Do Space and Time have an Archetypal Design?

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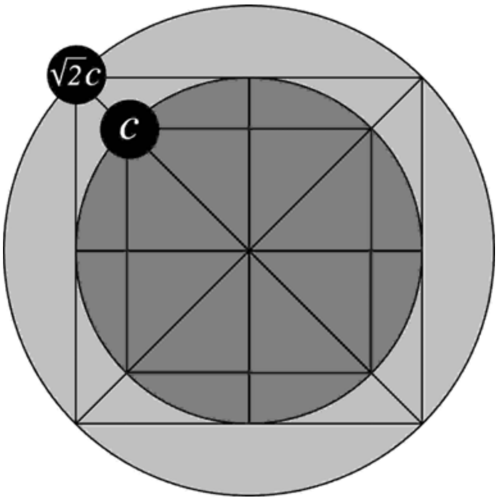


"The link between random presentation of experimental data and a theory (which organises and explains them) arises from primordial images present at the root of being. These primordial images cannot be formulated in conscious fashion, nor associated with ideas presenting a rational order. They are images with a deep emotional content. They are no thoughts but visions. .. The pleasure felt in realising that one has reached a new level of knowledge stems from the fact that these pre-existing images are in perfect harmony with the behaviour of material objects."

Wolfgang Pauli

Abstract: The physicist Wolfgang Pauli (1900-58), one of the founder of quantum mechanics, was highly fascinated of Jung's archetypes. He conceived them as the underlying principles of the physical world. He even suggested a research program in order to explore the physical meaning of these archetypes. But this research program never became reality. This article gives an example how this research program could look like. It refers to a structure consisting of different circles and squares that are put together in a specific way; a structure, which is traditionally called a *Mandala.* By making Einstein's special theory of relativity geometrically compatible with an *invisible entity* , which can be considered as a kind of "Meta-Ether", this archetypal structure surprisingly came up. As its speed limit is given by the speed of infinity, it includes the possibility to overcome special relativity theory (SRT).

Introduction

Wolfgang Pauli (1900-58) was probably the most colorful personality among the founders of modern theoretical physics. 1921 he published his first scientific paper within two months of leaving high school. By the age of twenty he had written a 200-page article on the theory of relativity that was praised by Einstein in the following words, 'no one studying this mature, grandly conceived work could believe the author is a man of 21. One wonders what to admire most ...the psychological understanding of the development of ideas, sureness of mathematical deduction, profound physical insight, capacity of presentation.'

Only three years later he discovered the *Exclusion Principle*, for which he was awarded the Nobel prize in 1945. It explains why there is structure in the universe. Electrons, protons and other particles called fermions are governed in such a way, that they cannot all be in the same quantum state. This restriction gives rise to the differentiation of the material world into the various chemical elements.

And finally he predicted the existence of the neutrino in 1930, twenty-five years before it was discovered experimentally.

But there was also a hidden side of Wolfgang Pauli: He was deeply interested in depth psychology, which culminated in a long exchange of letters with C. G. Jung from 1932 to 1958.

Jung had proposed the existence of a psychological dimension, which he called the 'collective unconscious'. This dimension was not only the place of instincts and other autonomous driving forces archetypes belonged to it as well. According to Jung archetypes were universal dispositions, common to all mankind. He considered them as objective, prior to individual experience, and acting as a source of imagination and creative work.

Pauli was highly fascinated of Jung's archetypes. Actually he conceived them as the underlying principles of the physical world. He even suggested a research program in order to explore the physical meaning of these archetypes. But this research program never became reality.

This article tries to show that the systematic exploration of archetypes like the Mandala could be in fact the most meaningful research program of the physics of 21st century.

The Problem: Can SRT Possibly Be Incomplete?

SRT imposed a locality constraint on physical theories: since nothing can go faster than light, very distant events cannot influence one another. In the last few decades it has become clear that quantum theory violates this constraint. It predicted non-local correlations of the quantum states of two or more objects that are spatially separated. This prediction is known as *quantum entanglement*. It has in fact been observed.

The physicist John Bell who made this prediction possible, said, that this experiment proved Einstein wrong. Just this phenomenon of quantum entanglement was one of the properties of quantum mechanics which caused Einstein and others to dislike the theory. In 1935 Einstein and two colleagues of him - B. Podolsky and N. Rosen - published the scientific paper: *Can quantum-mechanical description be considered complete?* [1]

It became known as the *EPR paradox.* It refers to a quantum-mechanical thought experiment with an apparently non-local outcome. Einstein famously described it as 'spooky action-at-a-distance'.

