

THEORETICAL PHYSICS IN CRISIS

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Abstract

Contemporary fundamental theoretical physics has been in crisis for a long time, as it cannot provide an answer to the most important question: “What is the basic structural unit of matter (space, time, energy) and how is the universe constructed of these elementary units?” The reason for this situation is explained below. Also shown, is the way to find answers to these basic questions.

CRISIS OF THEORETICAL PHYSICS AT THE BEGINNING OF THE 21-th CENTURY

Many people within living memory have tried to understand the material unity of our universe. The question is: What is matter and what are elementary building blocks of which it is constituted? Great progress has been made in science during the last centuries. Physics succeeded in the unification of matter and energy, matter and space, electricity and magnetism, electromagnetic and weak interactions. The important kinetic laws of macro-systems (gravitational theory) and micro-systems (quantum theory) have been discovered, but the basic questions concerning the essence of matter and motion have not yet been answered. Theoretical physics has an exceptional opportunity in searching for the answers to these questions, but now, at the beginning of 21-th century, it is in a crisis. Two of its pillars – gravitational theory and quantum theory represent independent directions. Elimination of this duality and unification of these two pillars of contemporary theoretical physics are a great challenge for scientific research but efforts remain unsuccessful to this date. Let us review the reasons for this.

There are deep discrepancies between Einstein’s theory of relativity and quantum mechanics. Einstein was clearly conscious of them. He did not want to accept some of the results of quantum mechanics which contradict the cardinal postulates of his theory of relativity. He regarded the quantum description of reality as incomplete and was not able to come to the terms with Heisenberg’s uncertainty principle, which predicates the impossibility of defining the precise velocity and spacial position of elementary particle at the same instant. In order to unify gravity with electromagnetism he constructed a field theory in competition to quantum mechanics. But he did not succeed. Einstein was sure, that despite the impossibility of making precise simultaneous measurement of velocity and position, the particle exhibited these characteristics, and they could be completely described without resorting to probability. Moreover, Einstein was concerned with the direct communication between distant particles resulting from quantum theory, which contradicted his theory of prohibiting direct communication and permitting only local action propagated with finite speed.

The unification of Einstein’s theory of relativity and quantum mechanics is impossible without eliminating their contradictions. Quantum mechanics uses uncertainty, statistics and probability without searching for their reasons. Their detection is necessary for making

quantum physics a complete theory. On the other hand, Einstein suspected the existence of such reasons, but did not suspect that such detection could deny the basic postulates of his special theory of relativity (STR). Einstein thought that something was wrong with quantum mechanics as his relativity of simultaneity denies direct action at a distance. However, the problem lies not in quantum theory, but in his erroneous relativity of simultaneity as a consequence of his STR.

Although STR is a mathematically consistent theory in its Minkowski four-dimensional space-time interpretation, it predicts relativistic effects like time dilation, length contraction and mass increase as a consequence of symmetrical mutual uniform motion of systems. But in reality the effect of time dilation is a consequence of asymmetrical motion between systems.

In the article "UNAVOIDABLE INTERACTION SEEN AS REASON FOR RELATIVISTIC TIME DILATION" <http://wbabin.net/physics/bolstein2.htm> it was proven that the time dilation cannot be a consequence of mutual relative motion of symmetrical systems, or of acceleration and deceleration. It was shown that if two clocks are in asymmetrical relation, then the slowdown of one of them is the measure of their mutual asymmetry. This asymmetry is caused just by their different motion relative to their common base – real physical surroundings (vacuum).

Slowdown of a clock as a function of speed is admittedly, the consequence of its interaction with the real physical environment.

Einstein's STR is accepted as a true theory because of experimental attestation of one relativistic effect - time dilation. But the fact that it was measured only in asymmetrical systems is omitted. So, the flying space ship is not symmetrical to the Earth. Analogically, accelerated, short-lived particles extending their lifetimes are not symmetrical to their surroundings.

