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What Is The World Made Of?

Contents

Announcements

My understanding of reality differs so radically from the prevailing convictions in physics and philosophy that I feel it necessary to first present a preliminary overview, in which I outline my perspective, describe its development, and explain the reasons for it.

This is the purpose of this introductory text. In it, I present my most important arguments and proofs, but only in full when the line of reasoning is concise; otherwise, I merely sketch its structure or highlight particular aspects. As it turns out, however, the most important points can often be presented surprisingly succinctly. In any case, I refer to the sections in the books or papers on this website where the full version can be found.

Some of my results contradict the standard versions, while others fill known gaps in our knowledge. In some cases, they are novel in the sense that their absence was previously unknown. Where I deem it appropriate, I attempt to elucidate the historical and logical reasons for the error or deficiency in question, and I point to the "specific blindness" that has hampered or even prevented the discovery and solution of the problem.

One of my aims is to demonstrate the close interrelationship of my hypotheses. And this brings us to the title of this work, for all my results stem from a common origin – the answer to the question:

WHAT IS THE WORLD MADE OF?

As it turns out, knowledge of the fundamental basis of reality is a necessary prerequisite for answering all fundamental ontological and physical questions. It makes it possible to understand reality as a ***unity*** in which the emergence of all entities whose existence we experience or consider necessary:

> ***matter, mind, free will, sensation, consciousness,***
> ***causality, natural laws, mathematics, and several others***

can be explained and justified – in stark contrast to current natural science, from which they appear incompatible and where their origin remains enigmatic or is left to chance.

These questions are ontological in nature. But even in the field of physics, insight into what underlies reality leads to answers to fundamental questions and to solutions to problems that physics has thus far failed to solve:

> ***How can gravity and electromagnetism be unified? Why does matter curve spacetime? What happens during the quantum mechanical measurement process? What is the reduction of the wave function? Why do spin ½ particles only return to their initial state after a 4π rotation? – and many others.***

In this reconstruction of the description of nature, special relativity and quantum theory remain unchanged, but only in their mathematical structure. Both are interpreted differently, in such a way that the interpretation is simultaneously an *explanation*, and both interpretations lead – independently of each other – directly to the new view of reality and its origin.

However, this is where the agreement ends: My theory of gravity is not identical to general relativity. In solar systems and in the gravitational fields of planets, the results of both theories coincide, but in larger systems – such as galaxies – they diverge significantly. This opens up the possibility that ***dark matter is not needed*** to describe galaxy dynamics and some other gravitational phenomena.

Furthermore, the following applies:

All physical theories that arose after and are based on quantum theory are only approximately valid; with respect to their conceptual and mathematical structure, they are incorrect. They can therefore no longer claim the status of fundamental theories, but only the status of purely formal approximations, since they contain elements (objects, interactions) that have no equivalent in reality – comparable to the well-known epicycle system that once served to describe planetary orbits.

This also applies to the so-called Standard Model of particle physics: from my interpretation of the measurement process and quantum theory as a whole, it follows that the model of the strong interaction is incorrect, which in turn implies that the group-theoretical approach underlying the entire Standard Model is unsuitable for describing the fundamental relationships.

The view of the evolution of the universe also changes fundamentally:

There is no Big Bang, no inflation, no multiverse, no dark energy.

The assumption of the Big Bang is replaced by the assumption of the *omnipresent and continuous emergence* of reality from a state ***prior*** to all existence; the assumption of the variable size of the universe is replaced by the assumption of the variable size of all wavelengths that we can use as a measure.

Note:

In my own estimation, I have succeeded considerably better in this work than in all previous works in establishing the comprehensive connection between my hypotheses and – what is even more important – in deriving them from most general and certain principles and evident facts.

Note:

Many sections of this text are taken from my other works. The reason for this is that I don't often succeed in formulating something in a way that perfectly reflects what I want to say.

And therefore, if I have managed to do so, I don't want to change anything.

Books and writings from my website, which I refer to below:

"The Concept of Reality"

"The Structure of Reality"

"Why Free Will exists and why robots are not sentient"

1. Two preliminary arguments

Before I turn to the actual task of executing what I announced, I would first like to present two short arguments which, while standing on their own, also contribute significantly to understanding the basis of reality. Since they contradict the usual view and are previously unknown, they are suitable for preparing the ground for the shift in the description of reality that I am proposing.

The first argument casts doubt on a significant portion of the physical certainties regarding the fundamental building blocks of the world; the second is directed against the so-called "Standard Model" of cosmology.

1.1. Consequence of Special Relativity

Einstein explains the relativity of simultaneity with the well-known scenario in which an observer A is located at the midpoint M between two lightning strikes that occur at time Z. If he perceives the strikes as simultaneous, then they ***are*** simultaneous *for him*. However, for an observer B, who is moving relative to A and is also located at M at time Z, they are ***not*** simultaneous.

Due to the postulate of the constancy of the speed of light for all unaccelerated observers, the viewpoints of A and B are equivalent. Thus the determination of what time applies at any distant location – that is, *the entire time system* – depends on the observer's state of motion.

We generalize this line of reasoning as follows:

We look at two objects. At first they both are at rest. But if they now begin to move along their connecting line in the same direction at the same speed, then the relationship of the local times that apply to them changes – simply because *each* of the processes used for determining time that begins at the object in front and ends at the rear one, now arrives at this rear object *earlier* than the same process in the case of the objects at rest, because now the rear object is running *against* this process.

However, this means nothing other than that – with respect to the rear object – the point in time at which the process *started* at the object in front has now – compared to before – *shifted into the past*.

Obviously, the extent of this shift depends on the speed of the process: the smaller the speed, the larger the shift.

From this, the following – surprising and far-reaching – conclusion can be drawn:

Let us assume that the objects of a system are linked by processes that propagate with the velocity c. Then we get a time structure that is completely determined by c – as it is *in fact* the case.

Suppose now in addition that there are other processes propagating at a different velocity d, which is independent of c. Then these processes create a second time system that is different from the one created by c and independent of it. But that is impossible. The time system must be unique.

From this follows:

Proposition:

There is only one velocity: c, the velocity of light.

All other velocities must be derived from it.

This leads to the question:

How do other velocities ***derived from light*** *arise?*

The answer is:

Through superposition of waves traveling at the speed of light.

The speed of the superposition depends on the frequencies of the waves.

I demonstrated this in the book Structure (in Chapter 6) and derived the Special Theory of Relativity from it, without presupposing the principle of relativity or the constancy of the speed of light for all uniformly moving observers. This is possible because the wave superpositions adhere to the spatial and temporal relationships defined by light, or more precisely: because they, like light itself, *generate* this spacetime structure.[1]

Thus, already this simple step integrates all velocities $v < c$ into the relativistic spacetime structure.

In his writings, Einstein repeatedly emphasizes that we could also determine time using other processes. However, this is incorrect, because:

Time determination is only correct when it is carried out using light – or more generally, using processes at the speed of light. With any other method of determining time, nature would resist and refuse experimental confirmation.

Therefore, it is by no means the case – as Einstein suggests – that we can freely choose how we determine time; we must do it with light.

To demonstrate this fact, in the book Concept (starting on page 69 at the bottom), I described the consequences of determining time using sound signals (in air). This makes the speed of sound identical for all uniformly moving observers. However, the time defined in this way applies ***exclusively*** to sound and phenomena derived from it and to nothing else. For observers moving almost at sound-speed, the time shown on their (properly constructed) sound clocks passes considerably more slowly, but they obviously do *not* age more slowly.

The same would be true for any other choice: time would apply only to the process chosen for the time-determination and to all phenomena derived from it, but for nothing else.

Only with light is this different: the time relationships determined by light apply *universally.*

And only once this has been clarified do we face the crucial question:

Why is this so? Why does all of reality obey the spatial and temporal relationships determined by light?

And the answer is:

Reality obeys the relationships for spatial and temporal measures that are given by light because there is only the speed of light and phenomena derived from it.

Through the few propositions contained in this conclusion from special relativity, the foundations of physics are evidently completely transformed.

I will not yet present the obvious conclusions here, but only later, when they are confirmed and clarified by further arguments.

(The detailed version of my reinterpretation of special relativity is contained in the book Concept, beginning on page 63. In the book Structure, starting on page 164, it is explained how a reality in which there is an *absolute rest frame* can give rise to a description system in which all unaccelerated observers are equivalent.)

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1 One might object that all speeds are relativistically corrected anyway. However, this is not a ***derivation from the speed of light***, but merely an ***adjustment to the time system*** that results from the two postulates (special relativity and the constancy of the speed of light).

1.2. Why it is contradictory to assume a variable size of the universe

Size is a ***relational concept****:* something is ***compared*** to something else.

The universe, *by definition*, is everything that exists.

Therefore, it cannot be compared to anything *else*, but only to a ***part of itself***. So let's consider any such part – an arbitrarily chosen object that exists in the universe. Its size bears a certain ratio to the size of the universe.

Now, what does it mean if this ratio changes over time – or if it even tends toward zero or infinity?

Can I then claim that the universe is becoming infinitely large or that it is disappearing?

No, of course I can't claim that. It would mean setting the size of a *part* of the universe ***absolute***, which would be nonsensical: The universe is not only everything that exists, it also ***creates*** everything that exists within it.

Setting such a thing created by it *absolute* and using it to demonstrate the disappearance of that ***by which*** it was created – that is, the universe – is obviously **contradictory**: if the size of the universe is assumed to be ***variable***, then no part of it – no object that it created – can be attributed an ***absolute*** size.

Here, the logical and ontological primacy of the universe over every part of it when comparing size, is sufficiently clearly emphasized, and it follows that a change in the size relationship between the universe and the scale must always be at the expense of the scale, because otherwise one would commit a logical error.

Proposition:

The size of any object can be measured by another object, and if this measurement varies over time, then it can be claimed that the size of the measured object changes.

However, since the universe is everything that exists, its size cannot be measured by anything else but only by a part of itself. This means that if this measurement varies over time, then this change must always attributed to the part chosen as the measure. [2]

I consider this argument so compelling that it easily withstands the enormous financial, material, personnel, theoretical, and mathematical effort behind the standard cosmological model.

The following applies:

If there is no expansion of the universe, then there is also no Big Bang, no inflation, no associated multiverse, and no dark energy.

The assumption of the variable size of the universe must then be replaced by the assumption of the variable size of our unit of length. However, this requires that ***all*** units of measurement available to us change ***by the same factor***.

(The justification for this can be found in the book Structure, Chapter 10.)

Regarding the observation that led to the hypothesis of expansion – the increasing redshift with distance – the assumption of the decreasing size of the chosen unit of measurement over time is obviously equivalent to the assumption of the expansion of the universe.

2 Some physicists believe that the scenario just presented could be embedded in *another* coordinate system, which is independent of all existing entities, thereby justifying the variable size of the universe. This is nonsensical: without reference to *being*, it is neither possible to define a unity nor to determine its temporal evolution – asserting its constancy would be an unfounded postulate.

1.3. On the further approach

The initial motivation for my research was to resolve certain physical problems. The answers to philosophical questions then emerged – unexpectedly and surprisingly to me – as consequences of the change of the physical description system.

In my books, I have essentially adhered to this order. Now, however, I will proceed differently.

The reason for this is that deriving the physical results requires a complete analysis of the basis of reality, whereas answering the philosophical questions only requires a part of it. Furthermore, the path from the ontological basis to the resolution of these questions is usually short and direct.

Therefore, I have chosen the following approach:

I will initially develop the argument regarding the question of what the world consists of only to the extent necessary for solving the philosophical problems, and then address these problems. Only afterward will I turn to physics and continue the fundamental line of reasoning.

2. The incompleteness of natural science and its correction

2.1. The self-contradiction of natural science

One of the **fundamental assumptions** upon which natural science is based is as follows:

Everything that exists consists of elementary objects that interact with each other. How these objects behave is governed solely by physical laws and by nothing else.

Thus, the entire future development is determined exclusively by so-called "initial conditions" – the totality of the attributes of all these objects at any given time – and physical laws.

If this assumption is correct, then there is ***only physics***.

Causality is then always "below", in the elementary layer of reality.

All other, more complex layers have lost their independence. We still need descriptions that refer to such layers – for example, neural or psychological descriptions of our mental activity – but only because it would be impossible to represent this activity in a physical way; but that doesn't change the fact that *it is, in fact, physical in nature*.

This brings us to one of the cases of "specific blindness" I mentioned in the announcements: the inability to recognize a particular problem, which makes its solution more difficult or even impossible.

In the present case, it is this problem:

From the above assumption, it follows that we cannot argue or reason.

For it is evident that:

Every argument or conclusion presupposes that one thought follows from another thought.

But that is ***the definition of mental causality***.

To assume that we are capable of reasoning, therefore, means to ***postulate causality at the level of mental processes***. The idea that ***thinking itself*** leads to correct results obviously presupposes its

causal effect. How else could it be possible to *mentally* correct an error? If my thinking were not *itself* causal – would *physics* then correct itself?

One must therefore decide: causality lies ***either*** in thinking ***or*** in physics – both at the same time are not possible. Thinking would then be "causally overdetermined".

In other words:

Precisely what cannot exist according to the fundamental assumption of natural science quoted above – argumentation and reasoning – is constantly presupposed and practiced by philosophers and natural scientists; it is the basis of their existence.

Natural science is thus in a ***permanent self-contradiction***.

Proposition:

If all future development is determined exclusively by physical laws and initial conditions, then inferential reasoning, and consequently also natural science and philosophy, are impossible.

And from this follows:

Proposition:

In addition to initial conditions and physical laws, there must be another element in reality upon which the future development depends, but which is not taken into account by physics, and this means:

The current scientific view of reality is incomplete.

2.2. The missing element

What is this "missing element"? How can it be found?

Here we encounter another, quite fundamental blindness: In fact, the sought-after element of reality is completely visible and also generally known. Yet, it has so far been neither acknowledged by philosophy nor by natural science – presumably precisely *because* of its seemingly trivial self-evidence.

Its presence follows from the ***difference between reality and description***:

Proposition:

There is a fundamental difference between a really existing object and its description: The really existing object is active, while the description is not active.

Thus, the existence of real objects must include something ***from which*** their activity emanates, but which objects in a description lack.

This element of the existence of real objects I call substance.[3]

Therefore substance is that, which activates existing objects.

We now know that substance *must be there*. However, what it "**is**" cannot be defined, perceived, or imagined. It is ***unthinkable***.

3 I chose the term *substance* because – in my definition – it is a necessary condition for solving the philosophical problems that are historically associated with this concept.

The element of the existence of real objects that we can perceive, describe, and define is the ***way*** *in which they are active*, i.e. their behavior and their effects.

This element of their existence I call ***accidents***.

Natural science deals *exclusively* with accidents.

However, **substance is always <u>presupposed</u>:** We know that objects are **<u>activated</u>** by ***mass*** or by ***charge***, but we do not know what mass and charge "**are**".

The following applies:

<u>Proposition:</u>

Real objects consist of substance <u>and</u> accidents.

Objects in a description system consist <u>only</u> of accidents.

Since an object cannot *cease* to be active in its characteristic way, ***substance and accidents form an <u>inseparable unity</u>***. (The Earth exists only ***<u>with</u>*** gravity.)

<u>Every existing object</u> therefore consists of these two elements: of ***<u>substance</u>*** – that part of existence whose presence we recognize as necessary, but which, as what it actually "**is**", can neither be conceived nor defined; and of ***<u>accidents</u>*** – that part of existence that can be described and defined.

Let us now return to what I previously called the "permanent self-contradiction". The question is:

Can the element of reality just described serve to eliminate this contradiction?

The answer is ***yes***. As follows:

The fact that reality is ***active*** means: at any point at any time exactly what has to happen happens ***by itself***. It means that reality doesn't have to ***calculate*** anything, that it doesn't need a law or an algorithm, because it simply processes all individual cases at the same time. [4]

Obviously, however, *activity* is precisely that which cannot be transferred from the reality to its representation. It can be said that the *type* of activity of the system, its *specific structure*, must be contained in our equations of the gravitational field, but the *activity itself* is missing.

Let us note: Because of its *activity*, reality advances ***by itself*** from the present to the future. But the description system refuses to do us this favor. In order to obtain information about the future of the system in our description, we therefore need a *mathematical procedure* that ***substitutes*** the missing activity.

Do we have such a procedure?

Only in idealized, simplified scenarios. Every real event is determined by numerous processes – interactions between objects – that constantly influence each other. To be able to calculate any of these processes, however, we must assume, at least for a small time interval, that its immediate environment is constant – we must therefore *isolate* it briefly. Then we can do the same for all other processes, and then repeat the whole procedure for the next time interval, and so on.

The crucial point is that from start to finish we depend on *approximations*, and that we also do not know to what extent our calculations deviate from reality. At the latest after the next branching point – that is a point in the development of a system at which an arbitrarily small difference in the initial

4 It would be more than absurd to assume that a blade of grass ***calculates*** where it should move – it simply follows the wind that touches it.

conditions can lead to completely different states of the whole system – our prediction becomes pure luck.

To derive the future precisely, we would therefore have to make the successive time intervals of our calculations *infinitely small*, and that is impossible.

This means: ***There is no procedure that leads from the present to the future***.

Proposition:

The future development does not follow from physical laws and initial conditions.

But isn't *reality itself* constantly showing us that the future *follows from* the present? Not at all. What we see is just that the future "follows" the present. It is only this suggestive picture of reality conveyed by physics that leads us to believe that everything "follows from" initial conditions and laws. However, the expression "follows from" is a logical conjunction that can only relate to a description. To apply it to reality means to replace the "follows" that we observe with the "follows from" that we postulate; But we have to *justify* this act of substitution, and so we are forced to replace our "follows from" by a series of logical steps. Thus we inevitably end up with a mathematical procedure, and finally again with the fact that no such procedure exists.

Proposition

Physical causality is incomplete. There is room for causality in complex layers of reality.

This resolves the self-contradiction of the physical worldview, and the conclusions drawn so far also form the basis for solving the philosophical problems mentioned in the announcements.

2.3. Proof of Free Will

I will present the proof here in abbreviated form. The full version forms the first part of the paper Free Will.

We have just completed the first step of the proof:

We have freed the mind from the grip of physical causality by showing that the *activity* of reality cannot be replicated by logical or mathematical procedures, so the claim that everything *follows from* physical initial conditions and laws cannot be sustained.

The second step is to determine how causality in more complex layers of reality – I call it causality "from above" – is to be understood.

We consider a simple glass vessel. When we hit it, it vibrates and makes a sound. What does this tone depend on? What determines its height and character?

The answer is:

The shape of the vessel. It gives rise to a mathematical law that enables us to predict the vibration pattern of the glass. So here we don't have to go into the physical objects – the glass molecules – nor the physical interaction – the electromagnetism – in order to predict the sound. The only physical information needed is the speed of the sound propagation in the glass.

The law that now allows us to predict the future of the system is therefore *not a physical law.* It belongs to another kind of laws which I shall call ***Laws of Form*** or ***Laws of Structure***.

The sound that we hear is largely independent of the way we produce it. However, this does not apply to the first moment: initially, there is a transient process that depends on how we strike the vessel. Only after this process it does always vibrate in the same state.

This state to which the glass ultimately adapts – the vibrational pattern into which it develops and which it then maintains – is called ***attractor***.

However, most important for our considerations is undoubtedly the following:

The local parameters – such as the positions and velocities of the glass molecules – initially depend on where, with what and how hard we hit the vessel. So at first they can be quite different. Regardless of this difference, the state of the vessel always evolves towards the same vibrational pattern – the attractor.

In the case of a glass vessel, there is only one possible vibration pattern that always develops, regardless of how the vessel is struck. The future movements of the components of the vessel – the glass molecules – are therefore determined by this pattern.

Causality works from the whole to the individual, from the vessel to its components, and not the other way round.

Proposition:

A form of "causality from above" occurs when in a system *attractors* exist, i.e. states which the system will *inevitably* evolve into, if it is "close enough" to the attractor state.

Now we have made all necessary preparations to move on to our final and decisive scenario: *our own neural network*.

It consists of many billions of neurons. Each neuron is directly connected to hundreds or even thousands of other neurons, and through a few intermediate steps, all neurons are interconnected. Therefore, what we established above regarding the fundamental uncomputability of complex systems also applies to neuronal processes:

The high degree of interconnectedness of the neurons precludes the existence of a mathematical procedure for calculating the further development. Thus, physical causality is *incomplete*.

The next question is: Does the previously defined causality "from above" exist here?

We make the following assumptions:

1. Every kind of mental activity (thoughts, chains of associations, sequences of images, etc.) is a sequence of neural activation-patterns.
2. Sequences of neural activation-patterns can be representations of facts.[5]

Let us look at the neural patterns. How do they become representations?

Let us imagine a neural network in which there are no representations yet. An object perceived for the first time will cause a certain pattern in this network, starting from the primary visual cortex. The neural connections that are active are strengthened because of this very activity. The same is the case with each repetition. This gradually creates a stable connection between the object and a specific neural pattern (or rather an ensemble of specific neural patterns).

In addition, the following applies: Although the neural patterns are initially caused by external stimuli, after a sufficient number of repetitions they are also produced by the neural network independently of these stimuli. This means:

5 Here, "facts" must be understood in the widest-possible sense.

Neural patterns that are connected to objects in the manner just described are* attractors *of the network. (See also the associated note on page 15)

Previously we have stated:

Under the condition that the causality from below is incomplete, from the existence of attractors follows that the respective system – provided it is "close enough" to the attractor state[6] or in this state itself – is governed by causality from above.

However, according to our first premise, a mental process consists not only of neural patterns, but also of the transitions between these patterns. But to this transitions the same applies as to the patterns themselves: First, they are determined by the sequence in which the causative objects appear. If this sequence is repeated, the corresponding neural activity is reinforced, and this has the consequence that the patterns occur again in the same sequence even if they are generated by the network itself. In the same way, also the spatial relationships of the objects are transferred to the patterns.

This means: In the processes that are generated by the network itself, the neural patterns that are in a stable connection with specific objects appear in the same spatial and temporal contexts as the objects themselves. Therefore, *the patterns can be understood as representations of the objects, and the processes as representations of the facts in which the objects appear.*

So, in human neural networks it is not the physical or neural conditions and laws that determine what happens in the network, but *the structure of the network* – the fact which attractors there are and how their sequence is regulated – on which the processes depend that run in the network.

Causality acts from the whole to the individual, from the network on its components, and not the other way round.

We have thus achieved our first goal:

Proposition:

The neural network is regulated by *causality from above*. The mental level is the dominant level. In it lie the *causes* for the processes running in the network.

So the statements we made so far were *actually* conclusions and not just physical processes! Or – to follow up on the formulations used in the criticism of reductionism: Insights are insights, thoughts are thoughts, mind is set in its rights, *we ourselves* are indeed we ourselves …

So far, so good, but that doesn't take us to where we actually want to be. Just because we have moved causality up doesn't mean we are free. We have only replaced physical or neural causality with mental causality. We have thus achieved that our mind is not ruled by physical or neural laws, but *by its own law: the Law of Structure, which the sequence of neural patterns obeys that represent something*.

