An Axiom of Chirality as the Basic Principle of Physics

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Abstract. Von Weizsäcker's theorem that the laws of nature are the way they have to be, so that perception is possible, is applied in practice. The metaphysical conditions of empirical perceptions are described. Then a type of mathematics is looked for that is as simple as possible and that does not contradict these metaphysical conditions. The theory therefore does without the axiom of infinity and the logical proposition $A = A$. Instead, a new "axiom of chirality" is introduced. The four entities space, time, substance and interaction are replaced by the single new, mathematically defined term event, which is perceived by the self and is countable. Already in the simple model of a space composed of only four points, terms such as neutrino, speed of light, mass, spin, fermion, boson, Planck's constant and black hole can be represented and the theory of relativity can be unified with quantum theory. It is conceivable that such a new physics, which is based on the event, leads to a theory of everything (TOE).

1. Introduction

For one hundred years, thousands of physicists have been searching in vain for a unified theory for the theories of relativity and quantum theory. Philosophically thinking physicists are convinced that the incompatibility of the theories can only be overcome by a fundamentally new approach in the methodology of theoretical physics [1]. The science of physical methodology and language is the metaphysics (in the narrower sense). In order to avoid misunderstandings, a few linguistic questions should be clarified from the outset.

Languages have their limitations, which cannot in principle be overcome. Among other things, the meaning of the words or symbols is always vague, because

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for their definition one needs further words, which for their part, need to be defined in turn. If, for example, one defines space as the sum of all points and the point as an infinitely small place in space, then the definition turns in a circle. Such cycles are fundamentally inevitable, even if every child has a certain conception of what a point is and what space is. Nevertheless, there are a few important terms, as they are to be understood in this work, which should be defined.

Physics describes observed nature and formulates by means of mathematical methods laws of nature, which permit predictions (about the future). *Nature* is the entirety of all those things which can, in principle, be empirically perceived [2]. In this sense, nature is *real* or *material*. *Mathematics* studies patterns in abstraction of the individual things which are patterned [3]. *Empirical perception* is a flow of information from the outside into the conscious mind of a subject. The *subject* is a – possibly transcendental – entity, which can take up, store and consciously process information. It is left open as to whether a subject can itself be part of nature. For the considerations in the present work it is sufficient to proceed from only one subject, the *ego*. Possible further subjects and intersubjective communication are not brought up for discussion, because such further subjects can never be unequivocally differentiated from objects. An *object* is a summary of quantities, whose current values permit predictions about these very values (in the future) [4]. *Information* can be defined as answers to potential questions which can be reduced to a countable number of so-called *binary choices*, i.e., to alternatives which can be decided with a simple yes/no answer [5].

We shall now examine the extent to which today's usual methods and terms of physics contradict the definitions above. Subsequently, those basic metaphysical conditions for a physics which conforms better to these definitions are to be described.

2. Physical and mathematical terms

The physicist seeks to describe nature with the help of a set of mathematical tools. In so doing, he must always remain conscious of what in his science is mathematics and what is physics, because physics has the task of describing the reality of nature as authentically as possible, whereas mathematics, with its logic and axiomatic theory is actually a purely theoretical construct, which remains to a large extent independent of nature. In order to make by means of the laws of nature statements about the future which are as reliable as possible, it is therefore important to be conscious of what in these laws is based on theory and what on reality. This consciousness has been increasingly lost in modern physics.

With respect to *mathematics*, the physicist is free to a large extent. There are, however, practical reasons to prefer one type of mathematics to another: Mathematics should be simple, Dirac would say beautiful, and should not contradict empirical observation. Its logic should be convincing for the physicist and its axiomatic theory immediately evident. In mathematics an infinite number of logical and axiomatic systems are possible [6]. Logical propositions, such as, for example, the propositions $A = A$ or $AB = BA$ contradict empirical observation however, and are therefore questionable in physics. If the A on the left and the A on the right of the equals sign were really alike, then one could not differentiate between them. Since one can, however, always differentiate between the two A's, this important proposition of logic is to be dispensed with if possible. Or it would then always be necessary to at least define precisely the extent to which the two A's are different and the extent to which they are alike. The abandonment of the proposition $AB = BA$ is already usual in the quantum theory [7]. Since infinity is never perceptible, not even – as so often claimed – an "approximate infinity" a physical theory should completely do without the term infinity and thus without "higher mathematics" [8, 9]. Thus irrational numbers (surds), such as π for example, or integrating, differentiating and the space-time continuum are dropped and mathematics becomes substantially simpler without the axiom of infinity. Following the abandonment of all these propositions, not a lot remains of the mathematics we learned in school.

