The Matrix Theory: A matrix of quanta of action replacing the space-time continuum

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Abstract:

In physics many fundamental problems are still unsolved, especially in the interdisciplinary field between macro and quantum physics. So what is the mechanism of curvature of space-time by gravity or of the dilation of time in moving systems? Why are the equations of physics time-symmetrical and why is there no tripartite division into past, present and future? What is the nature of the scalar Higgs field or – last but not least – how to connect the general theory of relativity (GTR) with quantum physics? These questions – and there are some more – indicate that it is time to develop new basic ideas and to prove if they might produce interesting solutions.
Looking for a mechanism of time dilation the idea of an absolute spatial reference system was challenged again on the basis of the GTR and the knowledge of modern physics, especially quantum physics. As a result, neither Einstein´s idea of relative movements as the cause for time dilations nor the ether theory of Lorentz could be confirmed. A third way was found: the model of a space-time continuum currently used in physics was replaced by a scalar field (= matrix) of action quanta. This replacement leads to amazingly simple solutions to the above mentioned questions, which are obviously connected.
So with this new model and with an outstanding role of the Planck quantum h a mechanism for time dilation and space curvature could be defined for the first time. Next it is shown that the GTR alone is able to explain time dilation both by movement and by gravity. Even a crucial link between GTR and quantum physics is found, and the exciting discovery is that the Planck quantum is the basis of the theory of general relativity! So GTR and quantum physics have the same origin. Furthermore it is assumed that this matrix of action quanta is identical to the Higgs field.
The number of potential solutions shows that this new idea – which is called "matrix theory" – can be essential for further work, like a new option to explain the dark energy or the criticism of Hamilton´s equations. But it has to be proved now, what cannot be done by my bureau without any help from other experts in physics.

Keywords: General theory of relativity, special theory of relativity, space-time continuum, time dilation, spatial reference system, ether concept, background independence, Planck quantum, scalar field, matrix of quanta of action, Ermakov equation, uncertainty principle, Higgs field, dark energy.

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1. Introduction

My bureau is specialized in finding new ideas for solving difficult problems in the fields of interdisciplinary sciences. Studying the field between macro and quantum physics, I encountered some fundamental questions, especially about the nature of time, which are still unresolved. Some of them are.:

(1) What is the mechanism of the curvature of space-time by gravity?
(2) What is the mechanism of the dilation of time in moving systems?
(3) Why do we need two different theories – General Relativity (GTR) for accelerated systems and Special Relativity (STR) for moving systems – to explain time dilation?
(4) Why do we find no quanta of time or space or space-time in quantum physics?
(5) Why are the physical equations time-symmetrical? Why does in physics no tripartite division of time exist, even though about 8 billion of people have this experience every day?
(6) How to solve the time paradox better known as the twin paradox?
(7) What is the nature of the time-dependent process of expansion of the universe, named dark energy?
(8) What is the link between the theory of general relativity and quantum physics?

Question (6) has to be explained now. In the twin paradox both twins shake their hands in the exact identical moment of time, then one is very fast moving in a rocket, both experience individual times, and when they meet years later, they again shake their hands in the exact identical moment of time, despite their individual times. How does nature do this?
Then I replaced this paradox with a swing paradox that makes the problem clearer. There we have a swing, a child is sitting on the swing and is then pushed by the father (see figure 1).

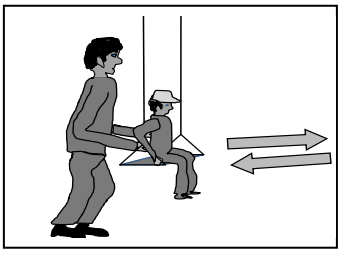

Figure 1: The swing paradox

The child is accelerated and then moves back and forth, is then pushed (accelerated) again by the father and so it goes. So there is a series of alternating identical times (when the child is touched by the father) and individual times (when it is accelerated and moves).
The alternating periods of identical times and individual times is shown in figure 2. As is shown in figure 2b), the periods between the identical und individual times are severely shortened. In the end they can become infinitesimally small. So a supposition is suggested that a solution to this paradox might consist in introducing a common now – despite the individual times. But if … how does nature do it?