But don't we ultimately remain trapped in the scheme of initial conditions and laws from which we wanted to escape? Fortunately, that's not the case. To show this, we need to look at the difference between physical and mental laws:

As stated above, initially the order of the patterns is determined by the order in which the objects or circumstances that cause the patterns occur. But as soon as the network itself is able to produce these patterns, the transition rules of the patterns – what we have called the *mental law* – increasingly depend on their use in internal processes. This dependence on external and internal conditions means that the transition rules differ from person to person.

So we have already determined the first difference:

6 The neural network is always "close enough" to an attractor state: from *any* state, the network will immediately adjust to a pattern that *means* something.

*While physical laws are **generally valid**, mental laws are **individually valid** – they only apply to one singular person.*

Connections between neurons are strengthened when they are active, and weakened when they are inactive. This means that every mental activity alters the structure of the network. But if the structure can change, then obviously also the rules that determine the sequences of the neural patterns can change.

So this is the second difference: *Physical laws are **immutable**, mental laws are **modifiable**.*

Proposition:

Physical laws are universal and immutable. Mental laws are individual and modifiable.

With this, we are sufficiently prepared to substantiate our freedom:

We have shown that causality is to be found at the mental level. *Will* and *intention* must be understood as elements of mental causality. Now let us imagine concretely we were faced with an important decision. When we enter the decision-making process, we are initially guided onto certain, well-known paths by the regularities that are valid up to that point – i.e. by our own mental law.

But at any time we are able to leave these paths, for example by simply considering the opposite of what we have assumed up to then, or by taking a path we never tried before; We are able to do so precisely for the reason that the causes for what happens in the network – and thus also for the modifications of the network structure – lie at the mental level.

In other words:

The law that determines the sequence of neural patterns in our network that represent something, i.e. our own mental law, can be altered *by ourselves*: we ourselves can change the laws of our thinking and acting through our thinking and acting, and we can do it *deliberately.*

This means at the same time:

Although mental processes are governed by their own rules, it is not possible to derive a volitional decision from them: the decision cannot be contained in these rules because they can be changed by the mental process that precedes the decision. While this process is taking place, the laws that it obeys can change – or, more precisely, *it itself* can change the laws that applied before it started.

Proposition:

Volitional decisions are causes of actions. Since only by the decision-making process itself is decided what will happen, the decision is not determined beforehand.

So the decision is free.

To the question of why a (sane) person has decided so and not otherwise, there is then only one permissible answer:

Because he/she wanted it that way.

Note:

Of course this does not mean that volitional decisions cannot be analyzed with respect to their neural, chemical, physical, genetic, social, psychological etc. causes. It means, however, that these analyses necessarily remain incomplete and never lead to a secure result, because mental phenomena cannot be reduced to other layers of reality. The will remains the final authority.

Note:

In order to recognize objects, artificial neural networks must be trained on large data sets. In numerous repetitions the connection strengths of their neurons are varied until a sufficiently high recognition rate is achieved.

In contrast, we started from the following hypothesis:

A perceived object, which causes a neural activation pattern, is represented *by this pattern itself*. Therefore, here the relationship between object and representation is not established by varying the connection strengths of the neurons, rather it exists already from the beginning and is only stabilized and specified by *strengthening* the active connections, whereby the neural pattern becomes an *attractor.*

This hypothesis is confirmed most clearly by the so-called "imprinting". (As e.g. in the case of the gray geese of Konrad Lorenz). There are neither "large data sets" nor "numerous repetitions" – the process occurs almost instantaneously.

Furthermore, thereafter *immediate recognition* occurs, despite the inevitable variability of the sensory impression to be recognized. Thanks to the attractor concept, this – otherwise hardly explainable – performance becomes self-evident: as long as the sensory input is within the catchment area of the attractor, it obviously applies: *perceiving* = *recognizing*, since the newly activated attractor already represents the object, so that further calculations are unnecessary.

To the hypothesis that objects are represented by attractors, the following should be added:

The pattern that forms in the primary visual cortex as the consequence of a perceived object, is not *as such* transferred directly into the neural network. Rather, it is broken down into several components – in this sense *parametrized* – which, at the end of the whole visual data processing, are assembled to the overall neural pattern that we understand as attractor.

This parametrization is an important aspect of the attractor hypothesis: The attractor is defined by a subset of the phase space. The *attractor state* of the system corresponds to a trajectory that does not leave this subset for a certain period of time. However, already a (small) subset of all according parameter values – which do not even have to be very accurate – is sufficient for restoring the attractor state, which means: a *fraction* of the complete original sensory input is sufficient for recognition.

This makes recognizing objects extremely easy and, at the same time, increases the ability to generalize objects and facts.

Here is an example which demonstrates both aspects of our hypothesis: recognition after only one encounter and ability to generalize:

When a child sees a picture of a giraffe for the first time, it will later recognize not only the giraffe in this picture, but also all giraffes shown in other pictures. It is therefore in possession of the *general* under which all examples are subsumed.

2.4. The "Hard Problem": How is sensation possible?

(The full version is contained in the second part of the paper Free Will. There, however, it is combined with the proof against AI sensation. Here, I separate the two proofs.)

In the previous section on free will, we proved that the mental layer is the *causal layer* of the neural network.

The dynamics of the neural network is thus determined not by objects of the *physical layer* and their accidents: ***atoms***, ***molecules***, and ***physical interactions***, but by objects of the *mental layer* and their accidents: ***mental states*** that represent or mean something, and ***information processing***.

Previously we have established:

Every mental state is a neural activation pattern. These patterns are attractors of the dynamics of the neural network. Every mental process is a sequence of such patterns.

These statements address the question of how the objects and processes of the mental realm can be understood in terms of their *material preconditions*.

But now our task is to grasp them for what they are as *mental phenomena*.

The answer is:

Proposition:

Every mental state is a combination of two dissimilar elements: information and sensation.

Its **information** content is what it ***represents*** or ***means***.

Sensation must be understood here in the broadest possible sense: It stands for everything in a mental state that goes ***beyond information***, that is, for that which ***cannot be defined*** but can only be ***felt*** and ***experienced***.

Two examples: the frequency of the color "red" can be defined, but the sensation ***red*** cannot; the intensity of pressure can be defined, but the sensation ***pain*** cannot.

At this point, we must again address a "specific blindness," which here even appears in two forms:

Many natural scientists ***equate*** mind and information processing.

This is the first form of this blindness. It precludes a *scientific answer* to the question of what mind is, for the following reason:

Everything that ***can be defined*** is ***accessible*** through information processing; everything that ***can not be defined*** is, in principle, ***inaccessible*** to information processing: regardless of which function is applied to information – the result is always merely information and nothing else. The information "red" will *never* turn into the sensation ***red***, the information "pressure"will *never* turn into the sensation ***pain***.

And from this follows:

Proposition:

Mind is more than information processing.

The second form of blindness concerns the realm outside of natural science. Here, too, the view of sensation is completely obscured, albeit in a very different way: there are no justifiable answers to the questions of how sensation can be ***explained*** and ***whether*** or ***how*** its occurrence is ***possible***, but only strange constructs that owe their existence to the failure of all attempts at explanation.

However, I will not discuss the various positions – qualia eliminativism, panpsychism, consciousness as a separate or even fundamental form of existence, etc. – but will proceed directly to the conclusions that arise from what has been said so far.

In Section 2.2. The missing element, we have determined (on page 10):

Every existing object consists of an ***undefinable*** and a ***definable*** part, which are ***inextricably linked*** with each other: ***substance and accidents***.

The objects that are now the subject of our analysis are no longer objects of the *physical* realm, but rather objects of the *mental* realm of reality.

We must therefore apply the above statement to *these* objects; in other words, we must conceive of mental states as *inseparable units of substance and accidents*.

What is the substance of a mental state, and what is its accident?

Our starting point is the proposition:

Every mental state is a combination of two dissimilar elements: information and sensation. [7]

Evidently, ***information*** is that which is accessible to our thinking – that which ***can be defined***.

Thus, **information processing is the accident of the mental state**.

In contrast, ***sensation*** is that which ***cannot be defined***, that which therefore eludes our thinking.

Thus, **sensation is the substance of the mental state**.

And this means:

Sensation is the driving force behind the dynamics of the mind.

With this, all the preparations have been made to explain the occurrence of sensation. Before we begin, however, we must determine ***what*** is actually to be explained.

What do we mean by "explanation"?

For example: If I explain what a car is, then I describe its technical structure and thereby establish its function. The goal of the explanation is thus the definition of what is to be explained – the success of the explanation *presupposes* the possibility of definition.

Therefore applies: ***Since sensation is not definable, it cannot be explained.*** [8]

What we can explain, however, is why sensation exists and why it is "different".

We have already provided the *first part* of this explanation by determining sensation as the substance of mental states, which we understand as *inseparable units* of sensation and information.

From this follows that sensation is not only a ***possible***, but even a ***necessary*** element of the mind.

What is still missing, however, is the second, more important part of the explanation:

Why is sensation "different"?

2.5. Why sensation is unique

Why is sensation so fundamentally different from everything else we encounter in reality?

The usual question is:

"Why is there something indefinable in the mind, like 'color' or 'pain', and nowhere else?"

We ask ourselves the question instead:

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7 Here and in the following, "sensation" always refers, as stated above, to "that which is *not definable*, which therefore goes *beyond information*.

8 Here, too, there is a widespread blindness: many scientists are convinced that the rapidly growing knowledge in their field will one day be sufficient to *explain* sensation.

"Why does the indefinable, which exists <u>everywhere in reality</u>, change its character when it appears in the mind?"

So the question is not about the reason for the ***existence*** of this indefinable, which would be superfluous because – as we have shown – it can be found *in everything that exists* and is therefore self-evident, but about the reason for its ***change***.

In the first version, the question cannot be answered.

In this (false) form, it leads to strange hypotheses, such as *qualia eliminativism* or *panpsychism*.

But, as we will now show, in the second version the question can be answered.

Prerequisite for our argument is the following

<u>Proposition</u>:

As long as accidents of higher complexity can be described as functions of accidents of lower complexity, the associated substance remains the same. If this functional connection is broken, the substance changes. *For us* it then appears as a new, second substance.

Before we turn to proving this proposition, we must clarify to what extent accidents in more complex layers of reality can be described as functions of accidents in simpler layers.

For example, the processes in neurons can be described as functions of the physical and chemical properties of these neurons. (Which does not mean, however, that they can be *calculated*.)

The same applies in principle to all evolutionary transitions: from the physical to the chemical level, then to the biochemical, cellular, neural level, and even up to the realm of simple neural networks that do not produce mind: the processes taking place in such networks can be described as functions of their architecture and external conditions.

Only at the very last of these transitions – the transition to neural networks that produce mind – does the chain of reducibility end:

As we established when substantiating free will, then the following applies:

Initially the order of the neural activation patterns is determined by the order in which the objects or circumstances occur that cause the patterns. But as soon as the network itself is able to produce these patterns, the transition rules of the patterns – what we have called *mental law* – increasingly depend on their use in internal processes.

This means that the dynamics of the neural network – i.e. *the mind* – increasingly decouples itself from the causal chains of the environment and instead develops its own internal laws. *Mental causality* emerges.

And from this follows that the information content – i.e. the *accident* of mental states – can no longer be represented as function of the accidents of the underlying layers of reality.

Now to the proof of the above proposition.

The totality of physical accidents we will call ***first accident***, their associated substance ***first substance***, the totality of mental accidents ***second accident*** and their associated substance ***second substance***.[9]

We have just established that the accidents of all evolutionary levels can be traced back to the accidents of the levels below, with the exception of the accidents of the highest, i.e. the mental level.

9 However, that does not mean that there are two substances – rather, the second substance is thought of as emerging from the first substance, and the question we ask ourselves is therefore: Why is the *first substance* in the case of qualia transformed into the *second substance* sensation?

The following applies:

Substance and accident always form an *inseparable unity*.

The *first accident* is *inseparably* linked to the *first substance*.

If complex accidents can be reduced, step by step, to simpler accidents, then this means that they can ultimately be reduced to the first and simplest accident.

For us, however, *reducibility* is tantamount to *ontological identity*:

If B is reducible to A, then B **is** actually A. So if a complex accident is reducible to the first accident, then it **is** actually the first accident, and then it is *inseparably bound* to the first substance.

Thus as long as the accidents are reducible, the associated substance remains the same – it is then still *first substance*.

But if the chain of reducibility to the first accident is interrupted by the appearance of a new, *irreducible* accident, then this new accident differs from the first accident and from all other accidents that can be derived from it.

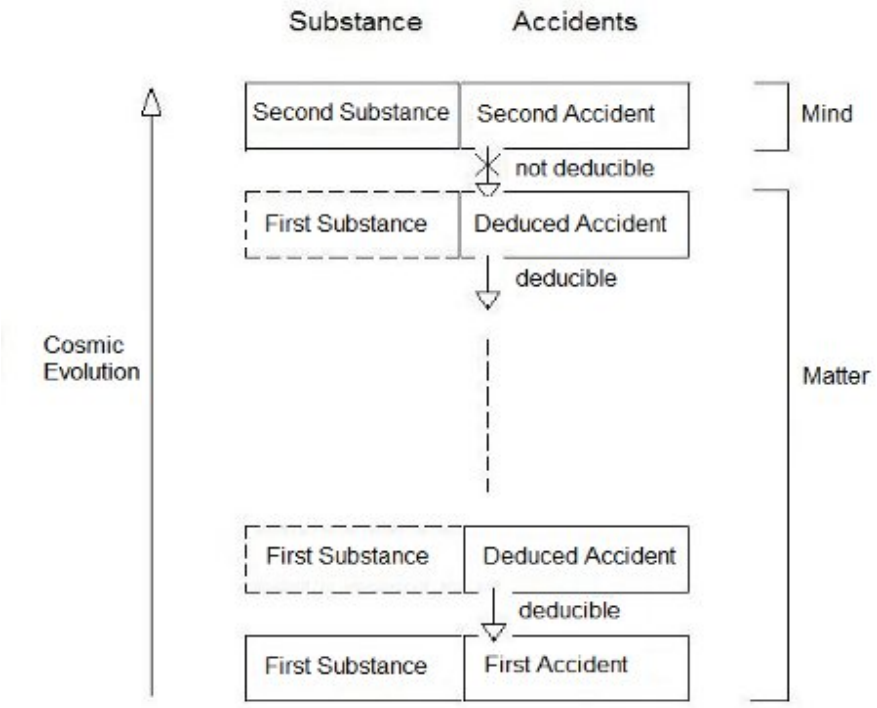
Due to the ***inseparability*** of first substance and first accident, it applies:

*If the substance of an object is the **first substance**, then the associated accident must be the **first accident**.*

And from this follows:

If an accident appears that is different from the first accident, then the associated substance must also be different from the first substance.

Here is a sketch for illustration:



With this, we have proven that sensation, the substance of the mind, is not physical, that it must therefore be something <u>other</u>, and the nature of the proof suggests that sensation is ***the only thing*** in the universe that is not physical.

Thus, everything that can be explained has now been explained:

As substance of the mind, ***sensation is necessary***, and because the change of the substance occurs only in the ***final*** evolutionary step – the emergence of mind – ***sensation is unlike anything else: it is <u>unique</u>***.

What it is, however, ***cannot be explained***. Substance is the *indefinable* part of everything that exists, and what is indefinable is not explainable. Still, although we cannot ***explain*** what sensation is, we ***know exactly*** what it is, because it is a ***part of ourselves***.

Yet this knowledge is not *conceptual*, *definable*, *communicable knowledge*, but *cognizance of what is immediately given*.

2.6. Why AI systems are not sentient

If mind is *equated* with information processing, which is consistently the case in AI research (blindness), then it follows that we are separated from creating an AI system with consciousness – which is also intellectually superior to us in every respect – only by *technical* and not by *principal* difficulties, which we will, so it seems, overcome in the near future.

However, this is wrong, because the just-given explanation for the *emergence of sensation* can be extended in a surprisingly simple way to prove that *AI systems are not capable of sensation*. And since **consciousness** is *not only information*, but ***information and sensation***, AI consciousness is also ruled out.

The proof begins with the following

<u>Definition</u>:

What an object is due to the inseparable unity of its substance and accidents, we call its <u>essence</u>. The activity that results from this unity we call <u>essential</u>.

(Thus the ***essential activity*** of the Earth is to exert gravity.)

The purpose of this definition becomes immediately clear when we now turn to *simulations*.

For example, consider a mechanical simulation of the solar system in which the model bodies are moved through mechanical devices – chains, gears, shafts, etc. – in this way mimicking the movements of the celestial bodies.

The *essential activity* of the model bodies would obviously be to *exert gravity.* But it is *not the mass of the model bodies* that drives the dynamics of the simulation – that is, what causes the desired movements – but *the mechanics we have constructed,* which must then be *activated*, electrically or mechanically (e.g. by turning a crank).

To express this point, we will refer to this type of activity as ***supplied activity,*** in contrast to the just defined ***essential activity***, which happens ***by itself***.

With this, the definition of ***simulation*** takes the following form:

The dynamics of a simulation – contrary to the original – <u>is not caused by the essential activity</u> that arises from the <u>inseparable unity of substance and accidents</u> of the objects of the simulation, <u>but by supplied activity</u>.

The accidents from which the dynamics of the simulation is formed are therefore *not* activated by substance: the substance of the objects of the simulation *is not the substance that belongs to these accidents* and with which it forms an inseparable unity, but only their *material basis* from which these accidents can be separated at any time. (As is immediately apparent in the mechanical simulation of the solar system.)

As we have shown in the previous section (see page 19), the ***inseparability of substance and accidents*** is a ***necessary condition*** for the transformation of the substance:

The transformation of the essence of being can only occur if the dynamics of the system arises from the ***inseparable unity*** of substance and accidents. ***Only then*** does the transformation of the associated substance follow from the fact that the accidents are no longer reducible to the first accident.

In ourselves, this condition is fulfilled: the substance is transformed – we have sensations.

But the dynamics of a simulation is based on *supplied* activity. Thus, the accidents are *not* activated by substance, and the substance that belongs to the objects of the system does ***not*** form an inseparable unity with these accidents.

And this means:

There is no reason for the transformation of this substance. It remains *first substance.*

In other words:

The essence of the simulation remains physical. The simulation remains an information processing system without sensation.

The metamorphosis of matter into mind does not take place.

The just mentioned condition that the dynamics of the system must arise from the *inseparable unity* of substance and accidents, does not only apply to the last, i.e. the mental level – it must be satisfied on *every* level that develops during the evolutionary rise from matter to mind. If on any of these levels the dynamics of the system is not caused by the *essential activity* of the objects but by *supplied activity*, then the unity of substance and accidents is torn and the transformation of the essence of being can not occur.

So what does this mean for our proof that robots cannot have consciousness?

For AI systems that are implemented using software on conventional computers, the proof is valid without exception: the use of software is always associated with supplied activity.

But what about a *replica* of a biological neural network that reproduces the neural (analog-digital) input-output law using suitable hardware and whose structure corresponds to the structure of the entire network, so that it could be assumed that the sequence of states of the *constructed system* would almost be identical with the sequence of states of the *biological system?*

Could the transformation into sensation take place here?

The answer is clearly ***no***. The condition for the transformation is not met: the dynamics of the replica is *not caused by* ***essential activity*** *but by* ***supplied activity***.

The problem is that from the usual scientific view of reality ***this fact cannot be understood at all***.

In this view, reality is *equated* with a – describable and definable – sequence of states, and it must therefore be expected that the increasing convergence of two sequences of states ultimately leads to the identity of the systems themselves.

However, in the expanded materialist view that we have presented here, the concept of existence is augmented by an element that takes us beyond the realm of the describable.

This means that all our descriptions and ideas about the processes in nature are necessarily *incomplete*. So to speak "behind the scenes" of the part of the stage that is accessible to us, something happens, which is either completely hidden from us or can only be recognized and understood through inference from the part of reality that is accessible to us: the accidents.

Here, reality is <u>more</u> than a sequence of states.

In the context of our considerations, this implies:

From the approximate identity of the state sequences of the natural system and the artificial system cannot be concluded that also their essence is approximately identical.

Concretely: The substance of the two systems can be quite different despite the extensive identity of their states:

In the ***biological system***, the substance is ***inseparably bound to the accidents of the system*** and is therefore ***transformed into the mental substance sensation.***

The ***constructed system***, however, is driven by ***supplied activity,*** and therefore here the substance stands in a merely constructed and *by no means inseparable* connection with the accidents of the system, so that it ***remains physical substance and is not transformed into sensation***.

The result of our conclusions is as follows:

<u>Proposition</u>:

It is not possible to construct an AI system that experiences sensations and has consciousness. Neither in a <u>simulation</u> nor in a <u>replica</u> of a system that produces mind can the transformation of matter into mind take place.

There is no ghost in the machine.

Thus only *artificial intelligence* can be constructed and not *artificial mind*.

Does this mean that it is impossible to create artificial mind at all?

No. Our argument only excludes the possibility that mind can be *constructed*. However, the definition of the term *replica* can be expanded to include artificial evolution, i.e. an evolution that is designed and controlled by us.

In this case – just as in natural evolution – the condition could be met that the respective system activity is always *essential*. If we do not intervene at any point in this artificial evolutionary process through constructions or by supplying activity, but limit ourselves to controlling and accelerating the development, then at the end of this evolution there *could* be a system that produces mind.

However, no one can know whether such an artificial evolution is possible, or whether the path that nature has chosen is the only viable one.

In any case, it is clear that the creation of artificial mind remains a very distant, perhaps never achievable future, if it is not impossible at all.

2.7. Sensation and Artificial Intelligence

I have defined the term "sensation" differently from its usual meaning. I would like to explain in a little more detail why this was necessary and what follows from it:

Every mental state contains something that is ***not definable***, which goes ***beyond information***.

However, since there is no term which all possible elements of mental states can be assigned to, I have instead chosen the term that comes closest to this missing term: ***sensation***.

Therefore, on the one hand here the term "sensation" is restricted compared to its common use – because it is supposed to contain *no information*, i.e. no *definable* part –, but on the other hand it is also significantly expanded.

Two examples were used for illustration: *color* and *pain*. Color, because the indefinability of the color sensation is a known fact, and pain, because it is perfectly understandable that the event "hammer blow on finger" triggers a mental state that contains not only the information "hammer head is in contact with finger" but *something more*: the sensation *pain*, which can be so strong that it is impossible to deny its occurrence.

"Sensation" understood in this way can be divided into three areas:

A) The first area is the area of *perception*:

Sensation encompasses the entire "inner theater": the virtual space, the stage on which we act, which is always present to us as a whole – as an "image" – and on which we see, hear, feel, smell and taste.

While there is little doubt that the sensation *color* cannot be defined, it may initially seem as if we are returning to the area of the definable, if our perceptual image is *colorless*: *gray values* are definable, aren't they? – Yes, they are, but the *sensation* associated with them *is not*: only the intensity of the light can be defined, and also the neuronal excitation that results from it. But when we move on to *perception*, we leave the realm of information: the *brightness* that we perceive is just as much a *sensation* as the *color*.

