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Article

What Is a Theory of Physics and How to Develop a New Theory of Physics?

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Abstract: Mathematics first is a logical system. But, the Mathematics Crisis showed that we cannot have a logical self-consistent mathematics system. Physics is a kind of applied science. It first need be valid to invent new production and understand new observation. In one theory of physics, the studied object is usually defined as an abstract concept. For example, the Sun is defined as a point particle in the Newtonian theory of gravity. In different theories of physics, the abstract concept for a same object is different. It determines that logical self-consistent is not needed for different theories of physics. Physics only can be developed from observation and experiment. But, in the past a century, physicists' main attempt is to have a standard model, such as the Grand Unification or the Theory for Everything, from mathematics derivation. Therefore, the current attempt to develop new physics is questioned. In recent, the strong gravitational field was studied. It is found that the fundamental physical constants which are measured in the weak field shall be varied in a super strong field. For the two reasons, modern physics need be advanced greatly.

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After 1900, many new productions were invented. The new innovations are much more than the sum of that before 1900. It is noted that all of the new innovations, including the productions of chemistry, biologics, medicine, informatics and so on, are based on or related with physics. But, it is generally known that, the development of physics was slowed or stopped. In the past several decades, no new theory of physics has been presented. Now, it is talking about the trouble with physics, even questioning whether or not physics is dead or ended.[1–5] Now, it is generally known that three factors are important to the progress of science. First, science research become an occupation for earning a living. "Publish or perish" determined the direction of scientific research.[6,7] That the researchers care for is to publish their work, rather than the scientific significance of their works. While, traditionally, scientific exploring is only a personal hobby to understand the world. In that time, scientific research is not for having benefit from exploring the world. Many explorers sacrificed their benefit, even including their life, to well understand the world. Second, academic publishing is a big business to make big money.[8,9] The papers that cannot be used to make money cannot be published or highlighted although the papers are very significant in science. For example, Katalin Karikó almost had lost her job for that her paper cannot be published in a powerful journal; and the mRNA vaccine had not been valued until the emergence of the new crown virus although the mRNA could be effect to invent other new pharmaceuticals. Therefore, the scientific research is directed by scientific journal: the effort of researchers is payed to the easily published subject.[10,11] It resulted in that the faked papers can be published in the most powerful scientific journals and can affect other researchers for more than decades. The notorious cases are the "faked amyloid-β protein"[12,13] and "cardiac stem cell scandal".[14,15] Third, scientific knowledge has been greatly increased, scientists and inventors require more training to reach the frontiers of their fields, and, the "low-hanging fruit" disappeared.[10,11]

We think, the three factors are also important to the progress of physics. While, in this work, the problem in the current theories of physics that could mislead the development of physics is studied. The relationship and difference among different theories of physics are focused on. We found, physics has been a very big and complicated system. It is very difficult for the smartest people to

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completely understand the whole system. It may result in that the direction for the physicists' effort to develop new theory of physics is unclear, or even wrong. Here, it is emphasized that, physics is an applied science. It need be valid to invent new production. Therefore, a theory of physics is a tool, rather than a logical system. In different theories, including Newtonian theory, electromagnetic theory and quantum mechanics, the definitions for a same object are different. For example, an electron in the Newtonian theory is defined as a point particle from which the Bohr radius of hydrogen atom was successfully known;[16] while is described as wave-particle duality with several quantum features in the quantum mechanics. In history, the different theories are presented by different people for different purpose.[17] As Newton presented his theories, his only purpose is to understand the observations in his time. And, the purpose of the electromagnetic theory is to understand the series of new experimental results about the electricity and magnetism in that time. If there was not the Newtonian theory, the electromagnetic theory also could be developed. In fact, the relationship between the Newtonian theory and the electromagnetic theory is little. And, before and after Newton, in a long time, it had been argued whether light is a particle or a wave.[18] The wave-particle duality is implied in this argument. Therefore, it is not needed that the definition for a same object is same for different theories. It only is needed that this definition is useful to the purpose of one theory. It should be determined that the self-consistent logics is not needed for different theories. And, in the Sec. 2, it should be shown that the most basic laws of physics are incomplete and the physical validity of them is limited. The Mathematics Crisis showed that mathematics cannot be logically self-consistent.[19] Therefore, it is questioned to have a standard model with logical self-constant for all of the theories of physics.

