Toward new thought for the unified theory of electromagnetic field and gravitational field (Ⅲ)

(quantum electrodynamics in KR space, Lagrangian of unified theory of field and experimental verification of theory)

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Abstract: In this paper, we analyzed the difficulties of Maxwell's electromagnetic theory and Einstein's gravitational theory in detail, built a unified theory of field including consistent nonlinear electromagnetic theory and gravitational theory on the basis of new starting postulates, and extended these results into quantum electrodynamics. In this process, we accepted a new geometrical space in which metric tensor and all main physical functions becomes implicit function, called "KR space" conforming to our starting postulates, and normalization of implicit functions in order to connect all physical functions defined in this space with real world. Here, we naturally unraveled problem of radiation reaction, a historical difficult problem of Maxwell-Lorentz theory, established new quantum electrodynamics without renormalization procedure and also predicted some new theoretical consequences which could not find in traditional theories.

Keyword：Unified theory of field, Gravitational field, Electromagnetic field, KR space, Breaking of gauge symmetry, Quantum electrodynamics,

Contents

6. Quantum Electrodynamics in KR Space (Non-linear Quantum Electrodynamics)

The classical theory underlies quantum theory and accordingly as long as basis of classical theory is varied, quantum theory also should be, in view of new angle, rethought and rebuilt naturally. As our theory for electromagnetic field is formulated in KR space, quantum theory also should be set up newly.

Sect. 17 Modification of Dirac equation

First of all, let us rewrite formula (5-21) for the total energy of a particle in electrodynamics, discussed in sect 5 (see reference [1])

$$E=\left[\bar{m}_0 c^4+c^2\left(\mathbf{P}-\frac{\bar{e}}{c}\mathbf{A}\right)^2\right]^{1/2}+\bar{e}\varphi \qquad (17-1)$$

where $\bar{m}_0$ is the effective inertial mass and $\bar{e}$ the effective charge (see formula (5-9), (5-15)).

Comparing formula (17-1) with formula for energy in Maxwell's theory, in formula (17-1) appear effective charge and effective inertial mass, instead of constant charge and constant mass in Maxwell's theory. Namely, if one replaces constant charge and constant mass in Maxwell's theory by effective charge and effective inertial mass, the formula for the total energy of a particle in KR space is obtained.

Now, for reformulating quantum electrodynamics, let us suppose that this relationship is held as it is. Consequentely, by replacing charge and mass in Dirac equation by effective charge and effective inertial mass, quantum mechanical equation in KR space is obtained. The result is

$$\left[\gamma^\mu\left(i\partial_\mu+\bar{e}A_\mu\right)-\bar{m}_0\right]\psi(x)=0 \qquad (17-2)$$

And then interaction Harmiltonian H_s and Lagrangian are

$$H_s=\int L dx^3\,,\qquad L=\bar{e}\bar{\psi}\gamma_\lambda A^\lambda\psi \qquad (17-3)$$

Now, let us express $\bar{e}$ as a quantum mechanical operator. To do this, we change $eA_\lambda u^\lambda$ in denominator of $\bar{e}$ as follows;

$$\frac{2}{m_0c^2}eA_\lambda u^\lambda=\frac{2}{m_0c^2}\bar{e}\left(1+\frac{2e}{m_0c^2}A_\sigma u^\sigma\right)A_\lambda\frac{\dot{x}^\lambda}{\left(g_{\mu\nu}\dot{x}^\mu\dot{x}^\nu\right)^{\frac{1}{2}}}=$$

$$=\frac{2}{m_0c^2}\bar{e}g_{\lambda\sigma}\delta^{\lambda\sigma}\left(g_{\mu\nu}\dot{x}^\mu\dot{x}^\nu\right)^{-\frac{1}{2}}A_\lambda\dot{x}^\lambda=\alpha_0\bar{e}A_\lambda\dot{x}^\lambda \qquad (17-4)$$

where $\alpha_0(\dot{x},g)=\frac{2}{m_0c^2}g_{\lambda\sigma}\delta^{\lambda\sigma}\left(g_{\mu\nu}\dot{x}^\mu\dot{x}^\nu\right)^{-\frac{1}{2}}$ (When one normaizes H_s, $g_{\lambda\sigma}\delta^{\lambda\sigma}$ becomes 1). If one expresses formula (17-4) as a quantum mechanical operator, the result is

$$\frac{2}{m_0c^2}eA_\lambda u^\lambda\to\int\alpha_0\bar{e}\bar{\psi}\gamma_\lambda A^\lambda\psi dx^3 \qquad (17-5)$$

Hence, formula (17-3) arrives at

$$L=\bar{e}\bar{\psi}\gamma_\lambda A^\lambda\psi=\frac{e\bar{\psi}\gamma_\lambda A^\lambda(x,g)\psi}{1+\int dx^3\alpha_0(\dot{x},g)\bar{e}\bar{\psi}\gamma_\lambda A^\lambda(x,g)\psi}$$

$$=\frac{L_m}{1+\int dx^3\alpha_0(\dot{x},g)L} \qquad (17-6)$$

$$\bar{e} = \frac{e}{1 + \int \alpha_0 \bar{e} \bar{\psi} \gamma_\lambda A^\lambda \psi dx^3}$$

where $L_m = e\bar{\psi}\gamma_\lambda A^\lambda \psi$. Therefore, L becomes an absolute implicit function and so do H_s in formula (17-3). The result is

$$H_s = \int dx^3 \frac{L_m}{1 + \int dx'^3 \alpha_0(\dot{x}, g) L} \qquad (17-7)$$

The implicit function, H_s becomes the key to solving problem of divergence.