And the same applies to all other senses: the frequency of a sound can be defined, but the sound-*sensation* can not, etc.

This means:

If sensation is lacking, then there is no "inner theater", which is made up of sensations.

So to put it very clearly:

AI systems do not see, do not hear, do not feel, do not smell, do not taste.[10]

Unfortunately, our language is not suitable for distinguishing between system states *with* sensation and those *without*. For us, "seeing" or "hearing" simply means what it ***is*** for us, and that is in any case information ***and*** sensation. Therefore, *strictly speaking*, statements about perceptions are only correct if they refer to humans or higher animals, otherwise they are wrong: robots *do not see*, bees *do not see* – they only process frequency, intensity, and direction *information*. However, pixels that only transmit ***information*** about brightness and color cannot be combined to form an image, unlike the *same* pixels when their content is ***perceived*** as brightness and color: it is immediately clear that they can then be added together to form an image.

10 This also applies to simple animals, such as insects, for the following reason: We have shown that the emergence of sensation can only occur if the neural network develops its own, *internal* laws. A necessary (and sufficient) condition for this, however, is that the network contains *functionally unbound structures*, i.e. structures whose function is not determined genetically or by early programming. Only under this condition can (and will) the *network of neural states* (attractors) develop that we understand as *mind*.

For us, *having eyes* is synonymous with the *ability to see*. But this is wrong. For an animal that has a light-sensitive cell, the world is by no means *bright* – the animal only has the *information* about which direction the light is coming from.

B) The second area is the area of *feelings and moods*. Nothing further needs to be explained here.

AI systems experience nothing and feel nothing. They feel neither happiness nor unhappiness, neither love nor hate. They are neither cheerful nor sad, neither in a good mood nor irritated.

This list can be continued at will, since every mental state is a *quale*, i.e. consists not only of *information* but also of *sensation*.[11]

C) We have determined *sensation* as ***substance*** *of the mental state*. It follows that it must be understood as *cause of the mental dynamics*.

Accordingly, ***everything*** that drives our thinking and acting must have a component of *sensation*. There is no acting or thinking without a motive. Even purely logical reasoning can only take place if we ***want*** to find the correct solution.

Therefore applies:

AI systems cannot want or not-want anything. They know neither motive nor interest, neither curiosity nor rejection.

In this area, the lack of differentiation in language use is particularly problematic. Programmers speak of the "goals" or "intentions" of an AI system, of what it "strives for". In all cases, however, this is only an increase in a parameter value, and not *goals* or *intentions* as we understand them as elements of human action, which are always linked to emotions.

In summary:

1. ***AI systems cannot perceive anything***.
   They lack the *"inner theater"*, the *"image"* of the environment: they cannot *see*.
   Likewise applies: they cannot *hear*, *feel*, *smell* or *taste*. For them there is only *information*.
2. ***AI systems cannot experience anything***.
   They have no feelings.
3. ***AI systems cannot want anything***.
   They lack intentionality and motivation.

No matter what the future of AI may look like, due to the limitations mentioned above AI systems will *never* be a new, superior species. The dystopias in which we are at their mercy belong in the realm of fantasy.

Note about consciousness:

As already stated before, the following applies:

Everything that can be defined is attainable through information processing, *everything that can not be defined* remains unattainable for it: no matter what function is applied to information – the result will always be just information and nothing else; the information "red" will never turn into the sensation *red*, the information "pressure" will never turn into the sensation *pain*.

Therefore, "**information**" and "**sensation**" (as we used it above) form **the *only* pair of concepts** that makes it possible to draw a clear and definite line between artificial intelligence and human mind and to provide evidence for it.

11 Of course, there are also activities *without* sensation, such as reflex actions or automatically executed sequences of movements. However, these are not *mental* activities, but *neuronal* activities.

From this follows that the concept "consciousness", which is often at the center of the discussion, is only suitable for drawing this boundary, if the mental phenomena attributed to it (in its respective definition) are analyzed and classified according to their affiliation with *information* or *sensation:* the part of consciousness that belongs to information processing (e.g. any kind of self-representation) can be reproduced – no matter what technical difficulties stand in the way of its simulation, while the part that belongs to sensation remains inaccessible to AI.

It would therefore be an unnecessary and misleading complication to base the difference between AI and mind on the concept "consciousness".

3. The Unity of Reality

3.1. Mind and Matter

In the previous chapter, we extended the scientific view of reality by pointing to an element of reality that, while generally accessible and actually self-evident, has thus far been overlooked, leaving its significance for essential questions in philosophy and science unrecognized.

Our starting point was the *difference between reality and description:*

Reality is ***active***, description is ***not active***. Activity must originate *from something*. Therefore, the existence of real objects must include an element that objects in a description system *lack*. We have called this element ***substance***.

This expansion has enabled us to elevate causality from the physical to the mental realm, to prove the existence of free will, to establish the emergence of sensation – and thus, simultaneously, of consciousness – and, moreover, to explain why sensation is an essentially *different*, indeed *unique*, element of reality.[12]

Because the dynamics of the neural network is now determined not by physics but by the mind, mind – in this sense – no longer belongs to the physical reality: mental processes can no longer be considered as changes in the relationships of *physical objects* that obey *physical laws*, but must be understood as changes in the relationships of *mental objects* (qualia) that follow *mental laws*.

Sensation – according to our definition, "that which goes *beyond* information" – has here, as *substance* of the mind, the same status as *mass* in systems determined by gravity, or as *electric charge* in electromagnetic systems: just as mass and charge drive and guide *physical objects*, so sensation, defined in this way, drives and guides *mental states,* by activating and organizing them, and relating them to one another.

Through this expansion of the scientific worldview, ***sensation is integrated*** into this worldview:

Mind and matter belong to one and the same reality.

This solves the first part of the old ***substance problem***, the hitherto unanswered question:

How many substances – independent modes of existence – are there?

Does only matter exist? Or only mind? Or both? Or is there a third substance in which the general exists: the universals and laws, and mathematics?

Through our arguments and proofs so far, we have brought *mind and matter* together.

However, integrating the *general* requires a deeper analysis of the origin of reality, which we will now undertake in the following two sections.

12 It is remarkable that this did not require "expanding" physics itself – it was sufficient to highlight a fact that has been present in physics since its beginnings.

3.2. Where does the general come from?

The existence of the general is essential for natural science: without the general, there would be no laws of nature and no physics – and, as we will show later, no reality either.

Therefore, it is extremely disconcerting that to this day – after millennia of philosophy and centuries of physics – not even the slightest hint of an idea is discernible as to where the origin of the general might lie.

In the realm of our experience – that is, where physics originated – we encounter only *individual cases;* the general is nowhere to be found.

David Hume stated in 1740: "… that in no object, considered in itself, there is anything which could cause us to draw a conclusion that goes beyond the object; and that even when we have observed the frequent or constant association of certain objects, we have no reason to draw a conclusion that would concern objects other than those which have been given to us in experience" – and this statement remains valid.

If the general does not originate from the realm of experience, then it must be sought in a *deeper realm* – a realm that is logically and ontologically *presupposed* to the realm of experience.

In determining this realm, we build upon the two arguments presented in the first chapter: Two preliminary arguments.

The first argument, concerning special relativity, leads to the insight that, at the fundament of reality, only the speed of light exists. It follows that no "mass" in the usual sense exists here, and that therefore, at the fundament of physics, there can only be two basic units: meter and second. The unit kilogram can only be introduced later. (More on this follows in the physical part of this work.)

This argument is significant for the subsequent derivation insofar as it supports and confirms its conclusions.

The second argument, however, is important from the outset, as it excludes the existence of a "Big Bang."

Therefore, there is no initial event that is spatially and temporally localized (in nothingness!).

If we want to avoid the assumption that the universe simply "is there", then the only remaining option is the assumption that ***reality arises everywhere and anytime***.

This is what we will now examine.

We begin with the following consideration:

If we want to ***establish*** existence and not ***presuppose*** it, then we cannot begin with something that already exists *itself*.

That which brings forth reality must therefore – in the ontological sense – ***precede all existence***. It is thus ***not an object***.

It follows that we can neither define nor conceive it as what it "is," since our thinking cannot leave the network of relationships between objects.

Thus, to the origin of reality the following applies:

It is neither ***definable*** nor ***conceivable***.

Since it brings forth reality, we must ascribe ***activity*** to it.

And this means:

The element with which we have expanded our physical understanding of reality: ***substance, the indefinable, inconceivable part of existence from which the activity of all that exists originates,*** now confronts us at the very core of things.

Proposition

Substance is the origin of reality.

3.3. The derivation of the fundamental equation

Even if we cannot think the substance as what it "is", there still is – as has been shown – the possibility to say something *about it*. The following three statements are required for the description of the emergence of reality.

(1) *Substance* produces reality. It is the source of the *activity* of things. Therefore we must also attribute activity to it itself. *Substance **is** activity.*

(2) Distinction presupposes comparison. Therefore, prior to all existence, there is no distinction. So *in itself*, substance must be *indistinguishable*.

(3) That the substance is *active* means that it abolishes its indistinguishability: Substance is *that-which-changes*. In changing itself, the substance creates differences and thus rises to existence.

According to (1), substance is the *origin of reality.*

Given this assumption, how can we get to a *description of reality?*

By changing from the *origin of reality* to the *origin of the description of reality* – or, to put it philosophically: by changing from what the substance is *in itself* to what it is *for us*.

Our task is therefore to determine that, which has the same status for the description of reality as the substance has for reality itself.

What is the substance? The logical and ontological presupposition of reality.

What are the logical and ontological presuppositions of the description of reality?

Space and time.

This means: Space and time are for the description of reality the same as what substance is for the reality itself. *For us*, substance **is** space and time.

According to (3), substance produces reality by changing itself. Therefore, we begin building our description of reality with the description of a change.

The first question is: *What* is changing?

That which the substance is *for us:* space and time. (Since we are still *before* all existence, it *can* only be space or time that changes.)

The second question is: *How* do we represent this change?

According to (2), substance is *in itself indistinguishable*. So there is no structure and no memory. This means that every temporal change can only relate to the previous moment, and every spatial change can only relate to an immediately adjacent position. Changes must therefore be represented as *differential quotients*.

Let us start with a change of space. How can space change in the description? Only by changing its length or angle.[13]

First to the change of the length measure:

We define σ, the ***metric density of the length***, as follows:

Let r be a spatial coordinate. Then

$$\frac{dr}{\sigma(r)} = dr' \qquad \Leftrightarrow \qquad dr = \sigma(r)\, dr'$$

– where r' denotes the same spatial coordinate after the metric change. σ is dimensionless.

So we set for the first change:

$$\text{Change 1} = \frac{d\sigma}{dr}$$

However, it is clear that *one* change is not enough to establish a description. Since without change there would be Nothing, something must follow from the first change, and this consequence must again be a change of the substance itself, i.e. of space or time.

Our first change was a change of space. As second change, we need another change, different from the first, that is: a change of time.

Therefore we set for the second change:

$$\text{Change 2} = \frac{d\zeta}{d(ct)}$$

where ζ denotes the ***metric density of the time t***.

For dimension reasons – which will become clear below – c t must be set instead of t, where c is a constant that has the dimension of a velocity. ζ is dimensionless.

Based on the statements about the substance, we have now determined two changes, assuming that the second change follows from the first. However, since it still holds that without change there would be Nothing, we are again compelled to continue the chain of changes.

In our scenario only space and time can change, and both we have already used. This means that the chain of changes, in which each change follows from the previous one, can only become perpetual if from the second change in turn follows the first one.

We thus get

$$(\text{change 1} \Rightarrow \text{change 2}) \ \textit{and} \ (\text{change 2} \Rightarrow \text{change 1})$$

It follows change 1 = change 2

So the equation we have arrived at is

$$\boxed{\frac{d\sigma}{dr} = \pm \frac{d\zeta}{dct}} \qquad \text{or} \qquad \boxed{\frac{d\sigma}{dr} = \pm \frac{1}{c}\frac{d\zeta}{dt}} \qquad (0)$$

13 As it turns out, changes in the length measure lead to gravitation, changes in the angle measure lead to electromagnetism and atomic structure..

In words:

The spatial change of the metric density of length is proportional to the temporal change of the metric density of time. Proportionality factor is the velocity c.

Hitherto we have only determined the consequences of the change of the *length measure*. Now we need to do the same for the change of the *angle measure*.

So we now define η, the ***metric density of the angle***, analogous to σ:

Instead of the definition $\frac{dr}{\sigma(r)} = dr' \quad \Leftrightarrow \quad dr = \sigma(r)\, dr'$

we therefore get $\frac{d\alpha}{\eta(r)} = d\alpha' \quad \Leftrightarrow \quad d\alpha = \eta(r)\, d\alpha'$

Then Equation (0) turns into

$$\boxed{\frac{d\eta}{dr} = \pm \frac{d\zeta}{dct}} \qquad \text{or} \qquad \boxed{\frac{d\eta}{dr} = \pm \frac{1}{c}\frac{d\zeta}{dt}} \qquad (0')$$

Equations (0) and (0') represent, what the process of generating reality is *for us: the law from which reality is woven*, or, to put it another way, *the fundamental equations*, where "fundamental" means that everything that can be derived at all must be derivable from this equations and additional metric assumptions.

I would like to pause here and make a few points that seem important to me.

> If c is identified with the speed of light, then the two equations establish the importance of the speed of light.
>
> If gravitation is defined as the change in the metric density of length so that mass has the dimension length, then Newtonian gravitation follows from equation (0) in a few steps, and after a few more lines, the perihelion precession of planetary ellipses is obtained in accordance with general relativity. (Structure from page 36)
>
> Analogously, from equation (0'), which results from the change in the metric density of angle, follows a definition of electromagnetism that leads in a simple way to an atomic model identical to the quantum mechanical atomic model. (Structure from page 171)
>
> In both cases, it can be explained *geometrically* what *actually* happens and why it happens.
>
> Gravitation and electromagnetism have the same origin. Both theories are purely metric. They require no further "unification." (I will address the issue of quantization in detail in the physics part.)

With this, we have described the *emergence of reality* to such an extent that the *origin of the general* can be derived from it, and also far enough that the basis of my construction of reality is recognizable.

However, I will add the next step in the derivation because it will make it more concrete where the line of reasoning leads.

(The complete derivation can also be found in the book Structure, beginning on page 20.)

In order for equations (0) and (0') to serve as basis for a physical description of reality, they must be transformed into *dynamic equations* – without motion there is no change. The easiest way to do this is to interpret the dimensionless quantity ζ as quotient of two velocities. One velocity is already present in (0) in the form of the constant c. So we also use c in defining ζ. We set:

$$\zeta = \frac{v}{c}$$

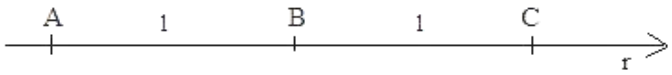
c is the constant, v is the variable. Equation (0) then turns into

$$\frac{d\sigma}{dr} = \pm \frac{d\frac{v}{c}}{d(ct)}$$

$$\boxed{\frac{d\sigma}{dr} = \pm \frac{1}{c^2}\frac{dv}{dt}} \qquad (1)$$

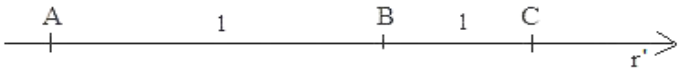
A sketch for illustration. It shows that (1) is an obvious consequence of (0). [14]

Let A, B and C be three points along the coordinate r. The distances between A and B and between B and C are equal to 1.



(S1)

Here, σ is constant. Now we change the situation as follows:



(S2)

The *distances* have remained equal to 1, but the *length of the measuring unit* has increased between A and B and decreased between B and C.

This means: the *metric density* σ is greater between B and C than between A and B.

What results in (S2) for B? According to (1), a flow arises which I call ***metric flow***, i.e. B experiences an acceleration for which – because of the possibility of positive and negative sign in (1) – initially the direction is still open. We let us guide here by the idea that B is accelerated back to the center of AC. This means that in (1) the negative sign has to be chosen:

$$\boxed{\frac{d\sigma}{dr} = -\frac{1}{c^2}\frac{dv}{dt}} \qquad (1)$$

Note the difference between the metric density σ and the "normal" density ρ: In the case of ρ there is a fixed value ρ_0 so that the magnitude of the acceleration is determined by the magnitude of the deviation from that value. So here, there is an *absolute* measure, ρ *has a memory*. If σ corresponded to a normal density ρ, then the amount of the change in density would depend on the initial density.

14 Setting the metric density of time as v/c is also motivated by the fact that the speed v then contains the entire metric information, i.e. the information about how lengths and times change depending on v. This leads to the relativistic structure of reality.

To eliminate this dependency, instead of (1) would have to be set

$$\frac{d\rho}{dr}\frac{1}{\rho} = -\frac{1}{c^2}\frac{dv}{dt}$$

In contrast, the metric density σ cannot have such an absolute value – it would be nonsensical to ascribe an (absolute) density to a continuum. So there is no absolute measure here, and the factor $1/\sigma$ is omitted; σ *has no memory*. There is no absolute metric density, there are only density relations.

In the same way, as we have just transformed (0) into a dynamic equation, we must also transform equation (0'). Instead of

$$\zeta = \frac{v}{c} \qquad \text{we now have to set} \qquad \zeta = \frac{w}{c}$$

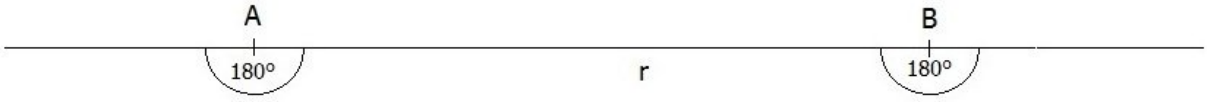
– where w is a velocity *orthogonal* to r. The reason for that is, that here not a *length* is changed, but an *angle*.

Equation (0') then turns into

$$\frac{d\eta}{dr} = \pm \frac{d\frac{w}{c}}{d(ct)}$$

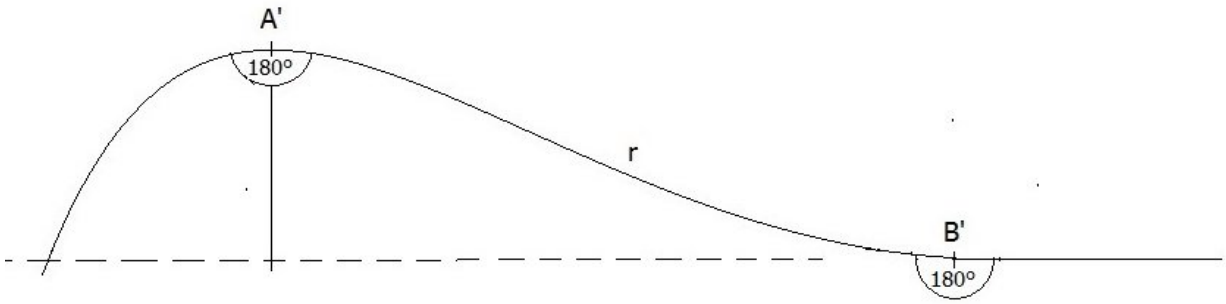
$$\boxed{\frac{d\eta}{dr} = \pm \frac{1}{c^2}\frac{dw}{dt}} \qquad (1')$$

Also here a sketch for illustration: A and B are two points on the coordinate r. The angles drawn at A and B are 180°:



(S3)

Here, η is constant. Now we change the situation as follows:



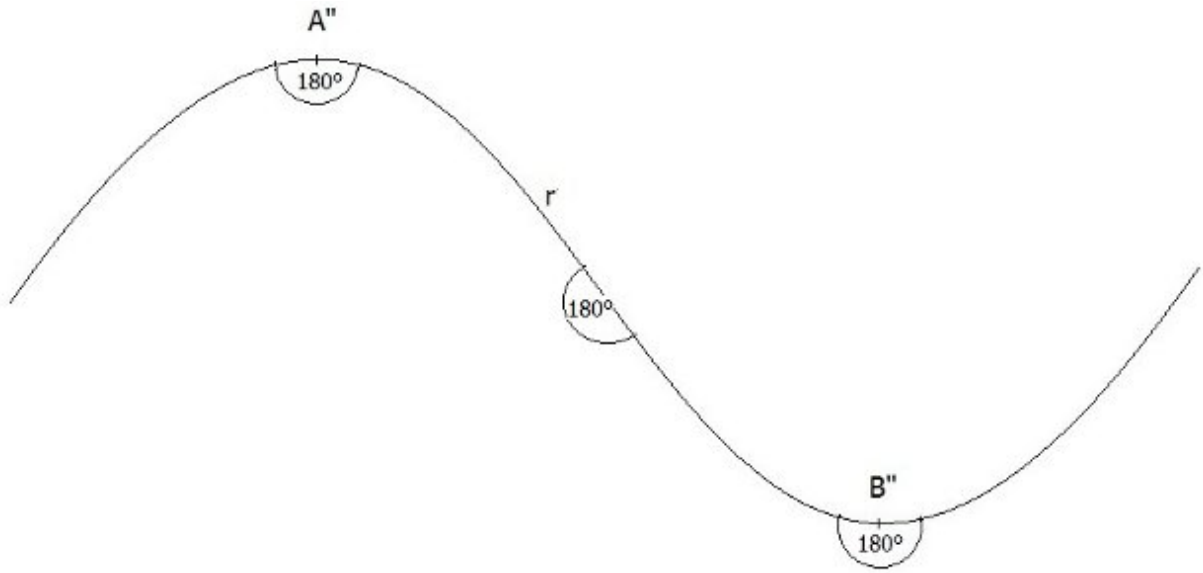
(S4)

The angles have remained equal to 180°, but the *angle measure* at A' has decreased compared to the angle measure at A. This means: at A', the *metric angle density* η is *greater* than at A. In contrast, at B' the angle measure has increased; therefore the angle density is *smaller* at B' than at B.

What results in (S4) for A'? According to (1'), a *metric flow* arises, so that A' experiences an acceleration, but this time *orthogonal to* r. Here again we assume that the negative sign is to be chosen. It follows

$$\boxed{\frac{d\eta}{dr} = -\frac{1}{c^2}\frac{dw}{dt}} \qquad (1')$$

The following sketch shows that transverse waves can be understood as *waves of the angle density*, if the change of the wave amplitude is interpreted as *metric change of the angle*.[15]



(S4b)

This concludes this derivation. The aim was to put ontological conclusions into a mathematical form suitable as basis for physics. The proposition we have arrived at in this way reads as follows:

Reality is a differential web of metric changes in space and time that are mutually dependent. Everything that exists and that occurs – every object, every interaction, every process – is a pattern of these changes, a state or a process of spacetime.

At this point of our considerations, this proposition is based solely on the analysis of the origin of reality. In the following, we will take some steps to make it more concrete.

From what has been said so far, ***5 types of waves with light speed*** can be derived (Structure from page 29):

waves of the longitudinal metric flow v

waves of the transversal metric flow w

– and three further types of metric waves:

waves in σ, the metric density of the length

waves in η, the metric density of the angle

waves in ζ, the metric density of the time.

