Necessity of Unification of Physical Fields and Knotty Points in Classical Theory of Field

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Abstract: We showed, through a simple example for creation and annihilation of particles well known in physics, why classical fields and further all physical fields must be unified. Also, we considered the difficulties of the present electromagnetic field theory and gravitational field theory in the view that the total energy of matter and all fields produced by it must be finite and be conserved. Unified field theory to be built in the future should be a true theory in which all those difficulties were removed.

Keyword： Electromagnetic field, Gravitational field, Classical theory of field, Law of energy conservation, Quantum electrodynamics

Since the presentation of Einstein's General Relativity (GR) in 1916, until now, many scientists has put a lot of effort into studying on the unification of classical theories of fields. But these studies have hardly focused on revealing internal physical relation existing objectively between two fields and then mostly tried to discover some unified mathematical means and formalities of space-time geometry which can put two theories in a vessel. The main starting idea of these studies is that two theories of fields are, in classical viewpoint, complete and perfect without any room for touching on and accordingly mathematical means and techniques to combine or unify two theories are the key to solution of all problems.

Maxwell's theory and Einstein's GR are quite distinguished in its physical contents and mathematical form of description (in view of main principle). It is explicitly impossible to find any physical relations between two fields described by these theories. Actually, in classical theories of fields, electric charge, source of electromagnetic field, has no relation with mass, source of gravitational field. On the other hand, energy of electromagnetic field and energy of gravitational field are conserved separately, and then there can be no argument about unified conservation involving mutual conversion between them. But now let us make the following assumption. Supposing that electromagnetic field has some physical relation with not only electric charge, source of electro-magnetic field, but also mass, source of gravitation, there appears real conversion of gravitational field into electromagnetic field and vice-versa, and these can be verified experimentally and then universally valid physical arguments for them can be established, what will result in? This presents new unprecedented tasks before classical physics and leads to the conclusion that the present classical theories of fields should be reconsidered from a critical viewpoint. That one reveals the objective relation between two fields and realizes the unification of two theories is, that is to say, to complete and develop the present classical theories of fields into a new stage, which should be accompanied by clarification and solution of the internal inconsistencies and difficulties of the present classical theories of fields.

1. Why Physical Fields Should Be Unified?

Let us consider annihilation of particle-antiparticle well known in physics. The non-relativistic approximate formula of energy conservation can be written as follows

$$m_0c^2+\frac{1}{2}m_0V_1^2+m_0c^2+\frac{1}{2}m_0V_2^2=2\hbar\omega \quad (1\text{-}1)$$

where m_0c^2 is the energy of free particle, a main result of Special theory of Relativity (SR). Actually, form Einstein's presentation on SR to now, in physics, m_0c^2 has been considered only as energy confined to particle. But in formula (1-1) it should be surely considered that m_0c^2 includes energy of particle, as well as energy of field created by the particle. Why should be viewed like that? It, in a word, is based upon the idea according to which the total energy of particle and field created by it should be always conserved. In case of considering m_0c^2 to be energy confined to particle only, the conservation formula of total energy of particle and field can be represented as follows:

$$\left(m_0c^2 + \frac{1}{2}m_0V_1^2 + \varepsilon_1\right) + \left(m_0c^2 + \frac{1}{2}m_0V_2^2 + \varepsilon_2\right) = 2\hbar\omega + \varepsilon \tag{1-2}$$

where ε_1 is the energy of electromagnetic field and gravitational field created by the particle and ε_2 the energy of two fields created by the antiparticle. From formula (1-1) and (1-2), we have

$$\varepsilon_1 + \varepsilon_2 = \varepsilon \tag{1-3}$$

Where ε is the energy of another matter newly appeared except photon after annihilation of a system of particle-antiparticle. But until now has not yet been found any experimental data which, except photon, another matter occurred. Therefore, if there is something except photon after annihilation of particle-antiparticle, it is no alternative but to conclude that only energy of fields remained as it is, as invariant not measured. On the other hand, as long as particle-antiparticle is annihilated, the mass, m_0, and charge, e, also vanish and accordingly gravitational field and electric field created by their source - rest mass and charge should also disappear. Therefore, the result is

$$\begin{cases} \varepsilon = 0 \\ \varepsilon_1 + \varepsilon_2 > 0 \end{cases} \tag{1-4}$$