String theories are now the most popular and widespread fundamental physical theories trying to unify the theory of gravity with quantum physics and creating a so-called "theory of everything". These theories are proud of the graviton derivation, but really, they stand on mistaken philosophical fundamentals and so they cannot explain the uniform essence of the material existence of the Universe. The "sand legs" of string theories are evident: we have one-dimensional strings or p-dimensional gates and on the other hand, specifically coiled eleven-dimensional space-time. So the strings are not the building blocks of space, they do not form it, only oscillate and coil in it. Space and strings have mutually independent existence. It is similar to the mutually independent existence of space and matter in Newtonian mechanics. Coiled spaces as the Calabi-Yau manifolds are only pure mathematical forms, abstracted shapes, without any content. They are voids having specific shapes. While the Newtonian empty space has no shape and is infinite, the Calabi-Yau spaces have shapes devoid of any content. Nay, these empty spaces contain holes. The configuration of the holes and bends in these empty shapes defines both the possible resonances of strings oscillation inside and outside these abstract spaces and the possible methods of their winding on these shapes. The relations between the strings and spaces are only external and formal. The strings, gates and Calabi-Yau manifolds are pure abstractions based only on the formal but not the dialectical logic of being. String theories are only pure abstract mathematical forms trying to find some real content for their construction, like mass and charge. But this attempt is quite artificial. String physicists meet new complications again and again and their mathematical apparatus becomes more and more complicated and inaccessible. If Einstein succeeded in unifying matter and space, string theories separated them. There are only external relations between strings and eleven-dimensional space-time. Everything is hidden under the Planck

scale where scientific imagination is unlimited. String theories are mistaken in their philosophical basis and give no answers to the basic questions of physics, although these answers are quite easy, because the truth is simple. In spite of this, truth is yet to be discovered.

In contrast with string theories the Loop quantum gravity is the background-independent theory in which space is represented by a structure called a spin network, evolving over time in discrete steps. Loop quantum gravity supposes space to be divided into discrete elementary parts (tops with loops and connecting edges) creating the spin networks, but the essence of these spatial components and the nature of gravity are not explained. The Loop quantum theory considers its greatest success in the possibility to compute the area and volume of certain part of quantum space through a spin network. The other great result of this theory is the evidence for a physical (quantum) discreteness of space at the Planck scale that has an atomic (discrete) structure. But the common features and differences between particles and vacuum are not explained. Loop quantum theory and other quantum theories of gravity are not able to give the clear answers to the basic questions about the material aspects of the Universe.

Contemporary physical theories are built on an axiomatic base, so they are only theories, and not the real knowledge of matter (space, energy). They only describe the manifestations of matter. Despite that, some physicists think they are capable of talking about the basic philosophical truths and detecting them. What philosophical truth have the string theories detected about the essence of matter? That one-dimensional string is the basic building block of matter and that there is also eleven-dimensional space-time? What is its elementary building block? Do the physicists discovering the basic universal interaction as a unification of four known interactions know what are they finding? They use a very complicated mathematical apparatus and hope to find the truth in this impenetrable jungle. This truth will be so complicated that only some mathematicians will pretend to understand it. As the essence of unity is unknown, finding a mathematical form for it cannot be successful and can only complicate the situation more and more.

The significant successes achieved by physics, mainly at the first half of the 20-th century, have profoundly influenced philosophy. Despite the unsuccessful detection of the essence of matter, technology has achieved very useful results. This fact influenced philosophy and caused its decay. Such decadent movements as subjectivism with existentialism, pragmatic positivism (constructivism, analytical philosophy, operational philosophy) have appeared. They refuse to look for the answers to the basic questions of being, consider them useless, and confine their investigation to what is useful. This decadence is one of the main reasons why the essence of matter has not been discovered. Physicists are not experienced in philosophy and philosophy often falls into line with physics and their operational results and consequently lapse into pragmatism.

The basic questions of physics are: What is the basic building block of matter and all its forms of existence like space, time, solid, radiation, vacuum, force fields? What is the essence of gravity, electromagnetic, strong and weak interaction? What form of nature is expressed by the basic cosmological constants? Contemporary physics does not know the answer to these questions and the theory of strings will never find them. This fact is demonstrated by the presence of multitude of physical theories. Some of them are far from reality and use absurd hypotheses on a par with the science-fiction.