Against the epistemological position of Niels Bohr and others Einstein claimed obstinately that quantum theory predicting such non-local correlations has to be incomplete. Therefore he stated the existence of *hidden local variables* hoping that quantum entanglement could be explained as a purely local phenomenon.

For more then thirty years Einstein's position could not be shaken. In 1964 John Bell formulated a theorem, by which quantum entanglement was experimentally distinguishable from such local hidden-variable theories. Later measurements made clear, spooky action at a distance took really places.

In spite of these measurements, SRT works still perfectly as far as the experimental predictions are concerned. No failure so far is recognizable.

Thus we are confronted with two highly successful theories, but between these two theories there exists an unsolved conceptual tension: They seem to base upon two very different 'pictures' of the universe. Briefly: a local and a non-local picture.

In order to reconcile these two pictures many physicists are looking for new theoretical approaches. These attempts are the frontier of modern physics and, certainly, the most fascinating aspect of it, because they touch deep unanswered philosophical questions about the fundamental nature of our universe.

In this paper a non-local 'space-time-picture' is presented, that allows to reconcile quantum theory and special relativity in an unexpected way. Actually this picture is of archetypal design: It is a *Mandala*. It consists of different circles and squares which are put together in a specific way. A Mandala is a well known archetype of universal character. Although it is distinguished by symmetry and beauty, to accept it as physically relevant that could be a challenge of relativistic thinking.

In the following chapter it is shown how the search for *a transcendent entity*, which is in traditional metaphysics called the ONE, led to the discovery of this archetypal structure of the Mandala.

Did God Have Any Choice in the Creation of the Universe?

In the late 19th century the existence of a hypothetical medium believed to be necessary to support the propagation of electromagnetic radiation, called the *ether*, was assumed. Already a few years later - in the beginning of the 20th Century - the existence of such an ether was doubted. A series of increasingly precise experiments had been carried out to prove its existence, but it could not be detected. All experiments failed. The ether remained *invisible*. Physicists tried to explain this strange conspiracy of nature but all these explanations tended to use arbitrary-looking assumptions. Only when Albert Einstein published his paper *On the Electrodynamics of Moving Bodies* (1905) this puzzle of nature could be solved. But nevertheless for many physicists his solution was hard to accept because he made the ether completely meaningless. Instead of that he presented a new space-time-theory without *any* reference to an ether: the SRT.

Although Einstein had to propose some very radical assumptions, f.e. the relativity of time, SRT became inseparable part of modern physics. And indeed all observations that have been made in the last hundred years were in perfect accord with this theory. Thus the majority of contemporary physicists hold that there is no need to suggest the existence of an ether. Nevertheless a small number of physicists continued research on the ether believing that the SRT is not the final answer in this issue.

In this paper a new ether-approach is attempted. It differs considerably from other approaches: It bases upon the assumption, that the ether is really *invisible*. Although such an ether may appear as a physically unfruitful hypothesis it explains in the most direct and simple way the reason why the ether remained so persistent unobservable.

Nowadays *the property of invisibility* is still evaluated as a dark and unclear concept. As long as we are fixed to this term *itself*, this impression is right, because something, which is really *invisible*, cannot be an object of any experimental test, but if we turn around our perspective looking at the visible Universe we will discover that invisibility is *a highly restrictive physical condition*. Curiously this insight becomes most clear if we follow Einstein's way of thinking. Often Einstein asked himself: Did God have any choice in the creation of the universe? By following this way of reasoning he hoped to understand whether God would arrange the universe in such a way or not. To Ernst Strauss, who was an assistant of Einstein, he said: "What really interests me is whether God could have created the world differently; in other words, whether the demand for logical simplicity leaves any freedom at all."

If we substitute the demand for logical simplicity by *the demand for invisibility*, the conclusion is near at hand, that an ether which is characterised by this specific property might also leave very little or even no freedom in the creation of the Universe. If such an ether shall exist, then the Universe has evidently to satisfy very specific conditions. In general it has to be organised in such a way that the ether cannot in principle be observed. Thus a Universe *with an invisible foundation* must have unavoidably a somehow »conspirational« structure. If we are able to precise this structure in physical terms then we can experimentally test whether our Universe does have such a structure or not. By doing this we will – at least *indirectly* - know whether the ether exist or not.

But how does this assumed conspirational structure look like? This was the essential question that had to be answered. In order to unveil it the first step that had to be done was: How could invisibility translated into a precise physical demand?

It was found that a Universe with an invisible ether had to satisfy a *very specific boundary condition*: Actually its limiting speed had to be formalized by the value of $v = \infty$.[2]

To give this special boundary condition a physical foundation *the relativistic structure of the Universe was presumed of being integral part of this conspirational structure.* As SRT was a very successful theory no other assumption seemed to be convincing. To trace the conspirational structure an extension of the relativistic space-time-picture (*i.e.* the Minkowski-diagram) to the required limiting speed of $V \to \infty$ was suggested.