Sect. 18 The normalization of S-matrix and its convergence

In this section, we define newly S-matrix in non-linear quantum mechanics and, by using normalization rule, normalize S-matrix and then see its convergence. If one starts with the theory of perturbation expansion of S-matrix treated in the traditional quantum electrodynamics, the nth-order term of the perturbation expansion of S-matrix is as follows:

$$S^{(n)} = \frac{(-1)^n}{n!} \int dx_1^4 \cdots dx_n^4 T\big(L(x_1) \cdots L(x_n)\big) \qquad (18-1)$$

where L is given by formula (17-6).

Now, in order to normalize $S^{(n)}$, let us express formula (18-1) as the concise form of implicit function. For this, first of all, we consider $H_s' = \int dx^3 \alpha_0 L$ which put in denominator of $\bar{e}$ in formula (17-6). According to the mean value theorem in mathematics, there must be t_0 satisfing

$$\int dt\, H_s' = T_0 H_s'|_{t=t_0} = T_0 \bar{H}_s' \qquad (18-2)$$

where $\bar{H}_s'$ is the average value of H_s', T_0 time interval between t_1 (before interaction occures) and t_2 (after interaction finishes), and T_0 is supposed to be finite. Next, in formula $H_s' = \int dx^3 \alpha_0 L$, as $\alpha_0 \ll 1$ holds, ignoring the difference of H_s' and $\bar{H}_s'$ does not give essential influence to final calculation of $S^{(n)}$. Hence, in calculation of $S^{(n)}$, $\bar{H}_s'$ is considered to be approximately same as H_s', Namely,

$$\bar{H}_s' = H_s'|_{t=t_0} \approx H_s' \qquad (18-3)$$

$$H_s' \approx \bar{H}_s' = \frac{1}{T_0} \int dx^4\, \alpha_0 L(x) \qquad (18-4)$$

Now, considering formula (17-6) and (17-7), formula (18-1) arrives at

$$S^{(n)} = \frac{(-1)^n}{n!} \bar{e}_0^n \int dx_1^4 \cdots dx_n^4 T\big(L_m(x_1) \cdots L_m(x_n)\big) \qquad (18-5)$$

where

$$L_m' = \bar{\psi}\gamma_\lambda A^\lambda \psi$$

and

$$\bar{e}_0^n = \frac{e^n}{\left[1 + V_{(n-1)} + (\alpha_0)^n \frac{1}{(T_0)^n} S^{(n)}\right]}$$

In denorminator of $\bar{e}_0^n$, $S^{(n)}$ is S-matrix of *n*th-order and $V_{(n-1)}$ is mixed product of arbitrary order of any different terms of $\frac{1}{T_0}(-i)\alpha_0 \int dx_j^4 L(x_j)$ from $j = 1$ to $j = \mathrm{n} - 1$ (As $g_{\mu\nu}$ terms of α_0 becomes 1 when one normalizes S-matrix, from the beginning, these are put in front of $S^{(n)}$ to avoid complication of calculation).

The formula (18-5) can be written in the following more concise form

$$S^{(n)} = \frac{(-i)^n}{n!} \cdot \frac{S_0^{(n)}}{1 + (\alpha_0)^n \frac{1}{(T_0)^n} S^{(n)} + V_{(n-1)}} \qquad (18-6)$$

where $S_0^{(n)} = e^n \int dx_1^4 \cdots dx_n^4 T(\bar{\psi}\gamma_\lambda A^\lambda \psi \cdots \bar{\psi}\gamma_\lambda A^\lambda \psi)$ is similiar in the traditional quantum electrodynamics. But from strict inquiring is found some difference. In formula for $S_0^{(n)}$, A^λ is, as mentioned in sect. 9 (see reference [2]), implicit function. The character of implicit function vanishes, when one normalizes it, and then A^λ leads to field potential in Maxwell's theory.

