Conceptual FrameWorks
Research papers

On mathematics and discrete space

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The ancient Greek philosophers – like Parmenides – reasoned that observable reality cannot exist by itself. It has to be a creation of an underlying reality. An all-inclusive existence that has a structure because observable reality shows structure at every scale size. Although observable reality is involved in a continuous transformation too. If our concept about the relation between phenomenological reality and the creating underlying reality is correct, the unification of the properties of phenomenological reality is part of an enveloping mathematical model.

Introduction
One can state that the scientific method – the empirical method of acquiring knowledge about the universe – has proved to be very successful because of all the impressive results in physics during the last centuries. The scientific method has even showed that all the different relations between the observable and detectable phenomena must have the same origin. A reality at the smallest scale size that must be responsible for the existence and evolution of the universe as we know it.

But one of the consequences of the scientific method is the dominance of empirical evidence. Therefore, if we construct a new "Standard model" it is difficult to determine if the model is 100% correct or not. Because we cannot exclude that in the future there will be an experiment or observation that shows that our new "Standard model" cannot be 100% correct.

An experiment and an observation can only show a mutual relation that is part of a local configuration of properties that are supposed to represent the involved phenomena. That is why there must be a nearly infinite number of different configurations in our universe. Therefore, the scientific method is not suitable as the ultimate judge to determine the credibility of models that describe the final unification.

If local observations/experiments within the volume of our universe cannot give certainty it is obvious that we have to switch to the determined properties of our universe that exist *at every point* in the universe. Actually, these all-inclusive properties are the universal conservation laws, the universal constants and the universal principles.[1]

Conclusion: if we want to judge a unified theory we first have to verify if the model can reproduce the all-inclusive properties in a convincing mathematical way.

References:
1. "*Empiricism and empirical information*" (2019)
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The concept of discrete space
Phenomenological reality is relational reality and the observer is part of it. That is why it is impossible to determine the properties of discrete space in a direct way with the help of the outcome of experiments. The consequence is that discrete space is a non-tangible concept and the proposed properties of discrete space are mathematical properties. Properties that can be retrieved if the concept of discrete space is transformed into a mathematical model.

The only certainty about the reality of the "tangible" existence of the mathematical model is that the mathematical properties of the structure of discrete space have to clarify the existence of the universal conservation laws, the universal constants and the universal principles.

One can assume that the mathematical model have to facilitate the simulation of the properties of the "tangible" phenomena, like elementary particles. Unfortunately, "tangible" phenomena have no existence without the underlying structure as described by the unified mathematical model. And the unified mathematical model doesn't represent only local reality. The mathematical model represent the properties of the structure of discrete space itself so we cannot simulate a phenomenon as a solitary local existence because the "tangible" phenomena emerge from the properties of discrete space. So if we want to simulate these phenomena we have to simulate the evolution of all the changes within a "flat" volume of space itself. A volume that is influenced at its boundary by all the changes of the whole non-local universe around.

"Meta-mathematics"

If a volume has a structure the volume must be a composition of smaller volumes. If the enveloping volume is a dynamical volume all the smaller volumes must have identical basic properties too otherwise there are no fluent transformations possible. Like an identical amount of volume of the small volumes because the proposed continuous transformation of the enveloping volume can only be met with the continuous change of the shape of every small volume.

The schematic figure 1 shows one unit of discrete space – green cube ($d_x = d_y = d_z$) – and some units around.

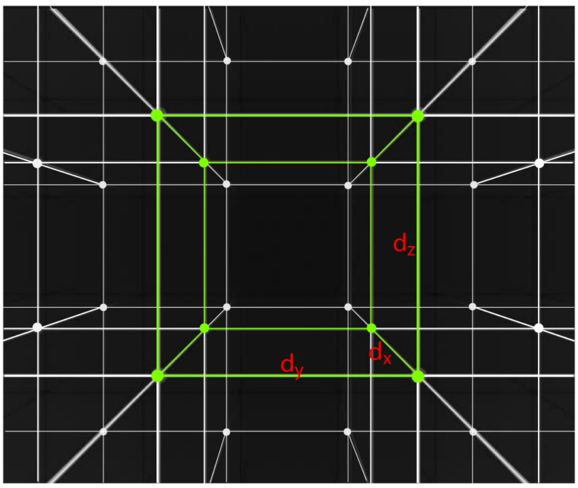

figure 1

The image shows a mathematical problem. It is about the proposed transformation of the shape of the volume of the green cube. To keep the volume of the unit invariant every change of the shape by the volume itself must be compensated by the adjacent volumes.