Important terms of *physics* are also questionable because they describe things which cannot be observed empirically at all. This applies in particular to space and time [10], and to the photon as well. A space without objects and a time without events are inherently never perceivable. So space and time are not aspects of reality, but at most, questionable mathematical models in which we think [11]. Instead, meaningful mathematical definitions for the terms object and event are required, something which, as yet, has only been unsatisfactorily achieved in theoretical physics. All sensory perceptions are conveyed exclusively by photons. These are thus central for every physical theory, which should conform with perception. Photons move at the speed of light, so their "internal clock" stands still according to the special theory of relativity. From the perspective of the photon it exists for zero seconds, even if from the physicist's perspective it has been travelling for billions of years. As the double-slit experiment demonstrates, the photon "is" during its existence not in *a* location, but in several locations simultaneously. When it meets our eye, it is completely destroyed; so strictly speaking, we do not see the photon, but the destruction of the photon. It is not surprising that a particle like the photon, which in certain respects exists for zero seconds, which is in no specific location and which cannot actually be perceived at all, is scarcely suitable as a model for the description of reality. This compels the metaphysician to ponder the meaning of the terms "is", existence and Be-ing.

3. Chirality as the fundamental principle of physics

Physics proceeds from perception, i.e. from an information flow. The information flow is ordered in the direction from the object to the subject, otherwise it would become chaos. In order to define an order, one needs a duality of two distinguishable orientations. In physics for example, in time these two orientations are before and afterwards, in the one-dimensional space left and right, in two-dimensional space clockwise and counter-clockwise, and with electrical charge positive and negative. Chirality (Greek *cheir* = hand) means handedness. The right hand is the mirror image of the left. Although both hands are isometric, they cannot be brought to coincidence with one another. So they are different from each other. However a third hand, which is likewise isometric to the right and to the left hand, which nevertheless cannot be brought to coincide with either of them, does not exist. For each hand, there is one, and only one, counterpart with opposite handedness. An object is called chiral if it has a mirror image which is not identical to the object[1]. Such a duality can be defined for mathematical or physical spaces with as many dimensions as desired. Every chiral object has an orientation. Its mirror image has the opposite orientation. Orientation is not an absolute characteristic; it can be only defined relative to the orientation of another, likewise chiral object or subject.

Chirality plays a fundamental role both in nature and in the metaphysics, because without this duality of being there is no order, no transmission of information and thus no perception, no memory and no thinking, not even on the assumption that thinking is something transcendental. In nature, one finds chirality from the enormous galaxies through to living and dead matter and down to the smallest elementary particle, to the neutrino with its spin. The image and mirror image of space, time, spin and electrical charge have inherently different physical properties, an example being the weak interaction [13]. However the CPT theorem (CPT symmetry) nevertheless shows that a connection between the orientation in space, time and the sign of the electrical charge must exist. There are few other phenomena with such a universal general validity as chirality, probably none at all. Not even time with its direction from the past into the future is so generally valid. The photons for example, so important for the physicists, are in a certain sense timeless, but chiral.

Mathematically, chirality plays a fundamental role in category theory [14]. Here chirality is represented by arrows which are meant to symbolize change, a morphism: each morphism has an origin and a goal. Mathematical morphism is therefore a good model for representing physical perceptions as causal information flows from an object to a subject. A mathematical structure changes, whilst something else remains unchanged. How the change is interpreted mathematically or physically, as a time, place, or structure of an object or as a relation, is left open by category theory. In category theory, each morphism can also apply in the reverse direction, even if it is not an isomorphism. The binary counterpart to each mathematical expression, to each theorem of category theory is obtained then by turning around all arrows in this theorem.

[1] "I call any geometric figure, or group of points, chiral, and say that it has chirality, if its image in a plain mirror, ideally realized, cannot be brought to coincidence with itself." [12]

4. To measure is to count

The physicist must register his perceptions, that is, the information flowing to him from the outside, in such a way that it is unequivocally communicable. Unequivocally means that the information, as far as possible, is to be stored in the form of numbers, because there are no misunderstandings about numbers, at least as long it concerns finite, rational numbers. This compels the physicist to measure. The measurement associates physical characteristics of objects with numbers which say something about the structure of these objects, and/or about the perception thereof. This information is clear only if the relation between the chiral orientation of the numbers ($\geq$), the object and the perception thereof is clearly defined by a convention.

The measuring process is thus always a counting process. For this purpose, the physicist must know three things, namely which elements of an object he wants to consider, which relations between these he wants to measure and in which units he counts. During a speed check of motor vehicle traffic, the radar latches onto the rear of the vehicle and one assumes that the whole car moves at the same speed as the rear, although the individual atoms make completely different movements. The radar measures only the speed; the temperature relations and other parameters are of no interest. One measures in kilometres per hour. All physical measurements can be attributed to three kinds of counting: units of length, periodic events (for example of pulse beats) or non-periodic events (for example radioactive decays) are counted. There are no other measurements.