In the past, so called "method of renormalization" according to which removes terms of divergence occurred in perturbation expansion is, in a word, to remove artificially infinite quantities by separating it from physical quantities, harming the logical system of the theory. In other words, the traditional theory assumed artificially that finite quantities such as charge and mass with real physical meaning, verified experimentally in classical physics comes to have divergent character of "necessary form" (necessary for elimination of infinite quantities occurred) in the stage of quantum electrodynamics and then concluded that finite quantities with physical meaning could be obtained from eliminating this infinite (infinite of necessary form) by infinite occurred in the process of interaction with field could be obtained. But this argument stands against principle of correspondence, a main principle of physics. According to principle of correspondence new theory involves, as an approximate form, the former theory which underlies it. However, allowing theory of renormalization, mass and charge belonging to equation of Dirac are not mass and charge (finite quantity) in Maxwell's theory and Schrodinger equation.

In view of methodology, the traditional quantum electrodynamics, in order to solve problem of divergence, divided any formulas into finite part and divergent part and by adding divergent part to mass, charge, combination constant, etc. and reformulating those, obtained measurable quantities. This is just basic idea of so called *renormalization*. As well known, the simplest method by which separates finite part and infinite part in integral formula is to expand Taylor series in external momentum. For example Taylor expansion of $\Gamma(P^2)$ in the neighborhood of $P^2 = 0$ is as follows.

$$\Gamma(P^2) = a_0 + a_1 P^2 + \cdots + \frac{1}{n!} a_n (P^2)^n + \cdots + a_n = \frac{\partial^n}{\partial P^2} \Gamma(P^2)|_{P^2=0} \qquad (18-7)$$

where coefficients of a_n with $n \geq 1$ are finite and only a_0 diverges logarithmically. If one expresses the sum of all finite quantities as $\tilde{\Gamma}(S)$, the result is

$$\Gamma(S) = \Gamma(0) + \tilde{\Gamma}(S) \qquad (18-8)$$

where $\Gamma(0)$ is infinite quantity and $\tilde{\Gamma}(S)$ finite quantity. This situation is similar to case where divergent term occurs in Maxwell's theory. Actually in Maxwell's theory, in case of expanding potential of field as a series in powers of V/c and considering radiation damping, the first term e/R of expansion would diverge and the second term $\mathbf{A}'^{(2)}$ of expansion of vector potential expressed by partial differentiation becomes finite (see sect. 2 of reference [1]). Such situation allows Maxwell's theory to subtract infinite quantity $\left(\lim_{R\to 0} e/R\right)$ regarding it as meaningless one or under an excuse according to which within small spatial area of $R \approx 10^{-13} cm$, not classical physics but quantum theory is essential, to "solve" such theoretical difficulty. What divergence in the traditional quantum electrodynamics occurs within small area (region of large momentum) and first term of expansion of Taylor series leads to infinite quantity is formally the same as the difficulty in Maxwell' s theory. This shows that divergence occurred in quantum electrodynamics is rooted in difficulty of classical electrodynamics.

Now in our theory, let us see how brief and concise the problem of divergence of *S*-matrix is solved without using method of renormalization which is complicated and artificial. At the first place, let us expand Taylor series of $S^{(n)}$ and put it into divergent term and measurable finite term. In this case, by expanding Taylor series of $S_0^{(n)}$ in the traditional scattering theory, included in $S^{(n)}$, we can obtain the sum of divergent term $S_{in}^{(n)}$ and finite term $S_f^{(n)}$.

$$S^{(n)} = S_{in}^{(n)} + S_f^{(n)} \qquad (18-9)$$

where

$$S_{in}^{(n)} = \frac{S_{0(in)}^{(n)}}{1 + (\alpha_0)^n \frac{1}{(T_0)^n}\left(S_{in}^{(n)} + S_f^{(n)}\right) + V_{(n-1)}} + C \qquad (18-10)$$

$$S_f^{(n)} = \frac{S_{0(f)}^{(n)}}{1 + (\alpha_0)^n \frac{1}{(T_0)^n}\left(S_{in}^{(n)} + S_f^{(n)}\right) + V_{(n-1)}} \qquad (18-11)$$

And C is a finite constant, $S_{0(in)}^{(n)}$, the sum of all terms divergent in *n*th-order term of the scattering matrix expansion in the traditional quantum electrodynamics and $S_{0(f)}^{(n)}$ convergent term (finite correction).

Next, by using normalization rule discussed in sect. 10 (see reference [2]), let us obtain measurable finite correction from $S^{(n)}$. According to normalization rule 4, the normalization of some quantity expanded in series becomes the sum of the normalizations of each physical quantities which constitute it. From this, the following form is obtained

$$\bar{S}^{(n)} = \bar{S}_{in}^{(n)} + \bar{S}_f^{(n)} \qquad (18-12)$$

First of all, we find $\bar{S}_{in}^{(n)}$. If one, in terms of normalization rule 1, transforms $g_{\mu\nu}$ (metric of KR space) into $\delta^{\mu\nu}$ (Minkowski metric) in implicit function $\bar{S}_{in}^{(n)}$, $S_{in}^{(n)}$ and $S_f^{(n)}$ in the denominator of formula (18-11) leads to $S_{0(in)}^{(n)}$ and $S_{0(f)}^{(n)}$ defined in the traditional quantum electrodynamics. And $V_{(n-1)}$ is replaced by already normalized quantity, $\bar{V}_{(n-1)}$. Actually, the normalization of scattering matrix is applied in turn from lower order terms and accordingly $\bar{V}_{(n-1)}$ is considered as already normalized term. Namely, the result is