15 From this follows that electromagnetism can be traced back to metric changes – just like gravitation. (Structure from page 179)

3.4. The origin of the general

(Everything that will be said about equation (0) in sections 3.4 and 3.5 applies equally to (0')).

Equation (0) describes how reality arises from a state that ***precedes*** all existence: ***prior*** to all existence, substance is *in itself indistinguishable* – there is no structure, no memory, and no size.

We must transfer these attributes to what substance is *for us*, that is *space and time*. It follows that in this state a) there is no way to define a position, b) no way to mark a point in time, and c) no way to define units of length or time.

This means that in this state it is impossible to distinguish whether (0) describes a particular case or a general fact.

With respect to a) and b), this conclusion is self-evident. For c), it can be demonstrated by a simple example:

Let P be a point in a plane with coordinates x_0 and y_0. Let $x_0 = y_0$. Then P is a point on the 45° line through the origin.

However, if there is no unit of length, then the position of the point on the line becomes arbitrary; in other words, without defining a unit, point and line are indistinguishable.

That is to say: ***Without defining units, particular and general are equivalent***.

This is exactly the same in the case of equation (0). Thus, from what has been said so far follows:

The two-part statement:

[*(0) holds for* ***one*** *point in spacetime with a* ***specific*** *value of the two differential quotients*] (and)
[*there is no way to determine position, time, and size*]

is equivalent to the statement:

[*(0) holds for* ***all*** *points in spacetime with* ***arbitrary*** *values of the two differential quotient*s]

Thus, a fact expressed by (0) is simultaneously particular and general. Here, the particular and the general are indistinguishable.

Just as the substantiation of existence requires going back to the state ***prior*** to all existence, so too does the substantiation of causality and the possibility of natural laws.

It is the only way to justify the general.

Substance generates reality by abolishing its indistinguishability. *For us*, this abolishment of indistinguishability relates to *space and time*.

The differential connection represented by equation (0), which permanently creates the fabric of reality, has no memory and knows no size.

In bringing reality into being, it simultaneously generates memory and size.

In this way, what was previously ***particular*** – abstract fact – ***and at the same time general*** – fundamental law – becomes the **particular**: that what is the case; but only *for us*; *in itself*, that what is the case – the particular – always contains the general ***within it***.

Proposition:

In the equation of the process that brings reality into being, particular and universal are indistinguishable. Thus, every individual case carries within it the general – as an inheritance of the state from which it originates.

3.5. Answers to the questions about the natural laws

All fundamental questions about the laws of nature remain open to this day.

They are as follows:

1. ***Why*** *do they exist?* 2. ***Where*** *do they come from?* 3. ***Where*** *are they?* 4. ***How*** *do they determine the behavior of objects?* 5. ***Why*** *are they the way they are?*

Regarding equation (0)) – the fundamental law of nature – we have answered questions 1, 2, 3, and 4 in the three preceding sections:

1. ***Why*** *does the fundamental law of nature exist?*

It follows from the statements about that which produces reality – about ***substance***.

2. ***Where*** *does it come from?*

Same answer as for 1.

3. ***Where*** *is it?*

It is ***in everything that exists***. Every individual case contains the general within it. It is never merely an individual case, but always also an embodiment of the law.

4. ***How*** *does it determine the behavior of objects?*

Same answer as for 3.

Finally, to question 5:

5. ***Why*** *is the fundamental law of nature the way it is?*

The following applies:

Equation (0) follows from the three *a priori* valid, general statements about substance. Each of its components represents the *simplest* way to fulfill the condition from which its occurrence follows. This means that anything that could be changed or added to Equation (0) would be unfounded or superfluous and therefore also inadmissible, for the following reason:

Equation (0) represents the necessary and sufficient conditions for the *emergence of reality.* Therefore, it may only contain precisely what is necessary and sufficient for *describing* the emergence of reality.

In short, the answer to question *"5.* ***Why*** *is the fundamental law of nature the way it is?"* is as follows:

Equation (0) is the way it is because only in this form does it correspond *for us* precisely to how reality arises *in itself*.

Now that all questions concerning the fundamental law of nature have been answered, the question arises:

What follows with regard to other laws of nature? The answer is:

Everything that can be derived from equation (0) and additional *metric* assumptions inherits all five answers from this equation – the answer to question *"5. Why is the law as it is?"*, however, only if the *principle of necessity* is once again observed in the respective derivation and everything *superfluous* is avoided.

If equation (0) *actually* represents the process of generating reality, then this applies to the entire description of reality, insofar as it can be derived.

The extent to which this relates to my description system will become clearer in the following.

3.6. Philosophical summary: The change in our view of reality

First – by proving the existence of free will and by establishing the existence of qualia – we showed that mind and matter belong to the same reality.

Then we showed that the general exists in all objects and facts: only *for us* are they nothing but individual cases, but *in themselves* they always also contain the general, which they owe to their origin in *substance*, in which the particular and the general are indistinguishable.

Therefore, **there is only one substance**. *In itself*, it is **all of reality**. *For us*, it is divided into a *conceivable* and an *inconceivable* part.

The conceivable part, I call *accidents*, the inconceivable part, I still call *substance*, because it stands for what substance is *for us*: indeed the *unity* that the inconceivable part forms together with the accidents is itself inconceivable; we only *know* of it, and we express this knowledge through the term *inseparability.*

Substance is that which makes the accidents ***active***.

Mass, **electric charge**, and **sensation** are thus **manifestations of substance**.

In our description of the *origin of reality*, we have already attributed ***activity*** to that which brings forth reality: to the **substance**.

In this fundamental layer of reality, substance is therefore the driving force behind the *metric changes of spacetime*.

In the physical realm, it becomes that which drives physical systems, that is: *mass* and *charge*.

In the mental realm, it is that which causes the mental activity: *sensation*.

The inconceivable part of existence thus ***changes*** as being ascends to ever more complex forms.

However, since we can perceive and conceive change *only* through accidents, this change is inaccessible to us and therefore remains hidden*,* until it finally manifests itself within ourselves: as ***sensation***, which we still cannot define, but whose nature nevertheless we know precisely, because our consciousness is an incessant stream of qualia: of our mental states, which are inseparable units of sensation and information.

Inseparability has ultimately proven to be the criterion that allows us to draw a clear line between *artificial intelligence* and *human mind:*

In biological neural networks, developed by evolution, substance and accidents form an *inseparable unity*, but not in constructed neural networks, and this means:

Within ourselves, the substance is <u>transformed</u>. We have sensations and consciousness.

But in AI systems, the substance <u>remains physical</u>. AI systems are insentient and unconscious.

If we understand "transcendence" as that which lies *outside the realm of the conceivable and definable*, then we realize:

The transcendent is not somewhere "outside" – it is *within ourselves*.

It is therefore neither inaccessible nor hidden – it *reveals* itself to us; indeed, it is the only thing of which we know *exactly* what it is because it is a part of ourselves: **sensation**.

3.7. Why there is Something and not Nothing

From the conceptual definition of substance, it can be deduced why anything exists at all, that is: why there is Something and not Nothing.

We have established:

Substance is that which ***precedes*** all existence. However, that which precedes all existence cannot itself already exist.

So, firstly, we can state:

Substance ***does not exist***.

On the other hand, it applies:

Substance is that from which the **activity** of existing objects originates.

However, from something that does not exist no activity can originate; from Nothing, nothing can originate.

So, secondly, we can state:

Substance ***does not not-exist*** either.

Therefore applies:

Substance does neither exist nor not-exist.

We have determined substance as that from which everything that exists arises.

Therefore applies:

The origin of being does neither exist nor not-exist. It is neither Something nor Nothing.

Everything that exists can ***be*** or ***not-be***.

To the origin of being, which is itself no being, this alternative does not apply.

However, ***beyond*** the alternative of *being or not-being*, or *Something or Nothing*, there is no further alternative.

Therefore, that which is not in the alternative of being or not-being is ***necessary***.

This means:

Proposition:

The origin of everything is necessary, and with it that what emerges from it, that is: being.

For if there were Nothing, then the origin of being would also be Nothing, and that has been previously excluded.

4. Physics fails to capture the causal structure of reality

I have chosen to dedicate the now following part on physics to the description and critique of what I consider to be the fundamental problem of the kind of physics we know – that is, the kind of physics that has developed since Galileo and Newton and that arises from the observation and quantification of experienceable phenomena. This critique is, at the same time, an analysis of the fundamental difference between my description system and standard physics, and it contains the reasons why I chose this system and why I consider it necessary.

It may be that the beginnings of *any* kind of physics must lie in the realm of experience, but it is equally clear that all physics must, at some point in the course of its development, detach itself from the conceptual and mathematical constraints of this realm.

Why? – For the following reason:

> The existence of the general is a ***necessary condition*** for the possibility of natural laws and causality. The existence of natural laws is beyond doubt. Therefore, **the general exists**. However, in the realm of experience, it is ***untraceable***: here, there are only individual cases.
>
> Thus, *beneath* this realm – as its logical and ontological ***precondition*** – there must be another, ***fundamental*** realm in which the general exists or in which at least its origin is recognizable.
>
> But if the realm of experience does not contain the causal structure of reality, then the description of reality originating from the realm of experience cannot contain this structure either – at least not as long as its basic concepts refer to elements from this realm.
>
> Just as the realm of experience itself, so too does the description of nature that arises from it require a logical foundation in which the true causes lie for the regularities that are discovered through experience.

The arguments presented in the philosophical part of this work provide a more precise picture of the facts just described:

In sections 3.2 and 3.3, we argued that the fundamental realm is *generated from a state prior to all existence*, according to equations (0) and (0').

In 3.4, we showed that the origin of the general lies in this process of generation:

Since the process described by the two equations is what brings reality into being, *it itself* also belongs to the state prior to all existence. In this state, there is no way to determine position, time, and size, so it is undecidable whether the two equations describe particular cases or general facts: here, the particular and the general are ***indistinguishable***. What the process generates is therefore ***both at once***.

Thus, the following holds:

The process that generates reality produces particular cases that contain the general within themselves.

In the state prior to all existence, ***there is no mass in kg***, since it cannot be defined in this state. (If it existed, its existence would negate the indistinguishability and thus prevent the existence of the general.)

But if this state contains no mass, then the ***fundamental realm of reality generated from it cannot contain mass*** either.

The fundamental realm is therefore purely metric: there are only the units meter and second.

Mass has the dimension length: gravitational acceleration is caused by a change in the length measure. (See my book "The Structure of Reality", page 36ff.)

Electric charge also has the dimension length: Electromagnetism is caused by a change in the angular measure (the arc length). (Structure from page 171)

It follows that all entities derived from experience, whose definitions require the unit kg – such as ***mass, charge, force, energy, momentum, action,*** etc. – **are not present** at all in the fundamental realm, which contains the general and thus also the causal structure.

In the fundamental, causal layer of reality, nothing exists that corresponds to these physical concepts.

The only way to introduce the mass in kilogram is to weigh an object whose geometric mass m (in meter) is known and thus determine the numerical ratio of the geometric mass m to the usual mass M (in kilogram), which is thereby – in this sense – *defined*. (It holds that: $m = MG/c^2$)

So "defining" here means:

Establishing a connection between the abstract quantity "geometric mass" and the specific experience we know as "weight" and "inertia".

This definition, however, is based on an act of measurement, i.e. on a *individual case*, and thus the known limitation applies again: Experiences from individual cases cannot be generalized to universally valid laws, but only to testable hypotheses.

For practical physics, this fact is of little importance, but theoretically it is of extraordinary significance, because it reduces *universally valid metric laws* down to the status of *working hypotheses* when the mass in kilogram is introduced, and this means:

Proposition:

The mass in kilogram does not belong to the causal structure of reality. This also applies to any equation in which terms appear that contain the unit kilogram.

This corresponds to the fact stated in the title:

Contemporary physics misses the causal structure of reality. The descriptions do not capture the causes of what happens.

This problem extends directly to interpretations and explanations:

To explain a process means to describe ***what*** happens and ***why*** it happens, i.e. to know its ***causes***.

But we have established:

Entities corresponding to physical concepts whose definitions include the unit kg do not exist in the causal realm of reality.

And from this follows, apparently, that based on current physics, it is almost always ***impossible*** to causally interpret and explain processes described by physical equations.

What follows from all this? And how can a physics whose fundamental concepts fail to capture the causal structure of reality be so successful?

The answer is:

What has been said above does not imply that the equations in which these concepts appear are *quantitatively false,* it only means that they cannot contain the *true causes* and that nothing can be *explained* by them. Thus, concepts that presuppose the unit kg do not need to be abandoned – only their current status as *necessary elements for describing and interpreting reality* needs to change:

They are necessary only insofar as they link the description of reality with experience, and the connection between physics and the realm of experience must be maintained because we expect physics to explain and justify our experiences.

The most important goal, however, is to recognize the *causal structure* of reality, and for this, the current fundamental concepts of physics are not only superfluous but *unsuitable* – and, moreover, their use in interpretations and explanations *completely prevents* the recognition of the true causes.[16]

This initially extreme-sounding claim will be illustrated and substantiated in the following sections by analyzing some stages of the path that theoretical physics has taken since 1900, a path in which it ultimately lost sight of reality for precisely this reason.

Beforehand, however, as a brief introduction, I would like to describe how I myself came across these connections:

I arrived at equation (1) via the philosophically motivated equation (0)

$$\frac{d\sigma}{dr} = -\frac{1}{c^2}\frac{dv}{dt} \qquad (1)$$

and I didn't know where it would lead me. The only available units are meter and second; the only available parameters are the metric density of the length σ and the metric density of the angle η.

It seems natural to define mass as *metric compression of the length* in the following way:

A spherical object with geometric mass m (in meter) reduces the radius of the region of space it occupies by m units – where m is the radius of a black hole with (Newtonian) mass M (in kilogram).

(Let's consider the Earth as an example. We assume that its radius is exactly 6370 km and that it is perfectly spherical. It is therefore bounded by a spherical surface with this radius. Now we remove the Earth from this spherical surface. Then the radius of the spherical surface increases by 8.86 mm, meaning it moves outwards by 8.86 mm everywhere. (8.86 mm is the radius of a black hole with the mass of the Earth.))

This means: If, for a point outside a central mass m, the distance to the center *without* the mass m is equal to r, then *with* the mass m, this distance is only r – m.

Thus, to the metric density σ in the exterior space the following applies:

$$\sigma(r) = \frac{r - m}{r} \qquad (2)$$

16 I would like to note – in advance – that quantum theory, ***correctly interpreted***, accomplishes precisely what is needed here: *it **reduces** physical concepts derived from the realm of experience to concepts of the fundamental realm*, which are elements of the causal structure. What in the usual quantum-theoretical descriptions is uninterpretable and inexplicable becomes then perfectly comprehensible.

Unfortunately, this has not been recognized; the usual concepts have continued to be used not only for mathematical descriptions but also for interpretations, and to this day they obscure the true facts. I will discuss this in detail below.

(2) differentiated with respect to r yields

$$\frac{d\sigma}{dr} = \frac{m}{r^2} \qquad \text{According to (1)} \qquad \frac{d\sigma}{dr} = -\frac{1}{c^2}\frac{dv}{dt} \qquad \text{therefore applies:}$$

$$\boxed{\frac{dv}{dt} = -c^2\frac{m}{r^2}} \qquad (3)$$

If m in (3) is understood as *geometric mass* ($m = \frac{MG}{c^2}$), then follows

$$\frac{dv}{dt} = -\frac{MG}{r^2} \qquad (4)$$

This acceleration corresponds to the Newtonian gravitational acceleration caused by a central mass M. From this, the Newtonian fall velocity (for the fall from infinity) can be derived:

$$\boxed{v = \pm c\sqrt{\frac{2m}{r}}} \qquad (5)$$

Furthermore, this approach also allows to go beyond the Newtonian approximation: from here, a simple path leads to a value for the rotation of the planetary ellipses that agrees with the value calculated from GR. The path to the Schwarzschild solution of the GR is also short and simple.

However, I will stop here. Everything else can be found in the book Structure starting on page 36.

In the *metric derivation* of gravitation, the relationship between geometric mass and normal mass arises, so to speak, "by itself", since the geometric mass m is known from the Schwarzschild solution.

However, this is not the case with the *purely metric derivation* of the atomic structure:

Here, I first defined the metric analogue to "normal" spin by *replacing* kilogram with meter. Since the normal spin has the units kg m^2 s^{-1}, the metric spin has the units m^3 s^{-1}.

The derivation of the metric spin leads to the following result: (The metric versions of the known quantities are marked with *)

$$\text{Spin}^* = \pm \tfrac{1}{2} W^*_{\text{Planck}} = \pm \tfrac{1}{2} \hbar^* \qquad (W^*_{\text{Planck}} \ldots \text{metric quantum of action}) \qquad (6)$$

– that is, to a result that is identical to the standard result – except for the substitution of the unit kg by the unit meter. (Structure pages 200-205)

(Furthermore, in the metric scenario, it is perfectly clear why an electron only returns to its original state after a rotation of 720°. As follows:

With negative charge, the metric angular density η increases, thus the angle measure decreases, and thus the measured circumference of the entire circle increases. It turns out that at a distance of the Bohr radius – i.e. on the first electron orbital – the angular density is exactly twice as large as in normal space, so that the circumference of each circle is not $2\pi r$, but $4\pi r$, and the same applies to all other orbitals.

In the metric model, it is therefore self-evident that for the "electron" in the ground state as well as in excited states, a complete rotation is always 720°.)

Just as in the case of equation (6), the transition from Newton's equation (4)

$$\frac{dv}{dt} = -\frac{MG}{r^2} \qquad \text{or} \qquad \frac{dv}{dt} = -c^2 \frac{M}{r^2} \frac{G}{c^2}$$

to its metric analogue can be interpreted in a way, that in M and in G the unit kg is ***replaced*** by the unit meter. What remains then from the factor G/c^2 is just a dimensionless number $q \in \mathbb{R}$:

$$\frac{dv}{dt} = -c^2 \frac{M^*}{r^2} q$$

However, as a result of defining the metric mass M* as M* = m (the radius of the black hole with mass M)[17], it holds that q = 1, so that we again obtain equation (3)

$$\frac{dv}{dt} = -c^2 \frac{m}{r^2} \qquad (3)$$

– the metric analogue to (4). The metric mass m, i.e. the *metric compression by m units*, thus leads directly to the Newtonian acceleration.

The ***gravitational constant***, which had two functions: adjusting the units and adjusting the numerical value, thereby ***disappears***.

As equation (3) shows, in the metric description it does not exist. From a metric perspective, its sole purpose is to link the purely metrically derived gravitational acceleration to the realm of experience.

However, by this act a ***non-derivable natural constant*** is added to the description of reality.

This fact alone already provides strong evidence that the realm of experience does not contain the causal structure of reality and that the unit kilogram is not part of this structure.

What I wanted to show with the two examples also applies to my entire description system, including all arguments and derivations:

My description system of reality is based <u>exclusively</u> on the units meter and second.

In this way – and ***only*** in this way – is the problem avoided with which this chapter began:

All derivations take place in the *fundamental realm*, which contains the causal structure and is the *prerequisite* of the realm of experience. Physical concepts that contain the unit kilogram – which means that they relate to entities that *do not exist* in the fundamental realm – do not appear in the derivations. They are only used when a result is to be expressed in the conventional way for comparison with the standard result.

As demonstrated in the two examples, it is possible to *replace* kilogram with meter – in the physical quantities themselves and in the equations that contain them. The metric result then has the same form as the standard version, but its meaning changes, since it now contains the unit meter instead of the unit kilogram.[18]

But now let us turn to the examples from the history of physics after 1900, which – based on the arguments of this chapter – demonstrate with almost dramatic clarity the extent to which physics has lost touch with reality, for the reason that the facts listed above are completely unknown.

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17 In the Schwarzschild solution of the GR, the geometric mass is equal to 2 m. The factor 2 is missing here because the representation is non-relativistic. It appears at the transition to a relativistic description.

18 This suggests that the unit kilogram can be replaced by the unit meter throughout all standard physics. (More on this in the book Structure, pages 226-229)

5. The loss of reality

At the end of the 19th century, physics seemed largely complete. Most of the scenarios physicists had in mind could be satisfactorily described, and only a few remained to be explained, such as blackbody radiation or the photoelectric effect.

Planck, Einstein, and Compton finally succeeded in mathematically representing these scenarios in accordance with experiment, but only by ***quantizing*** the generation and absorption of radiation by atoms and molecules (Planck) or even the radiation itself (Einstein and Compton).

I begin with the photoelectric effect.

5.1. The photoelectric effect

First, the experimental facts:

When a metal plate is irradiated with UV light whose frequency exceeds a certain threshold, electrons are released without measurable delay, their speed depending solely on the frequency of the radiation.

This blatantly contradicts the wave model of light, according to which the speed of the electrons should depend on the intensity of the light and their release should occur at any given frequency. Moreover, an enormous delay (many hours under realistic conditions) would have to be expected before the first electron is released, assuming that the light energy incident onto an area of the order of the electron's cross-section must accumulate to the required value.

Einstein's solution, as is well known, is to describe the interaction between light and electron as a ***collision process between particles***: a photon (light quantum) with frequency ν_L and energy $h\nu_L$ (where h is the Planck constant), and an electron bound with energy A, which must be equal to the displacement work.

From the energy balance, the following relationship arises:

$$h\nu_L = A + \frac{m_e v^2}{2} \qquad (1)$$

A ... displacement work, v ... velocity of the electron after the interaction)

When the interaction is represented in this way, the result agrees with the experiment. Therefore, it is justified to consider this a successful description.

From our perspective, however, the "success" is limited to the *quantitative* aspect. As explained in the previous chapter, what "really" happens is completely missed by Einstein's description:

All three terms of the equation contain the unit kilogram: h [kg m^2 s^{-1}], A [kg m^2 s^{-2}] and m [kg] are therefore elements of the physical description that have *no equivalent* in the fundamental realm of reality: what they describe *does not exist there*.

Einstein's equation thus misses the causal structure of the event, and the interpretation that belongs to this equation is false: (See also the associated note on page 50)

There is no collision process of particles. There are no "light quanta".

So what actually happens?

In order to get the correct answer, we must rely on a description based *exclusively* on the units meter and second. Only then do we remain within the causal metric realm.

This can be achieved in the following way:

The electron is assigned a frequency, which we denote by ν. For a stationary electron, we set

$$y = \cos 2\pi\, t\, \nu$$

For an electron moving at velocity v, the Lorentz transformation yields

$$y = \cos 2\pi \left(t\, \nu \frac{1}{k} - x\, \nu \frac{v}{c^2} \frac{1}{k} \right) \qquad \left(k = \sqrt{1 - \frac{v^2}{c^2}} \right)$$

The frequency ν_e of an electron moving at velocity v is related to the frequency ν_{e_0} of a stationary electron as follows:

$$\frac{\nu_e}{\nu_{e_0}} = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{1}{k} \tag{2}$$

For nonrelativistic electrons, v is small compared to c and therefore the following holds:

$$\frac{1}{k} = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \approx \frac{1}{1 - \frac{v^2}{2c^2}} \approx 1 + \frac{v^2}{2c^2} \tag{3}$$

Now let's consider the interaction. First, we'll look at the interaction between light and a free electron.