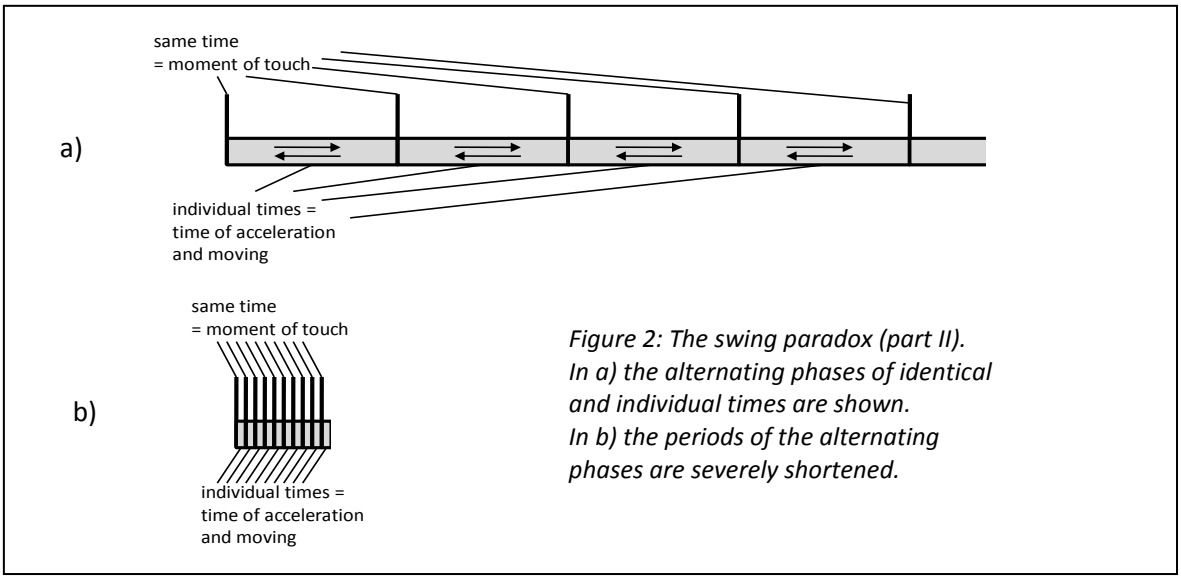

Figure 2: The swing paradox (part II).
In a) the alternating phases of identical and individual times are shown.
In b) the periods of the alternating phases are severely shortened.

The high number of these fundamental questions of time – and the stagnation to solve them – shows that our thinking in physics needs to be reconsidered in general. Probably we need a completely new idea to explain our known and verified physical observations.

Starting my search for a new theory, I defined the basics of my work. These are the following four well checked physical theories:

- The constant speed of light
- Einstein´s theory of general relativity (GTR)
- The discovery of the Higgs field
- Quantum physics with the Planck quantum of action

2. The constant speed of light

Starting with the constancy of the speed of light it quickly became clear, that the controversy over a fundamental question about the structure of our world, namely whether or not there is an absolute spatial reference system (often called "ether") is over a hundred years old but still not resolved.
Two different theories, namely Lorentz's ether theory and Einstein's special theory of relativity (STR) tried to explain the constant speed of light and led to time dilations and length contractions in moving systems.
Comparing both theories, in 2004 Thomas Filk and Domenico Giulini came to the following conclusion: "But what distinguishes Einstein's special relativity theory from the Lorentzian ether theory with universal forces? The answer may come as a surprise: the two theories do not differ in anything that can currently be observed! Both theories are equally capable of describing the known phenomena. However, the two theories differ

significantly in their basic assumptions about the structure of our world, although these assumptions cannot be verified as long as a microscopic structure of an ether does not appear. It is ultimately up to the individual's conviction which view of assumptions seems plausible to them" [1]. As was thus proven by the authors, the question of whether an absolute spatial reference system exists or not is still unanswered to this day!
So there is still the possibility that an absolute reference system is responsible for the constant speed of light – even if the idea of ether is currently referred to as a scientific error [2]. What seems to me far too superficial as a statement against the background of the work of Filk and Giulini. On closer inspection, the reason for the constant speed of light is even today not really clear.

3. The ether discussion and the Higgs field

It was even Albert Einstein himself who, with his further development of STR, namely the general theory of relativity (GTR), came to statements that contradicted the idea of getting by without an absolute reference system and, in contrast, formulated a kind of ether that was immaterial.
On May 5, 1920, Einstein presented the following speech (title: "Ether and Relativity Theory") in Leiden: "Recapitulating, we may say that according to the general theory of relativity space is endowed with physical qualities; in this sense, therefore, there exists an ether. According to the general theory of relativity space without ether is unthinkable." [3].
There are also some important voices in quantum physics, such as those from Nobel laureates Frank Wilczek (Nobel Prize 2004 for work on strong interaction) [4] and Robert Laughlin (Nobel Prize 1998 in Physics for explaining the Fractional Quantum Hall Effect), who speak of ether when looking at the quantum vacuum. Laughlin explains on the basis of the quantization of atomic spectra: "So the supposedly empty vacuum of the room is, in other words, by no means empty, but full of ´any stuff´. Matter that moves past it vibrates, which in turn changes the properties of this matter slightly. … One of the central problems of modern physics is to find a plausible explanation for this uniformity ('of this stuff', supplement by the author)" [5, p. 39]. And a little bit later: "The modern idea of the room vacuum, which is confirmed experimentally every day, is a relativistic ether. We just don't call him that because it's taboo" [5, p. 184].

This argument has recently been strongly supported by the discovery of the Higgs particle [6]. Studying the Higgs theory and the associated field, you can see the following: This field permeates the entire universe and does something no other field in physics has done before. Nothing is somehow attracted or repelled, but it makes it difficult for particles to start moving or slow down – for this a particle must therefore be accelerated. Further it is postulated that the inertia created by the interaction of a particle with this field is then the mass of the particle. The interaction that this theory formulates for a particle and an ubiquitous field (that is very reminiscent of an ether) suggests that may-be it is this field that causes ontological changes in time and length.
So there are many doubts about Einstein´s STR and many references to an ether, which has to be identified in the results of quantum physics.