Since each measurement is based on an interaction between the object and the measuring apparatus, and because each information transfer from one object to another changes both objects, the physicist only knows the value measured on the object before the measurement, The physicist functions in this respect like a measuring apparatus with a consciousness which stores the received information as a document of the past. About the present, he has no precise knowledge.

During the counting of periodic events, the physicist compares the number of events with the number of pulse beats or the frequency of his internal clock. In so doing, he assumes as self-evident that the cycle duration between two subsequent equivalent events is always the same at the same place and in the same state of motion, although he cannot actually know anything at all about this duration. This is called the "chronometric convention". Also the counting of units of length can be attributed to a counting of events, for example, the registered number of markings on a yardstick. Every kind of length unit can be derived from a time unit. However, strictly speaking the physicist does not know anything at all about the real distance between the individual markings. Here also one proceeds from a "geometrical convention", which in most physical theories reads: The length of a distance is independent of the location. That does not mean, however, that it is also independent of the state of motion of the distance. The chronometric and the geometrical conventions are necessary, but actually arbitrary agreements. Hence it follows that the physicist can never really measure and know length of time and distance [15]. All he knows are counted numbers of events. That leads to the question as to whether length of time and distance are concepts suited to physics, or whether physics is formulated better and simpler by a theory about counted events. For this, however, one would need a practicable mathematical definition of the term event.

5. Metaphysical conditions for physical theories

In summary the metaphysical conditions are to be enumerated which should comply with a physical theory, so that it is closer to reality than the conventional theories.

In order to take seriously the physicist as a subject who takes into his consciousness empirical perceptions from the outside, the ego must play a central roll in the theory. The theory should be simple, immediately evident and logical for the physicist. The things, which the theory describes, must be perceptible. For this, they must be causally linked. Chirality, the duality of all being, should be an important basis of every physical theory. Quantities of information are the subject matter of the theory which makes statements about how such quantities change. Whilst something changes thereby, something else remains unchanged. The structures of object and subject must be such that the information is representable on it and that it can flow from the object to the subject. For this, the perceiving subject and the perceived object must be indeed connected with one another, but nevertheless clearly distinguishable. The unit of measure of the information is the binary choice, i.e. the answer to a yes/no question. These units are finite and countable as events. Most of these basic conditions are only partially met by the existing physical theories.

Since ancient times, natural scientists have described the world with the help of the four entities of time, space, matter and interaction. Since Aristotle there have been repeated attempts to reduce the number of entities; the most recent being the string theories. The attempts have all failed up to now. Nevertheless analogies between the four entities seem to exist. Space and time are both chiral for the observer and they never appear independently of each other. The curvature of space affects matter and vice versa. Are space and matter really two different things? The photon with its particle/wave dualism is half particle, half interaction. Are space, time, matter and interaction really four different entities or rather, are they four different aspects of the same entity? And what, then, is this entity? Can the mathematically appropriately defined event take over this role as new, only entity? Seen physically, there would then be nothing real other than events. Only they are perceivable. Only they exist. Yes, the act of the perception would be an event. To measure is to count events. The events would be the atoms of Be-ing. It is conceivable that such a new physics, which is based on the event, leads to a theory of everything (TOE), with which the theories of relativity, quantum theory and presumably the four well-known interactions can be uniformly described.

The search for a new physical theory should be methodically approached as follows. It begins with the formulation of a new mathematical language, logic and axiomatic, the only initial condition of which is that it should be as simple as possible and that the axioms do not contradict the mentioned basic metaphysical conditions, which are a precondition for every perception. Therefore, the axiom of infinity will be dispensed with and the axiom $A = A$ will be replaced by a new axiom of chirality. These first steps thus just take into consideration mathematical simplicity and basic metaphysical conditions, Very soon it will become evident that the mathematics thus developed will surprisingly also be interpretable as a natural law in the physical sense. Skilfully applied to physical perceptions, the new mathematics is apparently suitable for the description and unification of the theory of relativity with quantum theory.

6. Axiomatic for event, space and time

It is necessary to find a mathematical definition of the term event which is practicable for physics and from which the terms *space* and *time* can be derived. It is beyond the scope of this article to set out a complete axiomatic. Such systems can be found, for example, with Shapiro [16]. Rather, we should begin with the simplest thing which mathematics has to offer, the point. According to Euclid, a point is a thing without parts. Whitehead's modern definition reads, "A geometrical element is called a 'point', when there is no geometrical element in it." [17]. For the moment it concerns neither a point in space nor one in time, nor even an object. There is no space to provide a background for the point. Indeed, there is not even an observer to assert that the point exists. To this lonely point I will now add one point after another and investigate what can be said at all about the growing number of points.

