Information, the Human Mind, and the Three Worlds View

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1. Introduction

Naturalism and classical physics cannot explain the functions of a conscious mind. In order to solve the mind- brain problem, several philosophers and scientists have presented a variety of ideas and hypotheses.

The philosopher Thomas Nagel [1] argues for a wider world view in his book *Mind and Cosmos: Why the Materialist Neo-Darwinian Conception of Nature Is Almost Certainly False*. Other philosophers and scientists have developed concepts that involve three separate worlds. Karl Popper [2] positioned world 2 of self or mind between the physical world 1 and the world 3 of culture. A slightly different version of the three worlds view was suggested by Sir Roger Penrose [3]: 1) physical world, 2) mental world, 3) Platonic world of mathematical concepts. To this view the physicist and philosopher C.-F. v. Weizsaecker [4] added information: *"Today mankind starts to become accustomed to the fact that information has to be taken as a third thing beside matter and consciousness. This is a rediscovery of an old truth. It is the Platonic Eidos and the Aristotelic Form in new clothes so that even a man in the 20th century may learn to have some idea of it."*

Table 1 Different variants of the three worlds view

	Popper [2]	Penrose [3]/Weizsaecker [4]
World 1	Physical World	Physical World
World 2	The Self	Mental World
World 3	World of Culture	Platonic World of Mathematical Concepts/Information

In Table 1 the mentioned variants of the three worlds view are compared.

Three forms of information will be differentiated. As a first form we will discuss ideas. Creative work starts in the mind. For example: a composer is seeking a short melody as a theme for his new composition. First trials are discarded till finally he has found his theme. This whole work was done only in his mind. Nobody had ever heard the melody. Then the composer plays the new melody on the piano. Before this first playing it existed as 1) pure information in his mind. Music played represents 2) a flux of information – information as a function of time. When recorded it is transformed to 3) stored information – information as a function of space.

1.1 Scope of this article

In the current paper we will study different aspects of information in connection to ideology and the three worlds view. After an overview of quantum approaches to consciousness we will argue that the mental world is closely related to the world described by quantum physics and that a quantum world exists, which is different from the macroscopic world. The photon's eigen-world is – according to special relativity [5] – independent of time and space. Finally, a hypothetical equivalence of information flux and energy will be suggested.

2. Information and ideology

2.1 A misleading worldview may impede the progress of science

An example for a negative effect of a misleading world view is Einstein's disbelieve in results of his own theory of general relativity. His calculations predicted an expanding universe, which Einstein rejected because it contradicted the world view of an eternal and stationary universe, which was generally accepted at that time. Therefore, he added a cosmological constant to his original formula and suppressed the expansion. Later Einstein admitted that the addition of the cosmological constant was a blunder (*meine groesste Eselei*).

The naturalistic ideology seems to be too narrow to explain consciousness. But – how may a world view be widened without opening it to superstition? The answer is that we should wait for the results of experimental tests before we accept a new concept in science. If, however, a new concept appears to be not testable in principle, it should be handled with greatest care. On the other hand, if a concept does not fit into the current worldview but may be tested by experiment, the result of this experiment should be awaited before a final decision is being made.

The discussion between Einstein and Bohr about the interpretation of quantum physics is an example. For Einstein it was unthinkable that random processes should exist without deeper laws, which could explain these effects. He expressed his argument with words like: "*God does not throw dices*". Bohr's replay was: "*Do not prescribe God what to do"*. Einstein finally designed together with Podelsky and Rosen the famous EPR gedankenexperiment to prove his view. However, the experiment, performed after his death, showed that Einstein had erred.

Therefore, a wider world view should be considered as a possibility as long as at least in principle an experimental test is possible. The feasibility of such a test for the hypothetical equivalence of information flux and energy will be discussed.

2.2 Different worlds with and without limitation of information

In the physical world information is bound to limitations. The most prominent example for this is Heisenberg's uncertainty principle. It quantifies the limitation of information about a particle, which can be perceived in the macroscopic world.