Splitting of theoretical physics into two separate and incompatible parts manifests itself like schizophrenia. The new physical theories are trying to unify something which cannot be unified. Quantum informatics, I consider to be the most advanced direction of contemporary physics. It connects quantum physics and informatics together. Being a cyberneticist, I am pleased with the successful development of this area of science which will both enlarge theoretical knowledge about the properties of matter and contribute to the great development of information technologies. I will be pleased if my discovery of the secret of matter could contribute to the development of this area of science.

MATTER IN CONTEMPORARY PHYSICAL UNDERSTANDING

Throughout time, humanity has been searching for answers to the questions about what is matter, space and time. These notions became formerly the basic categories of philosophical thinking, and later objects of physical research. Philosophy, with its instruments, has found the most precise explanation of these categories in Hegelian dialectical logic. Physics has so far reached only a particular knowledge by its approach.

Dialectical philosophy considers space and time to be the basic forms of matter. The unity of matter, space and time manifests itself. There is no matter without space and time and on the other hand, space and time do not exist without matter. Physics also accepts this general conception but its mission is to explain and describe the variety of forms and manifestations of matter.

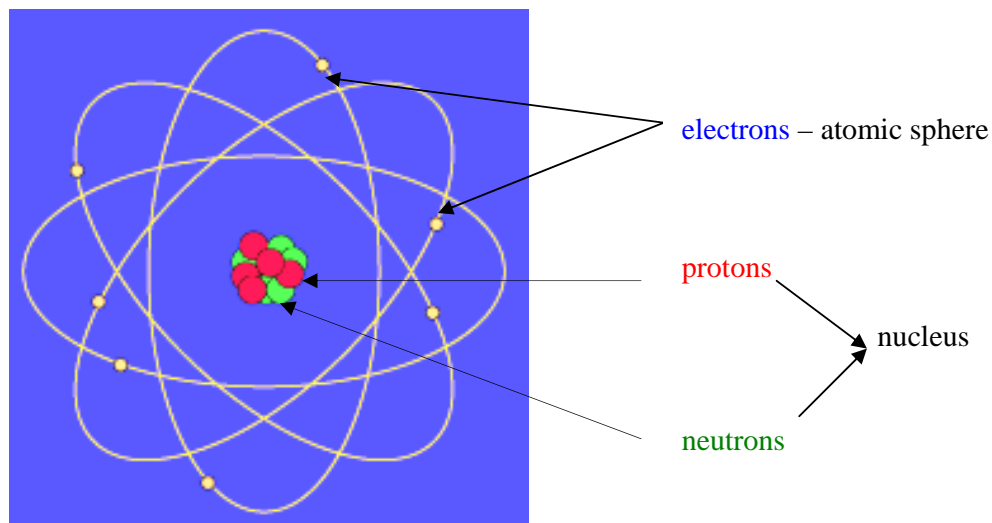
The most general forms of matter accepted by contemporary physics in its Standard model are:

- **material** (created by the basic building blocks - fermions),
- **fields** (created by the basic interactions with their carriers - bosons),
- **vacuum** (the space without particles).

ELEMENTARY PARTICLES – FERMIONS			
family	LEPTONS	QUARKS	
I.	e <i>electron</i>	ν_e <i>electron neutrino</i>	u <i>up</i> d <i>down</i>
II.	μ <i>muon</i>	ν_μ <i>muon neutrino</i>	c <i>charm</i> s <i>strange</i>
III.	τ <i>tauon</i>	ν_τ <i>tau neutrino</i>	t <i>top</i> b <i>bottom</i>

The elementary particles obviously belong to the first family. The particles belonging to the second and third families are created only during exceptionally high-energy collisions. These particles have their antiparticles. The atoms are created from the particles of the first family. The atomic sphere consists of electrons circulating around nuclei created by protons and neutrons consisted of **u** and **d** quarks.