Two points can coincide or not. If they coincide, then the distance between them is infinitely short. Since infinity is not perceptible and thus must be ruled out on metaphysical grounds, the two may not, and cannot, coincide. The set of the two points I call space. The distance "not zero" between the two points can be assigned a number, for example, the number 1. Thus there is no longer or shorter distances between the two points, but just the distance 1. An axiom of reflexivity must ensure that the distance is independent of the direction in which it is measured.

In a space consisting of three points, there are, thanks to the third point, possibilities for relations between the points; namely, the third point can lie between the other two or not. If no point lies between the other two, the three points form a triangle, whose sides all have the length 1. If the three corners have names, e.g., x, y and z, then they can be arranged clockwise or anti-clockwise in the two-dimensional space defined by the three points. Since points don't have names in nature, such a distinction is physically impossible, however. That said, there is another state, which is clearly distinct from a triangle, namely the case where a point y lies between x and z. y divides the line xz in two parts, each of which has the distance 1. Thus distance $xz = zx = 1+1 = 2$, and in this way it is clearly distinguishable from distance 1 in the triangle. In this way, all three conditions for a metric are fulfilled: the distance between x and x is zero and therefore quite invalid in physics, the reflexivity axiom is applicable and the distance xz is $\leq xy + yz$.

Now I permit the three points to move freely and to adopt different states in turn, both singly and as point sets. The individual points have four different states or possibilities of movement relative to the two other points. They are each characterised by an arrow symbol:

1. The point can move away from the two other points: $(\mapsto)$ = "away"
2. The point can move towards the two other points: $(\vert\!\!\leftarrow)$ = "approach"
3. One point lies between the two other points: $(\leftrightarrow)$ = "between"
4. The point can turn back: $(\hookleftarrow)$ = "turn back"

$(\leftrightarrow)$ designates the transition from $(\vert\!\!\leftarrow)$ to $(\mapsto)$, whereas $(\hookleftarrow)$ indicates the transition from $(\mapsto)$ to $(\vert\!\!\leftarrow)$. So the individual point moves in a defined sequence through the four states: it moves towards the other two points, passes between them, moves away from them and then turns back. What causes it to turn back? It is important to always keep in mind that the points do not move in absolute space, but only relative to the other two points, which form the point space for the third point. This distinguishes my theory from the conventional theories of space. It is not points moving in space, but rather – since the points themselves form the space – space moving through itself. Each time a point moves through between the others, the space turns itself inside out like a glove. If a point is situated at the tip of the glove's index finger and it moves away from the glove in the direction the finger is pointing, then as soon as the glove is turned inside out, this point will abruptly turn back to the glove and fly back into it. Exterior and interior have been transposed by the inversion of the glove. From the point's perspective, the direction of motion has not really changed; through the inversion of the space, the direction of motion, however, has reversed relative to the other two points, which form the space for it. The cause of the inversion of the space is always the point in the $(\leftrightarrow)$ state, i.e., the one which migrates through the other two. The inversion of a point space I now define as an *event*. Should the physicist find these ideas plausible, then he can formulate the following *axiom of chirality*:

$$(\vert\!\!\leftarrow) \quad \Rightarrow \quad (\leftrightarrow) \quad \Rightarrow \quad (\mapsto) \quad \Rightarrow \quad (\hookleftarrow) \quad \Rightarrow \quad (\vert\!\!\leftarrow) \quad \Rightarrow \quad \text{and so on.}$$

The axiom of chirality corresponds neither in the form nor content to the usual mathematical or physical axioms. Since it portrays a process and consists solely of arrows, it belongs most appropriately to category theory [18], which can thereby probably play an important role in theoretical physics. The four states of motion of the individual points are thus ordered and have a direction. The symbol $\Rightarrow$ ("if . . . , then . . . ") denotes in this context the phase change from one (motion)state to the next.

7. The four-point space

When not all of the four points lie on the same plane, then they form the corners of a tetrahedron, i.e., a three-dimensional space composed of four points. Here also, the points can adopt the four different states of motion (⇤), ($\leftrightarrow$), ($\mapsto$) or ($\hookleftarrow$). (⇤) is the state which leads to an event; ($\mapsto$) does not result in an event; ($\leftrightarrow$) and ($\hookleftarrow$) mean that in these states, an event occurs whereby ($\leftrightarrow$) is the cause and ($\hookleftarrow$) is the consequence of it. This view has the advantage that the term event can be defined without requiring the term distance: "to move towards the other points" no longer means that there is a distance between the points which becomes shorter, but simply that the motion leads to an event. Distances only ever change as a result of events, thereby becoming countable.