But, almost in the past a century, one of the main attempts of physicists is to have a theory of Grand Unification with standard model. Many works were done and several authoritative hypotheses were presented. Usually, there are two preconditions for the standard model. First, it is assumed that all of the theories and laws of physics are logical self-consistent. Second, it is believed that a new theory of physics is correspondent with a kind of new mathematics. And, the "new" mathematics is based on the larger than 3-dimension space, the extra dimension and the Planck scale. However, the high-dimensional space and extra dimension have not been observed and the Planck scale is unmeasurable. It resulted in that the current theoretical physics is unobservable. We know, physics is only the science of observation. Therefore, the current attempt to develop new physics need be reconsidered. On another hand, in recent, the strong gravitational field was studied.[20–23] It is found that there is not such a kind of vacuum in which the energy of the gravitational field is zero and the measurement cannot be affected by gravity. And, the fundamental physical constants, such as the speed of light with the electric constant and magnetic constant, measured on the surface of the Earth with weak field shall be greatly different from that measured in a super strong field. So, a new theory for the strong field is needed for that the measurement in the weak field, which is the ground of the current theory of physics, is changed by the strong field. For the two reasons, the current physics need be greatly advanced.

1. The model of the theory of physics

Before 1900, electromagnetics was established. Faraday's law of induction made electricity exploited which resulted in that our world has been advanced very greatly. This advance is much greater than that in all of the time before the electricity time. Although the concepts of electric and magnetic field were presented before 1900, till now it has not been well understood that the interaction of fields is beyond Newtonian physics.

The Newtonian first law is the law of inertia. It postulates that if a body is at rest or moving at a constant speed in a straight line will keep remaining at rest or will keep moving at the same speed unless it is acted upon by a force.[24] In the law of inertia, the physical law for a body at rest is same as for a body moving at a constant speed in a straight line. The principle of relativity is fundamental to the Newtonian physics. The fundamental equation for the Newtonian theory is the Galilean transformation. While in the electromagnetic physics, it is known that a magnetic field can be produced from a moving electric field and an electric field can be produced from a moving magnetic

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field. Therefore, the physical law for a moving electric/magnetic field is different from that for a field at rest. A new physics law about the interaction of electromagnetic field is produced from the moving electric or magnetic field. It means that the law of inertia and the principle of relativity are no longer valid for the moving fields. The new produced field need be understood in new physics. And, in the quantum physics, the studied object is expanded. Both the particle and field are studied in one equation, the Schrödinger equation; and, not only the interaction of fields is studied, but, the interaction between particle and field is also studied.

The Galilean transformation is a transformation of the coordinates of space and time. In this transformation, the studied object disappears for that the object only is treated as a point particle without volume and any other features. While in the electromagnetic theory, not only a new field is produced from a moving field, but also this field is with other features, such as interaction, direction, strength and so on. Therefore, it cannot be described with the Galilean transformation. The Maxwell equations is presented to describe the interaction between electric and magnetic field.

Maxwell equations is a new model that is different from the Galilean transformation. In the Maxwell equations, the variation of the field is the fundamental studied object. It is clear, a moving field cannot be described only with space and time. There are the features: 1) the variation of field is the studied object. 2) a new field is produced from a moving (varying) one. 3) a field is usually with a direction.

The fundamental equation of quantum mechanics is the Schrödinger equation which has the same central importance to quantum mechanics as the Galilean transformation to the Newtonian physics and the Maxwell equations to the field physics.[25] It is noted that, the Schrödinger equation is very complicated. The mass of the particle, the wave function and the potential of the outfield, and the quantum states (including spin, magnetic momentum, excited state etc.), are involved.

The Table 1 showed that, the physics model was changed from the Newtonian physics to quantum physics. As the studied objects are different, the fundamental equations are different. It also shows the history of the development of physics.

Table 1. The different theory of physics.