$$\varepsilon_1 + \varepsilon_2 \neq \varepsilon$$

Consequently, considering m_0c^2 only as the energy confined to particle, we lead to the conclusion that energy of electromagnetic field and gravitational field should vanish with occurrence of photon, which obviously stands against conservation law of the energy. From this is followed the logical conclusion about physical relation between mass and electromagnetic field which in the present classical theories of fields has been considered to have no relation so far, and about mutual conversion of electromagnetic field and gravitational field. In fact, the occurrence of photon as the result of annihilation of particle and antiparticle means generation of electromagnetic wave. With occurrence of electromagnetic wave disappears gravitational field of particle - antiparticle. In view of conservation law of energy, this shows that the gravitational energy of particle - antiparticle was converted into a part of electromagnetic wave. On the contrary, in case of pair creation, it states that a part of the energy of electromagnetic wave is converted into the energy of gravitational field.

We can obtain following conclusions, based upon all above-mentioned argument.

(1) When one considers a system of particle and field, the measured mass, m_0, is equivalent to the total energy of particle and all fields (electromagnetic field, gravitational field and nuclear field created by it), but not energy of particle only.

(2) The electromagnetic field and gravitational field are mutually converted; accordingly, there exists a unified conservation law of the total energy of particle and electromagnetic-gravitational field, involving mutual conversion.

These conclusions, of course, was never drawn in terms of some abstract assumption. These conclusions are based on experimental data about annihilation of particle-antiparticle well known and recognized in particle physics, and rooted in conservation law of energy, a foundation of physics. But, unfortunately, from the present classical theories of fields cannot be obtained these conclusions. So in the future, building a new unified field theory in the view of classical field theory, one must embody that the total energy of a particle and all fields produced by it is equal to m_0c^2, and remove the difficulties of the present electromagnetic field theory and gravitational field theory seen in the following sections.

2. The Difficulties of Maxwell's Theory of Electromagnetic Field

The classical theory of electromagnetic field or Maxwell's electrodynamics, as the unique theory of electromagnetic phenomena, until now, has been regarded as a perfect and completed theory. But this theory also involves some unavoidable inconsistencies.

(1) In Maxwell's theory, divergence of energy of electrostatic field seems to be an unavoidable difficulty and accordingly the conservation law of total energy of particle and its field is always

meaningless.

The classical theory of field evolves with taking a particle to be a point, from demand of Special theory of Relativity in which particle cannot have finite size. But, in case of regarding a particle as a point, the energy of electrostatic field always diverges. The law of energy conservation is based on the idea that energy of a finite material system is always finite. This is because of the fact that conservation law is meaningful only for finite quantity and can be studied quantitatively. That is why, for finite material system with infinite energy, the conservation law of energy leads to absence of meaning. This shows clearly that, in Maxwell's theory, the finiteness of energy and conservation law of energy is not valid and so, not well qualified as a scientific theory.

Understanding Maxwell's theory in the viewpoint of logics, one also can find inconsistency. For building of a consistent closed theory, starting definitions, all conclusions and laws following from them should not be inconsistent each other. But that there is inconsistency between basic definition regarding a particle as a point and conservation law of energy in Maxwell's theory shows that this theory is a not-closed theory with inconsistency. In the past, divergent problem of energy was solved within Maxwell's theory as follows. One artificially removed the term relevant to the divergence in energy of field, regarding it to be absence of physical meaning. Of course, this obviously is in opposition to rule of logics. On the other hand, in case of the divergence of energy of electrostatic field when action radius of electric field approaches zero, confining the applicable region of classical electrodynamics to electron radius, e^2/m_0c^2, outside this region of application it was concluded that not classical theory of field but quantum theory of field is meaningful. But, this "measure of solution" is also wrong. Actually, region of application of theory is defined in accordance with what exactly the theory can describe experiments, namely, by applicable limitation in which can give answer to experiment but not by some specific limitation that the theory falls to logical inconsistency.

When theory is not closed and has logical inconsistency, we fall to the poor situation that cannot distinguish whether disagreement between some consequences of the theory and experiments is based on internal inconsistency of the theory itself or actual limitation of application of the theory related to that the theory can give no perfect answer to experiments. Consequently, Maxwell's theory stands against the finiteness of energy and conservation law, and accordingly is a not-closed theory that involves contradiction.

