The Epistemological Crisis in Modern Physics

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ABSTRACT

In physics today, it often happens that experimental data is interpreted as proof of a phenomenon that has not been directly observed, but for which phenomenon there is a theoretical model. With the obtained data acting thereby as proof, the model then becomes recognized as "real," after which the theoretical phenomenon that the model describes also then becomes recognized as "real" – that is, the heretofore purely theoretical phenomenon is acknowledged as a physical reality, even though it has never been observed, by either instruments or human senses. This relatively new situation, in which unobserved phenomenon come to be treated as if they had been directly observed, has lead modern physics into deep epistemological crisis of which it is not yet aware. The purpose of this article is both to identify the epistemological crisis created by this situation, as well as to present a solution to overcoming this crisis.

Key Words: Epistemology, Higgs Field, Gravitational Waves

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Introduction

Recently, two Nobel prizes were given for the discovery of phenomena that have not yet been observed by either instruments or human senses, namely: the Higgs field and gravitational waves. In the Higgs field research, it was found that extremely rarely (one in millions of collisions of protons) a characteristic flux of energy can be measured that has been named the "Higgs boson." For modern physics, the discovery of the Higgs boson stands as proof of the existence of the Higgs field, even though such a field has been neither measured by instrument nor observed by human senses. Similarly, in gravitational wave research, it has been found that the laser light motion in the LIGO interferometer sometimes takes a bit longer or shorter time when passing the beams, and this has been interpreted as occurring when a gravitational wave is theoretically passing through the interferometer. For modern physics, the minimal time variability of the laser light stands as proof of the existence of gravitational waves, even though such waves have been neither measured by instrument nor observed by human senses. In both of these cases, there is an "epistemological gap" between obtained data and the interpretation of that data that represents a serious problem from the standpoint of the epistemology of physics.

The weak point of the methodology of modern physics

The Special Theory of Relativity (STR), published in 1905, deeply changed the methodology of physics. As a result of STR, it became and remains an accepted truth that time is the 4th dimension of space, and as such has an actual physical existence. The formalism $X\,4 = ict$ has convinced the majority of physicists that time is the 4th dimension in the space-time model. And so, as a consequence of the acceptance of the space-time model, physicists are also convinced that time, as the 4th dimension of space, has a real physical existence, although there is no direct experimental evidence whatsoever for this, nor

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has anyone ever experienced time as the 4th dimension of space. In this way, beginning with the STR mathematical model, and continuing ever since, it happens that mathematics overrules physics. Nowadays, if one has a consistent mathematical model, every peer review journal will publish it, without bothering about the epistemological stability of the article. Epistemological stability means the level of the adequacy of the model with respect to physical reality. The most epistemologically stable model would be a model which is related to physical reality through a bijective function of set theory. A bijective function prescribes to each element in known physical reality exactly one element in the model:

$$f : X \rightarrow Y \qquad (1).$$

Recent research where this "bijective epistemology" was applied has confirmed that the current model of space-time has no "bijective epistemological stability," because an element of the model, i.e., time as a fourth dimension of space, is not a known physical reality. (Fiscaletti and Sorli, 2015). It seems that Minkowski was aware of the fact that time has an exclusively mathematical existence, which is why he added the imaginary number i in the formula $X4 = ict$. However, after a period of time i was removed from the formula, which then became $X4 = ct$. Eventually the light speed c which is the constant was written as 1 and so the formula took on the form $X4 = t$, which, not coincidentally, is the exact mathematical description of the already held conviction and belief that material changes are running in some real physical time as the 4th dimension of space. This conviction and belief has no epistemological stability, and is the biggest theoretical failure of 20th century physics. Nonetheless, this conviction and belief still prevail in mainstream modern physics.