In the four-point space, all four possible states of motion can be assigned to one of the four points. Since always one point is thereby in the ($\leftrightarrow$) state following each phase change, the process of space inversions following one another never stops. The chain of events cannot break down, and after every event the result is once again a tetrahedron with the four corners in the four different states. Only a disruption from outside would be able to stop this process. An outside does not exist in the four-point space, however. In Figure 1, such an unrestricted sequence of periodic events is illustrated. Both the tetrahedron $xyzw$ as well as its process of movement are chiral. That is to say, image and mirror image of the tetrahedron and of its change process cannot be brought to coincidence with each other. The chiral orientation remains the same from phase to phase. The tetrahedron thus retains its identity, i.e. all its intrinsic characteristics remain unchanged, similar to a *physical particle*. From the perspective of an external observer, the motion of the four-point space is isotropic, i.e. no direction is distinguished in the three-dimensional space.

For the ($\leftrightarrow$) point, there are three possibilities. It can pierce the surface defined by the other three points in three different *locations*[2]: the surface in the triangle's interior, or above a side or above a corner (Figure 2). Consequently, in all there are six versions of the four-point space which can be differentiated by their intrinsic characteristics: each of the three possible states of the ($\leftrightarrow$) point can occur in two chiral variations with different orientations.

[2] The "locations" on the surface, which is defined by the three-point triangle, can be characterized by the relation "between": The sides of the triangle consist of the sets of all points which lie between the corners. The inside of the triangle consists of the points which lie between the three sides. The extension of the side beyond a corner consists of the set of all points with the characteristic that the corner lies between them and the side concerned. The points over a corner lie between the two sides extended beyond this corner. The points over a side lie between this side and the extensions of the two other sides.

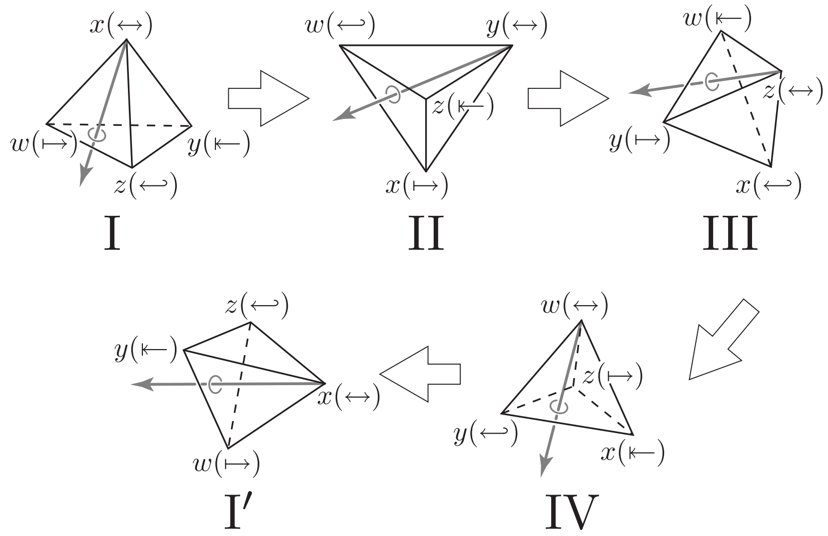


Figure 1. **Four-point space.** Following phases I to IV, the four-point space returns to the original state I′, although in another position from the perspective of the external, presumed observer. If one disregards the designations x, y, z, and w of the four corners, then the state of the four-point space is the same following each phase change, only its position has changed, whereas the chiral orientation has remained the same: viewed from $(\leftrightarrow)$ point, the triangle $(\mapsto)$, $(\hookleftarrow)$ and $(\mapsfrom)$ always rotates in an anti-clockwise direction.

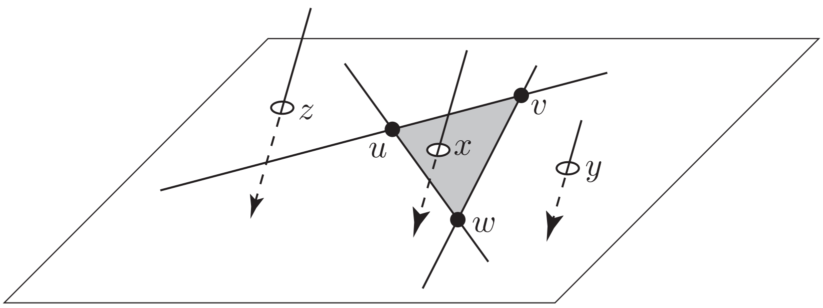


Figure 2. **The three possibilities for the point "between".** The plane which is defined by the triangle (u, v, w) can be pierced in essentially three different places by a fourth point: inside the triangle x $(\leftrightarrow)$, above a side y $(\leftrightarrow)$ or above a corner z $(\leftrightarrow)$.