So the following questions have to be investigated: Does an absolute reference system exist in the universe and does it actually affect time and length? And if so, what is the kind of this "ether"? Is there a way to find out what it is made of? And is it possible to find a mechanism for time dilation and length contraction? And what does it mean for theoretical physics? The following works are based on older results, which were carried out for the first time in 2007 [7].

4. Einstein´s GTR and its background independence

While in his STR Einstein formulated a time dilation and length contraction by movements like Lorentz did with his ether theory, Einstein discussed in his GTR an additional change in space and time through accelerations such as gravity (instead of speeds). Despite the close connection between space and time and changes in them through movements and accelerations, physics remains to this day with a kind of background in the form of a space-time continuum that experiences "dents" in it through these movements and accelerations. But as in his STR Einstein again could not formulate a mechanism in his GTR that could show how nature does it.
However these mutual influences in the GTR (called background independence) are very important and indicate much more – because a closely linked structure of space, time, acceleration and movements becomes clear. It would indicate not only a spatial reference system, but also the possibility that everything together (forces, space, time, movements) could be part and take on the role of the reference system.

The influence of moving matter on the ether by the ether brings this background independence to the foreground and leads strictly to the assumption that ether and moving matter cannot be separated but together (!) form the absolute reference system – as Einstein 1920 somehow had suspected. As the background independence shows, everything is inextricably linked. However, that would be a completely new concept of ether, a kind of a reference system that consists of everything that exists.
The idea of such an absolute reference system is new. To check it we have to search for the property requirements. Therefore the further path led directly from general relativity to quantum physics.
The question was: can Einstein's work, which has so far come to a standstill on the “wall of quantum physics”, be combined with quantum physics? Is there mutual access via this kind of "ether"?

Vacuum fluctuation is well known in quantum physics. The quantum vacuum, the apparent nothing "bubbles", and the Casimir effect also shows that the apparently empty space is not empty. Robert Laughlin says: "Our old view that space is fundamentally different from matter has been refuted” [5, page 160-161]. So Einstein's background independence is also evident in quantum physics. My work is therefore concerned with the search for a fundamental model that ...

- formulates an absolute reference system,
- corresponds to the background independence from Einstein's GTR and explains it,
- finally defines a mechanism for time dilations and length contractions and space curvatures and
- could explain the nature of the Higgs field and
- maybe even provide a common basis for GTR and quantum physics.

If such a model can be found that fulfills all these points, the chances were very high that it could be of fundamental importance.

5. Scalar field and anisotropy

I started with the postulate of a scalar field, since in the “initial state” there is no gradient and therefore no vector. Only the presence of matter in it and additional accelerations and movements in it would cause changes in lengths and time in the moving system and thus create gradients or motion vectors in this "ether": so analogous to the usual space-time continuum, I initially assumed a space-time "ether" as a scalar field.

Relative movements now do refer to an absolute reference system. So it is now possible to define an absolute resting position in this field. Accelerations and movements relative to this reference system, i.e. to this resting position, are the ones that lead to time dilations and length contractions in the moving system in an as yet unknown way.

If I now define an observer who is in this resting position and a system which moves relative to the observer and thus in this field, I will get the following results, which are different from the generally valid considerations.
A beam of light, emitted in the direction of movement by the system moving at the speed v, would be measured by the stationary observer as well as in the moving system at the same speed, namely the speed of light c – because of constancy of the measured speed of light.
For the observer, however, the case arises that – if he refers to the moving system – the light beam only moves away from the moving system in the direction of movement with the relative speed of c - v. In contrast, the same light beam is measured by the moving system with c.

In order to bring both observations into agreement, with this “ether” model, the time and lengths in the moving system must now be changed in the direction of movement so that – in relation to the speed of light – the following factor results:

(1) $$\gamma_{(1)} = \frac{c - v}{c}$$

A light beam emitted against the direction of travel, on the other hand, would automatically ensure this factor in the moving system:

(2) $$\gamma_{(2)} = \frac{c + v}{c} .$$

Analogous to Einstein´s work on light clocks the familiar Lorentz factor would then result for the moving system at perpendicular angles to the direction of travel:

(3) $$\gamma_{(3)} = \sqrt{1 - (v/c)^2} \quad .$$

This is shown in Figure 3. There is a moving system with a man on a motor cycle and an observer in the resting position (referred to an absolute reference system).

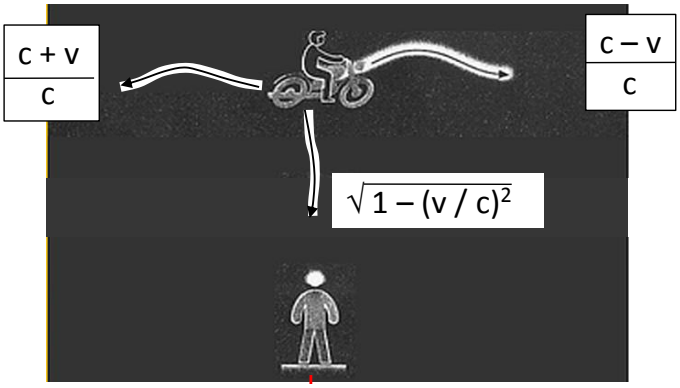

Figure 3: An observer, resting in the absolute reference system as a kind of "ether", and a moving system (a man on a motor cycle). The moving system sends light beams in different directions.