Since all known physical arguments were contradictory to this suggestion, the question arose: To which point of speed could the relativistic 'space-time-picture' be extended *without violating logic*? Was there such a point at all? Such a point could actually be found: It got visible shortly *before SRT was born*.

We are well informed about the circumstances of the birth of special relativity. In a talk given by Einstein himself in Kyoto, in December 1922, he told about this period intensively. He remembered that it was a very beautiful day. He visited his friend and colleague M.

Besso and began to discuss the physical problem that later on led to his theory. This problem was the conflict between the recently measured invariance of light and the traditional Newtonian rule of addition of velocity, which had worked well for more than two hundred years. Suddenly Einstein comprehended this matter and went out. The next day he visited his friend again and said to him without greeting: "Thank you. I've completely solved the problem."[3]

What did Einstein comprehend?

Actually he saw that the time could not be absolute, if the speed of light was really invariant. Perceiving this contradiction was in fact the key to the development of SRT: Einstein saw clearly, that the only way, by which this contradiction could be solved, was making time to a *relative* concept. As the absolute time was a very deep rooting concept in physical thinking, this insight was really revolutionary. It is essentially the perception of this specific problem that smoothed the way to SRT.

According to his talk in Kyoto Einstein wasted almost a year in fruitless considerations, before he perceived this special contradiction as the essential problem that had to be solved. But after seeing it he could solve the foregoing extraordinary difficulty thoroughly. Already five weeks after his recognition, the theory of special relativity was completed.

As in the last one hundred years Einstein's theory was very successful, nowadays this essential problem (*i.e.* the contradiction between absolute time and the invariance of light) and the solution (*i.e.* SRT) are mixed together. We do not distinguish both, because we implicitly think, that Einstein's theory is already *the final solution of this problem*. Therefore this problem was never formulated *in a precise* *and strict way*. If we do that, we make a surprising discovery: We suddenly see that SRT is everything but not an elegant solution. Actually Einstein made time *more relative* than it was really necessary.

In order to get this insight, the only thing we have to do is to define the absoluteness of time precisely. If we like to define time physically in an absolute way the existence of infinite fast signals are needed. Only by such a procedure we can give absolute time a physically serious basis. Thus if we like to make time (ontologically) to a *relative* concept, the only speed that we have to exclude is just the existence of infinite fast signals. Already by the exclusion of the speed of $V = \infty$ time looses its absolute character. And already this exclusion gives us – *at least from a logical point of view* - the possibility to solve the contradiction between the absoluteness of time and the invariance of light.

This very insight suggested that the relativistic space-time could actually be extended to the speed of $V \rightarrow \infty$. And more than that: It indicated that a space-time-structure »framed« by this limiting speed would be a far more elegant solution of that problem which led Einstein to his theory.

In order to solve the contradiction between the invariance of light the absoluteness of time, Einstein excluded all superluminal velocities from c until ∞. In other words: He acted in a much less elegant way.

This rough action was criticised right from the beginning when SRT came up. Hendrik Antoon Lorentz stated in a course of lectures given at the Teyler Foundation in Haarlem in 1913: "It should be noted that the daring assertion that one can never observe velocities larger than the velocity of light contains a hypothetical restriction of what is accessible to us, [a restriction] which cannot be accepted without some reservation.” [4]

And Lorentz′ statement had some weight: He was a leader in theoretical physics who fully grasped all the physical and mathematical aspects of the special theory of relativity. And his critique had nothing to do with personality conflicts. Those were alien to him. Einstein and Poincaré always spoke in praise of him.

How rough Einstein’s step really is, that becomes obvious, if we follow his own already mentioned metaphysical way of thinking: If we compare both »solutions« with respect of making time relative, the relativistic one and the »logical« one, then we can see, in Einstein’s universe God would have had such a choice. Only in a Universe, in which *all possibilities,* that logic allows, are realized, God wouldn’t have such a choice. And such a Universe requires seemingly only the exclusion of infinite fast signals. No other superluminal signal has to be excluded.

If such a solution would exist, it would unavoidably appeare far more elegant than Einstein’s solution of 1905 in which a whole section of physical possibilities (all superluminal signals) was cut off.

This insight was a milestone in the search for the conspirational structure. Finally this search ran into the archetypal structure of the Mandala. The details of this searching process are not discussed here.[5] What really counts, is to see clearly *the conceptual point* why this archetypal structure is such an elegant solution.