Examples for the limitation of information transfer in the macroscopic world are the limited resolution of an optical imaging system and the limitation of signal transfer by the bandwidth of an electronic circuit.

The smallest length with a physical meaning is given by Planck's length. Similarly, the shortest duration of time is Planck's time. Therefore, a given length and a given duration cannot be divided ad infinitum. In contrast to this the divisibility in mathematics is unlimited. The laws of physics are expressed in continuum mathematics – information, however, is discontinuous.

Zeilinger [6] emphasized "*that all knowledge in physics has to be expressed in propositions and that therefore the most elementary system represents the truth value of one proposition, i.e., it carries just one bit of information*." To combine the discontinuous information with continuum mathematics unlimited information would be necessary which obviously is impossible for a computer. In contrast to this the human mind is able to cope with infinity. This is an indication for a fundamental difference between the macroscopic world and the world of the mind.

The mind has access to another world where information is unlimited, the Platonic world of mathematical concepts. Roger Penrose [3] wrote about this world: "*Plato made it clear that the mathematical propositions – the things that could be regarded as unassailably true – referred not to actual physical objects (like the approximate squares, triangles, circles,*

spheres, and cubes that might be constructed from marks in the sand, or from wood or stone) but to certain idealized entities. He envisaged that these ideal entities inhabited a different world, distinct from the physical world. Today, we might refer to this world as the Platonic world of mathematical forms…."

"The mathematical forms of Plato's world clearly do not have the same kind of existence as do ordinary physical objects such as tables and chairs. They do not have spatial locations; nor do they exist in time. Objective mathematical notions must be thought of as timeless entities and are not to be regarded as being conjured into existence at the moment that they are first humanly perceived."

Divisibility and limitations of information in the macroscopic world 1 and in world 3 of Popper/Penrose/Weizsaecker are compared in Table 2.

Table 2 Divisibility and information limitations in world 1 and world 3

World 1	Macroscopic World	Limited divisibility of space and time, limited information and information transfer
World 2	Quantum/mental World	Intermediary
World 3	World of ideas/mathematics /information	Independent of time and space, unlimited information

World 1 is termed "macroscopic world". In the following the macroscopic world will be distinguished from the "quantum world", which will be placed in the modified three worlds view together with the mental world as an intermediary between the macroscopic world and the world of ideas/ mathematics/information. The mental world 2 acts as an intermediary between world 1 and 3. The human mind has the capability to deal with unlimited divisibility and infinity in world 3. However, the information transmission from world 2 to world 1 is limited.

3. Information and the mind-brain problem

3.1 Quantum approaches to consciousness

Wilder Penfield [7], a pioneer of brain surgery and well known for his maps of the sensory and motor cortices of the brain, expressed a view similar to that of Thomas Nagel. In his book *The Mystery of the Mind, a Critical Study of Consciousness and the Human Brain* he wrote: "*For my own part after years of striving to explain the mind on the basis of brain-action alone, I have come to the conclusion that it is simpler (and far easier to be logical) if one adopts the hypothesis that our being does consist of two fundamental elements… If one chooses the dualistic alternative, the mind must be viewed as a basic element in itself."*

Quantum approaches to the mind-brain interaction seem to be steps towards a solution of the mind-brain problem. Among others Beck/Eccles [8], Stapp [9] and Hameroff/Penrose [10] worked on such hypotheses.

One of the main objections against a quantum approach to consciousness was the argument that quantum phenomena could not exist in a warm and wet environment like the brain. However, Gauger et al [11] demonstrated that the two phenomena entanglement and superposition are sustained in a bird's brain "*for at least tens of microseconds*".

