.
DOI: 10.13140/RG.2.2.15509.37600
24. Louis Rancourt and Philip J. Tattersall (2015), *"Further Experiments Demonstrating the Effect of Light on Gravitation"*.
Applied Physics Research; Vol. 7, No. 4; 2015
http://dx.doi.org/10.5539/apr.v7n4p4

Free fall and manipulating Newtonian gravity

The conclusion that Newtonian gravity is the “one and only” gravity in our universe isn’t really convincing without an explanation that the unbalance of the primary scalar vectors by the decrease of local scalars of the Higgs field can explain the well known phenomenon *free fall*.[25]

Moreover, if the force of gravity can be shielded by a sheet of light – electromagnetic waves – the hypothesis must also explain the relation between Newtonian gravity and the electric and magnetic field.[24]

In practise free fall is the synchronous velocity of 2 objects with different amounts of rest mass by the gravitational force of a celestial body – a homogeneous field of gravitation – without an atmosphere (vacuum space).

Both objects – e.g. a hammer and a feather – represent rest mass and the nuclei of the atoms envelope decreased scalars: holes within vacuum space that interrupt scalar vectors (figure 18). Therefore, the hammer and the feather block scalar vectors created by the rest mass of e.g. the moon.

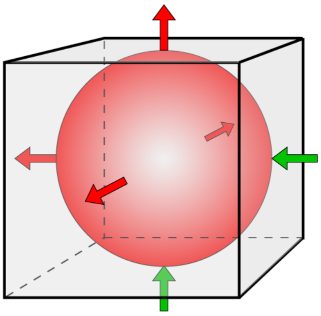

figure 19

The number of interrupted scalar vectors of the moon is determined by the number of decreased scalars of each object. But the number of decreased scalars of both objects determines also the amount of rest mass of each object. If an object with 10 times the mass of another object is moved in vacuum space by a force that is 10 times the force on the other object both objects will have the same velocity. In accordance with Newton's equation $F = m\,a$.

Experiments have showed that light can influence the strength of the force of gravitation. Figure 19 shows the principle. The schematic element (see figure 6) shows the distribution of the *deformation* of 1 quantum at the planes of the element at a certain moment.

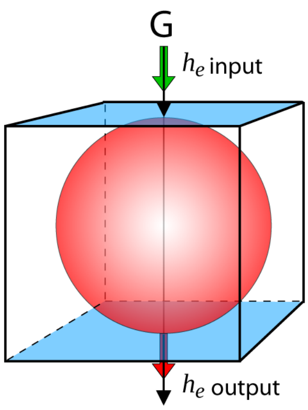

figure 20

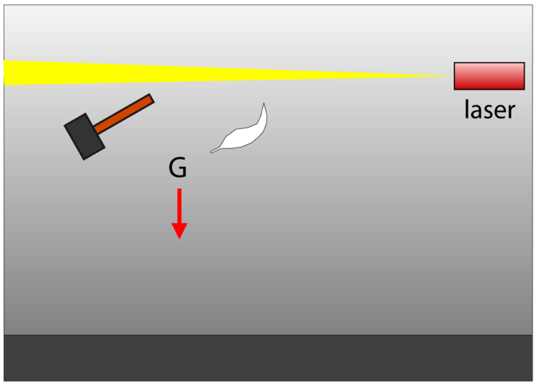

figure 21

The topological deformation from 2 adjacent elements (green arrows) is identical to the deformation to 4 adjacent elements (red arrows). Topological deformation is the transfer of volume within the boundary of the elements, thus: $V_{input} = V_{output}$. The number of planes that will deform at a certain moment is variable with a minimum of 2.

If the description of quantum gravity is correct, the model must clarify how light can influence the induced scalar vectors by the existence of matter. Figure 20 shows not only the deformation (1 quantum = h_e) but also the vectors of Newtonian gravity, the black arrows. The element in figure 20 deforms because the vector of Newtonian gravity (G) is the dominant vector at the moment. In other words, only the 2 blue planes are involved in the transfer of the deformation of 1 quantum: $V_{input} = V_{output}$.