What we get is an anisotropy in the moving system: in the direction of movement – let's refer to time – time goes slower, and against the direction of movement time goes faster. It is similar to a swimmer in a medium: in the swimming direction he fights against the pressure of the water, against the swimming direction, however, a negative pressure is created. The difference is – regarding again our moving system – that this happens within the moving system, at every point of the moving system. The consequences are that the medium, our scalar field, must not only penetrate the moving system and thus be present in every point of this system (!), but it must also enable this anisotropy in every point.
Something arises within the moving system that reminds me of a cat's skin: in one direction (against the grain) we feel resistance when we stroke it, in the other direction it is rather resistance-free. And this happens at every point on the fur, on every single hair. And this effect – to return to the moving system again – becomes stronger the faster this system moves in the scalar field. So if a system moves in the scalar field, resistance arises in the direction of movement. The opposite is true against the direction of movement – in every point inside the moving system.
The example of the cat fur, in which each individual hair contributed to this effect, led to the idea of defining individual smallest building blocks for the composition of the field, i.e. introducing "quantization". According to the background independence from Einstein's GTR, the next conclusion was that such a building block should contain as quantities space, time, mass or energy, forces, accelerations and movements.

6. A matrix of action quanta instead of space-time continuum

Looking for a quantized building block that could meet all these new demands, it was found that there is no such building block in physics. There is no module with the dimensions N, m^3, sec and kg.
However, one often overlooked failure at this point is that a force is always associated with a direction vector. Instead of space and force now length and force is sufficient as a component of the building block, since a direction vector spans every length into space. Instead of N, m^3, sec and kg, now the task was to find a building block that contained $\vec{N}$, m, sec and kg.
This building block actually exists. It is the basic element of quantum physics, it occurs in almost every formula of quantum physics, it is the quantity action. It is, as a suggestion, the Planck quantum h:

(4) $h = 6{,}626 \times 10^{-34}\ kg\ m^2/sec = 6{,}626 \times 10^{-34}\ \vec{N}msec$

So instead of a Lorentzian ether a matrix of quanta of action is found. Both as well the ether theory of Lorentz and Poincaré as the STR of Einstein and Minkowski are obviously insufficient to explain the constant speed of

light, and instead of the usual space-time continuum now something totally different occurs: this matrix of action quanta. This result could mean a big change in physics.
As Figure 4 shows, this block of constant size of action now makes a mechanism for time dilations and length contractions conceivable. If the force component within the module increases due to accelerations (as well as gravitation), length and time are becoming smaller. They are now contracted or dilated. So – using the Planck quantum as the building block of the matrix – the first time a possible mechanism for the dilation of time and contraction of length could be defined.

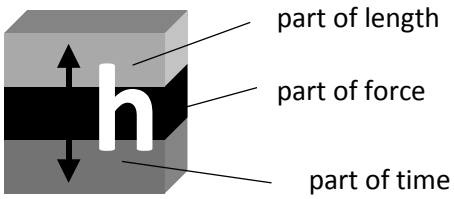

Figure 4: A quantum of action as a building block and its composition: forces (Newton), length (meter) and time (seconds). If a force is growing and acting, distance and time will be reduced in these building blocks of constant size.

With this "cat fur" (see above) and the vector properties of forces now anisotropies can be introduced in the next step. Depending on the direction of forces now increasing speed due to accelerations simultaneously (!) dilates time and contract lengths in the direction of accelerations and movements and extends them (time goes faster and lengths are becoming longer) against the direction of the force of accelerations and movements (see figure 5) – and the measured speed of light is always constant, because the ratio of length and time is always the same in any direction, even if the moving system changes speed.

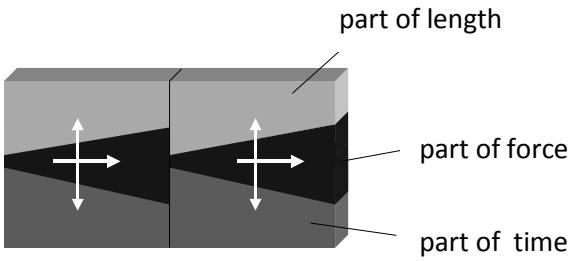

Figure 5: Generation of spatiotemporal anisotropies in the matrix by directional forces such as an acceleration relative to the matrix.

So finally this matrix allows us to define a mechanism for the curvature of space by mass and their gravity, too. The old question where to space is curved can now be answered by: not into space but into action. As any directed forces each acceleration (like gravitation) changes length and time in an anisotropic way – due to the direction of the forces. And if we look at the matrix and its structure of lots of quanta, as a result the space is curved. So a mechanism for the space effects of Einstein´s GTR can also be described for the first time..