The physical elegance of the Mandala

To see the physical elegance of the archetypal structure of a Mandala it is necessary to remember that the relativistic 'space-time-picture' – the Minkowski-Diagram (Diagram No. 1) has physically excluded all superluminal speeds including the speed of $V \rightarrow \infty$. In the following diagram the excluded space-time-section, often called as 'every-where', is black coloured.

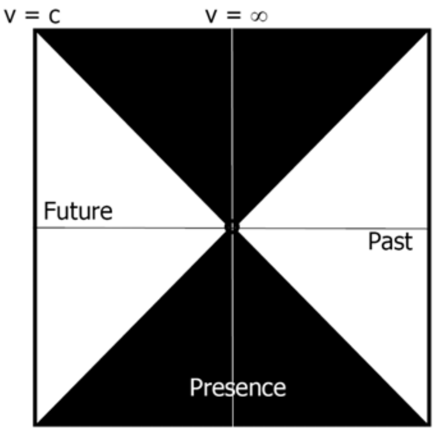


Diagram No. 1

At the first sight the structure of the Mandala looks very similar to Einstein's picture of the universe as far as the excluded space-time-section is concerned, but it is actually much less restrictive as the relativistic one. In the following diagram the 'space-time-picture' of the Mandala is presented.

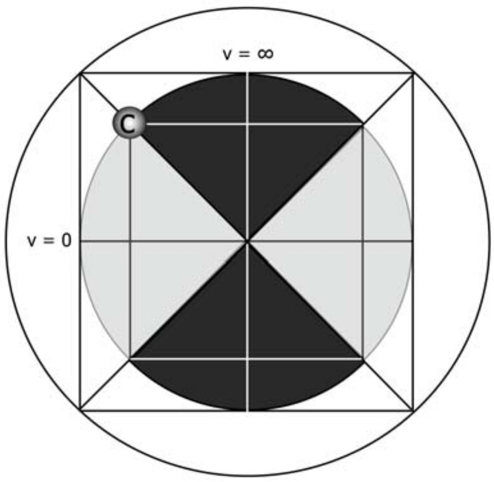


Diagram No. 2

If you compare the excluded (black) sections of both pictures, as it is shown in the following diagram No. 3, you can see: They are slightly different. The structure of the Mandala includes »somehow« superluminal speeds - SRT does not.

But there is a point, which is even much more important: If you go closer to the archetypal structure, you can see, that in the corresponding space-time-picture only one speed is *definitely* excluded: it is just the value of $v = \infty$, whereas all other superluminal speeds are only excluded *in parts*.

This formal speciality indicates that the archetypal space-time-picture of the Universe could be a or even *the* elegant solution of the contradiction between absolute time and the invariance of light: *In a Universe organised like a Mandala God would have no choice since all possibilities that logic allows would be realised.*

If our Universe would base upon such an archetypal structure this fact would have far-reaching consequences touching nearly all fields of human existence. It would change our view of the Universe as well as our view of man dramatically. It would bring a completely new tone into the dialogue of science and religion.

As this paper concerns only physical considerations one of the physical consequences is briefly described. It could be regarded as its most interesting »spin-off«: It is the possibility to travel faster than the speed of light. Although this possibility is not yet verified neither physically nor mathematically, it illustrates the great scientific potential of this archetypal structure.

Are Superluminal Travels a Future Application Case for the 'Physics of Mandala'?

In spite of the fact that the space-time-picture of the Mandala includes a superluminal space-time-section, this section cannot be reached by accelerating our spaceships beyond the speed of light – and it is the same cause as in Einstein's theory: If an object got to the speed of light, the greater the object's mass became. And the greater an object's mass was, the harder it was to accelerate the object to a yet higher speed. It required actually an infinite amount of rocket fuel to accelerate a spaceship up to the speed of light. According to this aspect the 'Physics of Mandala' makes at least *qualitatively* the same prediction as Einstein's theory.

A long time it was completely unclear whether the superluminal section could be reached or not. Finally the history of the discovery of antimatter shed some new light on this issue.

In 1930 the British physicist Paul Dirac developed the first description of the electron that was consistent with both quantum mechanics and special relativity. He formulated a very beautiful equation. But this equation had remarkably *two solutions*, but only one class of particles (*i.e.* the electrons) was known. According to his equation there should exist another class of particles with the same mass as the electron, but opposite electric charge and magnetic moment. Despite the fact that such particles were still unknown Dirac had confidence in the beauty of his equation and so he postulated the existence of a completely new class of particles, *i.e.* positive electrons. Already two years later Carl Anderson should observe such particles: He examined tracks produced by cosmic rays in a cloud chamber. One particle made a track like an electron, but the curvature of its path in the magnetic field showed that it was positively charged. The positive electron or briefly: the positron was found.