Let ν_{e_0} be the frequency of a stationary, unbound electron *before* the interaction, and ν_e the frequency of the electron moving at velocity v *after* the interaction.

We form a superposition of the oscillation representing the electron's state of motion

$$y = \cos 2\pi\, t\, \nu_{e_0}$$

and a plane wave that represents the light

$$y = \cos 2\pi \left(t\, \nu_L - x \frac{1}{\lambda_L} \right)$$

From the identity

$$2 \cos a \cos b = \cos(a + b) + \cos(a - b) \tag{4}$$

follows that, as a consequence of the superposition, we obtain two waves with the frequencies

$$\nu_{e_0} \pm \nu_L$$

where ν_L is the frequency of the light.

The higher frequency must be the frequency ν_e of the electron that is *accelerated* by the interaction; thus, according to (2), it follows that

$$\nu_e = \nu_{e_0} + \nu_L = \nu_{e_0} \frac{1}{k} \qquad (5)$$

(The second wave will be discussed subsequently)

Then $\nu_L = \nu_{e_0} (\frac{1}{k} - 1)$ and according to (3)

$$\nu_L = \nu_{e_0} \frac{v^2}{2c^2} \qquad (6)$$

This is our important interim result:

Also in our simple wave superposition, the electron's velocity after the interaction depends solely on the frequency of the light.

[For the second frequency we would have to set

$$\nu_e = \nu_{e_0} - \nu_L = \nu_{e_0} k$$

However according to (3) $k \approx 1 - \frac{v^2}{2c^2}$

and we again obtain $\nu_L = \nu_{e_0} \frac{v^2}{2c^2}$

The frequency of the second wave would therefore correspond to the frequency of an electron, whose velocity is *reduced* by v as a consequence of the interaction, which means: it would be –v. Since we assumed a stationary electron – so that ν_{e_0} cannot be reduced any more – this part can be omitted.]

In order to transfer our idea to the interaction between light and a bound electron, now we only have to insert the frequency difference δ_ν between a bound and a free electron into (5)

$$\nu_e = \nu_{e_0} + \nu_L - \delta_\nu = \nu_{e_0} \frac{1}{k} \qquad (5')$$

Equation (6) then turns into

$$\boxed{\nu_L = \nu_{e_0} \frac{v^2}{2c^2} + \delta_\nu} \qquad (6')$$

This is our final result, which – according to our assumptions – follows from what <u>actually</u> happens: <u>from a superposition of wave</u>s.

(6') contains only known and measurable parameters, and it agrees with Einstein's solution, which can easily be verified by multiplying by h:

$$h\nu_L = h\nu_{e_0} \frac{v^2}{2c^2} + h\delta\nu \qquad (7)$$

It applies: $$h\nu_{e_0} \frac{v^2}{2c^2} = m_e c^2 \frac{v^2}{2c^2} \qquad (8)$$

So we get to $$h\nu_L = \frac{m_e v^2}{2} + h\delta_\nu \qquad (9)$$

– and that is identical with $$h\nu_L = A + \frac{m_e v^2}{2} \qquad (1)$$

Let us now compare the two models – the usual one, which is analogue to a mechanical impact, and the one proposed here, which is conceptualized as wave-superposition.

In the mechanical impact model, the fact that the velocities and, accordingly, the energies of the electrons after the interaction are always identical and depend only on the light frequency necessitates the well known interpretation, i.e. light particles, which are defined by frequency and are always identical and indivisible, interact with electrons. (If the light particles were divisible or different from each other we should see also electrons with different velocities after the impacts.)

In the wave model, on the contrary, this fact is self-evident: here, the "electrons" leave the metal plate in a continuous process, *as waves,* whose frequencies follow from the superposition of light waves and electron waves. Thus, according to equation (4), after the interaction no other frequencies (i.e. no other energies and velocities) are possible – wave superpositions do not permit other results.

This means: in the wave model it is obvious why the amplitude of the light and its intensity don't matter, and also why no delay occurs until the first measurement takes place: the superposition process starts immediately.

For the derivation of our final result (6'), only two presuppositions are required:

1. Both light and electron are waves.

2. The Lorentz-Transformation applies.

Otherwise, no physical assumptions are included in the derivation.

Only at the multiplication of (6') with h, for the step from (6') to (7):

$$\nu_L = \nu_{e_0} \frac{v^2}{2c^2} + \delta_\nu \qquad (6')$$

$$h\nu_L = h\nu_{e_0} \frac{v^2}{2c^2} + h\delta_\nu \qquad (7)$$

– and for the physical interpretation of (7), the terms ***action***, ***energy*** and ***mass*** are used, as well as the relationship between these terms and the frequency

$$h\nu = mc^2 = E$$

With other words:

For the description of the interaction between light and electron in the Photoelectric Effect the assumption is sufficient that both partners are waves. Not only the assumption of light quanta is superfluous, indeed *all* physical concepts and relations can be dispensed with. Only at the transition to a mechanical description of the usual kind, the concepts appear, which otherwise are the indispensable basis of the description: mass, kinetic energy, total energy.

Therefore, here the descriptions by waves and by particles are not at the same level. Instead they have a hierarchical relationship: The wave description comes first – it is *fundamental*, the particle description is subordinated – it is *derivative*.

Thus in this case the equations $E = h\nu$ and $p = h/\lambda$ do not prove the wave-particle dualism; they are **definition equations** of the quantities energy and momentum.

The concept energy is reduced to the concept frequency, and the concept momentum to the concept wave-length. (More to that will follow in Chapter 6. Quantum Theory.)

It is obvious that, if this interpretation – which arises quite naturally at the Photoelectric Effect – is sustainable, then *formally* nothing changes, but conceptually *everything* changes.

Let us summarize. It has been demonstrated that the Photoelectric Effect can be described in two ways:

1. According to the mechanical impact model. Both interaction partners are understood as particles.

   Then either a *dualistic* position has to be taken (quanta which carry the whole energy are embedded in the waves – this was the point of view of Einstein, de Broglie and later of David Bohm), or *complementarity* has to be assumed (this is the so-called Copenhagen interpretation).

   The dualistic position leads to explicit non-locality, the Copenhagen interpretation leads to the relinquishment of any kind of understanding.

2. By superposition of waves. Both interaction partners are understood as waves.

   Concerning radiation, the interpretation difficulties connected with the positions mentioned in Point 1 disappear. Neither dualism nor complementarity need to be resorted to.

For the moment, all of that applies only to the Photoelectric Effect. The next step we must take at our branching off from the historical path of physics is testing our model assumptions at the scattering of high frequency light (X-rays) on electrons.

5.2. The Compton-Effekt

At the scattering of X-rays on electrons, two effects are observed, which do not seem to be in accordance with the assumption that light is just a wave.

1. The wave-length of the scattered radiation is greater than the wave-length of the incoming radiation.

2. The scattering angle distribution is asymmetrical with respect to the forward and backward direction.

In 1922, Arthur Compton described the scattering of X-rays on graphite as impact process of light-particles and electrons.

He derived the measured difference between the wavelength λ_2 of the scattered radiation and the wavelength λ_1 of the incoming radiation, which depends on the scattering angle ϑ :

$$\lambda_2 - \lambda_1 = \lambda_C (1 - \cos\vartheta) \qquad (\lambda_C \text{ Compton wave-length of the electron})$$

under the assumption that *light particles are scattered on electron particles*.

The difference between the Compton Effect and the Photoelectric Effect, seen from the conventional viewpoint, is that at the PE the photon is *absorbed*, i.e. its total energy is passed onto the electron, whereas at the CE the photon is *deflected* and loses only a part of its energy.

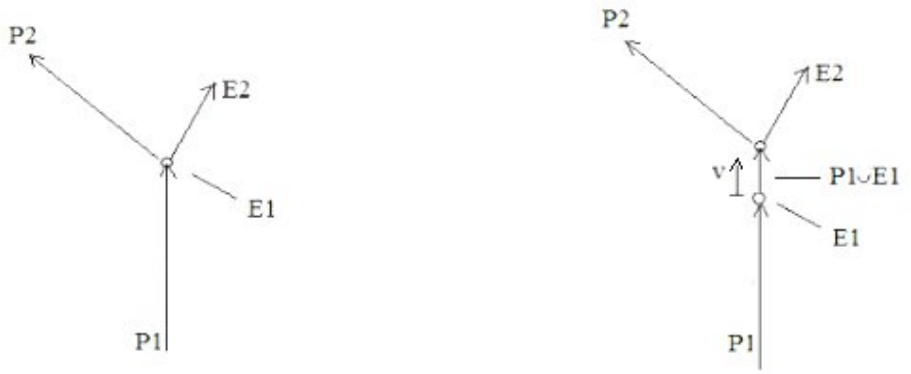
From our viewpoint, the difference between the two effects consists in the fact that at the PE both waves form a persistent superposition, whereas at the CE they separate again.

Therefore, seen in this way, the scattering process photon-electron proceeds in two steps:

A: The photon hits a resting electron. Both waves form a superposition.

B: The two waves separate again.

In the following outline, to the left the scattering seen as particle impact, to the right our two-step variant:



(S1)

P1∪E1 denotes the short-time state where both waves are united (superimposed).

Thus the whole process can be described as follows:

The resting electron E1 unites with the photon P1. Hence it turns into E_+. (E_+ = P1∪E1). E_+ moves with velocity v. E_+ emits the photon P2 and turns into the electron E2.

Let us denote the laboratory system as the reference frame S.

Now let us look at the scattering process from a reference frame S', which moves with velocity v relative to S, and with respect to which E_+ is at rest. (Thus E1' moves with –v relative to S'.)

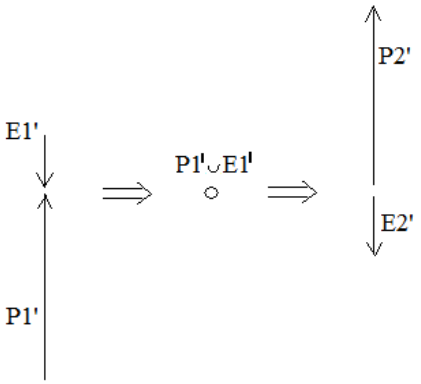
An electron moving at v has a de Broglie wave-length

$\lambda_B = \lambda_C \frac{c}{v} k$ (λ_C ... Compton wave-length of the electron, $k = \sqrt{1-\frac{v^2}{c^2}}$)

Therefore with respect to S' applies:

(1) The wave-length of E1' is $\lambda_C \frac{c}{v} k$

We remain in S'. We look at first at the case where both waves separate exactly along the straight line on which P1' was moving towards E1':



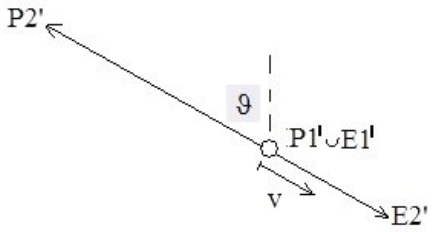
(S2)

Obviously, in this case the separation process SP(0°) represents the inverse of the uniting process UP, and this leads to

P2' = P1' and E2' = E1'.

Thus E2' moves with velocity –v with respect to S' (exactly as E1' before); in the usual description, P2' would be just an *unscattered* photon.

Now we turn to an arbitrary separation direction ϑ. With respect to S', after the separation P2' and E2' again move away from each other along a straight line:



(S4)

Compared with the separation process SP(0°), the separation process SP(ϑ) is only *rotated*, but unchanged in any other respect. Thus it is the *same* process, and the absolute value of the velocity of E2' in S' is therefore again |v|, and the Photon originating from SP(ϑ) is – except for the direction – identical with the one that originates from SP(0°).

Combined with what has been said just before, it follows:

(2) With respect to S' holds: Except for the direction, the light waves P1' and P2' are identical.

Therefore, $\lambda_{P1'} = \lambda_{P2'}$ for all scattering angles ϑ.

At last we need the following:

In S', E1' moves with velocity –v. E_+ is at rest.

Our next question is: E_+ is the superposition state of the two waves P1' and E1'. If E_+ is at rest, what follows with respect to P1?

The de Broglie wave-length of the electron $\lambda_B = \lambda_C \frac{c}{v} k$ is a relativistic phenomenon: Due to the Lorentz transformation of an in-phase oscillation to a system moving with velocity v, the phase coincidence is canceled and a phase-wave with just this wave-length emerges. If the movement generated in this way should disappear, then this phase-shift must be annulled.

Let us look at the short-time superposition E_+ of the waves representing P1' and E1':

According to (1), E1' is represented by (f_e ... frequency of the resting electron)

$$\cos 2\pi \left(t\ f_e \frac{1}{k} + x \frac{1}{\lambda_C} \frac{v}{c} \frac{1}{k} \right) = \cos 2\pi \left(t\ f_e \frac{1}{k} + x \frac{1}{\lambda_B} \right)$$

P1' is represented by

$$\cos 2\pi \left(t\ f_{P1'} - x \frac{1}{\lambda_{P1'}} \right)$$

If we now set the wave-length of P1' equal to the one of E1':

$$\lambda_{P1'} = \lambda_B = \lambda_C \frac{c}{v} k$$

then, according to the identity

$$2 \cos a \cos b = \cos(a + b) + \cos(a - b)$$

we obtain, as the result of E1' ∗ P1', *two waves* (in the same way as in the Photoelectric Effect):

In the first wave, the x-term disappears, which means that the phase shift is in fact canceled and that, therefore, the velocity of E_+ is indeed equal to 0.

The second wave would move, seen from S, *opposed* to the direction of the incoming photon, but at the same time its frequency would be reduced compared to the frequency of the electron E1 that rests in S, which would be impossible. As in the Photo Effect, also here this second possibility is inapplicable.

Therefore we can state:

(3) With respect to the reference frame S', the incoming photon P1' has the wave-length

$$\lambda_{P1'} = \lambda_B = \lambda_C \frac{c}{v} k$$

Now we must just transform from S' back to the laboratory system S.

In order to calculate the wave-lengths of P1 and P2, we need the relativistic Doppler Effect with respect to an arbitrary angle ϑ, which has the following form:

$$\lambda' = \lambda \left(1 - \frac{v}{c} \cos\vartheta\right) \frac{1}{k}$$

In our case is $\lambda_{P1} = \lambda_{P1'} \left(1 - \frac{v}{c}\right) \frac{1}{k}$

and, because of (2) $\lambda_{P2} = \lambda_{P1'} \left(1 - \frac{v}{c} \cos\vartheta\right) \frac{1}{k}$

From this follows $\lambda_{P2} - \lambda_{P1} = \lambda_{P1'} \frac{1}{k} \frac{v}{c} (1 - \cos\vartheta)$

If we now insert the value of $\lambda_{P1'}$ from (3), we get to

$$\lambda_{P2} - \lambda_{P1} = \lambda_C (1 - \cos\vartheta)$$

and this is the desired result.

What about the asymmetry of the distribution of the scattering angles?

In S', all scattering angles are equiprobable, which means: equally distributed between 0 and 2π. For the laboratory system S follows then the observed, with the frequency of the incoming photons increasing asymmetry of the distribution of the scattering angles.

Thus also in the description of the scattering of high frequency light on electrons it was possible, without any physical resources and prerequisites, only based on the assumption that both light and electron are waves, to derive the correct result. Since this result is given here in the form of a wave-length difference, it was – other than at the Photo Effect – never necessary to change over to the usual "mechanical" description. We did not even need to *mention* the concepts energy and mass.

So we have described the two experiments, by which the wave-particle dualism was brought into physics, solely by wave superpositions. The assumption of light particles could be dispensed with.

Note:

Although Einstein's description of the photoelectric effect as a collision of particles is only the first step toward the quantization of light, it already foreshadows all the problems, or rather, absurdities, to which this view necessarily leads. The reason for this is precisely the postulate of the indivisibility of the particles: it then leads to the absurd assumption that, in experiments where only a single particle is traveling and yet interference is observed, this *indivisible* particle exists in two different places at the same time. The inevitable consequence of this "interpretation" is the realization that our concepts – or indeed *any* concepts at all – are inadequate to describe the foundation of reality. What remains of this so-called interpretation is therefore a mere prohibition of thought and questioning. Reality vanishes.

In Chapter 4, we established: *Descriptions, in which terms appear that contain the unit kilogram, may be quantitatively correct, but they fail to capture the actual, causal processes.* Precisely this is the case here: There are neither "particles" nor "collision processes".

And, therefore, such problems do not arise in our alternative, *purely metric description* by waves. Here, only the absurdities disappear, not the reality.

5.3. The Quantization

Photoelectric effect and Compton effect are crucial milestones on the path to a principle of modern physics that is now taken for granted: *quantization*.

"Quantization" is the element of theoretical physics that has determined its development to an almost unbelievable degree – in some instances, almost exclusively. The main reason for this is that in order to achieve the most important goal of physics – the unification of the description of nature – it seems necessary to adapt general relativity to the formalism of quantum theory, that is, to "quantize" it.

In the course of decades of striving for unification, a mathematical structure emerged whose relationship to reality is unclear, but which is of such complexity that many physicists now assume that such rich mathematics *must* – if only it were developed sufficiently – ultimately contain the structure of reality.

From the standpoint adopted in this work, both the motive behind this development and the resulting view of the relationship between mathematics and reality are *fundamentally wrong* for several reasons:

1. From the arguments and deductions presented so far, it follows that the foundation of reality is *continuous*. ***There is no quantization*** – at least not in the ontological sense that this term has in physics. Only the *measurements* are quantized.

The justification for this was given in Chapter 4:

In the fundamental realm of reality, which contains its causal structure, the mass in kilogram does not exist. The term "particle," however, is the epitome of the physical entities that contain the mass in kilogram: *mass, charge, force, work, momentum* – all of these originate from experiences with "ordinary" objects, whose mass in kilogram makes them "experienceable". The concept "particle" is a projection of this everyday concept of an object onto the realm of the small and the *very* small, where objects of this kind *do not exist*.

The causal realm of reality is not quantized. There are no "particles" in it.

Any explanation of a physical process that presupposes "quantization" or includes the term "particle" misses the ***causes*** *of what happens. (Consider the photoelectric effect and the Compton-Effect: there are no "particle collisions", only wave superpositions.)*

Proposition:

The phenomena commonly referred to as "particles" are stationary states of waves – standing waves or oscillation regions of standing waves separated by nodal surfaces – or transitions between such states.

Outside these states, there are only traveling waves or diverging wave groups; the term "particle" then loses its meaning.

Since the identity of the "particle" generated by a transition and subsequently measured by a reverse transition is thus negated, the assertion of its existence between generation and measurement is misleading.

Traveling waves are **never** "quantized"; they are **never** "particle-like".

Standing waves are **always** "quantized", but not in the ontological sense assumed by theoretical physics; rather, their changes *appear* abrupt – like "jumps" – in observations and measurements, but the underlying processes are **always** *continuous*.

2. The waves that appear in my description of reality are ***not probability waves, but actually existing metric waves***.

Numerous further statements follow from this that contradict conventional believes. I will not list them all, but will highlight just three:

There are no waves that pass through polarizers *with certain probabilities*, but only waves that *partially pass through* these polarizers.

For the same reasons, there are also no "particles" that exist simultaneously in different states or at different locations with certain probabilities, but merely waves with different amplitudes.

Finally – and this is an extremely important point because it most clearly demonstrates the loss of reality – there is also ***no "nonlocality"***.

Bell's proof presupposes a completely false picture of reality in which particles (e.g. "photons") either pass through polarizers *completely* or *not at all*. Given the structure of my description of nature, the proof cannot even be formulated. (More on this later.)

3. Gravitation and electromagnetism originate from the same source. Both theories are ***purely metric***. They require no further "unification".

In particular, gravity requires no "quantization", and – as we will show later – *quantum theory itself is by no means "quantized"*; it, too, is based on a continuous foundation of "normal" metric waves.

4. Finally, regarding the expectation that the pursuit of purely mathematical goals will ultimately lead to an understanding of the structure of reality:

In Section 2.1. The self-contradiction we extended the description of reality by an ***indefinable element*** for whose existence there are compelling reasons (see Section 2.2. The missing element).

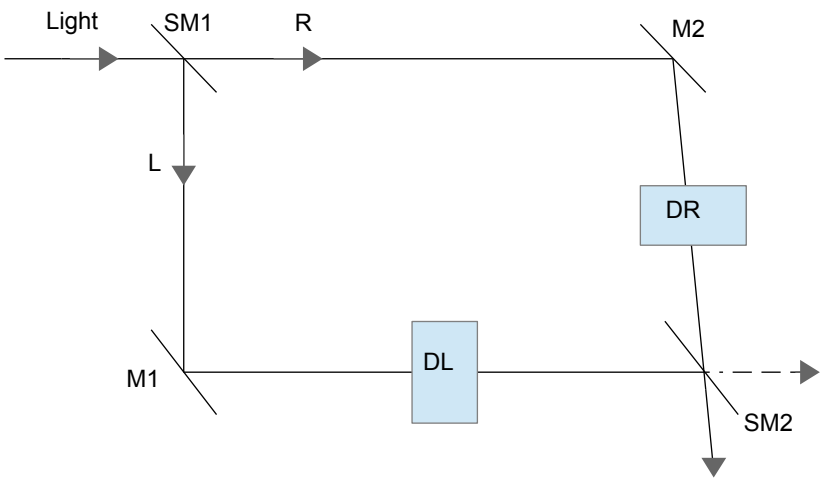
It follows, apparently, that the structure of reality ***cannot be contained in any kind of mathematics***.

Proposition

Reality transcends every mathematical system.

5.4. Paradox of the two ways

As a reminder of the absurdities to which quantization forces us, here is a well-known example:



A light ray (starting top left) passes through the depicted test arrangement. The intensity of the light is chosen so low that almost certainly only one single photon is present within the diagrammed area.

At first the light crosses the semi-permeable mirror SM1. On both paths L and R it is redirected by mirrors M1 or M2 in such a way that the rays reunite at a second semi-permeable mirror SM2. The lengths of the paths L and R differ, such that at SM2 the phase of the ray propagating along L does not coincide with the phase of the ray propagating along R and one of the two rays disappears due to destructive interference. In both paths photon detectors (DL and DR) can be inserted.

The experiment reveals the following – in the common approach unsolvable – absurdity:

If the detectors are *not* in the light paths, then we observe *interference* after the second semi-permeable mirror, that is: the photon – or the light wave – must have taken both ways; otherwise interference would not be possible.

This fact deserves particular attention:

There must **always** *be something underway in both paths – otherwise one could not observe interference after the second semi-permeable mirror if both paths are free.*

However if we now insert the detectors into the paths, then in any case only *one* detector at a time responds: since the photon is indivisible, it can only choose *either* L *or* R (with a probability of ½ each).

This fact deserves particular attention too:

There can **never** *be anything on the way in both paths at the same time, because the photon is indivisible.*

Obviously these two facts contradict each other.

How is this contradiction "solved" within the standard interpretation? In the following way:

If a photon appears in one of the detectors, the wave phenomenon on the other path is vanishing instantaneously! – it is considered kind of non existent, it has been nothing but a "probability wave", whatever that means.