	Studied object	**Interaction**	**New produced object**	**Fundamental equation**
Newtonian theory	Point particle	Isolated from other object	No	Galilean transformation
Electromagnetic theory	Variation of field	Interacting with other fields	New field	Maxwell equations
Quantum mechanics	Both particle and field	Interaction of field and particle	New field, energy and mass	Schrödinger equation

Point particle or singularity. In Newtonian physics, a studied object is assumed as a point particle or a singularity. For example, in Newtonian law of universal gravitation, in a reference system of S(x, y, z), the gravity between two bodies is $F = G\frac{M_1 M_2}{R^2}$, where $R = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2 + (z_2-z_1)^2}$. Thus, the body M_1 and M_2 is at the point $P_1(x_1, y_1, z_1)$ and $P_2(x_2, y_2, z_2)$ respectively. So, in the Newtonian theory, the volumes of the bodies M_1 and M_2 are zero. Thus, in Newtonian theory, a body is without any structure and cannot be varied. The unique feature of a point particle is the mass. It is clear, this is an abstract assumption. It is not a description for a real object. Therefore, a physics system is not based on the description of the real object. Instead, it is based on the assumed abstract concept. In different system, the assumed concept is different for a same studied object. For example, in the Newtonian theory, an electron is also a point particle. While in quantum mechanics, an electron is defined as such an object that is with a structure which is made up of mass and electric field and other features, such as the spin, magnetic moment, etc. Therefore, Newtonian assumption that a body is a point particle without a volume and a structure is only a convenient abstracted concept. In the Newtonian theory, it is valid and sufficient. But, it is no longer sufficient in quantum physics although the model of Newtonian point particle can be used to calculated the semi-classic orbit of hydrogen atom.

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Wave-particle duality. Therefore, the quantum mechanics need be first understood from the theoretical model of physics. It is impossible to understand the wave-particle duality with Newtonian point particle model. A point particle cannot behave as a wave. So, to understand the wave-particle duality, we need know that, in the quantum mechanics, there is no point particle. An electron is defined as such an object that is with a structure made up of a mass and fields which can behave as a wave. In another word, the field of the electron is observed in the quantum physics while in the Newtonian physics an electron only is observed as a point particle. Therefore, as an electron is moving through the Young's double slit experiment, the wave-particle duality shall be observed. Additionally, this electron can interact with the light out of this electron. Therefore, the energy of this electron is always changing. And, the interference fringe of a single particle is not mysterious as an electron is considered as a structure made up of mass and field.

It is noted that, any real macroscopic body is not a naked particle. Instead, in the simplest approximation, a real body is a complex structure made up of a particle and a gravitational field. Although in the Newtonian theory, in studying the orbit of the solar system, the Sun can be treated as a point particle. This is determined by the purpose of the theory. It is shown that it is a perfect to treat the Sun as a point particle for the Newtonian theory of orbit. While, we need know, in fact, everybody is with a gravitational field. Especially, the relativistic mass density of the gravitational field on the surface of the neutron star can be larger than the mass density of the star,[20] the wave-particle duality should be important to a neutron star in some unknown special area. And, it is well known that a magnetism is made up of a body and a magnetic field.

Therefore, the wave-particle duality is not mysterious as usually thought. In the quantum mechanics, the studied object need be defined as such an object that is with the structure of wave-particle duality; just as that in the Newtonian theory, the studied object only need be defined as a point particle or a singularity. Factually, it is interesting, wave-particle duality is closely consistent with the intuitive image of a real object while Newtonian point particle or a singularity is counter-intuitive.

And, it is noted that, the wave-particle duality is not the only or the most mysterious feature in the quantum mechanics. A quantum particle is usually described with other several quantum states, such as excited state, spin, magnetic moment, superposition, and so on. In the past decades, these quantum states are generally used to invent new productions. Almost every new electric innovation is based on one or more quantum states. For example, the laser is from exploiting the excited state; many new materials are invented from exploiting the spin and magnetic moment. But, how to understand these states are still mysterious.

So, in this work, it is presented that the Newtonian theory, electromagnetics theory and quantum mechanics are different theoretical models of physics. Generally, a physics theory is based on the defined concept of the studied object. Usually, there are three features for a theory of physics: 1) The studied object which is defined as a special abstract concept. For a same real object, the definition is different in different theory. 2) It is the assumed abstract concept that is descried with an equation; the motion and variation of the abstract concept is different from that of the real object, for example, in the Newtonian physics, an electron is defined as a point particle, the interaction between this electron and other field is not described. 3) New production can be invented with this system or new observation can be understood with it. In the Table 1., the defined concept, the equation and the new objects produced from the interaction are listed.