8. A neutrino model?

The mathematical model which has now been presented is not an end in itself. Rather, we are actually looking for models which on the one hand, come as close as possible to the basic metaphysical conditions, and on the other hand, are able to describe physical objects and perceptions thereof. The simplest known particle today is the neutrino. It also occurs in six different versions; as an electron-, muon- or tauon-neutrino with a left-handed spin or as one of the three corresponding antineutrinos with right-handed spin. Neutrinos and antineutrinos are distinguished by their opposite orientation, as in the model of the four-point space. So this model describes the intrinsic characteristics of the neutrino quite well. An explanation for their varying masses remains open.

9. The three-dimensionality of space and black holes

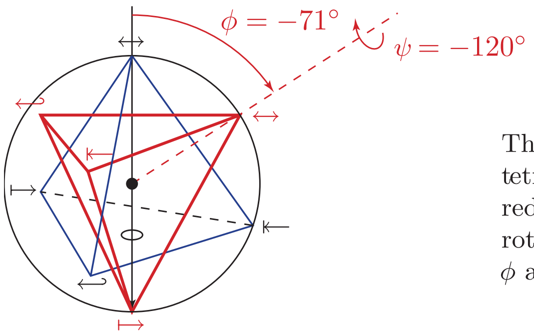
Since, according to the axiom of chirality, a point can only take up one of four different states of motion, only in three-dimensional space is it possible to construct a chiral tetrahedron with four different corners in such a way that the internal chain of events never stops of its own accord. This is probably the underlying reason why physical space as we believe we perceive it is three-dimensional. In four-dimensional space perception would be impossible, since there can be no distinguishable chiral particles there. Every empirical perception is probably based on precisely this possibility of distinction. Only three-dimensional space permits perception, and without perception there is no physics.

No point can leave the four-point space in which the four points are in the four different states. Whenever the ($\mapsto$) point looks to break out, the space inverts and the point moves towards the other three again. A three-dimensional space from which no point can escape, because the space inverts too quickly, I define as a *black hole*. Presumably this definition could be extended to include spaces with more than four points. The neutrino model is the smallest possible black hole.

10. The presumed observer

The physicist as a real observer is himself subject to the laws of nature. By means of his real measuring apparatuses he describes his empirical observations. He counts the perceived events, which for their part, are the quanta of perception. The counting consists of comparing the observed event count with an internal event count of the observer, quasi with his sense of time or his inner clock and its direction of time. A precondition for every measuring process is thus the existence of an observer and an interaction between the object and the observer. For the moment it should be assumed that an observer is present who has an inner clock and who can count, that the counting itself, however, is possible without interaction. This should be a so-called presumed observer. He stands for the ego postulated by metaphysics, which should, after all, be a part of any good physical theory. The ego as subject imagines itself as being external to the actual, existing world, which is not influenced by the ego's observation.

The presumed observer can view the four-point space from two different locations: either he perceives the tetrahedron from outside as a whole, how it rotates chirally in leaps from event to event (Figure 3), or, as an internal observer, he



The inversion of the blue tetrahedron relative to the red one corresponds to a rotation through the angles ϕ and ψ.

FIGURE 3. **Chiral rotation of the tetrahedron in three-dimensional space.**
$\phi =$ clockwise rotation about the axis through the centre of gravity (parallel to the blue side of $\hookleftarrow$ to $\mapsto$) of $-71°$.
$\psi =$ clockwise rotation about the axis through the centre of gravity and $\leftrightarrow$ of $-120°$.

accompanies one of the four points, and perceives how it repeatedly pierces the plane defined by the other three points and proceeds through a translation. In the four-point space, one observer is located outside and the other inside the black hole.

11. Space and time

The external, presumed observer, counts the events, i.e. the periodic inversions, or rotations, of the four-point space. The event sequence and the counting thereof are one-dimensional and chiral, that is, they have a direction. The dimension in which the periodic events are counted I define as *time*. The number of periodic events is the measure of the duration of time, which is thus a dimensionless number. Periodic means in this context that the object, i.e., the four-point space, is in precisely the same internal state before and after the event. This definition of time uses the term "event", whereas the entity event has been explained without using the word "time". So the event is more fundamental to physics than time.