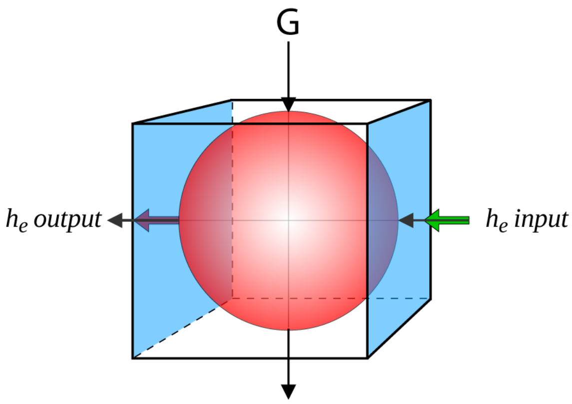

figure 22

But if I manipulate the free fall of the hammer and the feather with a shield of light – see figure 21 – I disrupt the scalar vectors of Newtonian gravity. Not with the help of an interruption by reducing the magnitude of the scalars but with the help of a stream of quanta within the electromagnetic field. Figure 22 shows the principle. The stream of quanta from the right side – created by the laser – influences the magnitudes of the scalar vectors within the involved scalars. In other words, from time to time the gravitational scalar vector G is not the dominant vector thus the topological transformation of the unit is caused by a quantum of an electromagnetic wave (n h_e). The result is an interruption of the gravitational acceleration if the element is – at that moment – involved in the propagation of an amount of deformation we call matter. Actually the hammer and the feather.

References:
25. James Geach (2018). "*Free-falling dead stars show that a cornerstone of physics holds up*".
https://theconversation.com/free-falling-dead-stars-show-that-a-cornerstone-of-physics-holds-up-99168

General relativity
If a scalar decreases its radius within vacuum space the scalar itself is in the centre of a large concentration of energy, a local topological deformation of the electric field (the deformable part of the volume of each element).

Our universe is non-local. Not only because the volume of all the elements in the universe tessellates space but also because of the instantaneous influence of all the scalar vectors within vacuum space (the vectors of the magnetic field and the field of Newtonian gravitation).

The main law of physics – the law of conservation of energy – is about the conservation of change. Actually, it is about the amount of change within the electric field. But every transfer of a quantum generates a corresponding scalar vector (magnetic field and the field of Newtonian gravity). In other words, there is a law of conservation of scalar vectors – the direction of redistribution energy – too.

The consequence is that the concentration of topological deformation doesn't stop with the creation of rest mass carrying particles. Everywhere in space elements are pushing quanta to concentrate topological deformation.

The existing observable concentrations of macroscopic topological deformation in space – celestial objects and celestial bodies – are created by the same mechanism of concentration by the electric field.

In other words, if I implement the gravitational constant in the equations of the theory of general relativity there is no difference between the gravitation of matter and the local concentrations of energy (mass within vacuum space). To calculate the influence of the mass within vacuum space I have to describe the geometrical properties of these accumulations of topological deformation. But that's nearly impossible because we cannot observe these local concentrations of mass within vacuum space in a direct and accurate way (Dark matter).[26]

In the theory of general relativity the total mass of matter is translated into amounts of energy of the electric field. This is correct because the volume of the decreased scalars of the Higgs field become part of the volume of the electric field (Higgs mechanism).

In other words, there is only one problem with the theory of general relativity, the theory isn't about the field of Newtonian gravity. Albert Einstein's theory of general relativity is about the curvature of the scalar vectors within the electromagnetic field. And because of the implementation of the gravitational constant the theory of general relativity mimics the field of Newtonian gravitation.