$$g_{\mu\nu} \to \delta_{\mu\nu}, \qquad g_{\mu\nu}\delta^{\mu\nu} \to 1$$

$$\left(g_{\mu\nu}\dot{x}^{\mu}\dot{x}^{\nu}\right)^{-1/2} \to (1-\beta^2)^{-1/2}$$

$$S_{in}^{(n)} \to S_{0(in)}^{(n)} \qquad (18-3)$$

$$S_f^{(n)} \to S_{0(f)}^{(n)}$$

$$V_{(n-1)} \to \bar{V}_{(n-1)}$$

In the approximate calculation, $(1-\beta^2)^{-1/2} \approx 1$ is used. Hence, formula (18-10) arrives at

$$\bar{S}_{in}^{(n)} = \frac{S_{0(in)}^{(n)}}{1 + \left(\frac{\alpha_0}{T_0}\right)^n \left(S_{0(in)}^{(n)} + S_{0(f)}^{(n)}\right) + \bar{V}_{(n-1)}} + C \qquad (18-14)$$

If one divides numerator and denominator by $S_{0(in)}^{(n)}$ and taking into consideration the fact that $S_{0(in)}^{(n)}$ is an infinite quantity, formula (18-14) leads to

$$\bar{S}_{in}^{(n)} = \left(\frac{\alpha_0}{T_0}\right)^{-n} + C \qquad (18-15)$$

By choosing properly integral constant C, formula (18-15) arrives at

$$\bar{S}_{in}^{(n)} = 0 \qquad (18-16)$$

Next, let us obtain $\bar{S}_f$. According to normalization rule 1 and 3, the following transformation is done for $S_f^{(n)}$ in formula (18-11).

$$g_{\mu\nu} \to \delta_{\mu\nu}, \qquad S_f^{(n)} \to S_{0(f)}^{(n)}, \qquad S_{in}^{(n)} \to \bar{S}_{in}^{(n)} = 0, \qquad V_{(n-1)} \to \bar{V}_{(n-1)} \qquad (18-17)$$

Therefore, formula (18-11) leads to

$$\bar{S}_f^{(n)} = \frac{S_{0(f)}^{(n)}}{1 + \left(\frac{\alpha_0}{T_0}\right)^n S_{0(f)}^{(n)} + \bar{V}_{(n-1)}} \approx S_{0(f)}^{(n)} \qquad (18-18)$$

Taking together formula (18-16) and (18-18), the result is

$$\bar{S}^{(n)} = \bar{S}_{in}^{(n)} + \bar{S}_f^{(n)} = \bar{S}_f^{(n)} \approx \bar{S}_{0(f)}^{(n)} \qquad (18-19)$$

The method discussed above can be applied to all terms of *n*th order formula of scattering matrix expansion and then, as the trivial result, be obtained measurable finite quantity with physical meaning. Here, the calculation for individual terms of S-matrix is omitted because it is no more necessary.

Synthesizing all arguments mentioned above arrives at the following conclusions.

First, from scattering matrix of non-linear quantum electrodynamics, we obtained finite corrections with the procedure which infinite quantities were removed naturally and by themselves. From this we can make the correct theoretical analysis for shift of Coulomb's law, Lamb shift and anomalous magnetic moment of electron.

Second, our theory was built on the basic of the new classical theory of field established in KR space. The experimental verification of theoretical results mentioned above is essential to confirm validity of new classical theory of field which non-linear quantum electrodynamics is rooted in.

7. Unified Action Integral Formula of Electromagnetics-Gravitation

We eventually arrive at the final conclusion for unification of electromagnetics-gravitation that we aimed and kept searching so much. Here, we intend to discuss, in the unified form, electromagnetic field and gravitational field which have been, until now, regarded as separate fields.

If so, what is meant by unification of electromagnetic-gravitation? What is its real meaning? This is a serious problem with historical controversy and a large number of scholars has different views about this. The unification of electromagnetic-gravitation involves the following essential meaning.

First, unification of electromagnetic-gravitation is unification of conservation laws of energy-momentum. Accordingly in this case the total energy of electromagnetic-gravitation should be subject to inseparable unified conservation law of energy-momentum, not be conserved individually and separately.

Second, unification of electromagnetic-gravitation is mutual dependency and physical connection between sources of fields. In Maxwell's theory and GR, charge and mass-sources of fields are independent of one another and has mutually no relation. However, in our theory effective gravitational mass $\overline{m}_g$ which is in position of source of gravitational field is dependent on electromagnetic field potential and in case of electromagnetic field effective charge, $\bar{e}$, dependent on gravitational potential.

Third, unification of electromagnetic-gravitation is the mutual relation between two fields. In our unified theory two fields are subject to a metric of space-time.