Therefore, if the green cube transfers a small part of its volume to the right – increasing the surface area of the right face of the cube (= outwards deformation) – one or more adjacent cubes must transfer the same amount of volume to the other planes of the green cube (= inwards deformation in relation to the boundary of the green cube). See the cross section of the mutual topological deformation of 2 identical invariant volumes (figure 2).

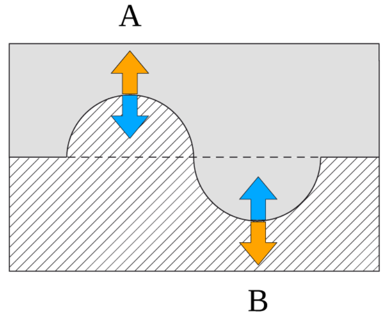

figure 2

The result of the transfer of volume within the boundary of the green cube in figure 1 results in an increase of the amount of surface area of the green cube. All the units of discrete space have to change the shape of their volume synchronously thus the surface area of every unit of discrete space is increased too. Although it is difficult to imagine how this is possible with the help of figure 1, the result of the transformation is easy to guess: a uniform change of the shape of every unit of discrete space (= the whole universe).

But the appearance of our universe isn't uniform. That means that the amount of surface area of *every* unit of discrete space cannot be the same. This seems to be a paradox.

The proposed topological deformation of the schematic green cube in figure 1 concerns the deformation of a homogeneous volume. But the property responsible for the continuous change of the shape of the unit isn't part of the model. Therefore, it cannot be excluded that only an invariant part of the amount of surface area is involved in the continuous transformation of the shapes of all the units.

In other words, the surface area (A) of every unit of discrete space is:

$$A = A_s + A_c \qquad [A_s = \text{variable};\ A_c = \text{constant}]$$

Therefore, the surface area of the schematic green cube in figure 1 represents:

$$A = A_s + A_c \text{ where } A_s = 0$$

Fractals

If the continuous transformation of the shape of every unit of discrete space is caused by an internal property of the units, all the dynamical changes in our universe are generated by the properties of the units of the structure of discrete space. The consequence is that all the generated local changes are mutual related and evolve in a deterministic way. Comparable with fractals.[2]

If nature shows fractal properties it is clear that one or more basic properties of the units of the structure of discrete space must be observable at every scale size. An idea that is confirmed by the dominance of the shape of the sphere everywhere in our universe.

If observable reality is created by the properties of discrete space and the dominant shape of compositions of properties are like spheres, it is obvious that one property of every unit of discrete space must be an internal "*spherical shape forming mechanism*". A property that shows a high degree of similarity with the proposed existence of the scalars of the Higgs field. A universal scalar field that exists everywhere in the universe.

In mathematics the only "real" scalar is the sphere. Because a sphere is the only geometrical shape that can be changed with the help of only one property, its radius.

If one of the properties of the units of discrete space is "a spherical shape forming mechanism" it is easy to change the schematic green cube in figure 1 into the same unit with a scalar inside (figure 3).

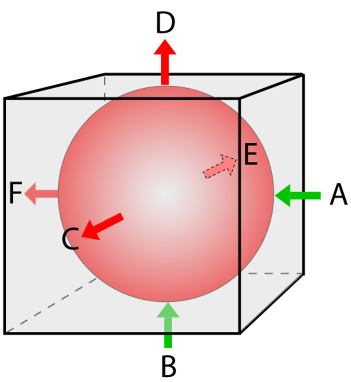

figure 3

The image shows a transparent schematic unit and a scalar inside. The arrows represent the topological deformation of the planes of the unit by the unit itself (green arrows: C, D, E, F) and by 2 adjacent units (red arrows: A, B). The topological deformation of A, B, is identical to the topological deformation of C, D, E, F because every unit has identical properties and the volume of each unit is invariant.