The quantum approach of Beck and Eccles can be applied both in animals and humans. They developed the hypothesis that the probability of the release of one

transmitter molecule, the exocytosis, can be increased by a quantum physical process. Their quantum approach includes a hypothetical quantum field, the "psychon". Sir John Eccles wrote [12]: "*It can be accepted that all mammals are conscious beings with some conscious control of their actions and some conscious experiences. The dendron-psychon interaction is thus essential to their mental life.*"

In contrast to this Stapp's approach is valid only for humans. He wrote [9]: *"Orthodox quantum mechanics brings into the dynamics certain conscious choices that are not determined by the currently known laws of physics but have important causal effects in the physical world."* These *conscious choices* can obviously not be made by animals. But the mind-brain problem seems to imply quantum effects, which can be studied also in animals. Therefore, both approaches may be part of a future solution of the mind-brain problem.

In the last chapter of his book *How the Self Controls its Brain* [12] Eccles expressed his conviction that the quantum mechanical approach could fully explain the human mind-brain problem: "*The self action on the brain (neocortex) can presumably be extended by suitable experiments… to include all of our conscious experiences' even the most subtle and transcendent.*"

However, it is questionable whether the quantum mechanical approach of Beck and Eccles will lead to a full understanding of the mind-brain problem. Roger Penrose seems to agree with this question when he wrote [13]: *"I argue that the phenomenon of consciousness cannot be accommodated within the framework of present-day physical theory…Nevertheless, it is not my contention that we should look outside science for an understanding of mentality, merely that existing science has not the richness to achieve what is required."*

Penrose and Hameroff [14] stated that their hypothesis lies outside "*the framework of present-day physical theory*" – and includes "*a quantum-gravity process related to the fundamentals of spacetime geometry*."

The Stanford Encyclopedia of Philosophy [15] concludes in *Quantum Approaches to Consciousness*: "*The proposal by Penrose and Hameroff exceeds the domain of present-day quantum theory by far and is the most speculative example among those discussed.*"
The other two approaches are summarized as follows: "*The approach by Beck and Eccles is most detailed and concrete with respect to the application of standard quantum mechanics to the process of exocytosis. However, it does not solve the problem of how the activity of single synapses enters the dynamics of neural assemblies, and it leaves mental causation of quantum processes as a mere claim. Stapp's approach suggests a radically expanded ontological basis for both the mental domain and status-quo quantum theory as a theory of matter without essentially changing the formalism of quantum theory. Although related to inspiring philosophical and some psychological background, it still lacks empirical confirmation.*"

These quotations indicate that quantum physical mechanisms seem to play an important role in the mind-brain interaction but that experimental confirmation is lacking up till now and that they will most probably not explain all observations.

3.2 Brain, death and consciousness

For a deeper understanding of the mind-brain problem a wider world view than naturalism seems to be necessary. Studies of experiences during cardiac arrest lead the author to the suggestion that also the quantum approaches of Beck/Eccles and Stapp cannot fully explain consciousness.

Lommel et al [16] reported the results of a prospective study on near death experience in survivors of cardiac arrest. Three years later Lommel [17] commented: "*During cardiac arrest, the functioning of the brain and of other cells in our body stops because of anoxia… Such understanding fundamentally changes one' s opinion about death, because of the almost unavoidable conclusion that at the time of physical death consciousness will continue to be experienced…"*

Sam Parnia started a prospective study (AWAreness during REsuscitation) to test the claims of Lommel. Discussing the results of the AWARE study [18] the authors stated: "*Despite many anecdotal reports and recent studies supporting the occurrence of NDE's (near death experiences) and possible VA (visual awareness) during CA (cardiac arrest), this was the first large-scale study to investigate the frequency of awareness, …our verified case of VA suggests conscious awareness may occur beyond the first 20–30 s after CA (when some residual brain electrical activity may occur) while providing a quantifiable time period of awareness after the brain ordinarily reaches an isoelectric state"*.