The next picture represents the Bohr model of the atom:



The world of elementary particles became broader and more complicated, representing about 400 types. Then it had been found that the strongly interacting hadrons (the protons and neutrons belongs to them) have an internal structure, that according to the Standard model, consists of bound quarks interacting mutually through gluons – immaterial vector particles. The non-abelian calibrating quantum field theory describing the strong mutual interactions between quarks and gluons is named chromo-dynamics (QCD). The independent existence of quarks and gluons is impossible. Their freedom is only asymptotic and so they can only be bound inside particles. When protons and neutrons were considered elementary particles, the pions were the mediators of strong interactions between them. The pions consist of one quark and one anti-quark according to the quark model.

According to the Standard model, the elementary particles are dimensionless point entities without any internal structure. It is quit clear that such an understanding is quite naive. These particles dispose of many properties (charge, mass, spin, ability to interact with other particles) thanks to which they differ from one another, so they possess various qualities, manifesting them outwards. The deep internal reason for this miscellaneous qualitative manifestation of these quasi-elementary particles is hidden in their different internal structure that cannot be detected by contemporary particle accelerators but can only be explained by the deep dialectical logic.

The elementary particles – fermions according to the Standard model act mutually by exchanging specific elementary particles – bosons. Contemporary physics knows the four basic types of interaction with four types of force fields – gravitational, electromagnetic, strong and weak.

BASIC INTERACTIONS	MEDIATORY PARTICLES – BOSONS
Electromagnetic	Photons
Strong	Gluons
Weak	Inter-medial bosons W^{\pm} a Z^0
Gravitational	Gravitons

The understanding of interaction as an exchange of bosons between fermions is a consequence of the mechanical approach to theoretical physics. For example, the electric attraction and repulsion between charged particles are represented by the mutual exchange of virtual photons. As the electrostatic force is a long distance one, every electron must exchange photons with an enormous number of protons and electrons in the Universe. It is remarkable that this absurd picture is more acceptable than much more logical picture of the direct connections (relations) between charged particles. The acceptance of particle interactions as direct relations between them is rather complicated for theoretical physic, because of Einstein's refusal to accept non-local actions. But non-locality as a direct communication between distant particles is a fundamental consequence of quantum physics, known as entanglement or EPR non-locality. If theoretical physics were not blocked by erroneous dogmas, it could have detected much earlier, that the vacuum is not an empty space between point-like particles, but is created by direct connections between them. All particles and interactions are space-creating and space-carrying direct connections and not point-like dimensionless particles without any internal structure.

Using the instruments of dialectical logic, theoretical physics could have already detected the nature of matter and would not have a problem understanding the vacuum as being created by direct space-carrying connections joining everything with everything.

The dialectical logic does not investigate the specific laws of motion of separate forms of matter, but only explains the basic reason for motion. The integrating aspect of all these forms is their energetic substance. All forms of matter are only different forms of energy. Energy, being motion or potential for motion, has its basic reason in the dialectical relation of contradictions. This means that **bipolarity as the dynamic relation of two opposite poles (anti-poles) is the basic building block of matter, space and time**. This fact has not been understood by physics in spite of the fact that bipolarity manifests itself everywhere, for example, bipolarity of electric charges and magnetic poles, action and reaction laws, kinetic and potential energy, attraction and repulsion, etc. Without an acceptance of the bipolar principle of matter, it is impossible to explain how matter as space and time are structured and constructed.

Contemporary physics has difficulty understanding the relation between continuity and discontinuity (discreteness) of matter. The gravitational or electromagnetic fields are described as continua. But on the other hand, they are represented by the discrete quanta of

electromagnetic energy – photons and gravitational energy – gravitons. The relations between discrete particles and their continual fields are not clearly explained. This duality is only accepted as a paradox of nature.

The clearest example is electromagnetic radiation which is both a wave of the electromagnetic field and a particle (corpuscle) – photon, an elementary quantum of energy. This duality of wave and particle is explained as a manifestation of complementary principle without deeper penetration into this concept.