If you look deeply *into* the structure of the Mandala you can see *two solutions* as well: the traditional relativistic function and a second function located *in an orthogonal direction.* See following diagram:

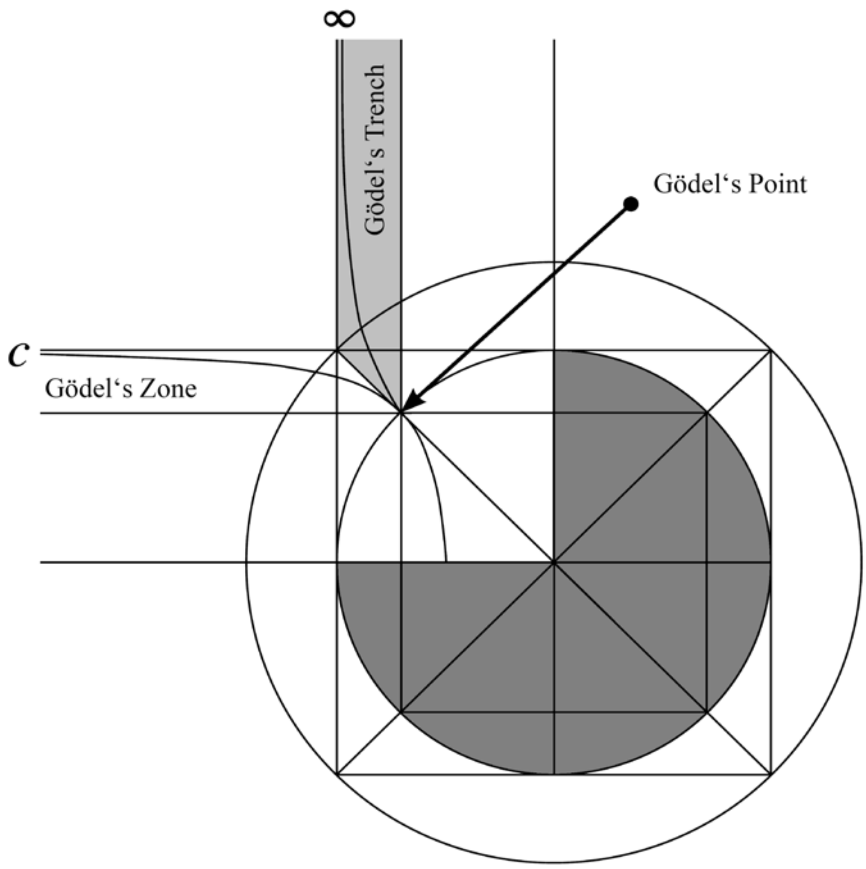


Diagram No. 3

The known relativistic function is limited by the speed of light. But the function which goes up extends the spectrum of possible speeds tremendously, since its speed limit is the velocity of $v = \infty$. Therefore this space-time-section encloses naturally *all superluminal velocities*. This zone I am calling 'Gödel's Trench'.[6]

But the real interesting point lies somewhere else: It is the fact, that both functions seems to touch each other at a point of speed, *which is* *lower than the speed of light*. Its value is: 0.707 … c or exactly: $c/\sqrt{2}$. Referring to a scientific paper of the mathematician Kurt Gödel, I call this point: 'Gödel's Point'.[7] Just this condition gives us, as conceived by me, the hope to reach superluminal velocities.

Of course in order to verify this possibility, further investigations are needed. Previous investigations have already shown that the structure of the Mandala has to be 'read' in a specific way.

How to 'Read' the Structure of the Mandala Physically

The structure of mandala as it is pictured in Diagram No. 2 represents probably a non-local space-time-continuum, since it allows *almost* instantaneous actions or, as Einstein coined it, spooky actions at a distance. But how do we have to read this archetypal structure? It is claimed that its inner circle is related to the concept of time - and the outer square is related to the concept of space. The whole structure is parametrized by ***the speed of*** $\boldsymbol{\sqrt{2}\,c}$ [8].

If we follow this interpretation and compare it with SRT then we do have a space-time in which space and time are also »mixed« but in an apparently different way. To perceive this difference clearly the well known work of the physicist L. C. Epstein is a very useful tool, because it 'calibrates' SRT in an advantageous way. [9]

In 1981 the physicist Lewis Carroll Epstein published the book **Relativity Visualized**. It included a new perspective how SRT could be 'read'. Mainly it was celebrated as an introduction for the popular reader, since it made understandable the weird consequences of Einstein's theory.