2. The fundamental logics of physics

In the book "From the physical concept to mathematical structure",[26] it is sentenced: Physics is not a truth. Physics does not reflect or describe the real object. Physics is only a tool; we use this tool to invent new production and to understand our world. At the time I first read these words, I had a very strange feel. Now, it is my understanding that our knowledge about the world is poor and incomplete. In one theory of physics, only one aspect of an object can be studied. For example, in the Newtonian theory of gravity, only the orbit of the celestial bodies in the solar system is studied. Other aspects about the celestial bodies, including the structure and original of the bodies, need be studied

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with other theories. Therefore, a real Sun cannot be described with only one single theory. Several theories including different subjects are needed to completely understand a real celestial body. For example, to know the structure of the Sun, not only the theory of physics is needed, but the theory of chemistry is important. So, the studied object in one single theory only can be defined as an abstract concept about one aspect of a real object. No such a theory that is able to study all of the features of a real object. And, it is important, as the defined concept for a real object is different, in different theories, the description of the motion and variation of the object is different although the real object is the same one. As pointed out in the above, the law for the motion of an electron which is defined as a point particle in the Newtonian theory is described with the law of inertia in which the electron can move in a straight line with a constant speed without any variation; while, in the quantum mechanics, an electron is always interacting with other objects and the electron behaves as a wave which is described with the Schrödinger equation. For the reason, a law of physics that is presented for studying a special object in one theoretical system is no longer valid to understand the same object studied in another theory although the real object is the same one. Therefore, the law and theory in one theoretical system is not consistent with that in another one.

It is important, the abstract concept is not from the features of the real object. Instead, it is from the purpose of this theory. For example, as the Sun is defined as a point particle or singularity in the Newtonian theory of gravity, it is because of that this defined concept is sufficient to know the orbit in the solar system. While to study the origin of the Sun, the structure of the Sun has to be known. Using the definition of the Sun in the Newtonian theory of gravity to study the origin of the Sun, the problem shall be shown at once. Therefore, a theory of physics only need be valid to a special purpose. The purpose of different theory is different, it is not needed that the logics for the definitions of the studied objects is consistent with each other in different theories.

And, the laws of current physics are incomplete.

(1) As I was a high school student, I was taught that the law of conservation of momentum and the law of conversation of energy cannot be valid at the same time to a same physical event. For an elastic collision between two balls M_A and M_B, as M_B is at rest and is collided by M_A with velocity v_A. Theoretically, for the law of conservation of momentum, there is $M_A v_A = M_B v_B$ and for the law of conservation of energy, there is $\frac{1}{2}M_A v_A^2 = \frac{1}{2}M_B v_B^2$. But, for a real physical event, if $M_A v_A = M_B v_B$, respectively, there are different results: a) $\frac{1}{2}M_A v_A^2 = \frac{1}{2}M_B v_B^2$, as $M_A = M_B$; b) $\frac{1}{2}M_A v_A^2 < \frac{1}{2}M_B v_B^2$, as $M_A > M_B$; and, c) $\frac{1}{2}M_A v_A^2 > \frac{1}{2}M_B v_B^2$, as $M_A < M_B$. And, it is also easily known: as $M_A v_A = M_A v_{A1} + M_B v_B$ and $M_A \neq M_B$, there is not $\frac{1}{2}M_A v_A^2 = \frac{1}{2}M_A v_{A1}^2 + \frac{1}{2}M_B v_B^2$.

(2) The law of conservation of energy could be violated by the parallel circuit and the superconductor. For the parallel circuit which is made up of n lamps with the same electric resistence R, there is $p = \frac{V^2}{R}$ for one lamp, where p is the electric power, V is the voltage. Thus, $\sum p = \sum \frac{V^2}{R} = n\frac{V^2}{R} \to \infty$, as $n \to \infty$. For the superconductor, as V=constant, there could be R=0 and $p = \frac{V^2}{R} \to \infty$.