Classical theories like Maxwell's theory of electromagnetism and Einstein's theory of relativity describe the motion of material objects, electromagnetic and gravitational fields by accurate space-time parameters. Quantum mechanics describes the motion of elementary particles by the functions of probability and statistics. Heisenberg's uncertainty principle says that the precise position in space and the momentum of particle cannot be exactly measured and do not exist simultaneously.

The mentioned discrepancies and unexplained dualities of contemporary physics result from an ignorance of the dialectical principle of building up of matter and its spatial evolution in time. Space in classical Newtonian physics, is an empty arena for the motion of celestial bodies and for their dynamic activity. Material objects are independent of space, which is absolute. In field theories, like Maxwell's theory of electromagnetism and Einstein's theory of gravity, free space (the vacuum) has physical properties such as the ability to transmit electromagnetic and gravitational waves. But the essence of the vacuum is unknown. The force fields are continuous but on the other hand they are transmitted by point particles – bosons. For example, the electromagnetic field is transmitted by the quanta of radiation – photons. How could the elementary point particles be a carrier of a continual field? What is the relation between continuity and the quantum character of fields? Is the force interaction between fermions caused by the continual fields emerging out of fermions, or discrete particles – bosons? What is the relation between the continuity and discontinuity of force fields expressed by bosons?

Is space continuous or discrete? The notion of a field is an indication of something monotonous, unlimited and continuous, surrounding all bodies where the forces of their mutual acting are "sowed". But on the other hand all bodies and particles are filled with force fields. The question is: Do the particles create the fields or the fields create the particles? By what reason is a particle as a discrete element of matter detached from a continuous field? As this reason is unknown, the solution is the so-called "complementary principle" that indeed, accepts matter duality, including the duality of the photon, electron and other particles, but does not explain a deeper unity of this duality. Continuity and discontinuity are only mutually complementary moments in this principle. Their relation is only external and does not follow from their intrinsic nature. The dialectical relation between continuity and discontinuity is not yet understood. Einstein supposed material objects as being only field compressions but did not know or could imagine how such a compression could occur. His theory of gravity was built as an imitation of Maxwell's theory of electromagnetism, but he remembered that the gravitational fields in contradiction to the electromagnetic fields have their source outside - in material or electromagnetic forms of energy. Einstein's gravitational fields are the metric fields relative to the geometrical properties of Riemann space. Einstein's equation of a gravitational field expresses the relation between the amount of energy and its space manifestation by Riemannian metrics. Left side of the equation represents the Riemannian tensor of curvature and right side is a tensor of momentum and energy. Einstein for the first

time, unified matter (energy) and space mathematically. But the reason for this unity has remained undiscovered.

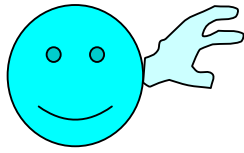
Getting matter and space into a mathematical relation, Einstein accepted the philosophical truth that space and time are only forms of matter, so space is not absolute but only has a dependent existence in relation to matter. This fact demonstrates the close relation between physics and philosophy. Philosophy builds its knowledge by notions and categories, physics and other exact sciences of inorganic nature incarnate this knowledge, try to put it into mathematical forms and test it in experiments. Formerly every truth was uncovered notionally and afterwards it was put into mathematical language, if possible. So philosophy has a legitimate precedence before the exact sciences. Einstein's theory of gravity is an example of how to incarnate the philosophical ideas into physics.

Philosophical dialectical principle has had no adequate reflection in physics, despite its brilliant explanation of the essence of motion. So my mission is not only to describe it philosophically, but also to put it into mathematical and physical form.