The centerpiece of this new perspective of SRT is the idea that there is in fact only *one* speed: the speed of light. *Everything is always moving at the speed of light*.[10]

At the first sight this idea may sound even stranger than SRT in its traditional form. But it demystifies Einstein's theory thoroughly: It makes transparent how close space and time are 'mixed' within the relativistic context. By uncovering this feature of special relativity the strange relativistic effects like time-dilatation and length-contraction that defy usually our ordinary intuition and the rules of Newtonian Mechanics become less strange.

L.C. Epstein has translated this unusual idea into a special diagram which he called technically the *space-proper-time diagram*.[11] Since nothing can be done to alter the speed of anything only *its direction of motion* through spacetime can be altered. And by changing our velocity – Epstein is talking of it as 'intermediate velocity' - we change our direction through spacetime and by changing our direction the relationship between space and time changes, too.

The connection between all these changes can conceptually be described as follows: If you compel a clock to run through space, it is able to do so only by diverting some of the speed (of light) it should use for traveling through time. As it travels through space faster and faster, it diverts more and more speed. The most extreme case is given by the velocity of light: If a clock is going through space as fast as it possibly can, then there is nothing left for traveling through space. The clock stops ticking. It stops aging.

In the following diagram you can see a special case, in which this description is summarized:

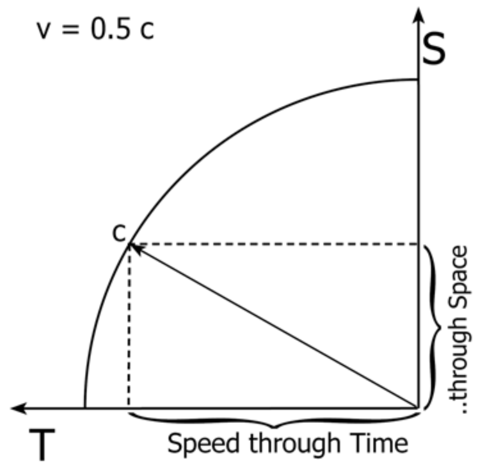


Diagram No. 4

The intermediate velocity of the depicted object is 0.5 c. As it is moving through space with this velocity of 0.5 c, its speed through time is reduced accordingly. Actually it ages 0.75 of a year of time. The connection between space and time in Epstein's diagram is guided by the simple equation: $x^2 + y^2 = 1$, whereas the speed of light is defined by the setting: $c = 1$.[12]

To show the relevance of Epstein's interpretation of SRT as far as the physical 'reading' of the structure of the Mandala is concerned it is helpful to apply it to the space-time-picture connected with 'Gödel's point' at the velocity of $c/\sqrt{2}$.

Following picture arose:

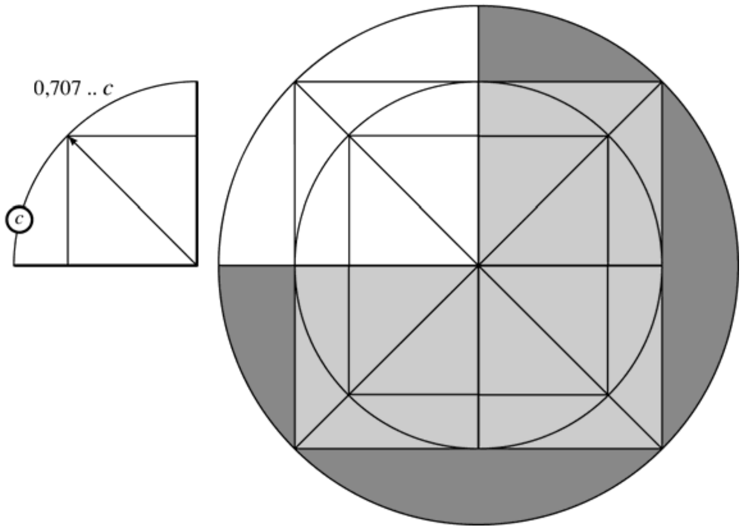


Diagram No. 5

This picture is easily recognizable as a natural part of the structure of the Mandala.

Such insights recommended Epstein's interpretation of SRT as a powerful tool in order to explore the physical meaning of the structure of the Mandala. And in fact by using this tool systematically a surprising insight came up: Like SRT the space-time of a 'Physics of Mandala' seemed to have a Lorentz invariant structure but its *interpretation* differed dramatically from Einstein's theory.

Is the relativistic reading of the Lorentz-Invariance correct?