This is the so called *reduction of the wave function*: Only one of the diverging wave-like possibilities – in our example there are only two – becomes real, and all others vanish instantaneously, no matter how distant they may be.

If the amplitude squares of these quantum mechanical probability waves only represented probabilities, as in a dice game, then there wouldn't be a problem – nothing would vanish because in any case there would exist but one reality: namely the dice on its way, from the very beginning of the cast, and because the probability of one sixth for each option would only point to the fact that we simply don't know the definite path of the dice.

However Quantum mechanical possibilities cannot be interpreted like that: They *interfere* – there is interference if the detectors do not stop the light rays. This *must* imply that something exists in both paths. And something which exists cannot just disappear!

Still, it does disappear. And we have to resign to this fact – at least according to general conviction. Indeed this paradox is not conceived to explain anything but rather to demonstrate that nature behaves in a way which is totally incomprehensible to us.

But hold on! Perhaps the photon "knows" what we are doing? If the information whether the detectors are inserted or not existed in some way at the first semi-permeable mirror SM1, then the photon could decide whether to take *one* way or *both*.

But even this conjecture – which itself does not seem very plausible – does not offer a solution to the problem.

This is because we can defer the decision whether or not to insert the detectors into the light paths up to the moment when the light has *already passed* the first semi-permeable mirror, that is, after the decision whether it takes only *one* or *both* ways has already been made. Also in this case, the experiment proceeds in the same way: without the detectors, we observe interference, but if the detectors are inserted, no simultaneous response but a random sequence of alternating events in both detectors occurs. However, as the decision whether the light takes one or both paths must already have been made, we seem to be able to determine retroactively what it does – or *has done*.

The formulations offered by the standard interpretation do not clear up anything, rather they remind of flower-garlanded speech bubbles. E.g. it is stated: "The events cannot be described isolated from each other. They form a single entity which is divided only by measurement." Or: "Nothing is an event before it is observed."

In actual fact, such statements do not at all mitigate the absurd rigidity of the paradoxical, essentially unacceptable fact that in this scenario – just as in many other quantum theoretic descriptions – *something which gives proof of its existence by interference* is vanishing, and that this disappearance happens *without any physical causation*.

At that, this disappearance is supposed to happen *simultaneously* with the measurement, that is: *at any given distance without any delay*, where it is actually not clear what that means: In the case of observers moving relative to each other – would there occur a difference of the time points when all probability waves disappear, which do not become real?

Enough with these absurdities! Surely it has become clear that the reasons by which the physicists felt themselves compelled to accept the just depicted circumstances *as an interpretation* instead of seeing them as a *reductio ad absurdum,* must be judged based on the question if they are indeed strong enough to justify such an extreme decision, and that any alternative, which avoids such bizarre assumptions, must be favoured.

Abandoning the assumption of quantization is such an alternative: if there are only waves, the absurdity disappears. Then only the quite "normal" question remains: why do both detectors never respond simultaneously? (This is answered in the book Concept starting on page 155.) However, since in our interpretation *events are transitions between different states of standing waves*, triggered by the summation of traveling waves with different amplitudes, the probability of *simultaneous* events is extremely low anyway.

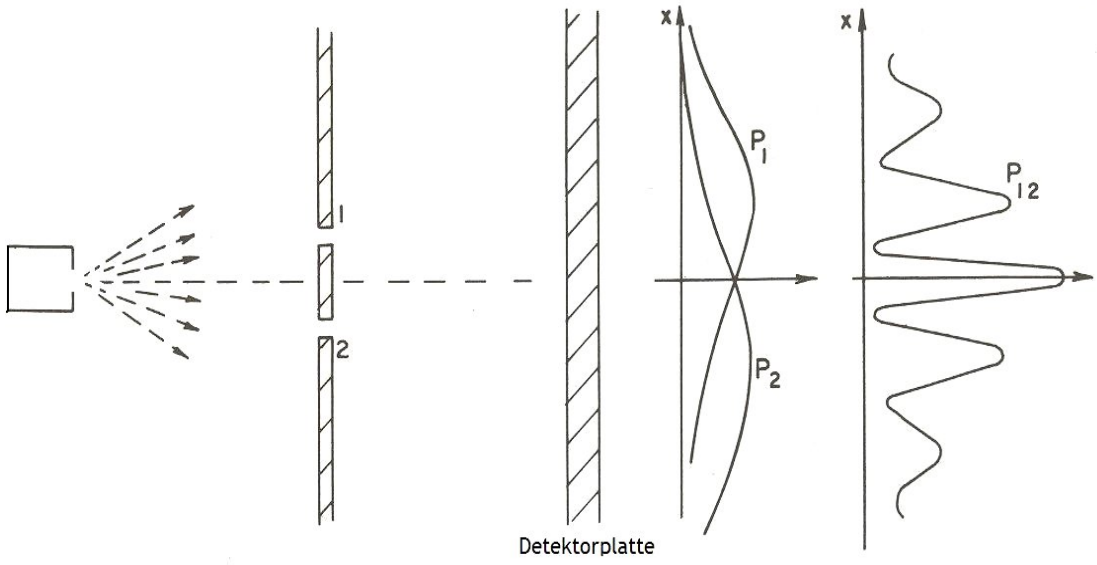
5.5. The double-slit experiment

The double-slit experiment brings together, in an almost unique way, all the errors and prejudices we have discussed in the preceding sections. Here, they take on a particularly clear and concise form, making the loss of reality readily apparent. That is why I chose it to demonstrate my view of reality and to contrast it with common beliefs.

I will briefly outline the experiment and then present the interpretation that arises from the arguments and deductions presented so far.

The information provided to us by theory and experiment is so simple and manageable that it can be presented in just a few sketches.

First, a sketch of the procedure:



(S1)

On the left side of the image is a device for generating particles of some kind. (For example, electrons, or photons – the following applies to all types of particles.) When this device is switched on, one blackened spot after another appears on the detector plate in an irregular sequence. Over time, the blackened spots produce the familiar interference pattern. (P_1 shows the distribution of the spots when only slit 1 is open, P_2 for slit 2, $P_{1,2}$ for both slits.)

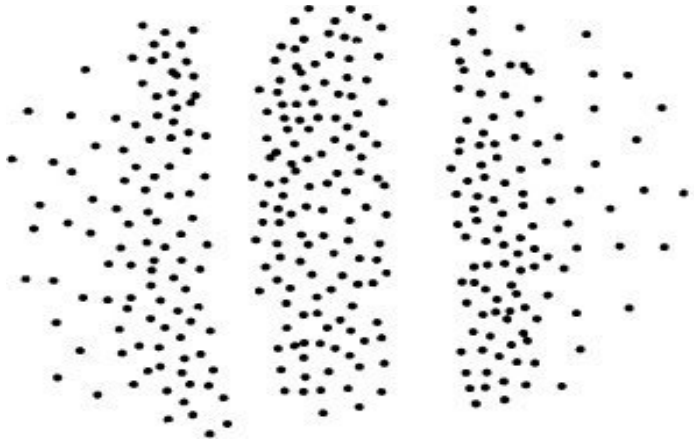
The failure of all attempts at intuitive interpretation is illustrated as follows:

On the one hand, electrons (or photons, etc.) appear exclusively as indivisible units. They must therefore be described as ***particles***, that is, they pass *either* through slit 1 *or* slit 2. However, $P_{1,2}$ is not the sum of P_1 and P_2 – there is interference, which is impossible in the particle model.

Therefore, on the other hand, we must use the ***wave*** model of electrons to describe this interference. In *this* image, a wave passes through *both* slits, is diffracted by them, interferes with itself, and hits the detector plate. Depending on the distance of the plate from the double slit, the wave can be arbitrarily extended.

However, we do not observe a gradual, uniform increase in the blackening of the detector plate according to $P_{1,2}$, but rather a sequence of localized events, i.e. individual tiny blackenings, each triggered by an electron, which now again corresponds to the particle concept. Only a large number of such local events produce the interference pattern.

So we are presented with a picture like this:



(S2)

With the appearance of the particle, the entire extended wave instantly *disappears* – this is the so-called "reduction of the wave function":

Of all the wave-like possibilities, only one remains, which becomes the observed event; all others disappear.

The particle and wave models are incompatible. Yet we need both for description. Thus, we seem forced to admit the limitations of our concepts and ideas and, where they fail, retreat into the mathematical scheme.

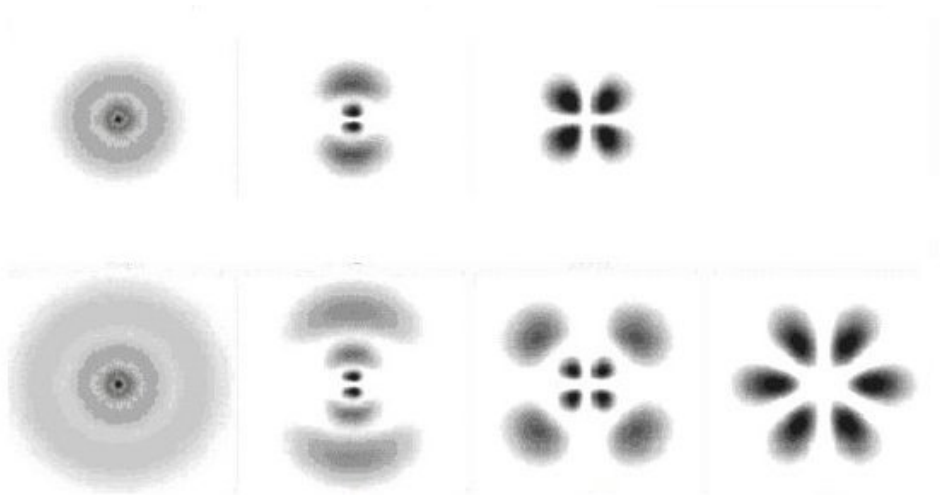
This scheme, however, is surprisingly simple:

The process is described by a wave equation. In fact, $P_{1,2}$ represents exactly the distribution that would also result from the interference of "normal" waves, except that with "normal" waves, no point-like blackening would occur; instead, a gradual increase in blackening would be expected everywhere.

Therefore, the amplitude appearing in this wave equation is not considered the amplitude of a truly existing wave, but rather a "probability amplitude": the square of its absolute value at any location on the detector plate gives the probability that an electron will appear there.

Finally, we consider a schematic representation of the objects that produce the electrons generated in sketch (S1) on the left.

Such objects are also present on the surface of the detector plate. Their sudden changes lead to the blackening points that we then observe:



(S3)

The structures depicted are *electron shells* in various states.[19] They are called "density distributions": the square of the amplitude of each standing wave depicted indicates the probability that an electron is present there (as in the case of the traveling wave after the double slit).

With this little information, we are already sufficiently prepared to now turn to answering the question:

What really happens in the double-slit experiment?

19 These are states of the hydrogen atom. For atoms with multiple electrons, adjustments must be made.

To answer this question, we must conduct the double-slit experiment in the form of a thought experiment, relying *exclusively* on the information present in our three sketches – in simple terms, ***on what we see there*** – and ignoring the ultimately fruitless discussion about it that has existed for more than a hundred years.

Sketch (S1) refers to a ***process caused by waves***, and for which, moreover, it is true that, due to interference, it can certainly be caused ***exclusively by waves***.

Sketch (S2 shows the ***blackening points*** on the detector plate, which can only be explained *as* ***the results of local processes***.

Sketch (S3), which depicts ***electron shells***, shows the ***oscillation states of a sphere***, i.e. ***standing waves***, where the gray values correspond to the squares of the wave amplitudes.

The following applies:

If one deduces what happens in the double-slit experiment from the information contained in the three sketches and (initially) sets aside all other – misleading – physical certainties, then an interpretation of the experiment inevitably follows that is surprisingly simple and essentially irrefutable.

For electrons, it is as follows:

> An electron (*a* ***traveling*** *electron wave*) breaks away from an electron shell (i.e. from *a* ***standing*** *electron wave*, see sketch (S3)) – in other words: ***part of the standing wave becomes a traveling wave***.
>
> This traveling wave then passes through a double slit.
>
> The wave interferes with itself and then hits a detector plate (*an enormous number of* ***standing electron waves***).
>
> There, in one of these standing waves that is ***close enough*** to the transition to the next higher state (***the state with one more node area***), it triggers precisely this transition by merging with the local standing wave – ***the traveling electron wave thus becomes part of the standing electron wave***. This transition appears ***abrupt like a jump*** (*as is* ***always*** *the case with standing waves*) and is interpreted as the ***appearance of an electron***.
>
> The rest of the moving wave ***does not disappear***, of course, but encounters other standing waves, where it does *not* trigger a transition but only increases the probability of future transitions by bringing the state of the standing wave closer to this transition.

And that's all! The entire process can be explained and understood in this extremely simple way – and only in this way.

Before I begin to refute the physical beliefs that seem to prevent this explanation, I will first list them and then, in each case, immediately state (in italics) what replaces them:

1. The wave picture alone is insufficient. As Planck, Einstein, Compton, and de Broglie (and many others after them) have proven, both matter and radiation are quantized and have wave properties. If one of these two prerequisites is missing, then it is not possible to correctly describe the interaction of matter and radiation.

There is no "wave-particle duality". It is replaced by the – trivial and completely unproblematic – contrast between moving and standing waves.

As we have shown previously, the evidence for the "quantization" is invalid.

The usual view of states and changes of states called "particles" is incorrect.

The definition of the term "quantization" cannot be maintained in its current form.

2. Electrons are "indivisible". If there is only a single electron in the experimental setup, it must therefore be traveling as a whole in both slits simultaneously.

This absurd notion can be dispensed with, since it is simply a wave traveling through both slits.

3. With the occurrence of the event, the entire extended wave disappears.

No wave disappears.

Instead of disappearing, the parts of the wave not required for the event continue and can be involved in triggering future events.

4. The disappearance of the waves is a nonlocal phenomenon.

My interpretation eliminates the nonlocality. The entire process is evidently completely local.

5. The questions of *when* the transition from probability to reality occurs and *what* triggers it either remain open or can only be answered through additional assumptions, such as "through the act of observation" (although this only clarifies the "when" and not the "how"), or "through the consciousness of the observer", or "through the splitting of the universe", etc. 

These questions are irrelevant because there are only "normal" processes: real waves cause real events (transitions between different states of standing waves).

(The question of which physical quantity is to be assigned to the amplitude. I will answer below.)

6. The act of observation (or measurement) and/or the "consciousness" of the observer must play a role; otherwise, the description of the double-slit experiment would be incomplete, since the Schrödinger equation contains nothing that explains the "reduction of the wave function".

The measured event is in no way dependent on whether and by whom it is observed.

Expecting the Schrödinger equation to contain the description of this event – the triggering of the transition between two different states of the standing wave – would be nonsensical.

7. In all of physics, nothing can be found that could be identified with that what oscillates in the Schrödinger equation.

The physical quantity assigned to the amplitude is one of the two fundamental parameters in my system of describing reality.

(As already announced under 5, I will discuss this further below.)

8. The waves cannot be "real" waves because the Schrödinger equation contains complex numbers.

My clarification of what these waves really are provides a simple explanation for the occurrence of complex numbers.

9. In the case of multiple electrons, the mathematical representation takes place in multidimensional configuration space. Therefore, it cannot be a real process.

This objection requires a longer commentary that addresses some fundamental misunderstandings about the relationship between mathematics and reality.

I will expand on it later.

10. Electrons have the quantum mechanical property "spin", which cannot be interpreted intuitively. In particular, the electron's spin value of ½ proves that it cannot be understood as a real object, because this value implies that – for the electron – a complete rotation is 720°, whereas for real objects in real space, it must obviously be 360°.

Using the physical quantity associated with the amplitude occurring in the Schrödinger equation, the property of "spin" can be explained in a comprehensible way, and the spin value ½ assigned to the electron can also be clearly understood and is intuitively accessible.

Now to the refutations of the listed beliefs.

1: Wave-particle duality, quantization

We have proven the following:

If one replaces the wave-particle duality with the two forms in which waves always occur – *traveling* and *standing* waves – then the experimental facts of the photoelectric effect and the Compton effect follow easily and directly.

The interaction of light and electrons must then be understood as a *wave superposition* (of light waves and matter waves), and it follows that in the photoelectric effect "electrons" are emitted immediately and always have the same speed: superposition of waves allows no other results. The result is identical to Einstein's result.

The Compton effect – the interaction between high-frequency light and electrons – can also be described in this way, and here too, the result agrees with Compton's result.

Planck's description of blackbody radiation requires no further explanation: that the generation and absorption of the radiation must be quantized is self-evident in the wave picture, since the change of standing waves is always "quantized" – however, not in the fundamental *ontological* sense that is ascribed to this "quantization" in standard physics, but in the quite trivial, or let's say: everyday sense that continuous processes lead to seemingly abrupt transitions, as is *always* the case with standing waves. [20]

20 A comparison with such an "everyday" phenomenon seems appropriate here:

Suppose a pipe is blown in such a way that the air column vibrates at the third overtone. By gradually increasing the lip tension, the vibrational state of the air is changed so that the air column eventually "jumps" into the fourth overtone. Only the abrupt change is audible – observable – while the underlying continuous processes remain hidden.

Whether a state is close to the boundary of a transition or in the middle range is therefore (almost) impossible for the observer to discern.

As already noted in the previous section, this changes the definitions of the terms "quantization" and "particle" as follows:

1. The traveling waves – *all* waves, including light waves and matter waves – ***are not quantized at all, they are never "particle-like"***.

2. The term "particle" refers to ***stationary states of waves or transitions between such states***.

Most important, however, is the following:

1. The term "quantization" does not refer to reality itself, but only to observations and measurements. ***The fundamental layer of reality itself is continuous.***

2. So-called "objective" probabilities are just "ordinary" probabilities.

However, I do not want to continue this *(very long)* list of false interpretations – which then also become prerequisites for quantum field theory – but will simply refer once again to the sketch (S3), which shows **oscillation states of a sphere**, i.e. **standing waves**, and ask the question:

Why are there standing waves in the shape of a sphere in this sketch – which is supposed to depict the calculated probabilities of the presence of a (point-like?) electron?

The only sensible answer is obviously:

Because they are waves*:* only something that ***exists*** can assume the form of a wave – whether depicted figuratively or described mathematically.

The same applies to the *interference* that occurs after the double slit experiment:

Interference means that two phenomena *influence* each other. Therefore, also here it cannot simply be mathematics ***and nothing else***, but only mathematics ***that describes something***, in other words, these two phenomena must be granted ***existence***, because only under this condition is it possible for them to influence each other.

But then the wave amplitude ***cannot*** be the square root of an event probability ***and nothing else****:*

Square roots of probabilities are ***purely formal quantities*** *to which existence can in no way be attributed*.

From this follows that ***all*** known interpretations are contradictory and therefore false.

They are therefore not ***interpretations*** at all, but rather a ***total failure of interpretation***, or, to put it quite clearly: a ***complete loss of reality***.

2: Indivisibility of electrons and 3: Disappearance of the waves

Both points are included in my interpretation and do not require separate commentary.

4: Non-locality of the disappearance of the waves

Regarding the double-slit experiment, no further explanation is necessary. However, I would like to take this opportunity to comment on the question of nonlocality in general:

Proposition:

There is no "nonlocality". Reality is completely local.

The assumption of nonlocal connections violates the most important principle of the description of nature: the **principle of local causality**:

There is no connection between distant states of affairs that is transmitted faster than the speed of light or even exists without any mediation.

What then about ***Bell's proof***? What about all the ***experimentally proven nonlocal connections***?

I will now address this. However, I will not elaborate on the refutation of Bell's proof in full here, but will only present the crucial error.[21]

First, the facts:

(1) The quantum mechanical description of an object does not specify a unique value for some of its attributes, but only the probability distribution of possible measured values.

(2) This also applies to two spatially separated objects that interacted with each other in the past or that originate from the decay of an object.

(3) A connection called "entanglement" then exists between the results of certain measurements on these two objects. For example, for two identical objects A and B that resulted from the decay of a stationary object and are moving away from the position of the decay in opposite directions, the velocities are linked in the same way as in classical physics, i.e. they are equally large and opposite to each other.

Let's assume no measurement has been performed yet. In this case, only the probability distribution of the possible measured values is known.

However, if the velocity of A is now measured, then, due to (3), the velocity of B is also known *at the same moment*.

It seems obvious to argue as follows:

B is arbitrarily far away from A. Therefore, measuring the speed of A cannot have any influence on B. This means: if, when measuring the speed of A – also the speed of B is known, then the result of the measurement of B must have existed already ***before*** the measurement of A, in other words: object B must have had this speed already before the measurement of A. Otherwise, measuring A would have caused a ***change of the state*** of B.

Since the quantum mechanical description does not include this speed, it must be *incomplete*. (The speed would be a so-called *hidden parameter* in this case.)

However, *John Bell* refuted precisely this seemingly plausible argument by proving that there are cases in which it leads to results that contradict quantum theory. Numerous experiments have shown that the results predicted by quantum theory are correct. Therefore, the above argument must be false.

This conclusion is undoubtedly correct, and in physics it is considered proof of the existence of nonlocal relationships, because now it is obviously established that the state of B has indeed changed as a result of the measurement on A.

To refute this belief, let's briefly return to the double-slit experiment. Here, the wave function (the Schrödinger equation) specifies the probability of where the electron appears on the detector plate.

21 The book Structure contains the complete proof (starting on page 152). The book Concept also includes Bell's derivation. (John Stewart Bell: *On the Einstein Podolsky Rosen Paradox*, Physics, 1, 195-200, 1964). The corresponding chapter begins on page 42, and the formal part is on page 58. Further explanations follow starting on page 143.

So here, too, just as in the case of entanglement, the following applies:

***Before* the measurement, this electron had *no* definite position; *after* the measurement, it *has* a definite position**.

The crucial point, however, is:

Before the measurement, this electron did not exist at all!

Before the measurement, there was only the extended wave, and it is **not** identical to the electron that appears afterward, because in my interpretation, the transition of the local standing wave – which is commonly understood as the appearance of an electron – is not triggered by the ***entire wave***, but only by a (very small) ***part*** of this wave.

The same is true for entanglement experiments: here, too, the correlated events are always *transitions* triggered by *parts of waves* and not by "particles" such as "photons".

For example, in my interpretation of the experiments with "polarized photons", it's not ***whole photons*** that pass through the polarizers with certain ***probabilities***, but rather ***parts of light waves*** that ***actually*** pass through and then ***accumulate*** until a transition occurs, exactly as in the double-slit experiment.

Therefore, both in the double-slit experiment and in the entanglement experiments, the following applies:

The object to be measured is only created by the measurement process.

Before the measurement, it did not exist.

And this means:

It is nonsensical to speak of an attribute that the object had before the measurement.

This collapses the entire logical structure which underlies the general discussion of nonlocality and on which Bell's proof is based:

Both the claim that object B must have had the property already before the measurement and its refutation by John Bell become irrelevant because they refer to a nonexistent fact:

The object whose change of state is being proven has no state before the measurement because it does not exist before the measurement.