The internal, presumed observer "experiences" the events as the piercing of the plane defined by the other three points. These events he experiences as a change of location via a translation, he reaches "a location further on". These changes of location are the quasi countable markings on his yardstick. Between the counted events, he moves with his point through the space of the three other points, a space, which from the perspective of the internal observer, rotates. Thus he counts only every fourth event in the four-point space; there are four such internal observers, one for each point. The dimension in which the changes of location are counted I define as *physical space*. Since, from the external observer's perspective, the four-point space rotates without a direction in space being especially distinguished, we receive, viewed from the outside, the impression of an isotropic, three-dimensional space. In this space, the number of location changes is a measure of the internal observer's distance covered. Since this measure is a number of counted events, distances involve dimensionless numbers.

Depending on the standpoint of the presumed observer, he counts the four-point space's events as a duration of time or as a distance. Put succinctly: whether an event is perceived as a change in space or a change in time is relative and depends on the standpoint of the observer. What the observer outside of a black hole perceives as a length of time is for the observer inside the black hole a distance. For the object itself, there is no difference between time and space, there are only events.

A *clock* is a periodic event counter. It runs most quickly for an observer who perceives and counts all events as rotations. The *standard length*, however, measures or counts changes of location. Every event which it does not count as a periodic rotation is lost to the clock, for the same observer cannot count any event twice, partly as time and partly as a change of location. Consequently there is a fastest possible time and a longest possible distance. The observer measures the fastest possible time when he counts all events as rotations and the object is at rest. He measures the longest distance when he perceives all events of the observed object as changes of location, i.e. when time stands still for the object. Such objects are, for example, the graviton or the photon. This state of affairs corresponds precisely to the conclusions of the special theory of relativity.

12. Velocity

The ratio of the number of location changes to the number of periodic time events is called *velocity*. The greatest velocity is measured when all events are counted as location changes and this number is compared with the event count of the presumed observer's inner clock. The corresponding velocity is called *light speed* c. It is the natural and unambiguous measure for all velocities. The observer's inner clock can be calibrated such that the ratio c of both numbers becomes 1. In this case, every event which is perceived as a change of location corresponds to a time event of the observer's inner clock:

$$c = 1 : 1 = 1.$$

In four-point space this means that the inner clock of the presumed observer always counts a time event of his inner clock whenever he is between the other three points. Consequently, the points inside the tetrahedron move at light speed. Since velocity is nothing more than a ratio of counted events, it is also a dimensionless number.

13. Frequency and mass

The ratio of the number of observed events (periodic events and location changes collectively!) to the event count of the presumed observer's inner clock I define as *frequency* ν. The minimum frequency during the observation of an object is measured when no change of location is observed, i.e., when an object is at rest. This minimum ratio I define as *rest mass* m_0. The frequency or rest mass of such a stationary particle is the result of the particle's internal events. It is thus independent of its state of motion. Mass and frequency are also dimensionless numbers. The external presumed observer's inner clock can be calibrated such that it always counts an internal time event whenever one of the neutrino model's four points is located between the three others. This calibration results in the lightest neutrino's rest mass becoming 1.

14. Spin, Fermion und Boson

The chirality of the four-point space is the consequence of its internal point motion as the tetrahedron inverts in the three-dimensional space. In Figure 3, these motions during a single event are illustrated as a change in two polar coordinates φ and ψ, whereby the rotational direction of the two angles must be defined for the orientation to be clear. The tetrahedron itself, as well as its rotational direction, is chiral during every event, that is, they cannot be brought to coincidence with their mirror image. This chiral, three-dimensional rotation I define as *spin*. The term three-dimensional rotation is intended to express that the motion does not require a fixed axis or direction of motion. So the spin is not an angular momentum, but rather the abstract consequence of a chiral particle having precisely two possible orientations in three-dimensional space. A neutrino, for example, has no axis and as long as it is at rest, also has no direction of motion. Nevertheless, it has a spin. Only with electrically charged particles and with the large systems of classical mechanics does spin manifest itself as an angular momentum with an axis [19].

The rotation of the space which is observed by the external presumed observer comes about as the two points ($\leftarrow\!\!|$) and ($\mapsto$), with a distance 1, fly right past each other at light speed whilst the ($\leftrightarrow$) and ($\hookleftarrow$) points remain at rest in this phase. It is thus

$$c \cdot c = c^2 = (1:1) \cdot (1:1) = 1$$

This description of the three-dimensional rotation is intuitive. For a more precise description of the three-dimensional topological changes, one would require an axiomatic system which is yet to be formulated. The equation can also be interpreted as the change in the two angles φ and ψ per event. The complete three-dimensional rotation is the product of the two changes in the angles. The chiral orientation of the rotation can be portrayed by allocating the rotation an algebraic sign $\pm$. By means of a chiral, three-dimensional object, for example a right hand, it must then be defined which orientation is to be positive and which is to be negative.