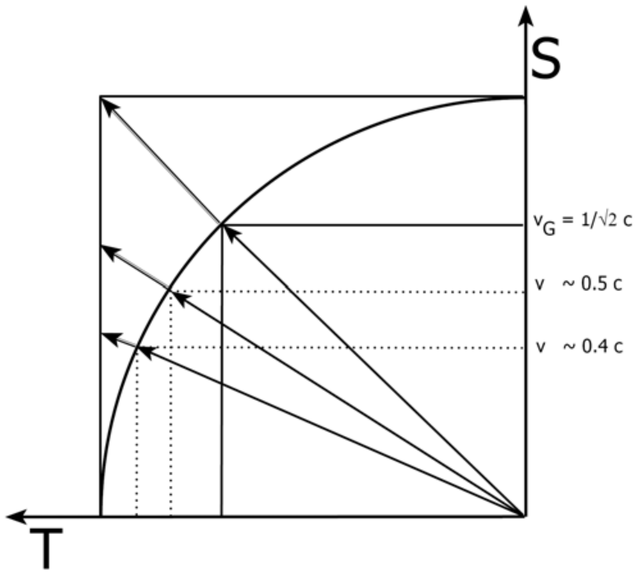
In modern physics, Lorentz Invariance is a key property of the relativistic spacetime. If a physical quantity remains the same under

Lorentz transformations, then it is said to be Lorentz invariant. The corresponding key quantity is called the *Lorentz factor* γ.

$$\gamma = \frac{1}{\sqrt{1 - v^2/c^2}},$$

In SRT this factor is considered of being *fundamental*: It has to apply to *all* physical phenomena. It describes how space and time are »mixed« *depending on the velocity*. If we look at the structure of the Mandala, we can 'read' its main geometrical components like the *inner circle* (time) and the *outer square* (space) in a way, that this Lorentz factor γ *equally* appears. In the following diagram No. 6 three examples of this 'Mandala-Reading' are given. They will make clear what is meant.

Diagram No. 6



If we use SRT putting f.e. the speed of c/√2 (i.e. Gödel's Point) into the above mentioned formula then we will get the value of γ = √2. Now let us consider the structure of the Mandala. In this structure the speed of c/√2 (or ~ 0.707 c) is placed *at the angle of 45° if Epstein's geometrical language is applied*. If we look at the ratio between the corresponding *vector of the outer square* and the *vector of the inner circle* just at this specific angle we can immediately see: We get exactly the same value like in SRT: $\gamma_M = \sqrt{2}$, if c = 1.

This lorentzinvariant structure of the Mandala could make understandable, why special relativity is physically working so well. Many alternative models, which like to go beyond special relativity, have a problem in explaining why the universe »conspires« in such a way that it looks extremely relativistic.

Although the space-time-picture of the 'Physics of Mandala' is of lorentzinvariant character, like special relativity, there is a tremendous difference. In special relativity the speed of light is the ultimate speed of the whole universe whereas in the Physics of Mandala the speed of $v = \infty$ takes this position.

Just this difference leads to a less restricted space-time-structure as it is expressed by the geometrical structure of the Mandala. As the limiting speed of this structure is given by the value of $v = \infty$ it represents a special kind of a *non-local* space-time-picture. It appears therefore reasonable to suppose that non-local effects like quantum entanglement do have counterparts in the context of space and time, too. It would be incomprehensible that nature acts differently if we change only our theoretical 'glasses'. If nature does have fundamentally a non-local design it should be visible in the behaviour of quantum mechanical systems as well as in the behaviour of light moving through space and time. In the past we could not grasp this unity of behaviour because we didn't have an appropriate space-time-theory in order to predict how non-locality does affect space and time. Special relativity spoke a strictly local 'dialect'.

How this effect could look like is discussed in my German book “Die Linien des Alten – Einsteins letzte Vision” (The Lines of the Old One – Einsteins last vision). [13]

Final remarks

Although a ‘Physics of Mandala’ as it is discussed in this popular overview consists only of a loose collection of some speculative ideas the structure behind satisfies all qualities that physicists like: it is beautiful and it is highly symmetrical. Therefore it is hard to believe that nature does not follow it.

Actually it would be not the first time that these qualities of the Mandala has touched modern physics. In the case of Karl Alex Mueller, who has won – together with J. Bednorz - the Nobel price in 1987, a major motivation was his feeling that the highly symmetrical crystal stucture that proved essential to the discovery of high-temperature superconductivity had the affective power of a Mandala. Mueller later chose the Dharmaraja Mandala to illustrate his source of inspiration; a Mandala whose basic geometrical design is exactly the same like the Mandala, presented in this paper.[14]

Therefore I am convinced that the exploration of this special archetypal structure will bring us a completely new outlook to the Universe, especially about the nature of space and time. As the Chapter “Is the relativistic reading of the Lorentz Invariance correct?” has already shown a ‘Physics of Mandala’ would lead us to a space-time-picture that differs essentially from the relativistic one. Although the Lorentz Invariance is embodied in both pictures, in a ‘Physics of Mandala’ time does have a less relative character. It is not ultimately limited by the speed of light. Only limited by an infinite speed it appears *almost* as absolute.