Figure 3 shows the scalar like an inscribed sphere of the cube because there is no reason to propose that the magnitude of the scalar – actually its radius – is restricted by an unknown limitation. It is obvious that the magnitude of the scalar is limited by the scalars of the adjacent units around.[3]

References:

2. *A brief description of mathematical fractals*
   https://en.wikipedia.org/wiki/Fractal
3. See page 8: "*On the construction of the properties of discrete space*".
   DOI: 10.5281/zenodo.3909268
   (https://zenodo.org/record/3909268)

The invariant part of the surface area

Figure 4 shows three units. The unit at the right side has transferred volume to the joined face with the unit of the centre (green arrow). The unit in the middle has to transfer the same amount of volume to the left (red arrow) because the volume of the unit is invariant.

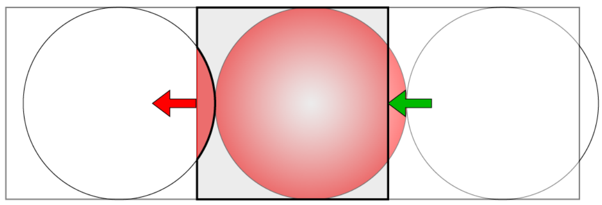

figure 4

As a result the surface area of the unit in the middle has increased. But the amount of surface area of the unit without the scalar – the surface area of the cube in figure 3 – has not changed. That means that the surface area of the dynamical part of the volume of every unit is invariant if the local scalars of the Higgs field have the same magnitude (identical radii). This condition is met nearly everywhere in the universe because in vacuum space all the scalars of the Higgs field have exactly the same magnitude.

Now I can precise the simple equation at the bottom of page 2 (A_s = variable; A_c is constant):

$A = A_s + A_c$ [A_s = scalar; A_c = deformable volume]

At the moment that the local concentration of topological deformation exceeds a certain threshold the magnitude of the scalar in the centre of the concentration decreases (the Higgs mechanism). The situation is drawn in a schematic way in the image below (figure 5).

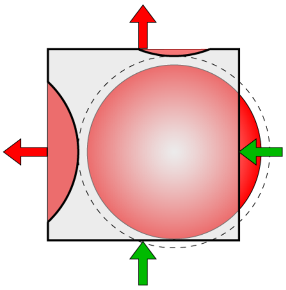

figure 5

The deformable part of the volume of the unit is drawn like a cube. This is not the shape of a real unit of discrete space but I have done it to simplify the deformation. I can construct figure 5 very precise to calculate the surface area of the "cube" but it is not necessary. The surface areas of all the deformed parts of the units around are identical (and invariant) so it is impossible that the amount of surface area of the deformed part of the unit in figure 5 with a decreased scalar inside isn't identical too.

Figure 6 shows a hypothetical symmetrical unit of discreet space, a dodecahedra. The boundary of the unit is build up by 12 rhombi thus the relation between the inscribed sphere and the deformed part of the unit – actually the deformed part of the internal "spherical shape forming mechanism" – is determined by the irrational numbers π and √2.

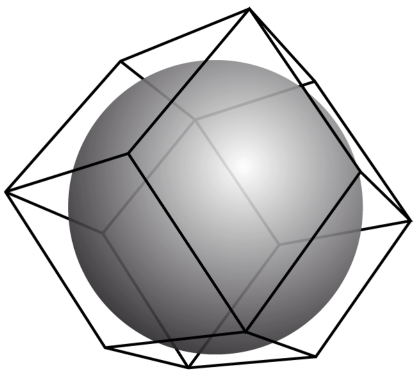

figure 6

The consequence of both irrational numbers π and √2 is the absence of stability between the scalar and the deformed part of "the internal spherical shape forming mechanism" (scalar mechanism).

The scalar mechanism
It is obvious that the "spherical shape forming mechanism" of every unit of discrete space has its stability in the centre of the inscribed sphere. That means that the increase of the magnitude of the scalar is an increase of its radius (and visa versa). The volume of the unit has no internal structure – units with a boundary – otherwise this imaginary internal structure would be the structure of discrete space itself.

Nevertheless, if I imagine that the inscribed sphere of every unit of discrete space is build up by concentric shells with equal thickness the resistance against the deformation of the sphere will be infinite (figure 7). If the radius of the scalar increases the resistance against deformation at the "outermost shell" is decreasing (e.g. r_{is} increases from 1,0 to 1,05). But the resistance against deformation of the volume of the unit around the inscribed sphere is unknown.