Documentation/Information:
26. Freeman, K.C. (June 1970). "*On the Disks of Spiral and S0 Galaxies*".
The Astrophysical Journal **160**: 811–830.
DOI:10.1086/150474

Beyond the force of gravitation
Imagine a local region of vacuum space. The only disturbances within the volume are the fluctuations within the corresponding electric field (topological deformation) and magnetic field (scalar vectors that affect the direction of the topological deformation).

At the moment that all the involved elements start to minimize the deformation of each scalar mechanism the average velocity of the transfer of topological deformation will increase, except for the small volume that is forced to accumulate the transferred deformation. Actually, it is the situation in the schematic figure 15.

However, figure 15 shows an evolution, a transformation of spatial properties during an amount of time in between the start of the concentration of energy and the end result. The aim of the drawing is to show how particles are created by the properties of the structure of the basic quantum fields. The duration of the evolution of the local concentration of deformation is nearly instantaneous because sub atomic particles are really small and the velocity of the transfer of quanta (c) is extremely high in relation to the size of an element ($\lambda_e \approx 0{,}5\times10^{-15}$ m).

But what about the creation of a local concentration of topological deformation within a volume with the size of a galaxy?

At the scale of our solar system the planets that are orbiting the sun show a direct relation between the mean orbital velocity and the mean distance from the sun (figure 23). A relation that is described by Kepler's third law.[27]

The red line in the graph of figure 23 shows to be equal to the trajectory of the scalar mechanism in figure 9. That cannot be by accident.

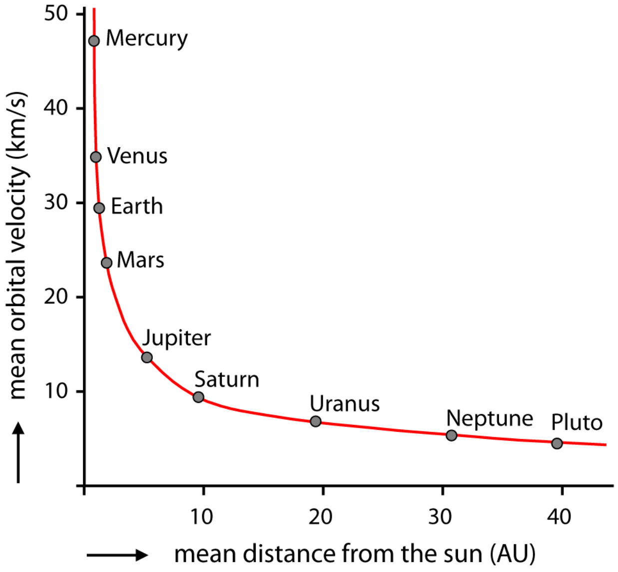

figure 23

The graph in figure 9 is calculated with the help of concentric circles that vary in a regular way (r_{is} = 1,0; 0,9; 0,8; 0,7; etc.). The resistance against deformation between 2 adjacent concentric shells is related to their respective surface areas.

The volume of our solar system is constantly disrupted by the emission of solar radiation of electromagnetic waves and high energy particles. Therefore it is not reasonable to expect that the inner volume of our solar system can concentrate considerable amounts of mass within vacuum space – Dark matter – nearby our sun. In other words, it is reasonable to conclude – like Isaac Newton did in the past – that the orbits of the planets of our solar system are caused by the force of gravitation alone. But this obvious conclusion cannot explain the strange relation between the scalar mechanism in figure 9 and figure 23.

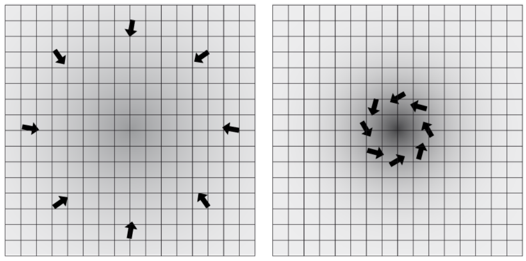

figure 15

I have copied figure 15 to underscore the importance of the use of the right concept to understand the relation between the orbital velocity and the mean distance from the sun by the orbiting planets.