(3) It is generally known that the principle of relativity is not valid to the rotation transformation. It can be explained simply: as a mass in a rotation transformation, the mass is moving with a rotation acceleration. And, a new formula $f = ma$ is produced. While the rotation transformation is generally used in designing the orbit of artificial satellite. It means that the validity of the principle of relativity is limited. But, it is generally thought that the principle of relativity need be obeyed by any theory of physics. However, as the interaction of electromagnetic field and the rotation transformation are considered, it shall be shown that this thought should be questioned.

The validity of a physical law is usually with a physical limit. For example, for $p = \frac{V^2}{R}$, in mathematics, there is $p = \frac{V^2}{R} \to \infty, as\ R = 0$. But, in physics, $p = \frac{V^2}{R} \to \infty$ cannot be arrived at. Now, superconductor is obtained in different ways. If $p = \frac{V^2}{R} \to \infty, as\ R = 0$ was physically true, we could have had infinite large energy. It is clear, we know, an infinite large energy cannot be obtained.

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Therefore, for an equation of physics, it is needed to clarify that its physical validity is limited. Neglecting the physical limit to derive the mathematical result from physical equations, it is certainly invalid physically, i.e., Lost in Math.

The inconsistency between the law of conservation of energy and that of momentum and that $p = \frac{V^2}{R} \to \infty \; as \; R = 0$ is invalid in physics showed clearly that a physical formula cannot be treated as a pure mathematics one. The validity of physics for a physical formula need be noted. A new physical result cannot be obtained only from the mathematics derivation with a pure mathematics way. Or, we shall "lost in math". If one should to obtain infinite large energy from $p = \frac{V^2}{R} \to \infty$, it should be a funny.

However, it is interesting, could a larger energy be produced from $\sum p = \sum \frac{V^2}{R} = n\frac{V^2}{R}$ or $p = \frac{V^2}{R}, R \to 0$? It only can be known from experiment. We think, this experiment is clearly significant, even if the results may be negative in a very large probability.

We know, the law of conservation of energy is one of the most fundamental laws in all of the physics science. It is used in almost every areas of current physics. As the law of conservation of energy is not self-consistent, it can easily be concluded that, "logical self-consistent" is not the precondition for that a theory of physics is valid.

It is emphasized that, mathematics is a science that is different from physics. Physics is a science of observation and experiment. It only can be proven or disproven with observation and experiment. While mathematics first is a logical system which is proven or disproven only with logical concluding. So, logical self-consistent is necessary for mathematics. But, the Mathematics Crisis[19] showed that the mathematics cannot be self-consistent logically. Compared to mathematics, it is easy to understand that it is impossible to have a logical self-consistent theory for physics.

But, currently, physics is believed to be a self-consistent logical system. It is believed that a standard model of physics theory can be obtained. Many people are trying to establish the Theory of Grand Unification or the Theory for Everything. Therefore, it is required that, a new theory and new experimental/observational result are consistent with the current law and theory.[27] And, currently, physicists prefer to find out new result from mathematics derivation. Little attention is payed to new observation and experiment. But, in fact, physics is a tool to invent new production which need not and cannot be self-consistent. The current trying of physicists is clearly questioned. It may be the main reason to that the development of physics is slowed or stopped.

It is very interesting that physicists are always believing that their knowledge about physics is complete. In 1900 Lord Kelvin[28] addressed the British Association for the Advancement of Science with these words: "There is nothing new to be discovered in physics now. All that remains is more and more precise measurement." Kelvin's words just means that he believed that they had the Theory for Everything.

The current physicists prefer to believe that they can have a complete theory which is called the Theory for Everything. In our today's perspective, it is clear, the physics in 1900 is not complete. Analogously, in the future physicists' perspective, the current believed Standard Model also cannot be complete. But, very unfortunately, many current physicists believe that it is possible to have a standard model for physics.

3. The basic function of physics science: To invent new production

It is noted that, a new production can be directly invented from a theory of physics. For example, an electric generator can be invented directly from the Faraday's law of induction. And, an orbit of satellite can be directly designed according to the Newtonian theory of gravity. Scientific findings benefit society through technological and innovations which helped to module the civilization and transformed life on the earth. Science and technology capabilities are fundamental for social and economic progress in a country. The Newtonian physics, the electromagnetic physics and the quantum physics are correspondent with the mechanical age, the electrical age and the internet and artificial intelligent age, respectively. Therefore, science was accepted by every country with different

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races, cultures and religions. And, physics is fundamental to the development of other scientific subject, such as chemistry, biology, medicine and so on.

