

# A Tentative Viewpoint About The Evolution of Relativity Theory

**Ge Guangzhou**

*Harbin Institute of Technology*

*92 West Dazhi St, Nangang District, Harbin, Heilongjiang Province, China*

## **Abstract**

This article is based on the pursuing understanding of the relativity theory by the author and thus puts forward the viewpoint about the evolution of relativity theory. The author at first introduces the Galilean relativity, special relativity and general relativity, and then endeavors to further expand the relativity theory based on the discussions on the interpretation of quantum, the relativity of electromagnetic field and the light velocity, and thus the author proposes three postulates which include the general equivalence principle, super light velocity and expanded relativity. By initiating this three postulates the author hopes to drive the the research on the relevant fundamental issues or provide some enlightening ideas.

**Key words:** Relativity, Evolution, Expansion, Unification.

## **1. INTRODUCTION**

This article will discuss the topic about evolution of relativity theory.

If we look back on the development or evolution of relativity, the first relativity is about the Galilean relativity, and then it's Einstein who put forward the theory of special relativity and general relativity. The theory of general relativity should not be regarded as the final theory although it has had many successful applications, otherwise the theory of general relativity should have resolved all the outstanding

physics issues including the quantum. Now that so far the theory of general relativity is not compatible with the quantum, the theory of general relativity should not be the final theory.

On the other hand, it should be noted that the aforementioned every relativity theory at different stages would correspond the different mechanics principle respectively. For instances, the Galilean relativity should correspond the Newtonian classical mechanics, the special relativity is at least considered to be consistent with the electromagnetic force, and the general relativity would expose the nature of the gravitational force. However, there is not yet the relativity theory that would correspond to the strong force or weak force which exists in the quantum theory. Thus the author would rather think that the relativity needs to be further expanded that it can be compatible with the strong force or weak force.

This article would commit to the further expansion of relativity and in the meanwhile the author hopes to drive the research into the unification of forces.

## **2. THE DISCUSSION ON THE PROCESS OF RELATIVITY EVOLUTION**

### **(1) Galilean relativity principle**

As the relativity principle of mechanics Galilean relativity principle is the foundation of Newtonian classical mechanics, that is, any classical mechanics experiments conducted in an inertial reference system will not determine if the inertial reference system itself is in the static state or in a state of uniform linear motion, or in other words, the mathematical format of a classical mechanical law will keep invariant in any inertial reference systems or all the inertial reference systems should be equivalent.

### **(2) Special theory of relativity**

**Special theory of relativity** was originally proposed in 1905 by Albert Einstein in the paper "On the Electrodynamics of Moving Bodies", and it is based on two postulates:

① **Principle of constancy of light velocity:** The velocity of light in a vacuum is the same for all observers, regardless of the motion of the light source.

② **Special theory of relativity:** The laws of physics excluding gravitation are invariant (i.e. identical) in all inertial systems.

The special theory of relativity is the generalization of Galilean relativity principle,

and it denies the absolute reference system or absolute space. Based on the special theory of relativity, all the reference systems which apply to mechanical laws will also apply to the electrodynamics laws and optical laws. It can be thus seen that Einstein generalized the application of Galilean relativity from the mechanics into the whole physical including the electromagnetics, as indicated that any experimental phenomena of mechanics or electromagnetics will not distinguish the absolute motion of the inertial systems which include the relative static state or uniform linear motion.

### **(3) General theory of relativity**

The general theory of relativity depicts the gravitational interaction and it's the theory about the nature of universal gravitation. Einstein had ever tried to include the universal gravitation into the frame of special theory of relativity, but eventually following many failures he realized the special relativity would not accommodate the universal gravitation. And then he generalized the special relativity into the general relativity and further based on the principle of equivalence between gravitational force and inertial force in the local inertial system he established the general theory of relativity which could be depicted by the Riemannian geometry of curved space-time.

① **Equivalence principle:** A gravitational field is equivalent to a corresponding acceleration of the reference system, or the dynamic effects of the inertial force field and the gravitational field are locally undistinguishable. And it should be indicated that the equivalence principle just applies to the local inertial system rather than the non local inertial system.