If so, why should electromagnetic field and gravitational field be unified? What is that reason? It, in a word, is rooted in the starting point of our theory based upon experimental fact according to which the total energy of particle and two fields is the same as mc^2. From this is derived the conclusion that two fields are no more independent and separate and then mc^2 becomes common denominator combining two fields into a metric. Furthermore, this idea underlies the foundation for building unified theory of all fields, including nuclear field. Actually, fields produced by a particle mean all fields, not some specific field, including not only electromagnetic-gravitational field but also nuclear field. The annihilation of proton and antiproton shows clearly that energy of nuclear field made by proton and antiproton is also, as in annihilation of electron-positron, converted into some part of energy of photon. Hence, in unified theory of three fields to be constructed in the future, three different fields should be embodied by the metric of KR space or other new metric of space, and in this case evolution of theory must be based upon the fact that the total energy of particle-fields is mc^2.

Sect. 19 The motion equation of particle and the equation of field in unified theory of field.

Let us rewrite Lagrangian integral formula shown in sect. 8

$$S = -m_0 c \int \left(g_{\lambda\sigma} u^\lambda u^\sigma\right)^{\frac{1}{2}} ds - \frac{1}{16\pi c} \int \hat{C}_{\lambda\sigma} \hat{C}^{\lambda\sigma} \sqrt{-g}\, d\Omega \qquad (19-1)$$

The formula (19-1) yields the following motion equation of a particle.

$$m_0 c \frac{du_\lambda}{ds} = \frac{1}{c} \hat{\alpha} \hat{C}_{\lambda\sigma} u^\sigma - \frac{1}{c} \widehat{K}_\lambda \frac{d\hat{\alpha}}{ds} \qquad (19-2)$$

where $\hat{C}_{\lambda\sigma} = \hat{F}_{\lambda\sigma} + \hat{R}_{\lambda\sigma}$, $\hat{\alpha} = \hat{\alpha}_{(E)} + \hat{\alpha}_{(g)}$ (see sect. 8 of reference [1])

$$\hat{\alpha} = \frac{\hat{e} + \widehat{m}_{0(g)}}{1 + 2\alpha \widehat{K}_\sigma u^\sigma} = \hat{\bar{e}} + \widehat{\overline{m}}_{(g)}$$

$$\widehat{K}_\lambda = \hat{A}_\lambda + \hat{G}_\lambda$$

If one uses rules of isotopic vector space, formula (19-2) yields

$$m_0 c^2 \frac{du_\lambda}{ds} = \left(\bar{e} F_{\lambda\sigma} - \overline{m}_{0(g)} R_{\lambda\sigma}\right) u^\sigma$$
$$- \left[e A_\lambda \frac{d}{ds}\left(\frac{1}{1 + 2\hat{\alpha}\widehat{K}_\sigma u^\sigma}\right) - m_{0(g)} G_\lambda \frac{d}{ds}\left(\frac{1}{1 + 2\hat{\alpha}\widehat{K}_\sigma u^\sigma}\right)\right] \qquad (19-3)$$

Next, the equation of field can be written as follows

$$\frac{1}{4\pi}\frac{\partial \hat{C}_{ik}}{\partial x^k} = -\frac{1}{c}\hat{\alpha}V^i\delta(\mathbf{r}-\mathbf{r}_0) \qquad (19-4)$$

As $\hat{e}$ and $\hat{m}$, in isotopic vector space, are orthogonal each other, equation (19-4) can be written as follows.

$$\frac{1}{4\pi}\frac{\partial \hat{F}_{ik}}{\partial x^k} = -\frac{1}{c}\cdot\frac{\hat{e}V^i\delta(\mathbf{r}-\mathbf{r}_0)}{1+2\hat{\alpha}\hat{K}_\sigma u^\sigma} \qquad (19-5)$$

$$\frac{1}{4\pi}\frac{\partial \hat{R}_{ik}}{\partial x^k} = -\frac{1}{c}\cdot\frac{\hat{m}V^i\delta(\mathbf{r}-\mathbf{r}_0)}{1+2\hat{\alpha}\hat{K}_\sigma u^\sigma} \qquad (19-6)$$

As equation (19-5) and (19-6) include the mixed term, i.e. $2\hat{\alpha}\hat{K}_\lambda u^\lambda = 2\alpha_{(E)}A_\lambda u^\lambda - 2\alpha_{(g)}G_\lambda u^\lambda$ related to source of field in the denominators of the right-hand sides, electromagnetic potential and gravitational potential are no more independent of each other, that is, equation (19-5) and (19-6) show the inseparable unification of two fields. The procedure finding electromagnetic potential is the same as in sect. 6. If there is a unique difference, it is that denominators of $\bar{e}$ and $\bar{m}_{(g)}$ include the mixed term $2\hat{\alpha}\hat{K}_\lambda u^\lambda$ (the mixed term of electromagnetic-gravitation). The resultant four-dimensional potentials of two fields can be written as follows: In case of electromagnetic field, potential is