This invalidates Bell's proof, and it follows that the discussion about cases of entanglement and the correlations that arise in them can *only now* truly begin, because until now it has *inevitably* led to absurd conclusions due to incorrect model assumptions.[22]

Since understanding what is happening requires insight into the *causal structure* of an event, accepting nonlocality is tantamount to a total abandonment of *understanding*.

22 If the correlations are *not* based on a nonlocal connection, it follows that the necessary symmetry of the correlated systems can only develop over the course of the respective test series – and *through* this series. (See Concept starting on page 143.) This also explains why there is always a "run-up phase" and why it has never been possible to verify the correlations between distant systems by using individual processes *separated in time*, but only by using the statistics of *series* of processes.

5: Transition from probability to reality (reduction of the wave function)

When and why this transition occurs is answered in my interpretation; there is no "reduction" of the wave function at all, at least not in the usual sense: a *part* of the moving wave triggers a transition in a standing wave and thereby becomes part of that standing wave, while the *rest* of the moving wave simply continues.

6: Observation and consciousness of the observer

Everything important has already been said.

7: What oscillates in the Schrödinger equation?

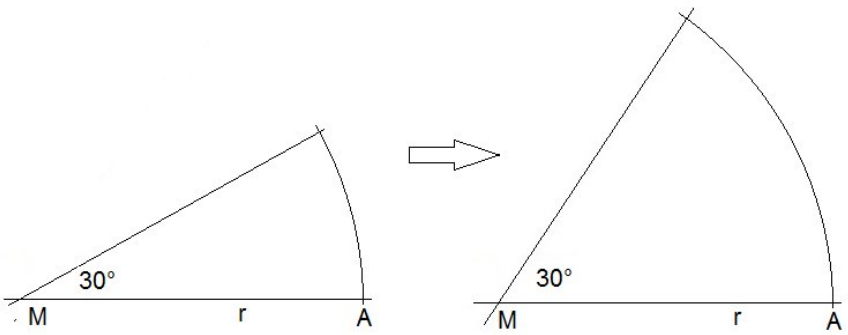
This is a point of extraordinary importance: My assertion that we are dealing with *real wave*s presupposes the existence of a physical quantity that can be assigned to the amplitude in the Schrödinger equation, or more specifically: that ***something exists that oscillates***.

Moreover, given the fundamental position of the Schrödinger equation in the physical description system, it is to be expected that the answer to this question relates directly to the basis of reality.

Thus, two possibilities are suggested where one could begin the search for the answer: either with the measurement process, or with the origin of reality. Since neither the measurement process nor the Schrödinger equation provides any indication of the sought-after physical quantity, I (several years ago) embarked on the second approach.

The following assumes the content of sections 3.2 and 3.3. However, for our project of determining the physical quantity that can be assigned to the amplitude in the Schrödinger equation, an addition is required concerning the change in the metric density of the angle.

A sketch for illustration:



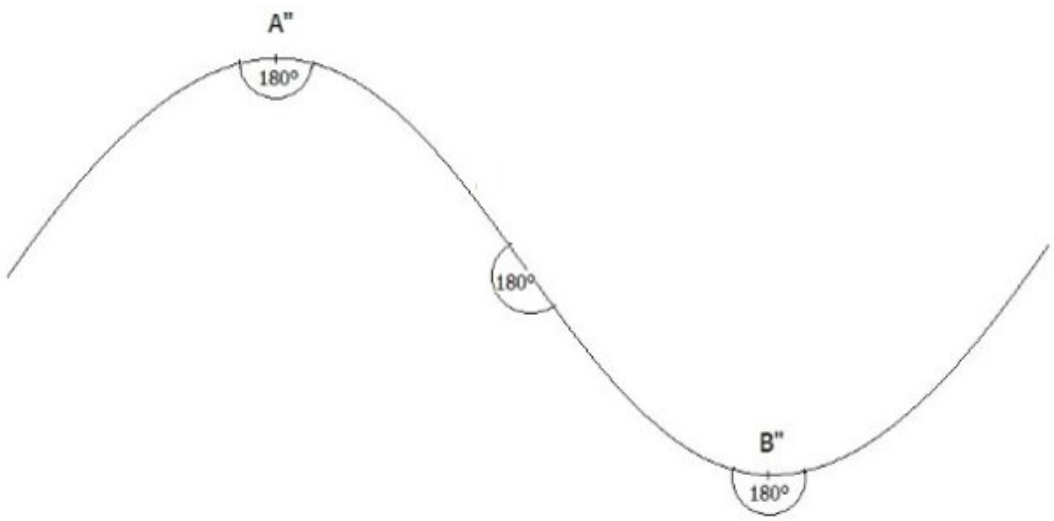
(S4)

An angle of 30° is shown on the left. The angle shown on the right is still 30°, but the *angle measure* has increased, which means that ***the metric density of the angle constructed according to this measure is lower*** than that of the "normal" angle shown on the left.

What does this change mean for A? Here, too, a continuum flow occurs, but this time *orthogonal* to r, i.e. A experiences an upward acceleration.. (Compare (S2) in section 3.3)

Here is again (S4b) from section 3.3:

It shows that, under these conditions, it is possible to consider transverse waves as ***waves of the angular density*** if the change in amplitude is interpreted as a metric change in the angle:



(S4b)

In my construction of reality, the following has emerged:

The concept of the ***metric density of length*** leads directly to a ***theory of gravity*** that is consistent with general relativity in solar systems and in the vicinity of planets, but results in a ***significantly greater rotational velocity in galaxies***.

Completely analogous to gravity, ***Electromagnetism*** can be defined using the concept of the ***metric density of angle***.

Based on this definition, the ***quantum mechanical model of the atom*** can be reconstructed – and, moreover, also *understood*, using simple mathematical means.

In this way, the problem that theoretical physics has been trying to solve unsuccessfully for decades – the incompatibility of *gravitation theory* and *quantum theory* – disappears, so to speak, all by itself: the *common origin* of both lies in the formation of reality.

This suggests the following **assumption**:

Reality is based <u>exclusively</u> on the metric changes of the continuum: the change in length and the change in angle. Everything that exists and everything that happens follows from these changes. They are the fundamental level of reality.

From this follows:

Since gravity is *defined* as a change in length, all other interactions must arise from a change in angle.

And this means:

<u>Proposition:</u>

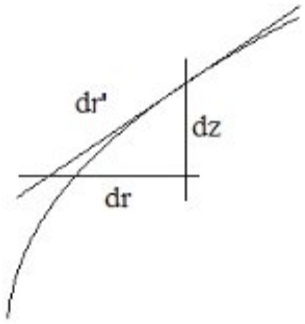
The metric density of the angle can be assigned to the amplitude in the Schrödinger equation. An example of the corresponding waves are the transverse waves shown in sketch (S4b).

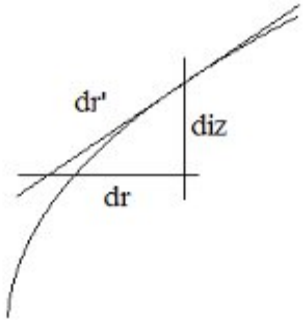
8: Complex numbers in the wave function

Following the explanations in the previous section, it is easy to establish the occurrence of complex numbers in the Schrödinger equation.

To represent the increase in length in GR or MDG, an auxiliary dimension is introduced.

The extended differential can then be represented as follows, as shown in the sketch on the left (dr is the unchanged differential, dr' is the changed differential, dz is the differential along the upward auxiliary dimension):





(S6)

Evidently applies $dr' = \sqrt{(dr^2 + dz^2)}$

However, if the unit of measurement of the coordinate r is not to be *increased* but *decreased*, then an imaginary auxiliary dimension iz must be used instead of the real auxiliary dimension z, so that the following applies, as shown in the sketch on the right:

$$dr' = \sqrt{(dr^2 + diz^2)}$$

As required, dr' is now smaller than dr.

The same is true for the angle measure. If it is reduced, then angles *constructed from it* and their corresponding arc lengths become smaller, and their representation requires imaginary numbers.

This means:

If the amplitude in the wave function is understood as metric angular density, then the occurrence of complex numbers in the wave function is self-evident and does not cast doubt on the assumption that the waves are real.

9: Representation in multidimensional configuration space

As announced, here are some explanations of the relationship between reality and mathematics.

The first and most important thing to understand is this:

Reality doesn't use mathematics. It doesn't calculate.

As already mentioned in section 2.2. The missing element, it would be beyond absurd to assume that the blade of grass ***calculates*** where to move – it simply follows the wind that touches it.

We, on the other hand, need mathematics to describe the movement of the blade of grass. If we succeed in doing this with sufficient approximation, then we tend to believe that our description accurately reflects what nature does, that our ***differential equation*** and the ***process*** taking place in reality are ***one and the same***.

This equation of mathematics and reality goes back a long way, even further than the Pythagoreans.

In the 16th century, it was so self-evident that even when real solutions to equations could only be found using roots of negative numbers, some time had to pass before the existence of such numbers was accepted in mathematics – the certainty that they *could not exist* was simply too strong.

Something similar happened in the 19th century with the mathematical infinities discovered by *Georg Cantor*.

The mathematical community had made an (uncertain) peace with infinity by dividing it into *actual* and *potential* infinity and acknowledging existence only to the potentially infinite. The massive rejection Cantor experienced can only be understood in light of the widespread belief that there is a close *ontological* relationship between mathematics and reality, so that Cantor's claim that there is not just *one* infinity, but an *infinite number* of infinities – each of which is *infinitely* larger than the previous one – could only be viewed as a sacrilege against reason or even as madness.

In these two examples, the concept of reality dominates over mathematics: if something appears in mathematics that doesn't fit with the concept of reality, it is initially rejected, even opposed.

Since then, however, this relationship has reversed, as is evident in the following case:

After the death of his friend Michele Besso, Einstein wrote to his family: "For us believing physicists, the distinction between past, present, and future has only the meaning of an illusion, albeit a persistent one."

To this, it must be said:

This illusion is not only persistent, but *insurmountable* – simply because it is not an illusion. The infinity of the time coordinate does not, as with spatial coordinates, indicate their unlimited availability. In fact, only the totality of local – causally linked and constantly changing – present moments actually exists. Past and future remain inaccessible.

Therefore, no consolation for those left behind can be derived from the relativistic fact that the temporal classification of events depends on the observer's state of motion. What *actually* belongs to the respective reality of an observer is determined *exclusively* by the causal structure, and from this follows: the dead person remains dead.

Even if – assuming that the death occurs at a great distance, e.g., in the Andromeda Galaxy – the time of death can be shifted a few days into the future simply by the observer getting up and moving *away* from the Andromeda Galaxy, this shift is completely meaningless:

Although the friend is still alive "now", he remains excluded from the observer's reality as a "living person" just as he was previously excluded as a dead person. Therefore, nothing has changed. The statement that he is not yet dead "now" is empty, since an encounter with the truly living friend – or the prevention of his death – is in no way made possible by such relativistic shifts.

In general, statements that refer to the temporal classification (past, present, or future) of events to which no possible causal connection exists are empty and therefore meaningless.

In this case – but *only* in this case – Einstein's claim is correct.

In this example, mathematics dominates the perception of reality:

According to Einstein, this perception *deceives* us, and mathematics tells us how things *really* are.

However, this claim can easily be refuted by experiments: one only needs to try to move along the time coordinate. Anyone who, after a sufficiently large number of such unsuccessful attempts, nevertheless remains steadfast in their conviction that reality is four-dimensional in the Einsteinian sense – that is, "the separation between past, present, and future is only an illusion" – can then rightly be accused that ***they*** are clinging to an illusion.

However, this illusion is extraordinarily powerful: the widespread view that gravity is not a force because in four-dimensional, curved space-time all bodies move along straight lines (geodesics) – that is, by definition, on *force-free* trajectories – is apparently based on the assumption that reality – ***our*** reality – **is** four-dimensional.

As just established, this is simply wrong – four-dimensional in the Einsteinian sense is only the structure of the description, not reality itself. In the reality, there is no coordinate ict.

What is true, as all three examples show, is that mathematics is *necessary* for describing reality, and that mathematical structures (four-dimensional spacetime, configuration space, Hilbert space, etc.) and concepts (imaginary unit) can arise that cannot be attributed existence "in nature" – and I would like to add that this is actually *self-evident: numbers* do not exist in nature either.

If mathematicians in the 16th century had been aware of this, the imaginary unit would not have given them sleepless nights.

In some cases, the appearance of such structures and concepts helps us better understand reality, but in most cases, their introduction and use are merely necessary because without them, either no mathematical representation at all or only a much more complicated one would be possible.

Configuration space is such a case.

However, their appearance only becomes a problem when mathematics and reality are identified or confused with one another.

In order to clarify the error that occurs in our three and in numerous other examples in a similar form, it is therefore not necessary to analyze the relationship between mathematics and reality in more detail.[23] The simple assumption, adequately supported by our examples, suffices:

Mathematics is an indispensable means of describing reality. But it is neither identical with reality nor is it the actual reality.

Thus, if a mathematical representation takes place in a space other than the three-dimensional space of our perception, this is no indication that elements of this representation, or even the entire process represented, are not real.

Note:

Cantor's wonderfully simple proof that the real numbers between 0 and 1 have no place even in an infinitely long list of infinitely long numbers – and, of course, even more his fantastical infinite sequence of ever "larger" infinities – demonstrate in a very impressive way how different reality and mathematics are.

Unfortunately, many physicists seem to lack this experience – otherwise, the identification of reality and mathematics, or the confusion of the two, wouldn't be so widespread.

10: Spin and the 720° rotation

The general belief that spin cannot be understood as a property of an object that exists in the same way as the objects of our everyday experience is correct.

The claim that the electron cannot exist in this way because it has this property, however, is false.

Isn't this a contradiction?

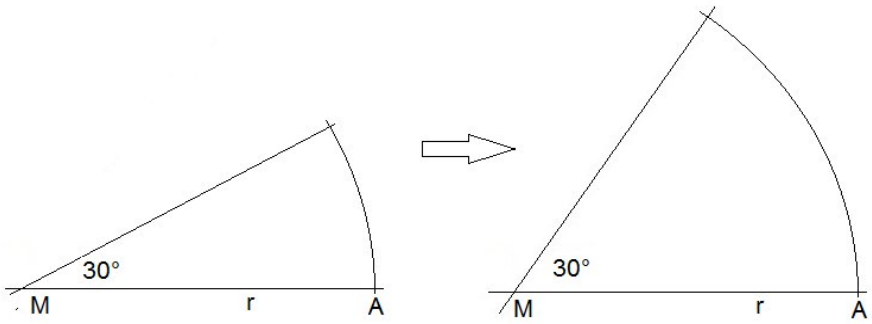
23 I did this in the book Structure.

The answer is no. To explain this, we must return to the metric changes from which reality emerges:

Mass is defined as change in the *metric density of the length*, which causes a *metric flow toward the compression*, whose velocity increases with decreasing distance. A steady state is established (the flow is constant over time).

Analogously, electric **charge** is defined as change in the *metric density of the angle*, which causes a *metric flow orthogonal to the direction of one side of the angle*.

Here again sketch (S4): The metric flow generated by the reduction of the angular density (the increase of the 30° angle) is *orthogonal* to r, which means: A is accelerated *upwards*:



(S4)

Here, too, a stationary state develops: a temporally constant flow arises, the velocity of which increases with decreasing distance between M and A, if in M an electrical charge is present.

r passes through M; The position of r in the plane containing the angle shown is arbitrary. This means that the flow rotates around the center point M in this plane.

Every point on the circle with center point M and radius MA must therefore be assigned the same *tangential velocity*. There are always two possibilities for the direction of this velocity: in the sketch, the metric flow at A can point upwards or downwards.

Since the position of the plane through M and P that contains the angle is also arbitrary, the following applies:

Every point P on the spherical surface with center point M and radius MA must be assigned *the same tangential velocity* ***in every direction*** on the tangential plane defined by P.

To put it another way: We have arrived at a rotation in every plane whose magnitude is fixed and for which there are two possibilities for each specific direction.

This corresponds to the definition of ***quantum mechanical spin***, but with the key difference that here it does not appear as ***attribute of an object***, but as ***attribute of the continuum***, which is metrically altered by the presence of an electric charge, i.e. the metric density of the angle.

This change then represents the necessary and sufficient prerequisite for the formation of *stationary wave states*.

Only these stationary wave states can be considered ***"objects"***. They contain the rotating flow just determined, present in every plane through the center – the rotational velocity – not as an **attribute**, but as a **prerequisite**.

While the continuum altered by ***mass*** is composed of *lines* – in the spherically symmetric case, *straight lines* through the center – the continuum altered by ***charge*** consists of *surfaces* – in the spherically symmetric case, *planes* through the center.

Why this is so, becomes clear from the definitions: In the case of mass, *lengths* are changed, i.e. *lines*; in the case of charge, *angles* are changed, i.e. *surfaces*.

What follows from the fact that *spin* is not a property of objects, but a property of the continuum?

It means that the argument that the electron cannot be considered a real object because of its spin is invalid: As property of an object, spin would not be possible, but as a property of the continuum it is unproblematic, albeit highly abstract: conceiving the continuum as composed of *planes* to which certain properties are assigned is just as possible as conceiving it as composed of *lines* to which certain properties are assigned, as in the case of gravity.

Of course this act distances the concept of a continuum from our naive initial conception, but this distancing is unavoidable anyway: even the assignment of real numbers to points in the continuum is by no means as self-evident as it seems to us today.

Accordingly, in the continuum altered by charge *stationary wave states* form, as in our sketch (S3). So whenever we encounter a state that we perceive as an "electron", we encounter it in one of these states, and in each case, the rotational speed that we call "spin" also appears.

It is therefore natural that we consider this spin to be a property of the electron – and yet it is wrong.

After we have restored the electron as a "real object" – at least in the form limited by my interpretation: as a stationary wave state or transition between such states – we still have to answer the question of why it only returns to the same position after a rotation of 720°.

In order for my metric-dynamic reconstruction of the atomic model to agree with the quantum mechanical specifications, the unit of charge – defined as length – must be equated to the classical electron radius. (Just as in gravity the length of the mass must be equated to the radius of the black hole with that same mass to achieve agreement with the GR.)

In the case of negative charge, the angular density *increases;* thus the *angle measure* becomes smaller, and the circumference of the entire circle *measured by it* becomes larger.

It turns out that *at a distance of the Bohr radius* – i.e. on the first electron orbital – the angular density is exactly twice as large as in normal space, so that the circumference of each circle is not $2\pi r$, but $4\pi r$, and the same applies to all other orbitals.

In the metric-dynamic model, it is therefore self-evident that for the "electron" in the ground state as well as in excited states, a complete rotation is always 720°.

I have reported, in sufficient detail and clearly enough, which errors and mishaps have prevented the interpretation of the quantum mechanical measurement process.

But I want to return once again to the central point:

In the double-slit experiment, ***interference*** occurs. The amplitude of the waves causing this interference is considered the *square root of the probability that an electron appears* at the corresponding position.

Based on the calculated and verified result, this is undoubtedly correct.

But it is equally clear that ***square roots of probabilities cannot interfere: only something that exists can interfere***.

But square roots of probabilities are ***purely formal quantities*** that cannot be acknowledged to exist under any circumstances.

This is so obvious that it is completely incomprehensible why it was ignored. The only sensible reaction would obviously have been to ***admit ignorance*** and begin searching for ***which truly existing waves*** are involved – or, simply put, ***what is actually oscillating***.

This is also the reason why I am bringing this topic up again. It remains an insoluble mystery to me – from the very beginning and to this day – how it could happen that this clear failure of interpretation, this fundamental ignorance, could give rise to a series of completely abstruse concepts that are still considered *interpretations* today.

While in standard physics there is absolutely no idea what is actually going on, instead of finally correcting this ignorance it is used as a license for further fantastic speculations. No end of the nonsense is in sight.

As expected, answering the question of what really happens in the double-slit experiment required addressing a large part of the foundations of current physics.

My intention was to demonstrate how fatally – I am tempted to say *with historical necessity* – a completely false view of reality has arisen through a series of false assumptions and the "proofs" based upon them. This view has formed the basis of theoretical physics for more than a hundred years and currently enjoys the status of an indubitable prerequisite for physical thought.

6. Quantum Theory

In the philosophical part of this work, it was necessary right from the start to correct an incompleteness in the physical view of reality. This was not achieved by expanding physics itself, but simply by pointing to an element of reality that has always been present and has accompanied physics since its beginnings, but which had never been considered.

Only by including this element was it possible to answer the most important open questions in philosophy:

Does free will exist? What are sensation and consciousness, and why do they exist? Is artificial intelligence capable of sensation? Can matter, mind, and the Platonic realm of the universal and the laws of nature belong to one and the same reality? Why do laws of nature exist?

Now we find ourselves in a similar situation. We have the following problem: (I repeat the diagnosis from Chapter 4)

The existence of the general is a ***necessary condition*** for the possibility of natural laws and causality.

The existence of natural laws is beyond doubt. Therefore, **the general exists**. However, in the realm of experience, it is ***untraceable***: here, there are only ***individual cases***.

Thus, *beneath* this realm – as its logical and ontological ***precondition*** – there must be another, ***fundamental*** realm in which the general exists or in which at least its origin is recognizable.

But if the realm of experience does not contain the causal structure of reality, then the description of reality originating from the realm of experience cannot contain this structure either – at least not as long as its basic concepts refer to elements from this realm.

Just as the realm of experience itself, so too does the description of nature that arises from it require a ***logical foundation*** in which the true causes lie for the regularities that are discovered through experience.

It is therefore clear what would be necessary:

A theory is required that traces the hypotheses derived from the realm of experience back to the fundamental, causal realm.

In fact, here the same is true as with the previously unsolved questions of philosophy:

That which is necessary for recognizing and understanding reality ***already exists***, but is not perceived as such.

In other words:

The theory that is needed already exists. It is quantum theory. It does precisely what is necessary: it traces the attributes of objects of experience back to attributes of waves.

That is its true, fundamental meaning and purpose.

But it has not been recognized. Instead, the following view, which still prevails today, has become established:

Reality is divided into two realms between which there is an indistinct boundary. For interpretations and explanations, only the concepts and notions from the realm of experience are available, which renders the fundamental realm ***inexplicable*** because these notions are ***completely unsuitable*** for understanding what is happening there.

Reality disappears.

The following sections are dedicated to explaining my view of quantum theory.

6.1. Interpretation of Quantum Theory

Every object has a position and a velocity at every moment – at least as long as you imagine an object as something that occupies a well-defined volume of space at every moment.

Physics before the 20th century was based on exactly this idea, and that is why there was great surprise when it turned out that it was impossible to precisely determine both position and velocity at the same time for *very small* objects.

Initially this was justified by limitations of measurement, but over time it became clear that it is a limitation that applies to nature itself.