Sam Parnia explained [19]: *In the AWARE study, a 57-year-old man described the perception of observing events from the top corner of the room, and continued to experience a sensation of looking down from above. He accurately described people, sounds, and activities from his resuscitation. His medical records corroborated his accounts and specifically supported his descriptions and the use of an automated external defibrillator (AED). Current AED algorithms show that this likely corresponded with up to 3 min of conscious awareness during cardiopulmonary arrest and CPR… It is thought that consciousness may be the product of either a "down-up" phenomenon, that is, consciousness or psyche (self or soul) is a by-product of brain cell activity—an epiphenomenon—arising from the coordinated activities of cerebral regions; or a "top-down" phenomenon, that is, consciousness is a separate entity that, while undiscovered by science today, is not produced by conventional brain cell activities and can itself independently modulate brain activity.*

In 2023 Parnia et al. [20] hypothesized that the dying brain removes natural inhibitory (braking) systems and that these processes, may open access to "*new dimensions of reality*".

Such a new dimension of reality seems to be the World 2, the Self or the Mental World of Popper, Penrose and Weizsaecker.

Therefore, the mind-brain problem most probably cannot be explained in the narrow frame of naturalism. Whether the quantum approaches to consciousness alone will be sufficient is questionable. The hypothesis of equivalence between energy and information flux, which are described below may also be a part of the whole picture. But at first the three worlds view in connection to three different forms of information will be discussed.

4. Different worlds and forms of information

4.1 The three worlds view and the quantum world

We have already discussed the fundamental differences of information limitations in the macroscopic world and in the world of mathematics. The study of conscious experiences, which led to quantum approaches to consciousness indicate that the mental world is closely linked to quantum physics. The observed visual awareness during cardiac arrest may – if confirmed – lead to a dualistic interpretation of the mind brain problem and thus to the acceptance of a mental world independent of the world of the brain. In the following we will discuss the possibility of a quantum world connected to the mental world but separate from the macroscopic world.

As mentioned above, Popper [3] distinguishes three worlds and explains: *"There is, first, the world that consists of physical bodies: of stones and of stars; of plants and of animals; but also of radiation, and of other forms of physical energy. I will call this physical world 'world 1'."*

"There is, secondly, the mental or psychological world, the world of our feelings of pain and of pleasure, of our thoughts, of our decisions, of our perceptions and our observations; in other words, the world of mental or psychological states or processes, or of subjective experiences. I will call it 'world 2', world 2 acts as an intermediary between world 3 and world 1."

"By world 3 I mean the world of the products of the human mind, such as languages; tales and stories and religious myths; scientific conjectures or theories, and mathematical constructions; songs and symphonies; paintings and sculptures."

Penrose [3] described his idea of consciousness (world 2) and his version of world 3 – the Platonic world of mathematical concepts – as follows: „*Recall my proposal that consciousness, in essence, is the seeing of a necessary truth; and that it may represent some kind of actual contact with Plato's world of ideal mathematical concepts. Recall that Plato's world is itself timeless*."

The similarity of mental properties to quantum effects led to the quantum approach to consciousness. Popper and Penrose placed the mental world between the Platonic and the physical world. This approach is now being extended to the suggestion that quantum effects belong to a world different from the macroscopic world and that this quantum world is closer related to the mental world than to the macroscopic world.

Henry Stapp [9] wrote about his quantum approach to consciousness: "*The proposed solution… is based on a postulated connection between effort, attention, and the quantum Zeno effect. This solution explains on the basic of quantum physics a large amount of heretofore unexplained data amassed by psychologists."*

Later Schwartz, Stapp and Beauregard added [21]: "*These orthodox quantum equations applied to human brains in the way suggested by John von Neumann, provide for a causal account of recent neuropsychological data. In this account brain behavior that appears to be caused by mental effort is actually caused by mental effort: the causal efficacy of mental effort is no illusion. Our willful choices enter neither as redundant nor epiphenomenal effects, but rather as fundamental dynamical elements that have the causal efficacy that the objective data appear to assign to them."*

However, this quantum approach to consciousness still lacks empirical confirmation. Similarly, the observations of Parnia are no final proof of extra corporal experiences. Nevertheless, both can be taken as indications toward a version of the three worlds view with the addition that the mental world is assumed to be closely related to the quantum world and that a combination of the mental and the quantum world are the intermediary world 2.