This difficulty of Maxwell's theory is represented as the more serious form on the stage of quantum electrodynamics. In this regard, Stephan Weinberg wrote:

"Earlier experience with classical electron theory provided a warning that a point electron will have infinite electromagnetic self-mass. Disappointingly this problem appeared with even greater severity in the early days of quantum field theory, and although greatly ameliorated by subsequent improvements in the theory, it remains with us to the present day.

The problem of infinites in quantum field theory was apparently first noted in the 1929-30 papers of Heisenberg and Pauli. Soon after, the presence of infinites was confirmed in calculations of electromagnetic self-energy of a bound electron by Oppenheimer, and of a free electron by Ivar Waller. …But it had become accepted wisdom in the 1930s, and a point of view especially urged by Oppenheimer, that quantum electrodynamics could not be taken seriously at energies of more than about 100MeV, and that the solution to its problems could be found only in really adventurous new ideas." [2]

It is the obvious fact that even in the quantum electrodynamics in which region of application of theory cannot be limited, the energy of electrostatic field is divergent. The artificial "measure of solution" by what defines limitation which in classical electrodynamics the theory can be applied to can no longer apply to quantum electrodynamics. It is no alternative but to conclude that this difficulty is rooted in the inconsistency of Maxwell's theory.

(2) In Maxwell's theory, because of the divergence of field energy, one cannot give answer to the experimental fact that the total energy of particle plus its field is equal to the finite quantity, m_0c^2

It was Albert Einstein who was concerned with the relation of mass and field and gave scientific answer to this for the first time. He, evolving the theory of gravitational field, proved that in gravitational field of central symmetry the total energy of particle-gravitational field is equivalent to the inertial mass of a system. This shows that equivalence of mass and energy of a particle in SR is more generalized into equivalence of total energy of particle-field and inertial mass of a system. However, this equivalence is confined to within the theory of gravitational field and, until now, the interrelation between total energy of particle-its electromagnetic field and mass has not yet been studied. On the other hand, the experiment formula (1-1) shows explicitly that the total energy of particle and electromagnetic field-gravitational field is equal to the finite quantity, $m_0 c^2$. This implies again the serious contrariety of Maxwell's theory.

(3) In Maxwell's theory, the consideration of radiation damping (radiation reaction) by an accelerated electric charge leads to a serious difficulty.

In case of considering electromagnetic wave radiated by a uniformly accelerated electric charge, it was experimentally verified that radiated field reacted on the electric charge and theoretical researches for radiation reaction have been going on from past to now [10-14]. But in Maxwell's theory, the description of radiation damping always leads to a serious difficulty and so this problem has been regarded as "the greatest crisis in Maxwell's theory" [3].

We now proceed the discussion of radiation damping in Maxwell's theory. The expansion of power series of four dimensional field potential in $\mathbf{V}/c$ can be written as follows

$$\varphi = \frac{e}{R} + \frac{e}{2c} \cdot \frac{\partial^2 R}{\partial^2 t} = \varphi^{(1)} + \varphi^{(2)} \tag{2-1}$$

$$\mathbf{A} = \frac{e}{c} \cdot \frac{\mathbf{V}}{R} - \frac{2}{3c^2} e\dot{\mathbf{V}} = \mathbf{A}^{(1)} + \mathbf{A}^{(2)} \tag{2-2}$$

where $\varphi^{(3)}$ is zero by the gauge transformation[4]. From this, damping force by radiation is represented as

$$\mathbf{F}^{in} = e\mathbf{E}^{in} = -\frac{1}{c}\dot{\mathbf{A}}^{(2)} = \frac{2}{3c^2}\dddot{\mathbf{d}} \tag{2-3}$$

$$m\dot{\mathbf{V}} = e\mathbf{E}^{ex} + \frac{e}{c}[\mathbf{V} \cdot \mathbf{H}^{ex}] + \frac{2}{3c^2}\dddot{\mathbf{d}} \tag{2-4}$$

where $\mathbf{E}^{ex}$ and $\mathbf{H}^{ex}$ are strengths of external fields and $\mathbf{F}^{in} = e\mathbf{E}^{in}$ is the force by field of point charge itself. Consequently, $\mathbf{A}^{(2)}$ was considered only as the additional field that contributes to damping force by radiation. But this argument is followed from the following premise.