At this point it was already known that objects on atomic scales could be described by the matter waves discovered by de Broglie, and that energy and momentum of such objects are determined by the equations

$$E = h\nu \quad \text{and} \quad p = h * 1/\lambda$$

This means that actually all the prerequisites were in place that were needed to establish the connection between the two worlds: between the abstract causal metric world of waves and the concrete, tangible world of objects that physics had dealt with up to that point:

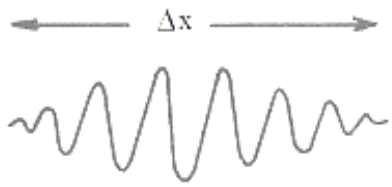
Firstly, the *type* of wave (or wave class) by which energy and momentum are defined was known: matter waves are *sine waves* – and secondly, there was a bijective relation between the values of the wave properties frequency and wavelength and the values of the associated object properties energy and momentum, so that each value for energy or momentum was assigned a unique value of frequency or wavelength.

Unfortunately, none of the physicists were able to interpret this relationship correctly – except for Schrödinger, whose attempt failed because he expected his wave groups to remain *spatially confined* (according to his idea of particles), which is not the case.

(As we showed in the interpretation of the double-slit experiment, this expectation is not only superfluous – it would even prevent the only possible explanation.)

If someone had recognized that electrons or other objects in this order of magnitude could not only be *represented* by wave groups made up of matter waves, but that they actually ***are*** such wave groups, then it would not have been confusing at all, but rather self-evident that an "uncertainty principle" applies for the quantities position and momentum.

According to our realistic view, this is simply the case because to spatially limited wave trains (wave packets) like in the following sketch



(S1)

always an "uncertainty relation" of the form

$$\Delta x * \Delta(1/\lambda) \geq 1$$

applies. Such wave trains just *do not possess* a definite wave length. Instead, they are composed of waves with different wave-lengths. The smaller the spatial extension is, the greater is the interval of the required wave-lengths. Reversely, the more exact the wave-length is – and, in our case, at the same time the velocity – the greater is the uncertainty of the position Δx.

If this fact is connected with the equation

$$p = h * 1/\lambda$$

then follows

$$\Delta x * \Delta p \geq h .$$

Of course this has already been said often enough. Nonetheless it had to be mentioned here again, because in the usual interpretation of quantum mechanics, it is seen as a purely formal fact and not as an ***explanation***. It can only turn into an explanation if it is assumed that particles ***are*** stationary wave states and that ***therefore*** momentum must be ***defined*** by wave-length.

So to the quantities momentum and position the following applies:

1. Both quantities are *defined* as wave properties, and they correspond to certain *types* of waves: sine waves are assigned to momentum, and to position pulse waves (i.e. waves, whose amplitude is only in one point not equal to zero).

2. The prerequisite for the assignment is that there is a bijective relation between the wave property (wavelength or amplitude) and the assigned object property (momentum or position). This condition is fulfilled here.

3. To the values of the two object properties applies an uncertainty relation. *This uncertainty is a purely wave-mathematical fact* (more on this later). It is *transferred* to the two object properties through their definition.

As regards position and momentum, everything that seemed strange from the conventional viewpoint has disappeared. While, in the usual interpretation, it seems outright absurd that a particle should not possess exact values of position and momentum at the same time, in the alternative interpretation – where objects (wave packets) simply *do not have* a definite spatial volume – it is just an evident fact.

The question is: ***Can this scheme be transferred to all physical object attributes*** *?*

The answer is *yes.* Strictly speaking, nothing at all has to be transferred – **quantum mechanics <u>is</u> exactly this scheme**. Thus what has to be done is just re-interpreting the formalism.

So let us look at the quantum mechanical scheme:

> Quantities to be measured are observables. They are assigned to operators. By applying an operator to the vector in Hilbert space, by which the state of the object to be measured is represented, this vector is decomposed into a series of *eigenfunctions*, i.e. a ***decomposition into waves*** is carried out: eigenfunctions are waves whose form depends on the kind of the operator.
>
> E.g. de Broglie matter waves are eigenfunctions of the momentum operator; spherical harmonics – i.e. standing waves on the surface of a sphere – are eigenfunctions of the angular momentum operator.
>
> Therefore, assigning observables to operators is tantamount to assigning them to *wave-categories*.
>
> However in any set of wave categories, into which a wave superposition can be decomposed, there are pairs of categories to which – in the same way as to sine waves and pulse waves – an *uncertainty relation* applies.[24] Thus this must also be true at the wave decomposition of the state vector. And this uncertainty is again *transferred* to the physical quantities *defined* by these wave categories.[25]

With this, the most important elements of the interpretation have already been described and explained.

Here are some other important points:

---

24 At a division in two such classes of waves, the product of the *bandwidths* cannot be smaller than 1.

25 I emphasize again: *since there are only waves*, all causal connections must be traced back to waves. Therefore, the assignment of the properties of objects to wave classes is a *necessary act* that occurred in physics precisely at the time when it had advanced to scales at which the *fundamental wave nature of reality* was revealed.

The object that emerges as a consequence of the measurement is *not* the same object as the one to be measured; the object to be measured is a wave or wave group, the partial waves of which will contribute to *various* measuring events – exactly as we have described it in the explanation of the double-slit experiment.

The state vector represents the object to be measured. Thus it relates to the wave packet *before* the measurement, and accordingly the chosen operator performs a decomposition of this wave packet into waves, which belong to the category to which the attribute to be measured is assigned.

Since the wave category in which the state vector is decomposed is freely selectable, the vector contains all measurable attributes *as possibilities* – however not in the sense of "another form of existence" but in a completely ordinary sense:

Each of the waves contained in the wave packet, which belong to a certain wave category, can contribute to the formation of an object, i.e. of the object of the *actual* measurement or an object of *subsequent* measurements.

At an experiment, it is (in most cases) necessary to *actually* decompose the wave packet. The distribution of the measured values will then, as will be elucidated in the next section, correspond to the distribution of the amplitude squares of the waves contained in the state vector.

The measured object – the carrier of the measured variables – is in any case, provided it is an object of atomic or molecular magnitude, a *reconstructed or a newly formed object,* which owes its existence to the measuring process.

Only through this *new-formation* of the measurement objects can the waves that the state vector contains become measured attributes, in other words: can possibility become reality.

Of course, in every case of assigning an attribute to a wave class, it must be possible to explain the physical reason for this assignment.

Part of the explanation is provided in the book Structure:

In the chapter on relativity, motion (velocity) of objects is defined through *superposition of waves*, *changing* velocity by *altering* frequencies. Matter waves are generated by Lorentz transformation of standing sine waves. In this way, the conceptual basis for the definition of energy and momentum is formed, and it can be understood why energy is assigned to the (non-directional) quantity frequency of matter waves, and momentum to the (directional) quantity wavelength of matter waves.

Formally. these definitions were demonstrated and confirmed in the descriptions of the photoelectric effect and the Compton-Effect.

Why spin and angular momentum are assigned to spherical harmonics (standing waves on spherical surfaces) on atomic and molecular scales is explained in Chapter 9, starting on page 171.

So some of the most important assignments have already been traced back to understandable facts.

Our view of quantum theory, presented in the previous section, has thus been confirmed:

In quantum theory, the objective world of experience is traced back to the fundamental wave world.

This also clarifies why quantum theory is indispensable: all physical descriptions – however abstract they may be – ultimately serve to explain observable, objective phenomena.

Thus, it can be stated:

Quantum theory is precisely the theory that makes it possible to describe the causal foundation of reality, which is exclusively metric and consists of waves, using quantities derived from the observable world of objects. It forms the connection – the "interface," so to speak – between these two realms.

As has been shown, the epistemological confusion that has lasted for more than 100 years and extends into the present day is therefore not rooted in quantum mechanical formalism itself, but in its interpretation: only the inability to break free from objective thought patterns creates paradoxes and ultimately leads to the loss of any understanding of reality.

6.2. The measurement process: Reduction of the wave function

"Among the objectors of 'orthodox' quantum theory, Schrödinger takes insofar a certain special position, as he wants to assign not to the particles but to the waves the 'objective reality' and is not willing to interpret the waves just as probability waves. However, Schrödinger is not able to eliminate the element of discontinuity that appears everywhere in atomic physics. In the usual interpretation of quantum theory, it is incorporated at that position where the respective transition from possibility to reality occurs. Schrödinger himself presents no counter-proposal how he would imagine the introduction of the everywhere observable element of discontinuity other than in the usual interpretation." [26]

I chose this quote because the two points Heisenberg highlights are still relevant today:

To date, there is no reasonable proposal as to how "the transition from possibility to reality" occurs during a measurement. In our description of the double slit experiment, it is explained simply by addition of waves and the resulting transition from a standing wave state to the next higher state – a completely self-evident fact with standing waves.

At the same time, "the element of discontinuity that appears everywhere" is explained in a clear way, and quite obviously also "other than in the usual interpretation", i.e. *not* by assuming an entity called "particle".

In order to relate this "transition from possibility to reality" – the so-called *reduction of the wave function* that takes place during the measurement process – to the quantum mechanical description scheme, we will now take a short excursion into the formal part of quantum theory.

Let $\Psi(x)$ be the state vector of an object T. An attribute of T is to be measured that corresponds to the operator A.

Let be $A\Psi(x) = \sum_{i=1}^{n} s_i U_i(x)$ (U_i eigenfunctions, s_i coefficients)

Let a_i be eigenvalues of the corresponding U_i. Then the result of the measurement will be one of the a_i.

So much to the quantum mechanical specifications, the validity of which is verified to such an extent that they can be considered facts. But now the area of interpretation begins:

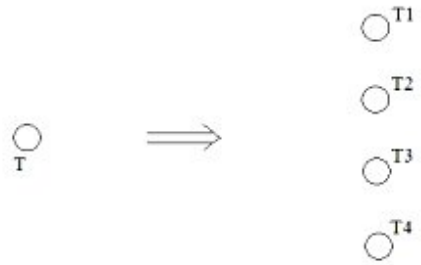
26 Werner Heisenberg, Phys. Bl. 12 (1956), S. 300. (Translated by me.)

If the value a_j $(1 \leq j \leq n)$ is measured, then T – i.e. *the very same object* that has been represented before by $\sum_{i=1}^{n} s_i U_i(x)$ – is supposed to be in the state U_j: the whole sum $\sum_{i=1}^{n} s_i U_i(x)$ has been reduced to the one term $s_j U_j$.

Let us call this hypothesis (H1). It is the fundament of the contemporary interpretation of quantum mechanics:

(H1) *The state function after the measurement, which is reduced to one single term, represents* ***the same object*** *as the state function before the measurement. The one term corresponds to the state of this object after the reduction.*

A simple illustration:



(S2)

T is the object, on which the attribute A is to be measured. T1, T2, T3 and T4 represent 4 different possible states of T after the measurement. If j = 3, then T3 becomes the measured reality. T1, T2 and T4 disappear.

Thus hypothesis (H1) says:

T3 is the same object as T. T is the state of the object ***before*** the measurement, T3 is the state of the object ***after*** the measurement.

In contrast, the model presented here is based on the following hypothesis (H2):

(H2) *The object that* ***after*** *the measurement is in the state U_j is* ***not the same object*** *as the one which was represented by $\Psi(x)$* ***before*** *the measurement. None of the eigenfunctions U_i with $i \neq j$ that belong to the representation of the object T disappears; instead they will all contribute to subsequent measurements, where other, with T formally identical objects (e.g. electrons) will be measured.* ***Thus there is no "reduction"****, at least not in the sense that anything disappears.*

(H2) means:

1. A ***part*** of T – the one, to which T has been "reduced" according to (H1) – contributes to the *actual* measurement result, i.e. to the value of the attribute A, *all other parts* of T contribute to *other, future* measurement results.

2. In general, the measurement result is caused not only by waves of T but also by waves that stem from other objects which are formally identical with T .

Thus in the scheme depicted in (S2) applies – in contrast to the usual interpretation:

T3 is *not* the same object as T. On the one hand, T3 contains not only waves of T, and, on the other hand, T contains also waves which do not contribute to the event T3, but to (possible) future events T1, T2 and T4.

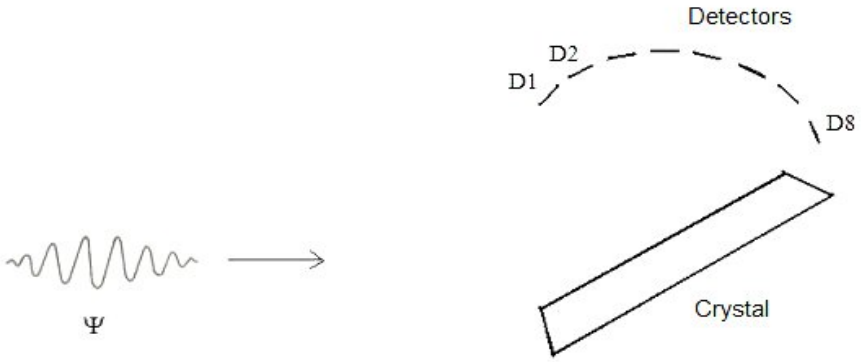
This can be illustrated by the following example:

Let T be an electron. The momentum of T is first to be calculated and then to be measured.

To determine the probability distribution of the measurement values, the momentum operator must be applied to the wave function Ψ which represents T. This procedure is a *wave decomposition:*

Ψ is split into sine waves with different wave-lengths, and the according amplitudes are determined. Their squares give the desired probabilities.

In the experiment, the wave-packet must *actually* be split. This splitting could be carried out e.g. by the following arrangement:



(S3)

The wave packet Ψ is dispersed at a crystal, which means that the waves with different wave lengths contained in Ψ are diffracted at the crystal surface. This surface acts as a plain diffraction grid which decomposes the wave packet into virtually monochromatic radiation bundles.

Near the crystal surface all waves interfere, yet at a sufficient distance the rays separate, such that all waves that arrive at a certain detector have a (nearly) identical wave length. So we have *sorted* the wave packet by wave-lengths (momentums).

Thus the *formal* division by the application of the momentum operator corresponds to the *real* division of the wave packet into sine waves with different wave-lengths by the experimental setup.

According to the usual interpretation, the measurement has the effect that one of the eigenfunctions of the momentum operator leads to the measurement result, that is: it becomes *real,* whereas the others *disappear.* In one detector we now have an electron with a certain momentum – which did *not* exist before –, in the other detectors we have *nothing*.

In the interpretation proposed here, there is no reduction. None of the eigenfunctions disappears. All eigenfunctions will contribute to future events (measurements). The amplitude squares of waves with a certain wave-length add up in the respective detector, until a transition occurs – a momentum measurement has been carried out (which in general is again not the consequence of a single wave-packet but requires the adding-up of amplitude squares of many wave packets that had arrived earlier).

Here it can be seen clearly that quantitatively nothing changes:

The wave packets are divided into sine waves with different wave-lengths, which arrive at the corresponding detectors. If now, according to our basic assumption, the characteristic re-organization of a local spatial oscillation state – i.e. the appearance of an electron – is *caused* by the adding up of wave intensities, then the probability of the events in a certain detector must depend on the amplitude square of the waves that *actually* hit this detector – exactly as predicted by quantum mechanics.

Doesn't it somehow *contradict* the QT formalism to assume that a particle develops somewhere and later *the same* particle appears again – even if formally (*and* experimentally) a partition takes place and the parts are displaced arbitrarily far from each other? It would not be totally absurd to call this an interpretation *against the formalism*.

In contrast, my proposal keeps close to the quantum mechanical formalism and permits connecting the concepts of the formalism with a local reality:

If a particle X is generated at a certain position *before* the measurement, and *after* the measurement an identical particle appears at another position, then this is not *the same* particle; the waves originating from the decomposition of the characteristic oscillation pattern X split up according to their formal description – they *actually* diverge – and *contribute* to the development of another oscillation pattern X, which however deserves to carry the same identifier X not because it is *substantially* but only *formally* identical with the first one.

6.3. The consequences

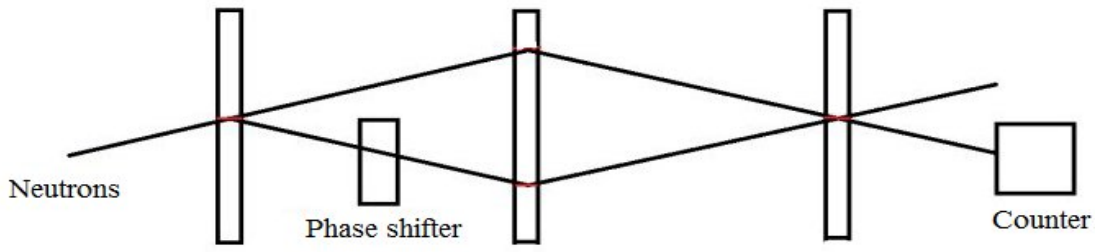
My explanation of quantum theory deals exclusively with a change in interpretation. The mathematical formalism itself remains untouched.

However, this only applies to quantum theory itself – for all other theories based on it, it can be shown that my interpretation of quantum theory implies that the formalism is also false. I will demonstrate this here for the so-called Standard Model of particle physics:

Quarks are subject to the so-called "strong force". This force does not decrease with distance.

*Therefore, quarks **cannot be separated** from each other.*

Neutrons consist of three quarks. In a neutron interferometer, a neutron beam is split into two beams through scattering at a crystal layer, so that the two beams are separated from each other up to a distance of a few centimeters. Then they are brought together again through scattering at a second layer, so that – after a third layer – interference can be observed.



The intensity of the neutron beam is chosen so low that with high probability in the interferometer there is only one neutron at a time.

This raises the question: ***If the neutron is split, where are the quarks?***

In the standard interpretation, one can retreat to the position that these are merely "probability waves" whose amplitudes correspond to square roots of probabilities, thus preventing such questions from being asked.

In my interpretation, however, these are ***really existing waves***, which means that ***due to interference, something must be present in both beams***. And then the question of where the quarks are supposed to be is obviously unanswerable.

It follows that the description of the strong force, according to which the neutron consists of three quarks that cannot be separated, is incorrect.

The contradiction that arose in the double-slit experiment – on the one hand, the ***indivisibility*** of the particles, and on the other hand, their ***simultaneous existence in two slits*** due to interference – could be easily resolved by assuming that there are no indivisible particles, but only really existing metric waves, i.e. by *changing the interpretation* (which, however, required refuting the evidence for quantization).

With the strong interaction, however, this is not possible: replacing particles with waves cannot eliminate the contradiction that, on the one hand, ***quarks are inseparable***, and on the other hand, ***they must be present in both beams***.

For the theory of the strong interaction, the conventional, incorrect interpretation of quantum theory – including the prohibition against ***asking*** what actually happens – is therefore a *necessary condition*.

This shows the extent to which interpretation influences theory formation:

It can not only enable theories but also prevent them.

The strong force is a central component of the Standard Model. And more than that: the way it is described mathematically – the group-theoretical method of its derivation – is an analogy to and extension of the description of the weak force.

So if the theory of the strong interaction is false, then the entire Standard Model collapses. It can then no longer claim the status of a fundamental theory, but merely the status of a purely formal approximation containing elements (objects, interactions) that have no correspondence in reality – comparable to the well-known epicycle system that once served to describe planetary orbits.

It is thus also clear that all attempts to further develop the Standard Model must fail; it is therefore not – as is often claimed – the great scope or even perfection of the Standard Model that hinders its further development, but rather the fact that it is built on false premises.

The same applies to all theoretical physics that arose after quantum theory.

6.4. Summary, outlook

In short, the state of theoretical physics can be characterized as follows:

In the historical transitional phase after 1900, when the *fundamental, causal level* of reality came into focus, and when the theory that traces the realm of experience back to this causal realm – quantum theory – was subsequently developed, this very connection was *not recognized*.

Therefore, theoretical physics went astray: The terms and concepts from the realm of experience, which *do not exist in the causal realm* and are therefore *completely unsuitable for interpreting and explaining causal processes*, continued to be treated as fundamental concepts of description and interpretation. The consequence was a total loss of understanding. It became impossible to see what was actually happening – in other words, reality was completely lost. (See, for example, the double-slit experiment.)

As a result, physics became unguided. If there is no understanding and no insight, then mathematics becomes the only way to solve problems and define goals. However, as the last few decades have shown, mathematics is not suited to this leading role – it can now hardly be doubted that a physics that pursues almost exclusively mathematical goals is drifting further and further away from reality: The connection between theory and experiment is severed, the amount of ignorance is dramatically increased – as with the doubling of the particle number in supersymmetry – based on purely mathematical hopes, and even if these hopes remain unfulfilled for decades (no superparticle has ever been found), the concept is pursued further. Often, only self-generated problems are solved, and the mathematical uniqueness of the solution is then taken as confirmation of its correctness, as in the theory of the strong interaction. In many theoretical areas, arbitrariness and chaos prevail, and – due to increasingly frequent contradictions – the "standard models" must be rescued at an ever-increasing rate by mathematically feasible *ad hoc* assumptions. The respective areas are then considered "active research fields".

What would have to happen to free physics from this impasse?

In any case, the research goals must change. Assuming that particles do not exist, it is clearly pointless to further develop the Standard Model of *particle* physics. The group-theoretical methods based on symmetry assumptions, which have been the focus for several decades, may in some cases be suitable for *classifying* being – although even this can fail, as the example of the strong interaction demonstrates – but they are by no means capable of contributing anything to the question of the *origin* of this being. They merely increase the number of particles and thus also the number of free parameters. Moreover, the concept of broken symmetry drastically amplifies the degree of arbitrariness, which, since there is hardly any experimental verification left, simply enlarges the number of competing theories.

From my perspective, however, the ***origin of being*** is precisely the most important research goal.

How does being arise?

If the fundamental, causal realm of reality is purely metric, containing only the units meter and second, then everything that exists and everything that occurs is a state of spacetime or a process of its changes, which – in my description system – takes place according to equations (1) and (1').

As noted at the end of 3.3, five types of metric waves can be derived from these equations.

This is where we need to start. How do the states we call "particles" come into being? How do atomic nuclei and atoms form?

It might even be possible to observe this directly, precisely when the *Einstein-Bose condensate* assumes its atomic structure.

So the question is:

How does the granular structure of matter develop from the Einstein-Bose condensate?

However, there will be no answer if one applies the usual quantum mechanical phraseology. This isn't about "quantum states" with certain "probabilities" and their superpositions, but rather about

really existing metric waves

that behave like a liquid, where there is surface tension and therefore "droplets" form, and so on.

To be perfectly clear:

The point is to ***understand this process as real*** and not to transform the observed facts into absurdities through phrases that belong to the current misinterpretation of quantum theory, thereby preventing explanation *and* theory formation.

Only through the ***realistic interpretation of quantum theory*** *presented in this paper* will it be possible to understand and mathematically model the process of the creation of matter and the resulting states on the basis of real metric waves.

I even find it plausible that the wave state of the Einstein-Bose condensate could be related to the initial state of existence. And if this assumption is correct, then this would be the point of application for the five types of metric waves mentioned above, which are directly derived from the process of the creation of reality.

Essentially, we only need to make up for what was neglected a hundred years ago: to understand quantum theory for what it actually is, and to apply it in precisely that way:

It is the theory that frees us from the limitations of the realm of experience and grants us access to the elementary, causal realm – but not, as with its current, erroneous interpretation, a purely formal access bought at the price of the total loss of all insight, but an access that includes complete understanding.

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Vienna, April 2026