7. Implications for physics

7.1. The time questions: Dilation, the tripartite division and the time paradox

Let´s now look at the quanta in the matrix, how they behave during the flow of time. The Lorentz factor, which is calculated as the average value perpendicular to the movement, is used to characterize the time dilation. It is shown how one quantum behaves from one moment to the next. To clarify the time dilation in a matrix of quanta of action now two different cases are shown in figure 6. Important is that time is only a part of the quanta of action.
The upper part of figure 6 shows how time runs in evenly quantized steps in a system that is at rest in the matrix. The situation is different for a system that is accelerated relative to the matrix, then moves evenly in a straight line and then is decelerated by an acceleration against the direction of the movement and then returns to a rest position (see lower part of figure 6).

The quantized times are dilated by the acceleration, time runs slower because the quanta of time become smaller, due to the Lorentz factor. These quanta of time then remain in this state, only to grow again when decelerating until they reach their original size in the rest position in the matrix.
What we see is that time dilations due to the Lorentz factor arise from accelerations relative to the matrix, and are maintained by velocities and the resulting momentum and inertia (relative to the matrix). So this matrix theory can explain time dilation as well as by accelerations as by the moving of systems.
There are no more two different causes necessary to explain length and time variations, their origin can be attributed to only one common cause, namely accelerations. This is because each movement has experienced a history of one or more accelerations relative to the field of the matrix, which together are the cause of the current time dilation.

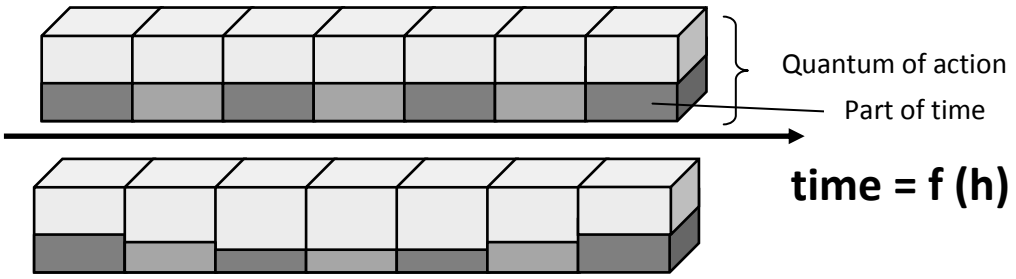

Figure 6: Time variations in resting and moving systems and the simultaneous passage of time

So there is no more need for Einstein´s original STR (before being expanded by Minkowski), which caused time dilation by relative movements of inertial systems. With an absolute reference system now the General Relativity is sufficient, but maybe it needs to be changed a bit. This could be an important step for a simplification in physics. However, the part of the quantum field theories that concerns the relativistic parts may also need to be revised.

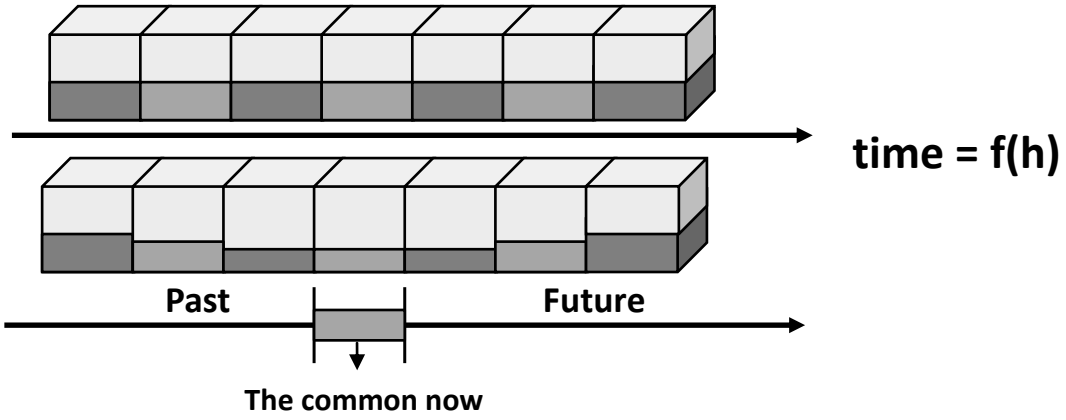

Figure 7: the matrix theory allows the tripartition of time and a common now

Since action and not space-time is now the decisive factor, there are individual time values, and yet they always remain in a common simultaneity (see figure 7). So there are more surprising findings in addition to the mechanism of time and length variations: a universe based on action quanta allows the introduction of the tripartite division of time into past, present and future in the form of a common and simultaneous present, with a present that is individually lasting for different length of time – depending on the history of an acceleration and speed. So there is a common quantized "Now" in the world possible, which, however, varies a little bit individually. And we can understand why a quantized time with a fixed value was not found in quantum physics until today.

Finally the time paradox (see Chapter 1), better described as the swing paradox, can be solved, too. With the introduction of the tripartite division of time into the past, the common "Now" and the future there is always a common simultaneity in the present, despite different time courses. So everything in the world is a process with a common flowing "Now", which reminds of "panta rhei" of Heraclitus.

In his book “Zeit und Wissen” C.F. von Weizsäcker dealt intensively with such questions, as did A. Einstein und R. Carnap, which can now be led to a solution and reasonable explanations [8].
And finally another age-old question can be solved: what is it that brings time into the world? It is – that is the result of the matrix theory – because the world is fundamentally made of action.