1) In the Lagrangian of interaction of particle and field, four dimensional vector $(\mathbf{A}, \varphi)$ of field should be viewed as the sum of external field and field of particle itself (created by particle itself), namely,

$$\mathbf{A} = \mathbf{A}^{ex} + \mathbf{A}^{in} \tag{2-5}$$

$$\varphi = \varphi^{ex} + \varphi^{in} \tag{2-6}$$

where $\mathbf{A}^{ex}$ and φ^{ex} are external fields and $\mathbf{A}^{in}$ and φ^{in} are fields of point charge itself.

2) For finding the force that the field produced by point charge acts on itself, in formula (2-1) and (2-2), radius of action by field should go to zero, namely,

$$\mathbf{A}^{in} = \lim_{R\to 0} \mathbf{A} \qquad \varphi^{in} = \lim_{R\to 0} \varphi \tag{2-7}$$

But one can easily understand that, under the above mentioned premise, the theory immediately results in inconsistency. Actually, converging radius of action R to zero, (2-1) and (2-2) yield divergence of $\varphi^{(1)}$ and $A^{(1)}$. Consequently, within Maxwell's theory, introduction of field created by electric charge itself necessarily gives divergent terms. This inconsistent conclusion, as mentioned above, is rooted in the fact that the energy of electrostatic field leads to divergence.

In order to overcome this difficulty, in consideration of damping force by radiation, divergent terms, $\varphi^{(1)}$ and $\mathbf{A}^{(1)}$, were artificially subtracted, concluding that they are insignificant terms, and only $\mathbf{A}^{(2)}$ independent of radius of action was regarded as the significant term relevant to radiation damping. Of course, this "measure of solution" is obviously in opposition to logical rule for construction of theory. Many experimental data show that reaction of radiation by electric charge, radiation damping, appears in reality and affects motion of electric charge. But in Maxwell's theory, the fact which introduction of radiation reaction leads to contradiction shows that this theory is not closed one involving inconsistencies.

(4) Because of the principle of gauge symmetry that underlies Maxwell's theory, the energy of material system loses physical meaning and accordingly energy conservation of material system arrives at absence of its meaning.

The principle of gauge symmetry that underlies classical electrodynamics, as well as quantum theory of field involves a serious problem to be reconsidered.

In SR, the relation among mass of a free particle, its energy and momentum is as follows:

$$m_0c^2 = \frac{E^2}{c^2} - P^2 \tag{2-8}$$

As referred to in many papers and textbooks, in case of a complex system which consists of elements (or subsystems), formula (2-8) holds [5]. In this case, the energy of the system is

$$E = \sum_i \varepsilon_i + U \tag{2-9}$$

where U is the interactional energy of constituent particles and $\varepsilon_i = m_i c^2 + T_i$, the sum of rest energy and kinetic energy, and then momentum is

$$P = \sum_i P_i \tag{2-10}$$

Now, if one chooses a coordinate system allowing momentum $\mathbf{P} = 0$ in which inertia center is placed at origin of the coordinate system, the result is

$$m_0 = \sum_i m_i + \frac{1}{c^2}\sum_i T_i + \frac{U}{c^2} \tag{2-11}$$

If $\sum_i T_i \ll |U|$, namely constituent particles maintain relative stability and kinetic energy of particles is supposed to be very small, formula (2-11) arrives at

$$m_0 = \sum_i m_i + \frac{U}{c^2} \tag{2-12}$$

From this, difference or deficit of mass is as follows.

$$\Delta m = m_0 - \sum_i m_i \tag{2-13}$$

$$U = \Delta m c^2$$

This conclusion, of course, was verified by many experiments relevant to fission. That is to say, formulas (2-12) and (2-13) are correct results proved by experiments. But in case of applying the principle of gauge invariance (gauge symmetry) to formula (2-12) and (2-13), at once, we arrive at inconsistency. Actually in formula (2-12), as long as the term of interaction U includes potential term of electric interaction, from the principle of gauge symmetry, any constant can be either added to or subtracted from potential φ. In this case, the mass and energy of a system cannot be uniquely determined and further by choosing properly a constant included in φ, the mass and energy of a system can be transformed to zero or even negative value. Consequently, from the principle of gauge symmetry, the energy of material system leads to loss of physical meaning. On the other hand, only when $U < 0$, system becomes stable, but as long as U leads to zero or positive value according to constant chosen, discussion about the criterion of stability and instability is impossible.