$$\hat{A}_i = \frac{1}{c}\cdot\frac{\hat{e}V^i}{r\left(1+2\frac{\hat{e}}{m_0c^2}\hat{A}^{ex}_\lambda u^\lambda + 2\frac{\hat{m}}{m_0c^2}\hat{G}^{ex}_\lambda u^\lambda\right)} \qquad (19-7)$$

where we took on

$$\varphi^{in}_{(E)} = A^{in}_0 = 0 \qquad (19-8)$$

for scalar potential of electrostatic field produced by charge itself, as shown in sect 11. In equation (19-7), if both sides are multiplied by $\hat{e}$, considering that unit vectors of $\hat{A}_i$ and $\hat{e}$ are the same in isotopic vector space, the left-hand side is eA_i and the right-hand side e^2. The result is

$$A_i = \frac{1}{c}\cdot\frac{eV^i}{r\left(1-2\frac{1}{c^2}G^{ex}_\lambda u^\lambda + 2\frac{e}{m_0c^2}A^{ex}_\lambda u^\lambda\right)} \qquad (19-9)$$

In case of gravitational field, potential is

$$\hat{G}_i = \frac{1}{c}\cdot\frac{\hat{m}V^i}{r\left(1+2\frac{\hat{m}}{m_0c^2}\hat{G}^{ex}_\lambda u^\lambda + 2\frac{\hat{e}}{m_0c^2}\hat{A}^{ex}_\lambda u^\lambda\right)} \qquad (19-10)$$

In formula (19-10) if both sides are multiplied by $\hat{m}'$ (m' is mass of another particle placed in field produced by m). From the definition of isotopic vector space

$$\hat{m}'\cdot\hat{m} = -m'm, \qquad \hat{e}\cdot\hat{A}^{ex}_\lambda = eA^{ex}_\lambda, \qquad \hat{m}\cdot\hat{G}^{ex}_\lambda = -mG^{ex}_\lambda \qquad (19-11)$$

and in isotopic vector space unit vectors of $\hat{m}'$ and $\hat{G}_i$ are always vectors with opposite direction and so, $\hat{m}'\hat{G}_i$ has negative value, we find

$$G_i = \frac{1}{c}\cdot\frac{mV^i}{r\left(1-2\frac{1}{c^2}G^{ex}_\lambda u^\lambda + 2\frac{e}{m_0c^2}A^{ex}_\lambda u^\lambda\right)} \qquad (19-12)$$

where $m_0 = m$

In case of scalar potential of static gravitational field, like in case of electrostatic field, the following formula holds.

$$G_0^{in} = \varphi_{(g)}^{in} = 0 \qquad (19-13)$$

The equation (19-9) and (19-12) show the obvious unification of electromagnetic field and gravitational field.

Sect. 20 Equivalence of total energy of particle-fields and inertial mass.

Here, we show that the total energy of particle and electromagnetic-gravitational field produced by it is the same as inertial mass multiplied by c^2. The energy-momentum tensor of matter is given as follows (see sect. 7 of reference [1])

$$T_{\mu\nu}^{(m)} = \frac{1}{\sqrt{-g}} m_0 c u_\mu u_\nu \delta(\mathbf{r} - \mathbf{r}_0) \frac{ds}{dt} \qquad (20-1)$$

and the energy-momentum tensor is

$$T_{\mu\nu}^{(f)} = -\frac{1}{4\pi}\left(\hat{C}_{\mu\nu}\hat{C}_\nu^\lambda - \frac{1}{4}\hat{C}_{lm}\hat{C}^{lm}\right) g_{\mu\nu} \qquad (20-2)$$

Referring to the argument in sect. 13 of reference [2] for the equivalence of total energy of particle-electromagnetic field and inertial mass, one can get easily the formula for the equivalence of total energy of particle–fields (electromagnetic-gravitational field) and inertial mass. In this case, the formula for the total energy of particle and fields can be finally written as follows.

$$U = m_0 c^2 + \frac{1}{2}\int \left(\hat{G}_0 + \hat{A}_0\right)\left(\hat{\bar{e}} + \hat{\bar{m}}_{(g)}\right)\delta(\mathbf{r} - \mathbf{r}_0) = m_0 c^2 + \frac{1}{2}\left(G_0^{in}\bar{m}_{(g)} + A_0^{in}\bar{e}\right)$$

$$(20-3)$$

where G_0^{in} and A_0^{in} are scalar potentials which are given by particle and acts on particle itself. These potentials, as shown in formula (19-9) and (19-10), leads to zero. On the other hand, the normalization of $\bar{m}_{(g)}$ and $\bar{e}$ yields constant mass, m_0 and constant charge, e. Hence, in formula (20-3) only remains $m_0 c^2$. This is owing to the fact that G_0^{in}, $\bar{m}_{(g)}$, A_0^{in} and $\bar{e}$ are defined by normalized quantities following from rules of normalization. Thus, the total energy of particle and fields is

$$U = m_0 c^2 \qquad (20-4)$$

This formula is formally equal to Einstein's formula for energy. But as for its real meaning, the two formulas are quite different. In Einstein's theory U is the energy confined to particle only, but in our case U is the total energy of particle-fields and measured mass m_0 is equivalent with the total energy.