7.2. The matrix and the Higgs field

Next it is striking how identical this solution is with the properties of the now quantized Higgs field (see above). Due to the Higgs field it is postulated that the inertia created by the interaction of a particle with this field is then the mass of the particle. Combining this with Einstein´s background independence, where mass influences time and lengths and space, it seems to be obvious that this matrix of action quanta and the Higgs field seem to be identical (see figure 8).

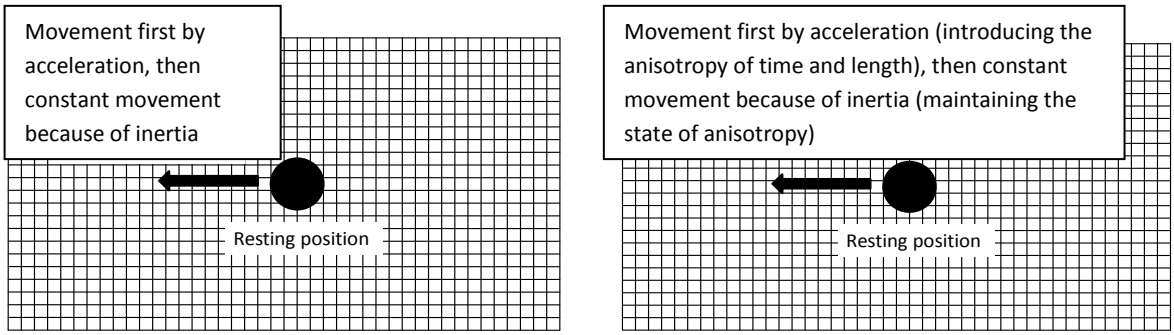

Figure 8: The properties of the quantized Higgs field (left) and the matrix (right) are the same

So the formulation of the matrix of action quanta can resolve the question of what the Higgs field consists of, this field in which matter receives its mass through the exchange of Higgs bosons. But this would have to be examined more closely.
Additional note: in contrast to the usual drawings of the Higgs field, dents around the mass were deliberately avoided here, because not any curvatures of space are decisive but quanta of action.

7.3. The microstructure of the matrix

Well known is Heisenberg´s uncertainty principle that seems to indicate that everything is out of focus below the Planck quantum. But regardless of that there are further clear calculation rules for various effects within our quantum of action. This may be surprising. But these rules do not only concern time and lengths, but are also expressed in the following equations when they are transformed.

E.g. the equation of the Klitzing constant changes now to:

(4) $$R_K = h/e^2 \quad \Longrightarrow \quad h = R_K \bullet e^2$$

... and the Josephson constant:

(5) $$K_l = 2e/h \quad \Longrightarrow \quad h = 2e/K_l$$

The famous equation for the Sommerfeld fine structure constant changes now to:

(6) $$\alpha = 2\,\pi\, e^2/(c \bullet h) \quad \Longrightarrow \quad h = 2\,\pi\, e^2 / (\alpha \bullet c)$$

... and the Compton wavelength:

(7) $$\lambda = h / (m \bullet c) \quad \Longrightarrow \quad h = \lambda \bullet m \bullet c$$

... as well as the Rydberg constant by replacing α:

(8) $$R_\infty = \alpha^2 / 2\,\lambda_e \quad \Longrightarrow \quad h = 2\,\pi\, e^2/(c \bullet 2\,\lambda_e \bullet R_\infty)$$

We can see here how closely the Planck quantum is connected to the elementary electric charge e and the speed of light c and, via the Compton effect, to the matter m and via c to lengths and to the time t.

Interestingly, there is another elementary quantum of action that was apparently known to Einstein [9], Schrödinger [10] and Eddington [11],

(9) $e^2 / c = \text{const.} = w,$

and reconsidered in the context of the fractional quantum Hall effect (FQHE) [12] where the ratios of multiples of this quantum of action and ħ appears. The FQHE is the first physical phenomenon in which this quantum of electrostatic action, w, manifests directly.

And there is a strong relationship between ħ and w, the Sommerfeld fine structure constant:

(10) $w / \hbar = \alpha$

The conclusions from all these equations may be useful. So some further work has to be done here.

7.4. The Planck quantum is the basis of Einstein´s GTR

As shown above the further development of Einstein´s GTR led directly to a reference system made of a matrix of action quanta. This leads to the conclusion that this matrix contains the cause of the dynamics of the world that cannot be derived from a space-time continuum. This matrix would also clarify why the intensive search by physics for specific time and length or space quanta has so far been fruitless. This will continue to be unsuccessful, since the quantized entity is action, not space or time.
As has also been shown, this matrix of the action quanta is the basis of both the background independence of the GTR and the Higgs field!

So the exciting discovery is that the Planck quantum is the basis of the theory of general relativity!

In summary, it can be said at this point that with the matrix theory, the Planck quantum has become very important, it turns out to be the central building block of physics and shows itself to be the crucial link between Einstein's GTR (with its background independence) and quantum physics (see Figure 9).