In Newton's classical mechanics, the energy of a rest object is not defined uniquely and is positive value or negative value. In SR, unlike this, the energy of a free particle is always determined uniquely as positive value and equivalent to rest mass. If one follows the principle of gauge symmetry, the formula (2-12), a main conclusion of SR that has already verified by experiment should be rejected and energy of material system leads to absence of physical meaning. Consequently, one arrives at failure in arguing conservation law of energy. If one accepts, as a truth, the equivalence of mass and energy verified experimentally and the fact that the energy of material system can be neither zero nor negative value, the principle of gauge symmetry should be reconsidered.

(5) Quantum electrodynamics regarding Maxwell's theory as the unique basis raises problem of divergence of scattering matrix within region of large momentum or small area of space.

The occurrence of divergent terms in approximation of higher order of scattering matrix presents unavoidable knotty points before electrodynamics. In fact, even though first order approximation in scattering theory is well conformed with experimental results, if the approximations of high order diverges, even correctness of first approximation is put into doubt and accordingly this theory leads to loss of qualification as a scientific theory of physics.

As well known, in classical electrodynamics also is raised problem of divergence within classical radius of electron $r_0 = e^2/m_0c^2$ but within small area of Compton wavelength degree, recognizing that quantum theory only is significant, by the way of confining applicable region of classical electrodynamics to Compton wavelength, this inconsistency was overcome. However, as far as quantum electrodynamics considers interaction of particles within any area of space, divergence occurred in any area cannot be solved by the same way as in classical electrodynamics. In this regard, in present quantum electrodynamics, this difficulty was "solved" as follow: At first, one defined boundary momentum *L* and next, separated infinite quantity from the main expression and then by including these in electric charge and mass, renormalized electric charge and mass to yield finite quantity only. But this cannot certainly be the right measure of solution. In fact, as recognized by many scientists, this measure of solution is very artificial and harm the logical system of the theory.

P.A.M. Dirac was strongly against the procedure of neglecting infinity by renormalization:

"This small correction is interpreted as giving the Lamb shift in the case of the energy levels of hydrogen or an extra magnetic moment of the electron, the anomalous magnetic moment, for an electron in a magnetic field. These calculations do give results in agreement with observation.

Hence most physicists are very satisfied with the situation. They say: 'Quantum electrodynamics is a good theory, and we do not have to worry about it any more.' I must say that I am very dissatisfied with the situation, because this so-called 'good theory' does involve neglecting infinities which appear in its equations, neglecting them in an arbitrary way. This is just not sensible mathematics. Sensible mathematics involves neglecting a quantity when it turns out to be small-not neglecting it just because it is infinitely great and you do not want it!

…

There must be some drastic change introduced into them so that no infinites occur in the theory at all and so that we can carry out the solution of the equations sensibly, according to ordinary rules and without being bothered by difficulties. ⋯ I feel that the change required will be just about as drastic as the passage from the Bohr orbit theory to the quantum mechanics." [6]

Mandel Sachs said as follows:

"While this (method of renormalization) is taken to be a success of the quantum theory, it is still not satisfactory because the renormalization procedures are not mathematically consistent. That is, while some predictions are correct, by changing the method of subtracting the infinities from the divergent series solutions, one may predict any other numbers for the same physical effects! This violates the scientific requirement that there is a unique prediction for any given experimental fact.

Thus, it has been my contention, as well as some others in the field (such as one of the original founders of quantum field theory, Paul Dirac) that quantum electrodynamics is not in a satisfactory state as a bona fide theory." [1]

3. The Difficulties of GR

Difficulties of GR, for the first time in history of physics, was presented by Schrodinger in 1918, and since then, was stated by many physicists like Fock, and discussed collectively in "the relativistic theory of gravitation" (English Edition , 1989) co-written by Logunov and Valssov etc., physicists of former Soviet Union[8].

With reference to all arguments until now, summarizing difficulties of GR is as follows.

(1) The energy-momentum tensor defined in Einstein's GR has no physical meaning.