8. Experimental Verification for Unified Theory of Electromagnetic-Gravitational field

Here, we first show that theoretical results obtained from our theory gives, without any inconsistency, good solutions to already known experimental facts. Next, we present new theoretical results (i.e. new theoretical predictions) which require experimental verification concerning mutual dependency of two fields.

Sect. 21 Consistent theoretical solution to already found experimental facts

As well known, practice (experiment in the physics) is the criterion which decides whether or not theory is truth and basic factor that ensures viability of the theory. But, under the pretense of constructing theory in agreement with experiment, one recognizes inconsistency and insufficiency of the theory, but if one removes artificially or neglect inconsistency of the theory for conformity with experiment, nobody can say that the theory achieved the good agreement with experiment. Consequently, what build a theory as the consistent-closed theory is the basic premise for giving right solution to experiment. On this context, problems on whether Maxwell's theory and quantum electrodynamics gave satisfactory solution to already found experiments arise. Explicit answer follows. No!

(1) Annihilation of particles and production of photon.

As already argued in sect 1(see reference [1]), the former consideration of pair annihilation of electron-positron (in general view, pair annihilation of particle-antiparticle) does not agree with conservation law of energy and total energy of electromagnetic-gravitational field results in loss of meaning. About this was already enough argued in chapter 1. Hence, traditional theory (quantum electrodynamics) fails to give the satisfactory solution to experimental facts associated with annihilation of particles.

Our theory found the unified Lagrangian of two fields and clarified finite character of the total energy of particle-fields and equivalence of inertial mass and total energy of particle-fields. Only this logic makes it possible to give right solution to experiment of pair annihilation of particle-antiparticle.

According to the traditional classical theory of field, electron and positron can approach infinitesimally till distance of interaction becomes zero. This stands against the actual experimental data. In our theory, electron and positron cannot approach closer than $r_0 = e^2/m_0c^2$ $(\approx 10^{-1}\ cm)$. Here, r_0 is the critical distance to allow approach of electron and positron. At just this critical distance r_0 is obtained a conclusion according to which electron-positron annihilates and photon produces, which is completely in agreement with experiment.

Now, let us see this in detail. The energy of particle shown in formula (5-18) is

$$E = \frac{m_0c^2\left(1 + 2\alpha_{(E)}A_\lambda u^\lambda\right)^{\frac{1}{2}}}{\sqrt{1-\beta^2}} + \frac{e\varphi}{\left(1 + 2\alpha_{(E)}A_\lambda u^\lambda\right)} \qquad (21-1)$$

and then allowing for

$$\varphi u^0 \gg A_i u^i, \qquad 2\alpha_{(E)}\varphi u^0 \approx 2\alpha_{(E)}\varphi \qquad (21-2)$$

where i denotes spatial components of space-time. In case of interaction of particle-antiparticle formula (21-1) yields

$$E = \frac{m_0c^2\left(1 - \frac{r_0}{r}\right)^{1/2}}{\sqrt{1-\beta^2}} - \frac{e\varphi}{\left(1 - \frac{r_0}{r}\right)} \qquad (21-3)$$

where

$$r_0 = 2\frac{e^2}{m_0c^2}$$

When a particle and an antiparticle approach r_0, the denominator of term relevant to interactional energy (second term of the right-hand side of formula (21-3)) becomes zero. In order for interactional energy to have finite value, charge, e, should be zero. Namely, at $r = r_0$ charge vanishes.

Let us consider the term relevant to particle in formula (21-3). At $r = r_0$, the numerator becomes zero. In order for the energy of particle to have finite value which is not zero, $\beta^2 = 1$ should holds in the denominator, that is, the particle has the velocity of light $(V = c)$. And m_0 should also vanish. This fact results from the requirement of SR that a free particle with rest mass cannot reach velocity of light. (Actually at $r = r_0$, $e = 0$ is allowed and then, owing to absence of interaction of particles, a particle becomes a free particle). This agrees with the experimental fact about annihilation of particles and production of photon.

Next, let us consider the capture of electron by proton. In case of proton-antiproton, the critical distance is $R_0 = e^2/M_0c^2$, where M_0 is the rest mass of proton and $M_0 = 1836\ m_0$ (m_0; rest mass of electron), accordingly, $r_0 \gg R_0 (r_0 = 1836 R_0)$. In this connection, if electron approaches proton, what will result in? As far as electron reaches $r = r_0$, life time of electron ends and from formula (21-3) follows $e = 0,\ m_0 = 0,\ \beta^2 = 0$.