The function to invent new production determined that the science can be falsified automatically. If new production cannot be invented as a scientific hypothesis announced, this hypothesis shall be questioned or disproven. It is well known, the current publication system is invalid to avoid the wrong or invalid hypothesis.[10] And, an invalid current hypothesis can be easily falsified as new production cannot be invented according to this hypothesis. This is the main reason that the "faked amyloid-β protein"[12,13] and "cardiac stem cell scandal" were disclosed.[14,15]

But, now, in physics science, the cosmology, even including astronomy, is such a subject that cannot be used to invent new production. It is only a science to explain or to understand the observed object. It become highly analogous to the philosophy. And, Werner Heisenberg[29] revealed how words and concepts in the world of relativity and quantum physics have profound philosophical implications for the nature of reality. Stephen Hawking[30] famously wrote that "philosophy is dead" because the big questions that used to be discussed by philosophers are now in the hands of physicists. But, it need be noted that, philosophy is such a subject that different people have different views on it. For a same theory of philosophy, conversely conclusions for it could be arrived at by different people. Therefore, as cosmology had become as a kind of philosophy, it should need not be accepted by every country as a subjects of science. So, the physics should be dead in scientific standard as it had become a philosophy. It is noted that, in cosmology and microscopic world, the subject that previously is understood with philosophy now is understood with physics more accurately. But, we need know that physics is a subject that is different from philosophy.

Now, there are these problems in the cosmology: 1) the high dimensional space, the extra dimension and the Planck scale are very important in the current cosmology. However, the space larger than 3-Dimension has not been observed; the extra dimension and the Planck scale cannot be observed. Therefore, as the high Dimensional space, the extra dimension and the Planck scale are prevailingly used, it resulted in that the conclusion in current cosmology cannot stand on the ground of observation. But, physics science is only a science of observation. 2) the falsification principle was directly given up in the Big Bang. First, in the 1920s, the Big Bang predicted that the universe should be 2 billion years old (Georges Lemaître).[31] It is clearly wrong. It is younger than the Earth. Second, in 1952, Walter Baade's prediction is 3.6 billion years.[32] It is younger than the Sun. Third, the current prediction is 13.7 billion years.[33] But, the oldest star in the Milky Way is 15 billion years.[34] Now, it was presented that universe need be older than 27 billion years.[35] It is clear, in regulative scientific standard, the Big Bang was disproven very early. 3) because the conclusion cannot be obtained from observation, in current cosmology, the only way to obtain a conclusion is with mathematics derivation which is mainly based on the high-Dimensional space, the extra dimension and the Planck scale. Therefore, it is certain, these conclusions are that "lost in math". Sabine Hossenfelder's Lost in Math may not be complete. But, she showed the problem in current physics in root. And, high-Dimensional space is generally used in the current theoretical physics. This is an important reason for that the development of current physics is slowed or stopped. It is important, the problem from the mathematics was noted by many people.[1–5] But, the high-Dimensional space, the extra dimension and the Planck scale are still prevailing in current theoretical physics.

It is a very interesting problem that, historically, in different races and times, there are different kinds of models of universe, is there some kind of relationship between the Big Bang and these models of universe?

It was presented that some theories are so elegant that can be purely theoretical theory confirmation.[36] It was shown that, the scientific standard is neglected by some of physicists.

4. Falsification theory in physics

Karl Popper[37] proposed the falsification theory. A scientific hypothesis is usually tentative or conjectural. It need be proven or disproven with observation. But, in current explanation, in Popper's falsification principle, no theory of science can be right permanently. Any theory of science should be disproven by new observation just as that the conclusion that "all swans are white" can be falsified

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by observing a black swan. We think, this understanding about falsification principle may be questioned although this may be Popper's original understanding. For one of modern scientists, it is usually thought that the theory of science is a logical self-consistent system. Therefore, a theory of science could be falsified logically just as the proposition that "all swans are white" can be falsified by observing a black swan. But, after we know that a theory of physics is a tool rather than a logical system, we shall know that this understanding is questioned.