As an additional argument for this view we will discuss the following statement of Zeilinger [22]: "*The assumption that a particle possesses both position and momentum, before the measurement is made, is wrong. Our choice of measurement apparatus decides which of these quantities can become reality in the experiment.*" Adding Sapp's statement that

"*certain conscious choices that are not determined by the currently known laws of physics have important causal effects in the physical world*" we may conclude that conscious choices which are events in the mental world, cause effects in the quantum world via interaction of macroscopic devices with quantum phenomena. By this interaction information is transmitted from the quantum world into the macroscopic world. This can be taken as an argument for the following modification of the three worlds view:

World 2 acts as an intermediary between the macroscopic world 1 and world 3 of ideas/mathematics /information. The world of quantum physics belongs together with the human mind to this world 2 – however – measurements are not included in the quantum world since they are performed in the macroscopic world.

Penrose [13] emphasized the time symmetry of Schroedinger´s equation and that only the state-vector reduction is time asymmetric. He wrote: "*The construction of a fully objective theory of state-vector reduction, which is consisted with the spirit of relativity is a profound challenge…*" Later he explained together with Hameroff [14] that their aim is to describe: "*a quantum-gravity process related to the fundamentals of spacetime geometry*."

According to the modified three worlds view the state-vector reduction is the return from calculations with complex time to results in real time – the return from a theoretical investigation of world 2 to results in world 1. Since measurements are conducted in world 1 our only approach to the quantum world itself is – from this point of view – limited to the theoretical approach.

From this viewpoint the search for a unification of quantum physics and relativity would appear as a journey down a cul-de-sac. This seems to be in agreement with Robert Laughlin's book [23] *A Different Universe: Reinventing Physics from the Bottom Down.* The German version of this book has the title: *Abschied von der Weltformel (Farewell to the Theory for Everything).*

4.3 The three worlds view and different forms of information

We all know different forms of information, i.e. thoughts, spoken words to express thoughts and printed words to store the information. In the following we will discuss the connection between the three worlds view and these forms of information.

We will use an example given by Penrose [13] who quoted a letter ascribed to Mozart: "*When I feel well … or in the night when I cannot sleep, thoughts crowd into my mind as easily as you could wish…. Those, which please me I keep in my head and hum them; at least others have told me that I do so. Once I have my theme another melody comes, linking itself with the first one, in accordance with the needs of the composition as a whole… I keep expanding it, conceiving it more and more clearly until I have the entire composition finished in my head though it may be long. Then my mind seizes it as a glance of my eye a beautiful picture or a handsome youth. It does not come to me successively, with various parts worked out in detail, as they will later on, but in its entirety that my imagination lets me hear it.*"

In this letter the creation of a complete composition in the composer's mind is described. The author of this letter most probably was Mozart for it is documented that Mozart did not work on music manuscripts. He wrote the final version without any earlier written versions with corrections. Mozart first created the complete composition in his mind in a kind of

holistic form (world 3 of ideas). In this stage his composition existed as pure information and was accessible only to his mind. Then his mind (world 2) transferred it part by part into time series (*my imagination lets me hear it*) and later by humming and by writing the final manuscript he transferred his composition into the macroscopic world 1.

After the pure mental work in world 3 the *imaginative hearing* can be interpreted as a transformation of pure information in world 3 into a flux of information in world 2. Later by humming some parts the information was transformed into a flux of information in world 1. Finally, by writing the music down, after having "*the entire composition finished in my head though it may be long*" – he transformed the pure information into stored information on paper. In this example three types of information are distinguished as shown in Table 4.

Table 4 Different forms of information

Pure Information	Information independent of time, space and physical information carriers
Dynamic Information	Information as a function of time or change of information per time in a system
Static Information	Information stored as a function of space (on paper, CD, memory chip, brain, DNA...)

In Table 5 the connection of these forms of information to the three worlds are demonstrated.