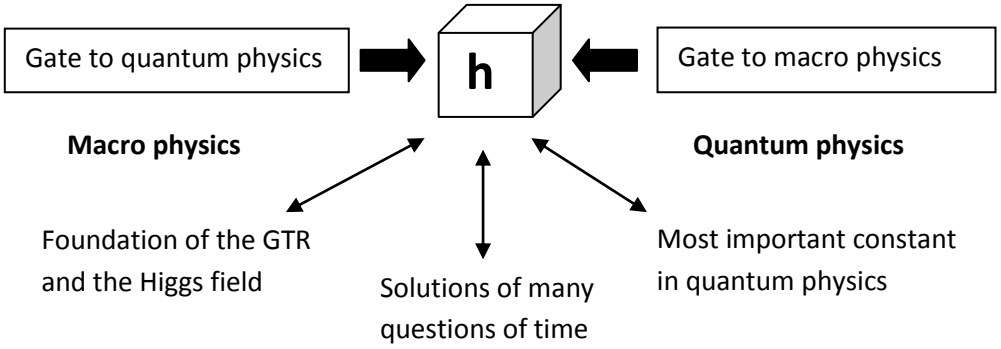

Figure 9: The Planck Quantum as an interface between macro and micro physics

Therefore this new matrix theory also could be of great importance for the quantum field theories, which are still based on a space-time continuum and still shy away from a quantized field of action.

7.5. The need for new systems of equations instead of Hamilton´s

The important role of the quantized action (Planck quantum) in the universe as a link between macro and quantum physics is also demonstrated and confirmed by the fundamental work of e.g. Dieter Schuch. In his work Schuch points out that since Schroedinger physics has enjoyed working with quantized energy states. But actually it is the quantity of action that is quantized. It is elementary, but it has faded into the background, maybe because time plays an important role in the action (action = energy x time), but not in energy. So energy can be determined well while action due to the time factor cannot be determined directly, but only over a period. Apparently, the basic material of the dynamic world is not energy, but action.

Schuch dealt with the irreversible dynamics of systems, which are described by macroscopic equations, while the formulas of quantum mechanics describe the reversible microdynamics of isolated systems. So how does reversible microdynamics create irreversible macrodynamics?
As Schuch noted, it can only be achieved by taking into account an arrow of time in quantum mechanics. However, this could not be constructed using the standard Schrödinger equations or Hamilton functions, which are all based on the quantized energy. Instead, Schuch found out that the transition from the physical micro to the physical macro area can be achieved via action quanta and consequently requires systems interacting with the environment. Therefore equations are required that deviate from the Hamilton equations previously used. These are, for example, Ermakov and Bernoulli/Riccati equations with a corresponding invariant that has the dimensions of action [13].
This is not surprising when the Planck quantum of action has proven to be the link between general relativity and quantum physics. After that it is necessary to revise the formulas of quantum mechanics and introduce the quantization of the action more than before. An important task of quantum physics for the future is becoming apparent, just as macrophysics should also be revised with the departure from the original STR, which is no more useful in a world with a field of action quanta as an absolute reference system.

7.6. Loop quantum gravity and the matrix

Also striking is the similarity of the matrix to the LQG (loop quantum gravity), which also works with the background independence, but calculates with loops of differently quantized space-time instead of quantized action, as e.g. show the works of Lee Smolin [14]. Maybe the matrix theory can be helpful to better understand the development of the LQG and to guide it to new ideas and solutions, and vice versa.

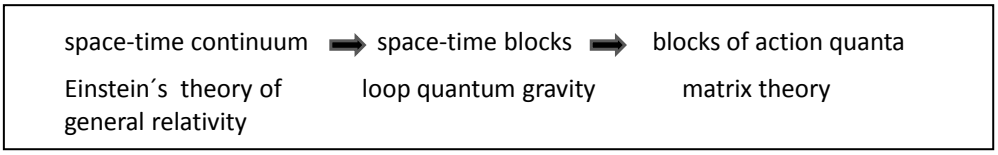

Figure 10: The development of space-time theories in physics

As shown in figure 10, a direct development from Einstein´s theories towards the LQG to the matrix theory can be observed.

7.7. The matrix theory and the dark energy

Finally the matrix theory gives opportunity for new cosmological theories and a new option to understand the dark energy. According to this matrix theory, the growth of space used as an explanation of dark energy needs to be redefined. Since everything is connected according to the background independence, the process of expanding the space does not make a sense. The cause is more likely to be a growth of the matrix of action quanta, which would not only be responsible for the expansion of the universe, but also supplies our universe with new energy and therefore matter, and in this way ensures the total energy density of our universe remains constant.

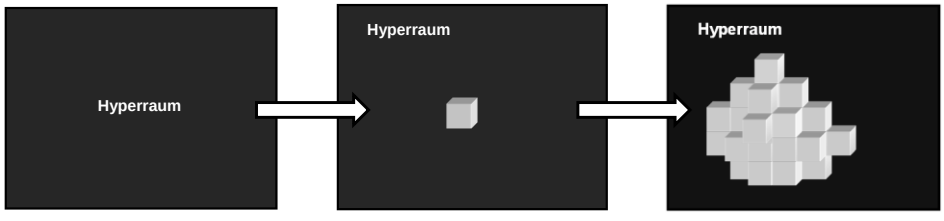

Figure 11: The process of a growing matrix of action quanta could be the cause of the dark energy.