The left image of figure 15 shows the start of the rotational transfer of energy within a certain volume of vacuum space. The right image shows a high concentration of energy and it is clear that the main amount of topological deformation of the involved elements represents a closed loop of topological deformation. The only cause behind the whole transformation seems to be the synchronous transfer of quanta and the velocity of the transferred quanta (c).

But at the level of the individual involved elements every element has a position and a shape that is directly related to its capacity – at that moment – to resist the V_{input} of the adjacent elements around and to manage the V_{output} too. The result is that all the elements together represent a spatial configuration with a rotational structure.

Every planet is the centre of a spatial configuration with a rotational structure and all these spatial configurations are enclosed by the spatial configuration with a rotational structure of the sun itself.

Suppose that the emission of electromagnetic radiation and high energy particles of our sun decreases. The result is the increase of the "infiltration" of the outer region of our solar system with mass (Dark matter). But increasing the amount of mass within the volume of our solar system results in an increase of the rotational transfer of the quanta within the solar system.

But that's not equal to an increase of the magnitudes of the scalar vectors of Newtonian gravity because the rest mass of the planets is unaffected. In other words, the proposed causality between the force of gravitation and the orbits of the planets of our solar system is a misinterpretation of the observations within phenomenological reality.

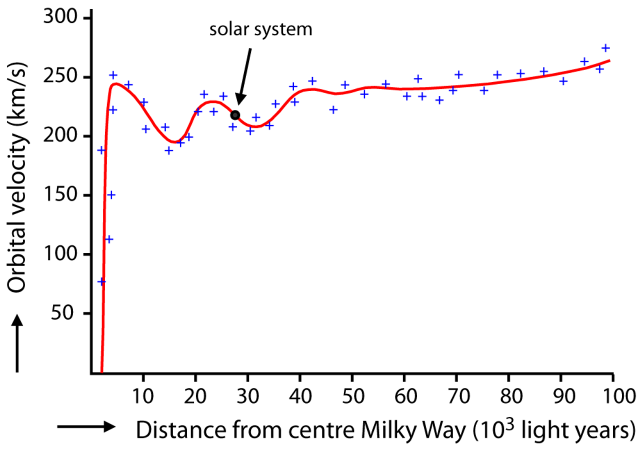

figure 24

The velocity of the stars within the Milky Way should be equal to the distribution of the velocity and orbital distance of the planets in figure 23 if the local properties of discrete space that envelope the Milky Way aren't influenced by the existence of Dark matter within the volume of the galaxy.

However, the density of Dark matter is higher if the emissions of the radiation of the stars is lower because of a less dense population of stars further away from the bulge of the Milky Way.[28] Exactly what the graph in figure 24 shows because the existence of concentrated energy – mass within vacuum space – forces the involved elements to increase the rotational transfer of quanta within the volume of the Milky Way. Actually, the rotation of particles (spin), planets and galaxies rely on the same principle.

References:

27. Johannes Kepler (1619). "*The harmony of the world*" (English translation). Kepler's third law (page 411). https://books.google.nl/books?id=rEkLAAAAIAAJ&pg
28. Bosma, A. (1978). "*The distribution and kinematics of neutral hydrogen in spiral galaxies of various morphological types*" (PhD Thesis). Rijksuniversiteit Groningen.

Conclusion

The conviction that the properties of discrete space can be constructed with the help of the concepts of one or more models of the grand theories is not really helpful. The Standard model of particle physics, Einstein's theory of relativity and the Standard cosmological model are all founded with the help of the phenomenological point of view.

Nevertheless, phenomenological physics is not restricted to the description of models. Conservation laws, universal constants and universal principles are also part of the conceptual framework. These universal patterns show the mathematical properties of discrete space in a direct way.