Table 5 Different forms of information in the three worlds

World 3	Pure Information
World 2	Pure Information, Dynamic Information
World 1	Dynamic Information, Static Information

In our example the dynamic information is the intermediary form of information between pure information in world 3 and static information stored in the macroscopic world 1.

Static information can be transformed into dynamic information, for example by transmitting a stored signal electronically. This process occurs in world 1 and is subjected to a limitation of signal transfer by the bandwidth of electronic circuits.

4.4 World 3 includes the eigen-world of light

Wheeler [24] explained: *When a photon is absorbed, and thereby "measured" – until its absorption, it had no true reality – an unsplittable bit of information is added to what we know about the world.*

Zeilinger [7] added "*The assumption that a particle* (e.g. a photon) *possesses both position and momentum, before the measurement is made, is wrong. Our choice of measurement apparatus decides which of these quantities can become reality in the experiment.*"

Until absorption a photon has no true reality in our macroscopic world – it is neither a particle nor a wave – but through absorption it appears in our world either as particle or as wave. However, what is a photon before it is absorbed in the physical world? What is the "eigen-world" of the photon?

The Lorentz-Transformations [5] for time dilatation and length contraction are:

Time dilatation: $\Delta t = \Delta t_{rest} / (1-v^2/c^2)^{1/2}$
Length contraction: $\Delta r = \Delta r_{rest} (1-v^2/c^2)^{1/2}$

Since the velocity v of the photon is c, Δt becomes infinite and Δr zero. Therefore, light in its eigen-world is independent of time and space.

What is a photon in its eigen-world? Before its absorption in our world it is in its eigen-world an "unsplittable" unit of information. We may, therefore, describe the photon as the elementary unit of pure information i_1 = 1 bit, independent not only of time and space but also independent of a carrier. The existence of the eigen-world of the photon is evidence for the existence of Penrose's world 3.

5. Information transfer from a photon to our world

5.1 Information-theoretic interpretation of Planck's photon formula

In the following an information-theoretic interpretation of Planck's formula will be deduced for the energy E of a photon which equals the frequency v times Planck's constant h: E = h v.

The deduction follows a gedankenexperiment by Brukner and Zeilinger [25] from which they concluded, "*that a single particle in Young's experiment is just the representative of one bit of information* – and ...*that the most basic notion of quantum mechanics is information.* "

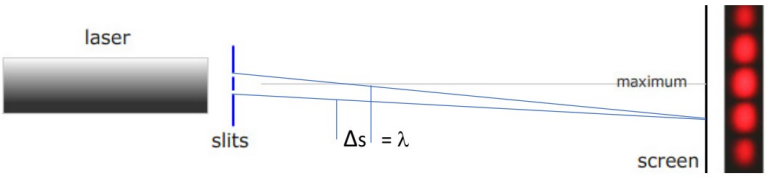
Young's experiment can be interpreted as follows: The transmission of the information 1 bit from the eigen-world of the photon to the detector is the elementary flux of information i_1=1bit/Δt. For the formulation of a quantitative hypothesis the time span Δt of this information transmission has to be determined

For this purpose, the gedankenexperiment of Brukner and Zeilinger [25] is modified with energy and time as observables instead of path and interference. Analogue to their approach the continuous energy observable has to be replaced by a dichotomic one. This can be achieved by using a light source with the a priori information that its frequency can be either v/2 or v and with low intensity so that the emission of single photons can be observed. For the frequency determination the classic double slit set up is being used with a photo detector positioned behind the slits so that the distances from the two slits differ by one wave length λ. If a photon reaches this location it can only have the energy E = h v since no photon with the frequency v/2 can reach this point.

The experimental system of this gedankenexperiment consists of the double slit, the photo detector in a special location and one photon representing the information 1 bit. In order to read the photon's information its presence at the detector has to be measured. This detection process is identical with the absorption of the photon. Therefore, the absorption of the photon can be interpreted as the transmission of 1bit information from the photon in its eigen-world to the photo detector in our world.