As demonstrated for the first time by Schrodinger, by choosing properly coordinate system, energy-momentum tensor of gravitational field vanishes outside a ball. From this follows the inconsistent conclusion that the energy-momentum of gravitational field cannot be localized and accordingly energy-momentum density of field existing in any point of space-time cannot be defined and then only total energy-momentum integrated through total space can be well-defined. As stated by many scientists, in this case, propagation of gravitational energy from one place to another is impossible and description of gravitational wave leads to principled inconsistency [8]

Actually, in GR, energy-momentum tensor τ^{lm} of field is defined as pseudo tensor and in this case, by selecting an appropriate system of coordinates, one can nullify all the components of τ^{lm} at any point of space-time [7]. On the other hand, in GR, energy-momentum conservation formula of integral form also possess a limitation. In this theory, energy conservation of matter and field can be written as follows.

$$\partial_n(T_i^n + \tau_i^n) = 0 \tag{3-1}$$

where T_i^n is energy-momentum density tensor of matter and τ_i^n energy-momentum density tensor of field. If matter is concentrated only in a volume *V*, Eq (3-1) implies that

$$\frac{d}{dx_0}\int_V \left(T_i^0 + \tau_i^0\right) dV = -\oint \tau_i^\alpha dS_\alpha \quad (3\text{-}2)$$

At present, there exist a whole series of exact solutions to the vacuum Hilbert-Einstein equations for which the stresses, τ_0^α, are everywhere null [9]. Thus, for exact wave solution to Hilbert-Einstein equations that nullifies the components of the energy-momentum pseudo-tensor, Equation (3-2) yields

$$\frac{d}{dx^0}\left\{\int_V \left(T_i^0 + \tau_i^0\right) dV\right\} = 0 \quad (3\text{-}3)$$

that is, the energy of matter and gravitational field inside V is conserved. This means that there is no flow of energy outward from V and, therefore, there can be no action on test bodies placed outside V. And vice versa, in case of absence of gravitational field, i.e. flat space-time, that is, when the metric tensor g_{ni} of the Riemann space-time is equal to the metric tensor γ_{ni} of pseudo-Euclidean space-time, components of energy-momentum pseudo-tensors may not vanish although there is no gravitational field and all components of the curvature tensor are zero. For example, in the spherical system of coordinates of the pseudo-Euclidean spacetime is given following formula

$$R^i_{klm} = 0,\ g_{00} = 1,\ g_{rr} = -1,\ g_{\theta\theta} = -r^2,\ g_{\varphi\varphi} = -r^2 \quad (3\text{-}4)$$

In this case, component τ_0^0 of Einstein's pseudo-tensor for energy density of the field yields [8]

$$\tau_0^0 = -\frac{1}{8\pi} \quad (3\text{-}5)$$

It is clear that the total energy of gravitational field in this system of coordinates would diverge because of $\tau_0^0 < 0$. In this case, Landau-Lifshitz pseudo-tensor demonstrates a different energy distribution in space [8].

$$(-g)\tau^{00} = -\frac{r^2}{8\pi}(1 + 4sin^2\theta) < 0 \quad (3\text{-}6)$$

Consequently, In GR, energy-momentum density of field, the main physical quantity characterizing the field is not determined by real field itself but by choice of coordinate system. That is to say, by a suitable choice of coordinate system, the field can vanish in case of existence of real field or appear even in case of absence of real field. This shows obviously that Einstein's GR failed to have a main character which must possess as scientific theory.

(2) The principle of equivalence, the starting idea of GR is not qualified enough as scientific principle of physics.

According to principle of equivalence, by choice of system of coordinate, inhomogeneous gravitational field in space-time cannot totally vanish, but in any infinitely small region of space, coordinate system can always be chosen in such a way that the gravitational field in the region vanishes, and accordingly in this region gravitational field can be replaced completely by field of inertia. Just this idea reflected main character of Riemann space in which curved surface, by any choice of coordinate system, cannot transform into flat surface but, for infinitesimal region, into Euclidean infinitesimal space, which just was the main reason that Einstein accepted Riemannian space as a form of space-time for evolution of the theory of gravitational field.

But as argued by Logunov, Vlassov and many physicists including Schrodinger and Fock, the above mentioned difficulty (loss of physical meaning of gravitational field) is rooted in equivalence principle. In fact, in GR metric tensor g_{mn} is both metric of space-time and function of field. Therefore, equivalence principle that metric, g_{mn}, in any point of space-time can be transformed to Euclidean metric (constant metric) leads us to the inconsistent conclusion that energy-momentum density tensor of field localized in a point of space-time can become zero and gravitational field occurs even in Euclidean spherical system of coordinate (empty space without gravitational field), as long as energy-momentum tensor of field consist of metric tensor, g_{mn}.