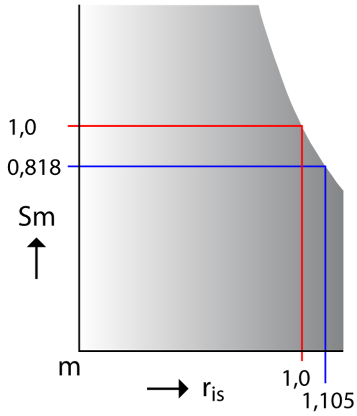

figure 7

It can be expressed with the help of the duration of the linear transfer of Planck's constant (input → output deformation).

All the units of discrete space tessellate the volume of the universe. Every unit has an invariant volume thus all the units in the universe transform their shape synchronously. That means that the linear pass on of topological deformation is the same every where in the universe, the constant speed of light. The amount of topological deformation is a fixed quantity because the change of direction of the transfer is of course determined by the synchronization; Planck's constant.

In between the start and the end of the transfer of the fixed amount of topological deformation – Planck's constant – there is no turn of direction possible. In other words, the detection of the velocity and position of a phenomenon is limited by the size of the units of discrete space (Heisenberg's uncertainty principle).

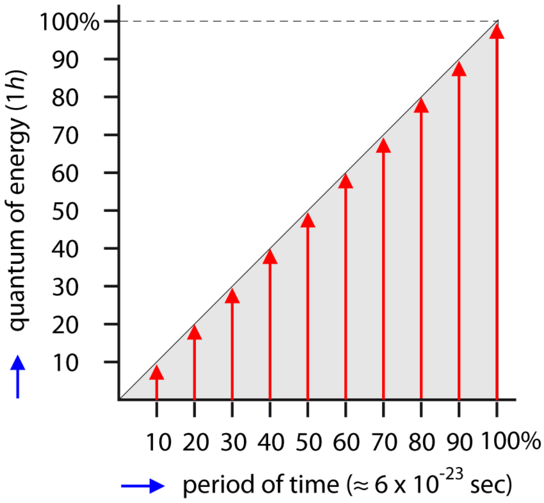

figure 8

The continuous dynamical changes of the shapes of all the units of discrete space means the conservation of the total amount of change, the conservation of energy. The change itself is a flux of infinite small amounts of volume that is transferred within the boundary of every unit. Because of the synchronization of the change of all the units the continuous flux of infinite amounts of change is divided in identical amounts of change, Planck's constant (*h*).

Figure 8 shows the transfer of the fixed amount of topological deformation (1 *h*) within the boundary of 1 unit. The flux of the infinite small amounts of volume is the grey area and the red arrows are the corresponding vector(s) inside the scalar that are generated by the transfer of the quantum of energy (the magnetic field). Because in vacuum space every internal influence on the scalar of the unit is transferred to/from the other scalars around at the points of contact between the scalars.

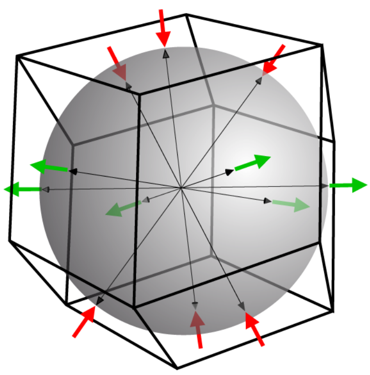

figure 9

Figure 9 is equal to figure 6 but I have drawn the vectors inside the half transparent scalar – the points of contact are in the centre of every plane – and the red and green arrows show the direction of the topological changes in each plane – outwards or inwards in relation to the shape of the unit – at a certain moment (just an example).

Nearly the whole universe is vacuum space. The transfer of influence by a vector is instantaneous thus our universe is non-local at every moment. That means that every change in the universe is influenced by all the other changes at exactly the same moment.[4] Non-locality is directly related with the conservation of momentum (actually the conservation of vectors).

Conclusion: the hypothetical model corresponds with the universal properties like the conservation of energy, Planck's constant, the constant speed of light, Heisenberg's uncertainty principle and the principle of non-locality.

Reference:

4. "*Discrete space and the underlying reality of Quantum Mechanics*" (2021)
DOI: 10.5281/zenodo.5236617
(https://zenodo.org/record/5236617)