② **The general theory of relativity:** All systems of reference are equivalent with respect to the formulation of the fundamental laws of physics.

The general theory of relativity is the generalization of the special theory of relativity, in which Einstein directly deleted the concept of inertial system from the relativity theory by replacing the “inertial system” with “any reference system”.

The difference between the special relativity and general relativity: The special theory of relativity just applies to the inertial systems which space-time background is the flat four dimensional space-time, but the theory of general relativity applies to all the reference systems including the non inertial systems which space-time background is the curved Riemannian space-time.

#### (4) The further expansion of the relativity theory

##### ① Theoretical preparation

In order to further expand the theory of relativity, after some thinking the author would like to conduct the following theoretical preparations.

##### A: The hypothesis of new quantum

According to Feynman's Path Integral Principle, although a particle may pass through countless possible paths from its start point to its finish point, among them just one path should really occur. Thus it could be deduced that the particle or quantum could be assumed as the combination of real path and virtual path, and in here the real path is the one path that should really occur and the virtual path is the countless possible paths. And as such the quantum could be regarded as the unification of real path and virtual path instead of the duality of wave-particle, and the quantum so interpreted could be referred to as the New Quantum or the New Quantum Hypothesis, and likewise a photon so interpreted could be referred to as the New Photon.

According to the new quantum hypothesis, in order to further depict the nature and motion of the new quantum the relationship between the real path and virtual paths of the new quantum needs to be formulated. The author then finds the Hamilton Principle should be able to formulate this very relationship, which represents the law of determining the real path out of the possible countless virtual paths.

According to the literature of analytical mechanics, Hamilton Principle is the variation principle which is applicable to dynamic holonomic system, that is, in the space  $(q_1, q_2, \dots, q_N; t)$  of  $(N+1)$  dimensions, the time integral of kinetic potential  $L(q, \dot{q}, t)$  of the line linking any two points will get the stationary value in its real movement path.

Suppose

$$S = \int_{t_1}^{t_2} L(q, \dot{q}, t) dt \quad (1)$$

S is referred to as the Hamilton action quantity, then

$$\delta S = 0 \quad (2)$$

And then its variation form is

$$\delta S = \delta \int_{t_1}^{t_2} L(q, \dot{q}, t) dt = \int_{t_1}^{t_2} \left( \frac{dL}{dq} \delta q + \frac{dL}{d\dot{q}} \delta \dot{q} + \frac{dL}{dt} \delta t \right) dt = 0 \quad (3)$$

And so the dynamic problem of mechanical system should come down to be a variation principle, that is, as far as the holonomic system is concerned, among all the possible movements of the system, which is conditioned by the same start and finish time, the same start and finish locations and the same constraints, the movement that enables Hamilton action quantity  $S$  to be the stationary value should be the one that really occurs in the system, and this is referred to as Hamilton Principle. Thus Hamilton Principle should depict the system's action quantity with the integral equation and use the variation method to calculate the motion equation of overall system.

And thus the Hamilton Principle should represent the law of locating the real movement from all the possible movements of the system, or the law which determines the real path out of virtual paths. Therefore, Hamilton Principle could be employed to formulate the relationship between the real path and virtual paths of the new quantum, and as such the system's action quantity should be able to be represented by the Hamilton action quantity.

### **B: The relativity of electromagnetic field**

According to the new quantum hypothesis, the new photon so produced would substitute for the original photon and act as the action quantity of the physical space system outside the nucleus in the atom. Considering the original photon exists as the action quantity of electromagnetic force and it should now be replaced by the new photon, the new photon should then impact the nature and interpretation of electromagnetic force. From this perspective the electromagnetic force could be reinterpreted.