Now let us make the following imaginary thought experiment. Supposing that there is homogeneous and static gravitational field, in this field the particle accelerates to radiate gravitational wave, gravitons. On the other hand, in view of equivalence principle, static and homogeneous field, by an appropriate transformation of coordinate system, can vanish to be the state of "null-gravitation". Of course, in this empty space or the state of null-gravitation is followed an inconsistent conclusion that with uniformly and rectilinear motion of a particle vanishes gravitational wave radiated by particle, i.e. graviton. This shows that equivalence principle reflects the inconsistent idea that can either create or remove such objective matter as static field or gravitons. Besides, in GR gravitational mass is not invariant under transformation of three-dimensional spatial coordinate system, and so the descriptions about three effects of gravitation (Red shift of Light, Reflection of Light and Shift of Mercury's Perihelion) have not uniqueness in view of theoretical analysis, and moreover by choice of coordinate system, the radiation strength of gravitational wave can be either zero or negative value. These obviously are inconsistent.

It is our contention, as well as Logunov, that these difficulties are rooted in equivalence principle. The conservation law of energy-momentum is a main idea of physics, whereas the equivalence principle is very essential for building of GR. Sacrificing conservation law of energy, this principle cannot certainly find any foundation for its existence as the principle of physics.

(3) In GR, the conservation law of the total energy-momentum of matter and field is not based on a main principle of physics relevant to homogeneity and isotropy of space- time, and moreover, has not physical meaning.

From Newton's time to now, the relation between conservation law of energy-momentum and homogeneity - isotropy of space-time has been recognized as an important and main principle in all theories of physics including classical electrodynamics and quantum electrodynamics. But in case of applying this principle to GR, one reaches the inconsistent conclusion.

The Lagrangian density of matter and field and action integral formula can be written as follows.

$$L_M = L_M(g_{mn}, \phi_A\ ), \qquad L_g = \sqrt{-g}R$$

$$S = \int \left(L_M + L_g\right) d\Omega \tag{3-7}$$

where L_M is Lagrangian density of matter and L_g Lagrangian density of field, g_{mn} metric tensor, and ϕ_A field of other matter. In this case, infinitesimal transformation of space-time $x'^i = x^i + \delta x^i$ results in infinitesimal transformation of metric $g'^i = g^i + \delta g^i$ and from $\delta S = 0$ is followed

$$T^{ni}_{(M)} + T^{ni}_{(g)} = 0 \tag{3-8}$$

where

$$T^{ni}_{(M)} = -2\,\delta L_M/\delta g_{ni}$$

is the symmetric energy-momentum tensor of matter,

$$T^{ni}_{(g)} = -2\,\delta L_g/\delta g_{ni} = -\frac{C^4}{8\pi G}\cdot\sqrt{-g}\left[R^{ni} - \frac{1}{2}g^{ni}R\right]$$

is the energy-momentum tensor of field. Equation (3-8) also implies that all components of the energy-momentum tensor density of the symmetric gravitational field $T^{ni}_{(g)}$ vanishes everywhere outside matter, Thus, these results imply that the gravitational field in GR does not possess properties inherent in electromagnetic field [8]. Consequently, drawing conservation law of energy-momentum (field plus matter) from general principle of homogeneity and isotropy of space-time naturally, we reach the inconsistent conclusion. If so, why results in the inconsistent conclusion. In GR g_{mn} is both metric of space-time and variables of field, and accordingly obtaining the equation of field from variation of field δg^{mn} coincide mathematically with drawing conservation formula of energy-momentum from variation of metric δg^{mn} following by variation of space-time $\delta x'$. The conservation formula drawn by this method is invalid as showed in formula (3-8). In order to avoid this inconsequence, in GR the concept of energy-momentum was defined by the illogic and artificial method as follows: The field equation of Hilbert-Einstein can be written as:

$$-\frac{C^4}{8\pi G}\cdot g\left[R^{ik} - \frac{1}{2}g^{ik}R\right] = -gT^{ik} \tag{3-9}$$

where $\det g_{ik} = g$, R^{ik} is Ricci tensor and T^{ik} the energy-momentum tensor of matter. Then, the left-hand side can be represented as the sum of two non-covariant quantities