Let us come back to Einstein's theory. Einstein was anxious about quantum theory because of two reasons: Quantum physics asserts that a particle in motion has no precise coordinates in space. The second and much more significant reason derived from quantum theory is the existence of non-local connections and direct communication between spatially separated particles. This conflicts with Einstein's theory of relativity and his concept of a continuous field. According to his concept, the "here and now" in accurate space-time coordinates depends on the field being quite near. Maxwell's equations make possible a prediction about what will happen a bit farther away and later, if we know the state of things now. Direct non-local action not only contradicts Einstein's theory but represents a certain return to Newton mechanics on a higher level. Einstein considered quantum theory as incomplete and its uncertainties, probabilities and statistic character as a result of not knowing the deeper intrinsic nature of quantum phenomena. Since quantum mechanics came into being, the problem of direct non-local connections is unavoidable. Some theories with hidden parameters tried to support Einstein's local principle. Every local theory has to meet Bell's inequalities. The theoretical results of quantum mechanics manifest a violation of Bell's inequalities and non-local action was confirmed many times by experiment. Theories with hidden parameters are unable to eliminate these awkward consequences of quantum physics. The existence of non-local connections and direct actions through space shows that the problem is with Einstein's special theory of relativity.

The duality between field continuity and the discontinuity of energy quanta, the misunderstanding of the relation between bodies (particles), fields and vacuum and the contradictions between two grand physical theories are the result of a misunderstanding of the dialectical nature of space, not knowing its elementary structural unit and the principle of construction of the Universe. These questions will be explained step by step.

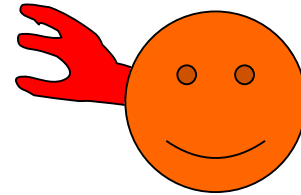
Let us see how simply and clearly the problem of duality of continuity and discontinuity can be removed, looking at mutual interaction between two fermions. Let the electron and proton represent the fermions, so the virtual photon as a boson carries their mutual electromagnetic interaction. Particle physics interprets this interaction in the following way:



**electron
(fermion)**



**photon
(boson)**



**proton
(fermion)**

An electron and proton exchange a virtual photon and so they create their mutual electromagnetic interaction. These three particles do not carry space inside, do not create it, but only move towards each other in empty space - vacuum. This naïve presentation of electromagnetic interaction creates the following serious problems:

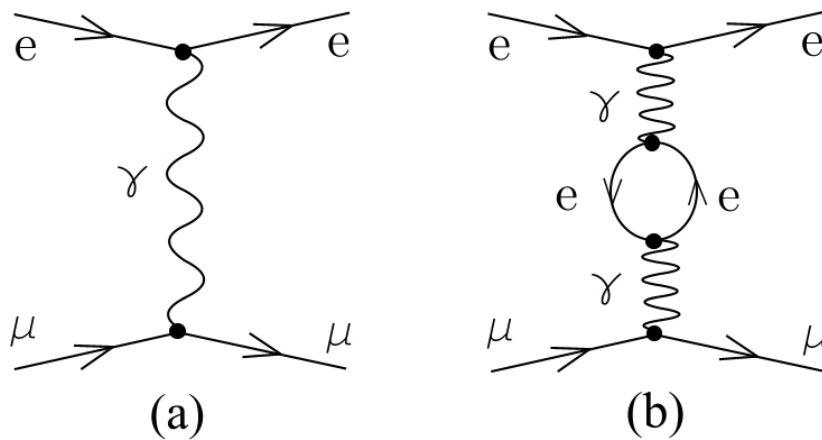
- How do the electron and proton know how to exchange the virtual photon if there is no direct relation between them? How can the concrete electron send a photon in the correct direction to the proton that receives it and consequently react by mutual attraction? How does the proton know that the concrete photon comes to it from a certain electron and not from other charged particles? How does the moving virtual photon know what fermions it needs to get into an interaction if it does not carry any information about them?
- If there is the huge number of charged particles in the near and distant surroundings, how does every particle exchange photons with all others? How does every electron or proton know that it needs to exchange photons with all other electrons and protons if there are no direct connections between them? Do virtual photons only freely fly between electrons and protons in empty space, accidentally collide with them and so cause an electromagnetic interaction?
- What is the electromagnetic field like? Is it something continual, emanating from every charged particle and reaching an unlimited distance or is it an unbelievable flow of virtual photons flying from or in every charged particle in order to mediate interactions between all charged particles in surroundings? If the electron is a point, a dimensionless particle without internal structure, then the sea of virtual photons flying from it creates an unbelievably absurd picture. Einstein's dogma of local action does not allow virtual photon to know where these points (electrons) are, but nevertheless, photons come to and go from a concrete point (electron) in order to transfer an electromagnetic interaction to all other electrons (points) and protons being in the near and distant surroundings - even in the whole Universe.