If the system's action quantity transforms to the new photon from the original photon, the electromagnetic force as represented by the original photon should be replaced by the force that applies to the new photon, or exactly the electromagnetic force is supposed to be replaced by the force that applies to the physical space as represented by the new photon. Considering the motion of new photon could be formulated by the Hamilton Principle and further the Hamilton Principle be the necessary and sufficient

condition of Lagrange equation of the holonomic system, this Lagrange equation should be able to formulate the force that applies to the physical space as represented by the new photon, and thus by replacing the electromagnetic force with the force which is represented by Lagrange equation of the holonomic system, the electromagnetic force should be so reinterpreted. Therefore the author would hereby introduce Lagrange equation of the holonomic system, which is Euler-Lagrange Equation.

According to the literature of analytical mechanics, Euler–Lagrange Equation could be formulated as follows:

$$\frac{\partial L}{\partial q} - \frac{d}{dt} \frac{\partial L}{\partial \dot{q}} = 0 \quad (4)$$

Among them, Lagrangian  $L(q, \dot{q}, t)$  is the function of time, coordinate and velocity, the generalized coordinate  $q = (q_1, q_2, \dots, q_N)$  is the function of time, and the generalized velocity  $\dot{q} = (\dot{q}_1, \dot{q}_2, \dots, \dot{q}_N)$  is also the function of time.

The zero on the right side of the equation indicates that the system's generalized force is to be zero, which means that the system would not be affected by any forces but be kept in a balanced and stabilized condition, which just coincides with the New Photon Case as aforementioned. And thus the very condition of the system's generalized force being zero indicates that the electromagnetic space system outside the nucleus in an atom as represented by the original photon should have become the new physical space which is constituted by the energy distribution as represented by the new photon.

Based on the reinterpretation of the electromagnetic force outside the nucleus, the electromagnetic space outside the nucleus as represented by the original photon should be equivalent to the new physical space which is constituted by the energy distribution as represented by the new photon, or it could be further assumed/deduced that the physical phenomena that occur in the inertial reference system under the action of the electromagnetic force should be identical with that of the non inertial reference system which is constituted by the physical space as represented by the new photon, and this assumption could be referred to as the Relativity of Electromagnetic Field. Thus the space of electromagnetic field should not be abstract but be dominated by the energy distribution of the physical space as represented by the new photon that is formulated by the Hamilton Principle.

**C: The super light velocity is possible**

According to the literature of analytical mechanics, as far as the holonomic system of  $N$  degree of freedom is concerned, if a system's motion is depicted by  $N$  generalized coordinates of  $q_1, q_2, \dots, q_N$ , the system's motion could be equivalent to a point's motion in this space of  $N$  dimensions, and this space could be referred to as configuration space or coordinates space and this abstract point could be referred to as the configuration point. Thus the motion of configuration point in the configuration space should represent the whole system's motion, and the configuration point's path in the configuration space could be referred to as location path which is the system's motion path. And thus the motion position of every moment of the system should correspond to one point of this assumed motion path. Suppose under the active force and in the period from  $t_1$  to  $t_2$  the system moves from the location of  $A(q_{j1}, t)$  to the location of  $B(q_{j2}, t)$ , the configuration point's motion path in the augmented configuration space of  $(N + 1)$  dimensions is to be the real motion path or real path. There's but one real path and its motion equation is

$$q_j = q_j(t), j = 1, 2, \dots, N \tag{5}$$

While under the conditions of same start/finish time and same start/finish locations, any one possible motion of the particles system close to the real motion as permitted by the constraints could be referred to as the possible path or virtual path. The virtual path is countless and its motion equation is

$$\tilde{q}_j = q_j(t) + \varepsilon_j \eta_j(t), j = 1, 2, \dots, N \tag{6}$$

$\varepsilon_j$  is the arbitrary micro amount,  $\eta_j(t)$  is the arbitrary function of  $t$ , and

$$\eta_j^{(t)} \Big|_{t=t_1, t=t_2} = 0.$$

Considering the New Photon is deemed as the unification of real path and virtual path, the abstract configuration point as aforementioned should represent the New Photon