The weak point in the methodology of modern physics is that much of modern physics is based on mathematical models that are proven by *indirect experiments* (indirect experiments are those which do not directly measure the modelled phenomenon that is the subject of the given research). As a result, conclusions are arrived at that lead these modelled phenomena to be treated as if they had an actual physical existence, despite the complete absence of any direct physical evidence of that physical existence. As already mentioned, Higgs field and gravitational waves are two recent examples of this indirect methodology where the physical existence of the phenomenon is based exclusively on the mathematical model and indirect experimental data. These two "phenomena" have been only theoretically predicted and described through mathematical models and never directly observed. However, how much each model corresponds to the physical reality remains an open question.

Higgs mechanism is the most mysterious model of modern physics:

- physical properties of Higgs field are not known
- Higgs field interaction with gravity field is not known
- Higgs field interaction with the electromagnetic field is not known
-Higgs field interaction with relativistic particle giving him relativistic mass is not known.

Proton mass is 938 MeV/c2. In LHC proton is accelerated close to the light speed and is additionally absorbing energy of the quantum vacuum which represents its relativistic mass which is 6,5 TeV/c2. Relativistic mass of the proton we express in following formula:

$$m = \frac{\gamma \cdot (\rho_{PE} - \rho_{SE}) \cdot V}{c^2} \qquad (2).$$

where γ is Lorentz factor, ρ_{PE} is Planck energy density of quantum vacuum, ρ_{qvE} is energy density of quantum vacuum in the centre of relativistic proton, V is the volume of the proton. In LHC millions of relativistic proton collisions happen every second. Very rarely (once in a billion collisions) happens that energy flux of a 125 GeV/c2 is released. We call this momentary energy flux with duration $1{,}56 \cdot 10^{-22}\ s$ "Higgs boson". Higgs boson is not a "particle" which would exist in the universe on its own. It is manmade momentary flux of energy and is not proving existence of Higgs field which was never observed and measured.

Higgs mechanism starting idea seems wrong and so the whole model of Higgs mechanism seems a failure: "Must be a field which is giving mass to elementary particles". This idea is against mass-energy equivalence principle which is one of the pillars of physics: "Mass of a body is a measure of its energy-content" (Einstein 1905). Mass is the intrinsic physical property of a given particle and cannot be the result of particle interaction with some field.

A historical overlook of how mathematics has overruled physics

Length contraction was postulated by George FitzGerald (1889) and Hendrik Antoon Lorentz (1892) in order to explain the negative outcome of the Michelson–Morley experiment and rescue the hypothesis of the stationary aether (Lorentz–FitzGerald contraction hypothesis) (FitzGerald, George Francis, 1889). Length contraction was later adopted by Einstein and used in his STR and also in his General Relativity Theory (GRT).

The idea that a moving object can change its length has no basis in any observed physical phenomenon. At the time the hypothetical "length contraction" was mathematically described, no one cared much about the negative epistemological consequences of such a purely mathematical entity being introduced as a new phenomenon in physics.

In large part mathematical models play the decisive role in modern physics. If you are a theoretical physicist and you have a mathematically consistent model of a given phenomenon that your model predicts could exist, no one will ask you about the epistemological stability of your model. To the contrary, an experimentalist will try to prove the validity of your model through some indirect experiment.

As previously stated, the mathematical introduction of "length contraction" originated at the end of 18th century. Let us go back to that time and imagine that we are actively participating in the ether research. We cannot see the ether directly with our senses. We can only see the light that we suppose is the wave of the ether. However, instead of conceiving and assuming that the ether is stationary, we assume that the ether is not stationary, but is instead moving with the objects. Operating on this assumption, we can imagine that the Earth is moving through the ether in such a way that the ether which surrounds the Earth is itself moving and rotating with the Earth. This way of conceiving of the ether means that we cannot strictly divide the ether from physical objects, as they are intrinsically bonded and so should be examined together. This way of conceiving of the ether is rescues the ether hypothesis without the introduction of length contraction. In this dynamic ether model, the photon is the wave of the ether and behaves according to the Doppler effect. Every inertial system is moving in the ether, and light, which is a wave of the ether, has the same velocity in every inertial system. When the distance between the source of light and the inertial system shortens, the light increases in frequency, and when the distance increases, the light frequency decreases. In this dynamic ether model, the ether that surrounds the Earth is rotating with the Earth. We call this phenomenon ether drift (in modern physics it is called "quantum vacuum dragging effect") and it fully explains and mathematically describes the Sagnac effect, which STR cannot explain (Fiscaletti and Sorli, 2016).