From this thought analysis, it is evident that Bohr's complementary principle does not explain the dual nature of matter manifesting itself as the relation between continuity and discontinuity, of the wave and particle character of the electromagnetic field. This principle is only accepted as a physical paradox of nature. Another great barrier to correct thinking is the ban on the existence of direct action at-a-distance as a consequence of the special theory of relativity (relativity of simultaneity). These problems are now very obvious and result in contemporary physical theories that are far from reality. Despite the experimental evidence of

the existence of non-local connections, quantum physics looks as if it is having problems with their full acceptance. Otherwise it would have had to discover that the interactions between particles are caused by their mutual direct connections not by point-like virtual bosons flying between them at limited speed.

Let us come back to the electromagnetic interaction between charged particles. The theory describing electromagnetic interactions on the quantum level is known as quantum electrodynamics (QED). It is the most precise physical theory as its predictions are in greatest measure, in harmony with experimental results. QED is the quantum theory of the electromagnetic field with a photon as a quantum. Although Richard Feynman (the famous creator of QED and its mathematical apparatus and formalism) tried to find an illustrating interpretation of applied mathematical procedures for describing electromagnetic processes, the results of his effort are unsatisfactory. But they represent a certain aid for physicists and represent a considerable simplification in computation.

He created the form of graphic illustration of mathematical expressions that appeared during calculations, which are known as Feynman's diagrams that represent at the same time, the graphical illustrations of processes.



(a) the tree diagram
 (b) the diagram with one closed sling

The above pictures are examples of Feynman's diagrams of electromagnetic interaction between electrons and muons. External direct lines represent the motion of particles – electron **e** and muon **μ** before and after interaction. The electromagnetic interaction is represented by the tops (knot points) of the diagrams, where two direct lines of charged particles meet the one wavy line of photon **γ**. In this case the photon is “virtual”, not real, and so it cannot be detected. Now we meet one serious problem in interpretation, where the nature of the electromagnetic interaction is unclear. Although the photon is virtual only, it moves with the limiting speed of light and carries a certain energy and momentum. If the interaction in diagram (a) is interpreted as an emission of a virtual photon by an electron and its consequent absorption by muon, the result is a change of energy and momentum for both particles, where the whole energy and momentum of the system is conserved in both tops of the diagram. In

diagram (b), the process of electromagnetic interaction is supplemented by the virtual inter-process of rising and extinction of an electron-positron pair. We could continue in complicating this situation, but the exchange of virtual photons is the basic sense of these processes. In order to guarantee the permanent continuity of the electromagnetic interaction of separate particle with all charged particles in the Universe, the quantum electromagnetic field of every charged particle must be represented by an infinite sea of virtual photons, which are emitted and absorbed by the charged particle.

As quantum physicists realize, this interpretation is rather naïve since virtual photons cannot be detected. They note that the internal wavy line of the diagram represents only a mathematical value known as the propagator of electromagnetic or electron-positron fields. So now we can clearly see the root of interpretation problem. The reality is replaced by mathematics, which definitely obscures the real nature of electromagnetic interaction instead of disclosing it. Well, the very effective and useful QED is only one of many theories where reality is successfully replaced by mathematical formalism without any possibility of making a clear and simple interpretation of real processes. Saying that the direct lines of electron and muon represent the quantum wave functions of these charged particles cannot make the understanding of these phenomena more clear. The interpretation problem of quantum physics remains unsolved and physicists try to persuade us that it is not necessary to try to interpret the mathematical procedures as it is not clear what reality they hide. This situation inspires the feeling of secrecy and mystery. Theoretical physics should give the simple and logical explanation of physical reality but instead, leads us into the sphere of puzzles and paradoxes hidden in complicated mathematical relations.