In order to fulfil the basic metaphysical condition, that the flow of information from the object to a real (instead of presumed) subject changes both of them, the orientation of the spin must change during the perception, that is, it must reverse. So the real subject can never perceive the three-dimensional rotation itself, but only its change. Mathematically, this can be expressed most simply such that the perceived, minimum change to the rotation, namely quantity 1, is the difference between $-\frac{1}{2}$ and $+\frac{1}{2}$, whereby the quantity $\frac{1}{2}$, which is not perceivable and real *per se*, is defined as the angular momentum of the four-point space and the particle with the spin $\pm\frac{1}{2}$ is defined as a *fermion.* In this way, the spin orientation becomes a binary choice: plus or minus.

The four internal presumed observers together count the same events as the external presumed observer. So the individual internal observer counts only $\frac{1}{4}$ as many, namely those when he is in the $(\leftrightarrow)$ state. The rotation of the four-point space as a whole must from the perspective of the internal presumed observer be just as big as it is from that of the external observer. However, since within the four-point space he only perceives every fourth event as such, from his perspective the rotational motion from event to event is four times greater than it is for the external observer: it is

$$4 \cdot \tfrac{1}{2} = 2.$$

This spin, like that of the fermion, can be positive or negative. So it is ± 2. Particles with integral spin I define as *bosons.* Thus, the same four-point space has, from the perspective of the external observer, a spin of $\frac{1}{2}$ and is therefore a fermion, whereas the spin from the internal observer's perspective is 2, thus the object is a boson. The internal observer measures a four times greater rotation per time event of his inner clock than the external observer. Put succinctly, whether this particle is perceived as a fermion or a boson is relative and depends on whether the observer is inside or outside the space, that is, the black hole.

15. Planck's constant *h* and energy

Central to the description of the spin was the equation

$$c \cdot c = c^2 = (1:1) \cdot (1:1) = 1 = h.$$

This constant h I define as *Planck's constant.* Since h is nothing other than a ratio of counted events, h is also a dimensionless number, namely 1. h is the smallest possible angular momentum an observer can perceive, since at least one event must take place for a rotation to come about. There are no half events. With c and h, one and the same physical constant is involved, which is perceived by the observer outside a black hole as the minimum angular momentum; by the internal observer on the other hand as the maximum velocity of the point he accompanies.

If the mass m_0 of the four-point space is synonymous with the frequency ν and $c^2 = h$, then

$$m_0 \cdot c^2 = h \cdot \nu = E.$$

This equation unifies the special theory of relativity with quantum theory. The quantity E I define as *energy* E. This is also a dimensionless number.

16. Discussion

Similar to some Greek philosophers, more modern ones such as Kant and von Weizsäcker also assumed that the laws of nature are nothing more than the conditions for every perception, and that nature thus becomes a unified whole [20]. “We must always be prepared to change the axiomatic foundation of physics in order to do justice to the facts of observations in the most logically perfect way possible.” [21] The theory now developed rudimentarily from the axiom of chirality with just four geometric points fulfils the basic metaphysical conditions for a physical theory according to Section 5: The metaphysical ego corresponds to the presumed observer. The theory is simple and – at least for me – immediately evident. It describes perceptible things such as, for example, the neutrinos. The events are causally connected, finite and countable. The spin is chiral and supplies the information content of the object as a binary choice, which changes when perceived by a real subject. The theory can already at least intuitively describe a startlingly great number of aspects of modern physics, and even, in part, deduce them from metaphysics, for example the connection between relativity and quantum theory. And all without recourse to concrete physical experiences with the development of the theory. Such experiences served at most as inspiration. I assume that by simple extensions of the outlined theory also the remaining natural constants, all elementary particles with their interactions, indeed thermodynamic and cosmological phenomena as well, can be described. This way the proposed theory would become a theory of everything (TOE).

For this purpose, the axiomatic system of the suggested theory is yet to be completed, to which category theory could be a useful beginning. It must further be investigated how distances and black holes in spaces with more than four points are to be defined. Ultimately, the presumed observer is to be replaced by a real one, subject to the laws of nature. Thus the difference of opinion between Einstein and Bohr concerning the reality and completeness of the quantum theory could be bridged: For Bohr, only the events empirically perceivable by the real observer would be real as a whole, whereas for Einstein, even the individual points perceivable only by a presumed observer are real. According to this ontology, “God really doesn’t play dice” anymore. The suggested theory with the axiom of chirality thus introduces new perspectives for theoretical physics.

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