This also corresponds more closely to the type of expansion reminiscent of a yeast cake in which the raisins spread evenly in all directions as the dough rises. Each quantum now represents a germ for the development of further quanta, which must lead to the conclusion that our universe did not have to be created by a big bang, but rather out of nothing (see figure 11).

So there are chances that the process of a growing matrix of quanta could be identical with the dark energy. And new answers become possible, especially when we realize that our universe is not a closed system, as the Noether theorem or the increase in vacuum energy in an expanding universe also suggest.

A mathematical calculation could serve as proof of the correctness of the matrix theory, so that a possibility for testing is shown here. But it seems very difficult to cope with this with the proven mathematical framework of physics, since it is not a question of a firmly calculable energy, but the process of a growing physical action (see chapter 7.5.). This is obviously a major mathematical challenge for physics.

8. Outlook

8.1. Conclusions

The solving of the different time issues has often been postponed by physics. The matrix theory with its field of quanta of action is the first theory that can provide answers to the questions about the mechanism of time and length variations and the curvature of space and the tripartite division of time into past, present and future. According to this new theory there is no temporal symmetry in macrophysics but a flow of time and via the outstanding role of the Planck quantum as the basis of General Relativity and of the Higgs field now macro and quantum physics can be meaningfully linked.
Then a new approach to explaining dark energy is now possible, since the law of conservation of energy according to the Noether theorem does not apply to our universe, since this is not temporally invariant as a result of the expansion. So according to the matrix theory our universe is not a closed system.

It is the multitude of fundamental solutions that this new matrix theory naturally provides that makes me suspect that with this theory an important new approach to understanding the world could indeed have been found. And maybe it can help to initiate new research.
Ultimately, if you summarize the development of this new theory, it is nothing more than a well-founded exchange of the space-time continuum by a matrix of quanta of action.

8.2. Predictions

There are some predictions. So it will be basically impossible to find fixed values for time, length, space or space-time quanta. The space-time is not really a continuum, it only looks like. It is a consequence of the action quanta, since times and lengths can take on different values there. A revision of the quantum field theories on the basis of the matrix of action quanta with its quantization instead of a space-time continuum could mean some progress.
Next it should be possible to calculate the dark energy according to the matrix theory to prove it. One obstacle might be that process-oriented mathematics based on action quanta is still in its infancy.
Another possibility to prove the matrix theory would be the proof of an absolute reference system in the universe, an evaluation of GPS data on this might be helpful.

8.3. Perspectives

With the introduction of an absolute reference system consisting of action quanta, it may be necessary to revise some relativistic parts of the theory of relativity for the quantum field theories. The next is that there is obviously a problem of mathematized physics with time-dependent processes. The development of process-oriented physics therefore seems to be an important task for the future.

It may be that these results are of general importance. It would therefore be important for them to be discussed further. But this cannot be done by our bureau of interdisciplinary sciences, so collaboration and support from experts for quantum mechanics, general relativity and astrophysics is required.

References:

[1] Filk, Th.; Giulini, D.; „Am Anfang war die Ewigkeit“, 2004, Beck (München) p. 144

[2] Ruffing, R.; „Kleines Lexikon wissenschaftlicher Irrtümer“, 2011, Gütersloher Verlagshaus, pp. 29

[3] Einstein, A.; Speech: „Äther und Relativitätstheorie“ in Leiden. 1920, Julius Springer (Berlin)

[4] Wilczek, Fr.; „The Persistence of Ether“, Physics Today **52**, pp. 11, 1999

[5] Laughlin, R. B.; “A Different Universe: Reinventing Physics from the Bottom Down”, Basic Books 2005 (New York), translated into german language: “Abschied von der Weltformel”, 2007, Piper (München)

[6] Pressemitteilung des CERN: „New results indicate that particle discovered at CERN is a Higgs boson.“ March 14th, 2013

[7] Harder, M.: “Einsteins Irrtümer”, ISBN 9783837011890, BoD (Norderstedt), 2007

[8] von Weizsäcker, C.F., “Zeit und Wissen”. Carl Hauser, München, Wien, p. 278ff (1992)

[9] Einstein, A.; Phy. Z. **6**, 185 (1909)

[10] Schrödinger, E.; Z. Phys. **12**, 23 (1922)

[11] Eddington, Sir A.S.; New Pathways in Science (Cambridge University Press, 1935), p. 234

[12] Wadlinger, R.L.P., Hunter, G., Kostro, L. and Schuch, D.; The Quantum of Electrostatic Action and the Quantum Hall Effect. Phys. Essays **3**, 194-197 (1990)

[13] Schuch, D.: “Quantum Theory from a Nonlinear Perspective – Riccati equations in Fundamental Physics”, 2018, Springer (Cham, Switzerland)

[14] Smolin, L.: “An Invitation to Loop Gravity”, http://arxiv.org/pdf/hep-th/0408048 (February 2008)