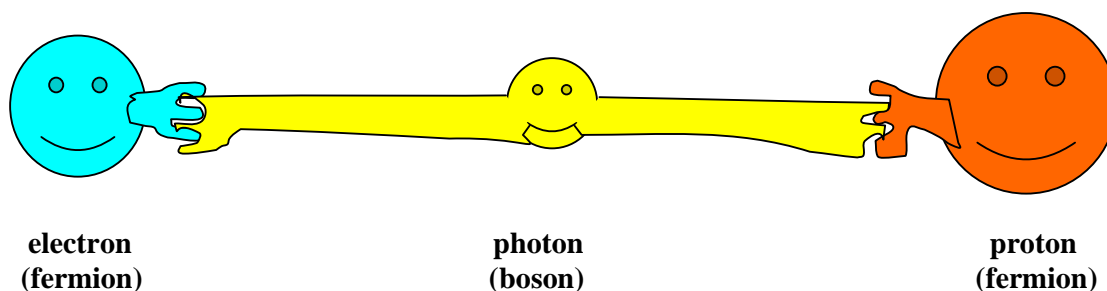
The interpretation problem with virtual photons is a consequence of non-acceptance of direct non-local interactions. The fact that the virtual photons are not real, but only the mathematical propagators of electromagnetic interaction, is clear evidence that this interaction must be represented by direct connection between charged particles. As Feynman wanted QED to be relativistic, he preferred the existence of virtual photons moving with limited speed instead of direct connections. So the next paradox appeared - the real electromagnetic field is only a consequence of virtual, i.e. mathematical existence of virtual particles. Such a mathematical approach was also transferred to the other quantum field theories like:

- quantum theory of weak interactions which was unified with electromagnetic field quanta into a quantum theory of electroweak interaction,
- quantum theory of strong interactions – quantum chromodynamics QCD,
- quantum theory of gravity as an attempt at quantisation of gravitational field

In these theories the virtual particles – bosons are also the carriers of forced fields. In order to be exact, these particles – photons and inter-medial bosons Z^0 a W^\pm can also exist like real particles. As the carriers of interactions between fermions they become unreal virtual mathematical spooks. Gluons as intermediaries of strong interaction cannot exist as free particles and gravitons have never been detected. The reason for this will be explained later, by discovering the nature of gravitational interaction.

Let us have a look at the real picture of force interactions between particles that is devoid of thought inconsistency and the unexplained paradox of matter duality. In this picture, the interacting particles and their mutual interactions represent structures consisting of elementary quantum connections. Their nature will be explained later. Both the particles and interactions are composed of the same elementary connections and so there is no difference between them. Particles and interactions are not points moving in space, but they are carriers and creators of

space and also vacuum and fields. Let us have a look at the following picture of an electromagnetic interaction between two charged particles:



In this interpretation, the photon represents a direct connection (relation) between the electron and proton. It is not the virtual photon as an object of mutual exchange between particles, but the real direct connection whose structure is the same as the structure of a free photon. So the electromagnetic interaction between electron and proton is not the permanent exchange of virtual photons but the direct connection whose intensity depends on the distance between particles and their mutual motion. Other interactions have an analogical character, including gravitay, which is created by the huge number of elementary quantum connections between massive objects, even though these elementary quantum connections emerge from every elementary particle connecting it with the whole universe. All known interactions are represented by the certain structures of elementary connections. The simplest is the photon connection. The inter-medial bosons Z^0 a W^\pm as carriers of weak interaction represent the more complicated structures of direct connections. There is no principle difference between particles and interactions as both consist of elementary quantum connections. The vacuum is not an empty space but the space of quantum relations connecting everything with everything. There is no difference between vacuum, matter and fields. All consist of the same elementary connections creating the basic building blocks of the universe. Now there is no problem in understanding the relation between continuity and discontinuity. The particles and interactions represent discontinuity as they are separate parts (quanta) of space, but at the same time being the structures of quantum connections they represent the continuity of space. The quantum connections represent both the quantum character of space, matter, force fields and their continuity. Every elementary connection is at the same time, the quantum of space (discontinuity) and the continual relation of anti-poles (continuity).