In physics, sometimes it happens that erroneous ideas are summed up. The idea of a stationary ether resulted in the ether being thrown out of physics. Without a medium for light, Einstein had to create the idea that a photon can move in an empty space deprived of physical properties. This idea is the cause of a crisis in today's physics, because the Standard model then tries to describe physical reality only in terms of fields and particles that exist in a supposedly empty space. We have, in modern physics, three main fields: the electromagnetic quantum vacuum of quantum electrodynamics QED, the Higgs field, and the gravitational field. However, none of these fields is able to be combined with any of the others to create the unified model.

Our research group has developed an Advanced Relativity model that gives the ether the new name of "dynamic quantum vacuum," and in which model the photon is a wave of the quantum vacuum. Inspired by the work of Max Planck, in the Advanced Relativity model the ether is given the physical property of Planck energy density, which has minimal variations according to the mass of a given physical object: diminished energy density of ether (quantum vacuum) corresponds to the mass of a given physical object:

$$E = mc^2 = (\rho_{PE} - \rho_{qvE}) \cdot V \qquad (3),$$

where ρ_{PE} is Planck energy density, ρ_{qvE} is energy density of quantum vacuum in the centre of a given massive particle (or massive body), m is mass of the particle (or massive body), V is volume of the particle (or massive body) (Sorli *et al.*,2017). The Advanced Relativity model works perfectly without introducing a Higgs field and without a gravitational field. In the Advanced Relativity model, mass and gravity both originate in the variable energy density of quantum vacuum.

Introduction of bijective epistemology in physics

Bijective epistemology requires that a phenomenon that is to be examined needs to either be observed with the senses of the observer, or detected with an instrument. Human perception and/or instrumental perception are the obligatory elements in order to begin research on a given subject. When the research subject is only theoretically predicted, that is, based on an existent model, it needs to either be confirmed with a direct human observation, or a direct instrumental measurement. A good example of this is Dmitri Mendeleev's research, who published the first periodic table of the chemical elements in 1869, based on properties that appeared with some regularity, as he laid out the elements from the lightest to the heaviest (Kaji, 2002). When Mendeleev proposed his periodic table, he noted gaps in the table and predicted that as-then-unknown elements existed with properties appropriate to fill those gaps. And as he predicted, those unknown elements were later discovered by different researchers.

By comparison, the discoveries of both the Higgs field and gravitational waves are epistemologically weak, because neither of these phenomena have been measured directly. Nonetheless, these "discoveries" are recognized as amongst the greatest achievements of modern physics. Whether or not this will still be the case in 2117, is doubtful. There is no doubt that the periodic system of elements will be still valid in 2117, because it is based on direct measurements. Indirect measurements applied in the research of the Higgs field and gravitational waves should be carefully examined before their full application be is used as a standard in future research. This question seems philosophical, but it is not, as it touches the core of physics and deserves the attention of both theoretical physicists and experimentalists.

The realization of Einstein's vision of completeness of a theory

Bijective epistemology fulfils Einstein's vision of "completeness" of a theory." "If, without in any way disturbing a system, we can predict with certainty (i.e., with probability equal to unity) the value of a physical quantity, then there exists an element of physical reality corresponding to this physical quantity." And for a theory to be complete, "every element of the physical reality must have a counterpart in the physical theory" (Bernstein 1999). In Advanced Relativity, every element in the model corresponds to exactly one element in the physical reality.

Einstein used to say: "Imagination is more important than knowledge. For knowledge is limited, whereas imagination embraces the entire world, stimulating progress, giving birth to evolution." We must add here that scientific imagination, in order to lead us to coherent models, needs to be based on human perception and direct experimental data. If not, something can be imagined in a mathematical model (that has no real correspondence with the physical world, after which we then tirelessly search for that something until its existence is seemingly "confirmed" with an indirect measurement. Here we are proposing a new research methodology in physics, which fully allows creative imagination, but is based on human perception and direct experimental data.