and the velocity of New Photon should then be determined by its velocities along both its real path and virtual path. According to its motion equation the virtual path is countless possible path that it means the New Photon could possibly occur simultaneously in the countless path which is depicted by the virtual path's motion equation, and then the New Photon should be able to occur in here and over there about at the same time, and thus theoretically its velocities pertaining to the countless possible path would not be hemmed in by the fixed light velocity. In the meanwhile, as the real path is originated from the virtual path as per Hamilton Principle, its velocity pertaining to the real path should also be not hemmed in by the fixed light velocity and this could be further confirmed by the motion equation of real path itself. Now that neither its real path nor its virtual path should be restricted by the fixed light velocity, the New Photon which is the unification of real path and virtual path should not be restricted by the fixed light velocity. Thus in the case of New Photon the fixed light velocity could be broken through and this phenomenon could then be referred to as the super light velocity. In addition, it should be indicated that the New Photon should eventually take the real path as its actual motion route, which should represent the sole route of the New Photon traveling from its start point to finish point, and thus it could be deduced that the real path should so represent the shortest route running between the two points located in the space.

## ② **Three postulates**

Based on the above theoretical preparations, the author would propose the following three postulates.

### **A: The general equivalence principle**

Based on the theoretical preparation B as described above, the action particle of electromagnetic field (i.e. photon) could be replaced by an appropriate physical space which is to be constituted by the energy distribution represented by the new photon, and the energy distribution as represented by the new photon is actually the integral of energy to time as determined by Hamilton principle could be then referred to as the energy-time metric.

In brief, the action particle of electromagnetic field (i.e. photon) could be replaced by an appropriate energy-time metric, or they are equivalent to each other. Considering the universality of Hamilton principle, which is actually the least action principle used

for depicting an object's motion law, this equivalence which originates from the electromagnetic field could be further generalized to apply to other fields such as the gravitational field, strong field or weak field, that is, now that every field has a corresponding action particle, it could be assumed that the action particle of every field, just as the photon could be replaced by the appropriate energy-time metric, could be replaced by its corresponding energy-time metric which is determined by the Hamilton principle, that is, **the action particle of a field is equivalent to the corresponding energy-time metric or the physical space as determined by the appropriate energy-time metric, this equivalence could be referred to as the general equivalence principle.**

According to the general equivalence principle, the concept of force is no longer absolute, or all the forces could be replaced by the physical spaces as determined by the energy-time metrics which are corresponding to their action particles respectively.

According to the above, the general equivalence principle so produced should be universal and it should apply to all the reference systems, and thus it should have expanded the existing equivalence principle of general relativity, which could just apply to the local inertial system rather than the non local inertial system.

### **B: The principle of super light velocity**

Based on the theoretical preparation C as described above, the movement route of the new photon is just the real path originated from all its possible virtual path according to the Hamilton principle with its velocity to be determined by the motion equation of either its real path or its virtual path. Thus the system becomes self-consistent because the velocity of new photon is to be totally determined by the system itself. This light velocity could then be referred to as the super light velocity as in this case the velocity of new photon would not be restricted by the fixed light velocity. Now that the super light velocity is possible, or the limitation of light velocity could be broken down, the author would propose the principle of super light velocity.

**The principle of super light velocity: The light velocity is no longer the limitation of the universe's velocity and the super light velocity is possible.**

According to the principle of super light velocity, the concept of simultaneity could be further extended.

The existing understanding of the concept of simultaneity is: If the two physical

events occurring at different space points are simultaneous in some inertial system, they are not simultaneous in the other inertial systems which moves relative to the very inertial system. Therefore, in the special theory of relativity the simultaneity has no longer absolute meaning but it just has the relative meaning due to its correlation with the inertial systems. However, as far as the two events occurring at one same space point are concerned, the simultaneity is still absolute.

However, the simultaneity could be extended as follows based on the principle of super light velocity:

On one hand, the two physical events occurring at different space points could be “simultaneous”, if only they belong to the one same “motion routing” which is the real path as determined by the Hamilton principle. It should be indicated that there’s an assumption underlying here which is to assume that the two physical events correlating by “super light velocity” as “simultaneous”, and it should be further noted that the two events would not be restricted or constrained by any other reference systems.