Thought experiment with Young's experiment:

Light source emitting at random the frequencies ν or ν/2
intensity low so that emission
of single photons can be observed.



Frequency determination:
Photodetector in the location with maximal intensity
for light with path difference λ

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5.2 Information transfer from the world of the photon to the macroscopic world. According to special relativity time does not flow in the world of the photon and space is shrunk to zero. Therefore, from this point of view the information transfer from the photon to the detector takes no time. This viewpoint has to be distinguished from the viewpoint of the interaction of the photon in its eigen-world with the macroscopic world which starts at the double slit. At the double slit the photon appears as a wave. The travelling time between the double slit and the detector is indefinite but the energy is determined by the special location of the detector. The duration of the absorption is $\Delta t = \lambda/c$. Thus, the information transfer from the photon in its eigen-world to the detector in our world is determined and the elementary flux of information has been quantified to be $i_1 = 1\text{bit } c/\lambda$.

Therefore, Planck's formula for the energy of a photon $E = h\nu$ can be interpreted as Planck's constant h multiplied by the elementary information flux i_1: $E = h\, i_1$.

5.3 Energy hypothesis for a complex information flux

For the transmission of a complex signal with the information n bit the information flux I becomes $I = n\, i_1$. If the transmission is carried out in a given time interval Δt the time interval for the individual bit becomes $\Delta t/n$ and the information flux is $I = n\, i_1/\Delta t$.

The above described gedankenexperiment consists of a double slit, a photo detector and 1 bit of information in the form of a photon. The absorption of the photon or the decrease of 1 bit of information causes an increase of energy at the detector. Therefore, an increase of information in a system will be equivalent to a negative energy: $-E = I\, h$.

These considerations lead to the hypothesis of a generalized energy conservation law: The sum of the energy E plus a relativistic term, $m\, c^2$ plus a new quantum-physical term, I h is constant: $E + m\, c^2 + I\, h = \text{constant}$.

A flux of complex information may be created by playing back stored information or by transforming pure information into a flux of information. The spoken word of God is an example for the latter. In creation God transformed his eternal plan/word (Greek logos) into the spoken word (Greek rhema, see my article: "Information in the Bible and in Science").

This spoken word is used for the *word of his power* by which God upholds all things (letter to the Hebrews 1,3). This Bible word led me to the idea that the dark energy suggested by

astronomers to explain the accelerated expansion of the universe may be this *word of his power*.

The unidirectional time flow in our world is one of the great problems of physics today. Penrose [11] explained that a fine tuning of $1/e^{10123}$ is necessary to explain this time flow. This fine tuning corresponds to an information of about 10^{123} bit. We will estimate the resulting energy according to the above described hypothesis, when this huge information is flowing through the universe. The longest duration for this information flow is the age of the universe. Planck´s constant multiplied with the information 10^{123} bit and divided by nearly 14 billion years is the resulting negative ("dark") energy. Divided by the volume of the observable universe we get for the resulting energy density approximately 10^{-15} Joule/cm^3, which match the astronomical observations. A negative energy density acts as a pressure which is thought to cause the accelerated expansion of the universe.

5.4 Feasibility of an experimental test of the hypothesis

An experimental model of negative („dark") energy seems to be possible by measuring the repulsive force F between two glass fibers through which the information flux I_{flux} = 20 Tbit/s is flowing [26]. This force F is F = (E/d) n, with E = I_{flux}h the energy equivalent of the information flux and n the number of bit in a fiber with the length l = 1 m and the diameter d = 10^{-6} m. With these Parameters the expected force would be **F = 1.3 nN.**

A force measuring instrument was developed by PTB (Physikalisch Technische Bundesanstalt) [27] with a measuring range 0.1 pN ≤ Fm <10 µN and the uncertainty of 10^{-3} at 1 nN.

An experimental test of the hypothetical equivalence between energy and information flux is necessary as a next step on the way which could lead to a better understanding of consciousness as well as to a quantitative theory of information in Physics. Shannon´s [28] theory only deals with the transmission of information.

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