In 1904, Poincaré sentenced [38]:

> *Perhaps likewise, we should construct a whole new mechanics, that we only succeed in catching a glimpse of, where inertia increasing with the velocity, the velocity of light would become an impassable limit.*
>
> *The ordinary mechanics, more simply, would remain a first approximation, since it would be true for velocities not too great, so that one would still find the old dynamics under the new.*

It is noted that, Poincaré's sentence has a very big effect on current understanding about the theories of physics. Now, it is usually thought that, Newtonian physics is an approximation to Einstein's theory of relativity for the low velocities and to the quantum mechanics for the macroscopic bodies. And, the Newtonian physics could be falsified or overturned by the theory of relativity and the quantum mechanics. However, as we know that the studied object defined in the Newtonian theory is different from that in quantum mechanics as shown in the Table 1, we shall know that they are different models of the theories of physics. The definition of point particle or singularity in Newtonian theory cannot be falsified or overturned by the definition of wave-particle duality in the quantum physics. No one should argue that the concept of point particle for the Sun in the Newtonian theory could be falsified by that the observed real Sun is very big sphere with a very complicated structure.

So, we present that, in the understanding about falsification theory, a theory of science is such a subject: 1) a theory is a tool that is valid to a special purpose, such as to invent a new production or to understand a new observation; 2) the studied object is defined as a special abstract concept; and, 3) this theory need be falsified. As a new production is invented or a new observation is understood with this theory as this theory predicted, this theory is valid. It is nonsense to say that such a theory can be disproven. Therefore, it is only a misunderstanding to say that the Newtonian theory was overturned by the theory of relativity. And, Newtonian theory is not an approximation to the theory of relativity or to the quantum mechanics. For example, only Newtonian theory of gravity is valid to design an orbit of artificial satellite. No other theory is valid to design an orbit of a satellite.[39,40] Therefore, it is clear, it is nonsense to say that Newtonian theory of gravity is falsified by any other theory.

On internet, it is a current thoughts that a hypothesis cannot be falsified by only showing that this hypothesis is wrong. A new hypothesis that can replace the wrong old hypothesis need be presented to falsify a current hypothesis. It is clear, this is a sophistry. For example, as a new drug was produced from a hypothesis, and it was known that this drug can make people dead, then, everyone knows that this hypothesis need be given up at once.

5. The future development of physics

The purpose of this work is to find a way that could promote the development of physics. We find, there should be two ways to develop a new theory of physics.

5.1. Strong gravitational field and new theory of gravity.[20–23] These conclusions were obtained from strong field: The gravitational field is much more fundamental for that the relativistic mass of the gravitational field of a neutron star is almost 10^{21} times the mass of the neutron star. And, it is astonishing that the relativistic mass density of the gravitational field on the surface of a neutron star can be larger than the mass density of the neutron star. Therefore,

1) The fundamental physical constants in strong gravitational field need be reconsidered. Comparing to the weak gravitational ones, it is stressed that there is not such a kind of vacuum

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in which the energy of the gravitational field is zero and the measurement cannot be affected by gravity.[23] Therefore, the traditional concept of vacuum presented by Evangelista Torricelli in 1600s need be reconsidered. But, the current fundamental physical constants are measured in the Torricellian vacuum. It is believed that the measurements of these fundamental physical constants cannot be affected by any factor. As the super strong gravitational field is considered, it shall be shown that, the action of the gravitational field on the measurements of these fundamental physical constants is very great. For example, as a light line on the surface of the Earth with a weak field is treated as a straight line, it is approximately valid in current physics although no light line is straight for that any light line is always being bent by gravity; while the curvature of a light line by a strong gravitational field cannot be omitted.[22]

2) A new image about our universe shall emerge. "*Our universe is made up of baryonic matter (star, planet, etc.) and gravitational field. In all of the space, it is filled with gravitational field. No space can be a vacuum. And, there are many baryonic matter (star, planet, etc.) which one of the matters appears as a very little point in the space. It is calculated that the relativistic mass of the gravitational field of a neutron star is almost 10^{21} times the mass of a star for that the volume of the field is much larger than the star. Therefore, in our universe, the gravitational field is the main part while the baryonic matter (star, planet, gases and so on) is very little. Because of the tremendous energy of gravitational field, the dark energy and dark matter is questioned.*" (copied from Ref.[23])
3) Some of the fundamental of quantum mechanics need be revised. We know, there are quantum vacuum fluctuation, polarization of vacuum, vacuum phase transition, vacuum zero-point energy, spontaneous breaking of vacuum and so on. If the Torricellian vacuum is invalid in the strong gravitational field. All of these subjects need be reconsidered.