On the other hand, as far as the two physical events occurring at the one same space point are concerned, their simultaneity is no longer absolute but relative. In fact the proposition of “one same space point” is problematic because there’s no “one same space point” in an absolute sense, or simply put, at one moment there may be some space point which belongs to some “motion routing” or space, but in the meanwhile this space point may belong to some other “motion routing” or space, that is, so called “one same space point” may simultaneously belong to the different “spaces” respectively, therefore, the so called “one same space point” has in essence no absolute sense but relates to its very “motion routing” or it just has relative sense.

In brief, there are but the simultaneity of two physical events locating along the real path as determined by the Hamilton principle that has the absolute sense due to their breaking down the constraints by the light velocity, whether they belong to the two different space points or just one same space point. And further this two events themselves would not be restricted or constrained by any other reference systems, otherwise the very simultaneity would only have the relative sense. Thus it could be assumed that this extension of simultaneity of two physical events as resulted from the principle of super light velocity has so broken down the constraints by the reference systems, or rather the very simultaneity just relates to the “motion routing” of the events themselves. At this sense, the real path as determined by the Hamilton principle could also be referred to as the “simultaneous line”.

### **C: Expanded principle of relativity**

Based on the general equivalence principle as described above, all the forces including the gravitational force, electromagnetic force, strong force and weak force could be replaced by the physical spaces as determined by the appropriate energy-time metrics which are corresponding to their respective action particles, or in other words, the action particles of all the forces could be uniformly replaced by the new quantum and the motion of this new quantum which is actually the energy-time metric is to be determined by the real path as formulated by the Hamilton principle. Therefore, from this perspective it could be assumed that the “force” has now become an unnecessary concept, or the “force” should have been thus “unified” in this particular manner.

In the meanwhile, based on the principle of super light velocity the motion of new photon should not be restricted by the light velocity but be determined by the system itself, and further the extension of simultaneity as resulted from the principle of super light velocity has so broken down the constraints exerted by the reference systems. Thus in a larger sense it could be assumed that the constraints by the reference systems should have been so broken down or exactly the concept of reference systems is not so necessary.

According to the above discussion, the author would propose a larger relativity or exactly the expanded relativity.

**The principle of expanded relativity: The laws of physics are invariant (i.e. identical) in themselves, as will not be constrained by any reference systems at all.** Or in other words, the laws of physics are self-consistent and have nothing to do with the external reference systems.

In fact, in the physical world there should not be the absolute or abstract external reference systems, or rather there should just be the reference systems with the true physical meaning, which are actually the physical systems as represented by their configuration points or action quantities and could thus be referred to as the physical reference systems. For instances, the solar system and the atom are the two different physical reference systems for the objects moving in them respectively, that is, as far as an electron’s motion is concerned the corresponding physical reference system is the atom, and for a planet’s motion the corresponding physical reference system is the solar system, and thus based on the principle of expanded relativity the physical laws are invariant whether the physical reference system is the solar system or the atom.

### ③ Discussion on some ideas of experimental verification

#### **A: The unification of electromagnetic field and gravitational field**

As an instance of experimental verification of the unified fields, the author would n here have some discussion on the unification of electromagnetic field and gravitational field.

According to Einstein's general theory of relativity, a planet in the solar system would not be driven or affected by the gravitational force but it conducts a free motion in an appropriate physical space which is the curved Riemannian space-time, that is to say the "gravitational force" is not a necessary concept.

But the existing understanding of an electron in the atom is quite different, and it's generally believed that an electron would orbit the nucleus due to the effect of electromagnetic force, and the space outside the nucleus should constitute an electromagnetic field with the action quantum to be the original photon.