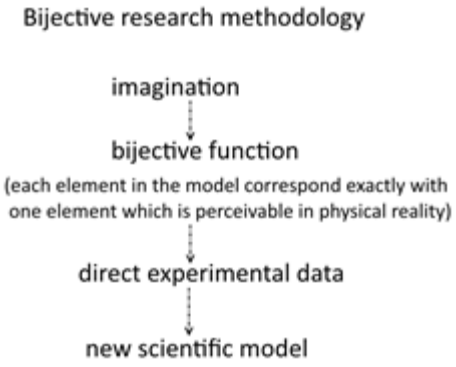

Figure 1. Bijective research methodology

Bijective research methodology excludes the possibility of an error in the process of scientific research in physics. This methodology gives more credibility to creative imagination that is based on direct perception, by either instruments or human senses, rather than to pure mathematical speculation, which is often disconnected from the physical world. The Higgs mechanism, for example, is based on pure mathematical speculation and as such is epistemologically unstable.

Discussion

Advanced Relativity is based on bijective research methodology. Advanced Relativity has kept the ether as the physical basis of the universal space. The ether is not in the space; ether is the "stuff" out of which space is made. The ether is dynamic, in the sense that the ether is moving with the objects and is rotating with them. We have given the ether the new name of "quantum vacuum". In At the end of the 18th

century, light was understood as a wave of the ether. We cannot see and detect the ether directly; we can see and detect light as its vibration. Advanced Relativity has adopted this view because Einstein's idea that a photon could move in an empty space deprived of physical properties is more philosophical than scientific: light needs a medium and this medium must also be an element of the scientific model of the physical world. Between the ether (quantum vacuum) of physical reality and the ether (quantum vacuum) in the model of Advanced Relativity, there is a bijective function:

$$f : X \rightarrow Y \quad (1)$$

Where X represents ether in physical reality and Y represents ether in the model of Advanced Relativity.

Advanced Relativity is built on bijective methodology and has the following advances:

1. In universal space, it is always NOW. Linear time "past-present-future" belongs to the mind, and with clocks we measure the duration of material changes, i.e. motion in space.
2. No signal can move in time, every signal can move in space only, and time is the duration of its motion. CMBR radiation is the radiation of the quantum vacuum, where it is always NOW. This view calls into question the Big Bang Theory.
3. In space the velocity of light changes minimally and depends on the energy density of quantum vacuum. "Gravitational time dilation" actually means that light minimally diminishes in speed, because in a stronger gravitational field, the energy density of the quantum vacuum is a bit lower, which changes its permittivity and permeability, and so changes the velocity of light.
4. Mass and gravity both have their origin in the variable energy density of the quantum vacuum.
5. Dark energy is the energy of the quantum vacuum.
6. In Advanced Relativity, there is no "inner observer," "outer observer," "coordinate time," or "proper time". The velocity of clocks in all inertial systems is valid for all observers and does not depend on them.
7. The relative rate of clocks in inertial systems depends only on the variable energy density of the quantum vacuum and is valid for all observers. GPS proves that clocks on satellites and on the Earth's surface run with the same rate for all observers. It this were not so, GPS would not work (Fiscaletti and Sorli, 2016).
8. The curvature of space in GRT is the mathematical description of the variable energy density of quantum vacuum. Space is not "curved" in a physical sense (Fiscaletti and Sorli, 2015). NASA confirms universal space is "flat"; it has Euclidean form (NASA, 2013).

Conclusion

The epistemological crisis of modern physics has its roots in the conviction that the development of new mathematical models will further the progression of physics. However, this is only partially true, because the mathematical models of modern physics are often the result of pure speculation, grounded in neither human perception nor direct experimental data. To overcome this crisis, this article has proposed a new methodology, in which that which is imagined, and eventually modelled, is based on human perception and direct experimental data.

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