5.2. The possible development in the microphysics. First, the attosecond physics was developed. With the attosecond technology, you can see the movement of atom and electron.[41] This is a strong tool to directly observe the motion of electron into an atom. The quantum entanglement was observed.[42–44] Especially, the entanglement of macroscopic systems was observed.[45] Here, we focused on that, the entanglement between macroscopic systems is that the quantum state in the systems is entangled. Therefore, observing the changing of the quantum state by measurement, some of new results about quantum mechanics, including the interaction between two bodies, could be observed.

Generally, quantum entanglement is an interaction between two quantum objects with a distance, attophysics can be used to observe the motion of an electron in an atom. Now, the image of quantum entanglement was captured.[46,47] From quantum entanglement and attophysics, more new results should be directly observed in future.

6. Conclusions

Physics very powerfully prompted the development of our society. Now, theoretical physics is developed as a very great and complicated system. But, the boundary conditions and suitable area of the law and theory of physics have never been studied. It resulted in that, currently, the theory of physics is misunderstood as a logical system and an equation of physics is treated as a pure mathematics one. In this work, the problem in current physics is discussed seriously by showing the incomplete of the law and the limit of a theory. We find, 1) Till now, the understanding about physics is mainly guided by the current thoughts. It is clear, the Theory for Everything is just another sentence for that Kelvin[28] addressed the British Association for the Advancement of Science. And, the current understanding that Newtonian theory is an approximate to the theory of relativity and to quantum mechanics is clearly because of Poincaré's words.[38] However, after Kelvin, physics has been greatly developed. For current physicists, it was clearly known that Kelvin's sentence is not right. It told us that the understanding about physics need be reset on the serious studying. 2) In different theories, the definitions for a same studied object are different. And, the validity of the physics laws is limited. And, the most basic law, the law of the conservation of energy, is not only limited, but also is contradicted with the conservation of the momentum. So, the theories of physics

are not logically self-consistent. 3) For the above two factors, the effort of current physicists to have the Theory of Grand Unification with standard model is questioned. 4) Mathematics cannot be self-consistent logically.[19] But, now, physicists believe that a new theory of physics is correspondent with some kinds of new mathematics and is trying to obtained new theory of physics from mathematics derivation. But, the mathematics in the frontier of current physics is mainly based on the space larger than 3-Dimension, the extra dimension and the Planck scale which have not been or cannot be observed. It shall result in that the conclusion from the derivation is unobservable. It shall certainly result in that physics is deviated from science, such as "Lost in Math". 5) In several decades, the development of physics has been slowed or stopped.[1–5] Therefore, the problem and mistake in current physics need be stressed seriously. If falsification was neglected, the mistake in the powerful current theories of physics could not be revised, physics should not can be developed.

It is our purpose to find a way to develop the new theory of physics. It is discussed that, in future, the physics should be developed from two directions. The first direction is the new theory of gravity which is based on the observed strong gravitational field. In the weak field, a space can be roughly treated as a vacuum in which the energy of the gravitational field is treated as zero and the measurement affected by gravity can be omitted. While, in a super strong field, in any a space, the energy of the gravitational field is very large and the measurement is greatly affected by gravity. Therefore, the fundamental physical constants which are measured in a "vacuum" need be reconsidered. Thus, a new theory is needed for the strong field. It shall be a reconsideration in root for the physics science as the fundamental physical constants need be revised. The second direction should be the physics for the microscopic world, mainly including quantum entanglement and attosecond physics. Now, many new results about the quantum entanglement are known. It is being tried to develop quantum computer[48,49] and quantum communication.[50–52] A new theory should be developed from these new observations and experiments.

It is very important: could we exploit and control the gravity as studied in [53,54]?

The super strong fields are very mysterious to us for that the relativistic mass density of the gravitational field on the surface of a neutron star can be larger than the mass density of the neutron star and the relativistic mass density of the observed largest magnetic field is $10^8\ kg/m^3$.[20] And, the quantum entanglement is also mysterious: what makes two objects entangled?

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