However, according to the hypothesis of new photon, this original photon which is originally regarded as the release by the electron transition should be replaced by the new photon, or exactly there should be no quantum jumps between different energy levels in an atom but only the energy levels as represented by the new photon. And thus the electromagnetic field outside the nucleus should be replaced by the energy distribution of the physical space as formulated by the Hamilton Principle and the effect of electromagnetic force should become the characteristic of the corresponding physical space itself. So replacing the original photon with the new photon the forced motion of an electron in the electromagnetic field outside the nucleus should be able to be looked upon as the free motion that occur in an appropriate physical space. Therefore an electron outside the nucleus should conduct the free motion just as a planet might in the solar system.

Now that an electron outside the nucleus should conduct the free motion just as a planet in the solar system, the electromagnetic force could be regarded as "unnecessary" as it should be replaced by the appropriate physical space just as the gravitational force, which is the physical space as represented by the new photon. Further, the physical space which substitutes for the electromagnetic force is just the same as the physical space which substitutes for the gravitational force although they appear to be different, because the laws of physics should not change with the different physical reference systems according to the expanded principle of relativity, that is, as far as this issue is concerned the physical laws should be invariant whether

the actual physical reference system is the atom system (relative to the electron) or the solar system (relative to the planet). Therefore, the electron should follow about the same physical laws as the planet might, in here the physical laws are the Hamilton principle and Euler–Lagrange Equation and the shared physical space system so produced by them, and thus from this perspective the electromagnetic field should be deemed as unified with the gravitational field.

**B: A thought experiment regarding the super light velocity**

The author would now propose an idea regarding the experiment of super light velocity.

Now that the phenomenon of super light velocity should be theoretically possible, how could this be possibly verified? The author would then roughly present an idea of thought experiment regarding the design of an aircraft.

Considering the design of an aircraft, which would fly to the Mars or other stars from the earth, what occurs first is probably how fast the aircraft should travel or what orbit/route the aircraft should follow?

There's a question identified here if it's the velocity of the aircraft that should determine its movement orbit, or on the contrary it's the aircraft's orbit that should determine its velocity?

Generally it seems like the velocity is more important than the orbit, that is, the aircraft should at first reach certain velocities as required to break away from the constraints exerted by the gravity of the earth or sun, and then it could subsequently travel at the given orbits at the corresponding velocities, and eventually fly to the destinations as planned.

However, on the other hand how should we design the given orbits? Or exactly is it possible to design the aircraft's orbit so that it could possibly affect the aircraft's velocity? Or further, what if we design the aircraft's given orbit to make it travel along the real path as determined by Hamilton Principle?

Based on the super light velocity, if the orbit is to be designed as per the real path as determined by Hamilton Principle the movement velocity of the system or its configuration point would not be restricted by the fixed light velocity and the case of super light velocity should then apply to the aircraft's movement and the aircraft will so break through the limitation of fixed light velocity.

Thus in here it's not the velocity that determines the orbit but on the contrary the orbit that determines the velocity, as could be identified as above as the most significant feature of the design of this aircraft.

Therefore, the key to the design of this aircraft is at first locating the appropriate routing as the given orbit, specifically the aircraft should be designed to follow the real path as determined by Hamilton principle, and then we could see how long it would take this aircraft to arrive at the Mars or any other stars when the so called fixed light velocity would not be the limitation of flying the aircraft. The author believes this should be a very interesting experiment with its mechanism being the principle that the real path should be taken as the shortest routing between any two points in space.

### **3. CONCLUSION**

According to all the above and especially based on the expanded principle of relativity it should be assumed that there should be no photons, no action particles and no forces, but there should be the new quantum, the super light velocity and the unification of forces or fields.

### **REFERENCES:**

- [1] Einstein A. (1916), *Relativity: The Special and General Theory* (Translation 1920), New York: H. Holt and Company.
- [2] Feynman, Richard P., Hibbs, Albert R., Styer, Daniel F.,(2010). *Quantum Mechanics and Path Integrals*. Mineola, NY: Dover Publications. ISBN 0-486-47722-3.
- [3] *Analytical Mechanics*, L.N. Hand, J.D. Finch, Cambridge University Press, 2008, ISBN 978-0-521-57572-0.