It think it is just this restoration of an almost absolute time by a 'Physics of Mandala' that will enable us to solve a problem, which worried the late Einstein seriously. It was the presence, or the *Now* as Einstein called it. In his 'Intellectual Autobiography' the philosopher Rudolf Carnap has reported about a conversation with Einstein in 1954. In this conversation Einstein declared that he was painfully worried about the fact that the psychological experience of the Now meant something special for man, something essentially different from the past and the future, but that this important difference did not occur within physics. [15] Opposite to his SRT a 'Physics of Mandala' is very close to this moment of the Now; maybe it is close enough in order to understand how Nature has realized it physically.

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[1] Phys. Rev., 47, 1935, pp. 777 - 780

[2] Hansen, Helmut, "About an Anomaly that challenges Relativity", Proceedings of the 15th Natural Philosophy Alliance, April 7 – 11, 2008 at the University of New Mexico, Albuquerque; Vol. 5, No. 1, pp. 73 – 84 (2008)
The paper can be downloaded; see:
http://www.worldnpa.org/pdf/abstracts/abstracts_21.pdf

[3] see: *"Subtle is the Lord…"*, The Science and the Life of Albert Einstein, Abraham Pais, N.Y. 1982, p. 139

[4] Lorentz, H. in: "Subtle is the Lord…" The Science and the Life of Albert Einstein, Abraham Pais, N.Y. 1982, p. 167

[5] The details of this discovery are documented in my German book: *Die Physik des Mandala*, published in: Windpferd-Verlag, Aitrang 2007.

[6] It may look curiously that the velocity of $v = \infty$ appears suddenly at this point – and not at the point shown in Diagram No. 2, but it can be shown that both values are intimately connected. If you connect the points of the function of Gödel's Trench successively with the central point of the structure of the Mandala by drawing »world lines« you will see that these lines will move just to the point pictured in Diagram No. 2 - or to the right parallel line in Diagram No. 4. If it would be possible to reach the velocity of $v = \infty$ both lines would in fact »coincide«; a case, which is physically excluded.

[7] Kurt Gödel, best known for his incompleteness theorem, developed a hypothetical universe on the basis of the equations of the general theory of relativity, that admits time travel. He wrote this paper in 1949 to honour his friend and Princeton neighbour Albert Einstein. Einstein acknowledged that his friend had made an important contribution to the theory of relativity. Gödel has also calculated the conditions that are necessary in order to make such time travels. One of this conditions concerns the velocity that a space ship has to reach. Surprisingly Gödel calculated exactly the same value as it is distinguished by the structure of the Mandala. He wrote: "… the velocity of the ship must be at least $1/\sqrt{2}$ of the velocity of light. "
Gödel, Kurt, *A Remark about the Relationship between relativity theory and idealistic philosophy* in: Albert Einstein: Philosopher-Scientist, ed. by Paul Arthur Schilpp, 1949, p. 561
[8] see: Frontpage
[9] Epstein, Lewis Carroll, *Relativity visualized*, San Francisco 1981; the useful character of this idea has already been advanced by other physicists f.e. Brian Green (author of the book "The Elegant Universe").
[10] ib. p. 79
[11] At the end of his book Epstein shows how this diagram can be transformed into the classical Minkowski diagram, which he calls the „spacetimecoordinatetime diagram". Epstein makes clear, that both diagrams only different views of the same thing, like the plan drawing and elevation drawing of a house. See: Appendix B "Another view", pp. 203 - 206
[12] Solution of diagram No. 5: $(0.46)^2 + (0.88)^2 = 1$
[13] Hansen, Helmut; *Die Linien des Alten – Einsteins letzte Vision*; Hamburg 2009, the book can be downloaded from the documentserver of the Freie Universität Berlin. It contains fulltext versions of essays, conference proceedings, research reports, etc. which have been authored by members or institutions of this university. Follow the link:
http://edocs.fu-erlin.de/docs/receive/FUDOCS_document_000000002486
[14] see: *How a Scientific Discovery is Made: A Case History* (American Scientist 84 (July-August 1996) 364-375), by Gerald Holton, Hasok Chang and Edward Jurkowitz.
[15] R. Carnap „Intellectual autobiography" in P.A.Schilpp, *The Philosophy of Rudolf Carnap* (La Salle, The Library of Living Philosopher, vol. XII, 1963, p. 37