$$-\frac{C^4}{8\pi G}g\left[R^{ik} - \frac{1}{2}g^{ik}R\right] = \frac{\partial h^{ikl}}{\partial x^l} + g\tau^{ik} \tag{3-10}$$

where $\tau^{ik} = \tau^{ki}$ is the energy-momentum tensor of gravitational field and $h^{ikl} = - h^{ilk}$ spin pseudo-tensor. This transforms Hilbert-Einstein equations (3-10) into equivalent form

$$-g\left(T^{ik} + \tau^{ik}\right) = \frac{\partial h^{ikl}}{\partial x^l} \tag{3-11}$$

From the obvious fact that

$$\frac{\partial^2 h^{ikl}}{\partial x^k \partial x^l} = 0 \tag{3-12}$$

Hilbert-Einstein equation yields the following "differential conservation law"

$$\frac{\partial}{\partial \tau^k}\left[-g\left(T^{ik} + \tau^{ik}\right)\right] = 0 \tag{3-13}$$

which formally is similar to the conservation law for energy-momentum in electrodynamics [4]. Of course, this argument is never made on the basis of homogeneity and isotropy of space-time. Moreover, energy-momentum tensor defined in conservation formula (3-13) as pseudo-tensor can vanish by a suitable choice of coordinates system or diverges in Euclidean spherical coordinates, and so is invalid as a physical quantity that characterizes physical field. On the other hand, as showed in formula (3-3), conservation of energy-momentum of integral form also leads to difficulty and in case of discussion of energy-momentum of system we also arrives at the inconsistent conclusion which it or inertial mass depends on choice of spatial coordinate [8].

(4) In case of taking matter to be a point, in GR the energy of material system also would diverge.

When one, neglecting macro-character of objects that comprise material system, regarding them as points and calculating energy of the system, in addition to interactional energy dependent on spatial distribution of objects, there appear such divergent terms relevant to self-energy as in Maxwell's theory [4].

(5) Radiation damping (radiation reaction effect) by gravitational wave created by an accelerated particle arrives at serious choplogic.

Until now, despite so many studies concerning gravitation, radiation damping by gravitational wave has hardly been studied. It is because intensity of gravitational wave is too small to measure and then to account for radiation damping effect much smaller than it has no significance. On the other hand, owing to the characteristic of nonlinear equation of gravitational field, it is impossible to obtain the correct solution of the equation and accordingly the strict theoretical consideration of radiation damping effect by radiation wave cannot be given.

But, now let us suppose an imaginary thought experiment about what radiation damping will result in. In this case, the result leads to difficulty that stands against conservation law of energy. In GR, gravitational field is always attraction field and accordingly interactional force between object and field has negative value. Therefore, force of radiation damping, namely interactional force with self-field produced by object also has negative value. Thus, from this is drawn the inconsistent conclusion that an object, with radiation of gravitational wave, does not lose energy by damping force but by force in direction of motion comes to obtain energy. For actual approximate calculation, one can get formula for radiation field of gravitational wave by a power series under approximate condition of weak field. In this case, the first term of expansion is proportional to $-1/r$ like radiation reaction in electrodynamics and as for the interaction with self-field, term of interaction with attraction field has negative infinity. Of course, although this argument is not based on a rigorous calculation and more or less imaginative, the result of the thought experiment presents the main difficulty of GR. All of these shows that Einstein's GR is also not a closed theory

4. Conclusion

We considered the main difficulties that Maxwell's theory and Einstein's GR involve. Summarizing all argument above mentioned leads to the following conclusions.

(1) In present classical theory of fields, total energy-momentum conservation law does not has physical meaning

In case of Maxwell's electrodynamics, the energy of field created by an electric charge always diverges and owing to principle of gauge symmetry, the energy of material system arrives at absence of physical meaning. In Einstein's GR, energy-momentum tensor does not possess physical meaning and the total energy-momentum conservation formula also leads to inconsequence.

(2) It is impossible that within Maxwell's theory and Einstein's GR give the correct solution to experimental data which the total energy of particle-field is equal to m_0c^2.

If one sticks to that the present theories are consistent and closed ones, we should give up main principles of physics for total energy conservation of matter-field and the finiteness of physical quantities, which of course has not objective validity and is never possible.

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