Notes: we can think that in formula (21-3) an electron is not captured by a proton but converted into photon, i.e. $e = 0,\ m_0 = 0,\ \beta^2 = 1 (V = c)$. But this conversion cannot be made. It is because this conversion stands against the conservation law of charge. The proton maintains life time of existence as far as antiparticle does not arrive at $r = R_0$. Thus electron is annihilated to be captured by proton and then a system of proton-electron is converted into neutron. This also was verified experimentally.

But from the traditional theory does not follow the possibility of capture of an electron by a proton. According to Maxwell's theory, proton and electron can approach, irrespective of difference of mass, near infinitely and from this leads to the conclusion that at $r = 0$, charge of electron and proton becomes zero simultaneously. Moreover, in this case is not drawn the conclusion that mass of electron becomes zero. Actually annihilation of a charged particle is meant by the simultaneous vanishment of charge and mass. But the traditional theory does not yield this conclusion.

The annihilation and occurrence of particles are singular physical effects appearing in strong field, namely of near distance between particles (particle radius). In the theory of field experimental verification of physical effects manifested in strong field is of decisive significance to confirm validity of the theory. Actually in Einstein's GR also existence of Black Hole (Black Star) relevant to gravitational radius $\left(R_{(g)} = 2k_{(g)}\, m/c^2\right)$ or gravitational singular point was predicted but not yet discovered. By the way, in electromagnetic interaction the annihilation and production of particles have already been observed through the experiment. With regard to our theory the consistent solution to the annihilation and production of particles is also of decisive significance to verify validity of this theory.

(2) The radiation damping effect

It have already been verified by experiment that in electromagnetic field accelerated charge radiates electromagnetic wave and necessarily is acted upon by damping force. But all attempts to explain radiation damping effect within framework of Maxwell's theory lead to a knotty point (see sect. 2 of reference [1]). Our theory, as already shown in sect. 12 of reference [2], gives the consistent solution to radiation damping.

(3) The decay of a system of particles and deficiency of mass (difficulty of gauge symmetry)

Let us consider decay of a system of particles into two particles. In this case, the result is

$$Mc^2 = m_1c^2 + m_2c^2 + \varepsilon \qquad (21-4)$$

where m_1 and m_2 are masses of collapsed particles and ε energy radiated outside. Therefore, from formula (21-4) follows

$$M > m_1 + m_2 \qquad (21-5)$$

But, in the view of Maxwell's theory, the explanation for this experiment arrives at difficulty. As shown in sect. 2 of reference [1], according to principle of gauge symmetry, electric potential of subparticles which constitute a system can be changed into arbitrary value and energy of a system transformed to zero or negative value by the proper gauge transformation. This shows that gauge principle does not agree with formula (21-4) and (21-5), verified strictly by many experiments.

In our theory, gauge principle is not, from Lagrangian integral formula, allowed and as a result, electric potential is defined so that it has a unique value. Hence, our theory explains formula (21-4) and (21-5) without inconstancy.

(4) The main experimental results of quantum electrodynamics.

As well known, Lamb shift and anomalous magnetic of electron were verified by many experiments. But renormalization method, a main methodology in the traditional quantum electrodynamics is artificial and harms logical system of theory (see sect. 18).

In our theory, the consistent solutions to experiments mentioned above is of important significance to validity of our theory.

(5) The experimental results in gravitational field (shift of Mercury's perihelion, deflection of light ray, red shift of light spectrum).

As mentioned in sect. 3, Einstein's GR involves unavoidable difficulties and so, the theoretical solution of GR for three effects of gravitation is also not satisfactory.

Our theory for gravitation, based upon good solutions to difficulties of GR, is combined with theory of electromagnetic field whose validity have already been confirmed in macroworld as well as microworld and can also successfully explains three effects of gravitation. This is of essential significance in verifying validity of theory of gravitation.

Sect. 22 New theoretical results to be verified by experiments (theoretical predictions)

In this section, we consider the theoretical results, obtained from unified theory of fields, to be verified by experiments.

(1) Variation of electromagnetic field by gravitational field.

Until now on, in physics electromagnetic field and gravitational field have been discussed separately and with no relation between them. But in our theory electromagnetic field and gravitational field are no more independent.

Now, let us consider electrostatic field (scalar potential) created by a charge placed in the static, constant gravitational field. From formula (19-9) follows

$$\varphi_{(E)} = \frac{e}{r\left(1+\frac{2}{mc^2}\widehat{m}\hat{G}_0 u^0\right)} \approx \frac{e}{r\left(1-\frac{2}{c^2}G_0\right)} = \frac{e}{r\left(1-\frac{2}{c^2}\varphi_{(g)}\right)} \qquad (22-1)$$

where G_0 or $\varphi_{(g)}$ is gravitational potential which has positive value. Then, formula (22-1) gives

$$\varphi_{(E)} = \frac{\varphi'_{(E)}}{1-\frac{2}{c^2}\varphi_{(g)}} \qquad (22-2)$$

where $\varphi'_{(E)} = e/r$ (electrostatic potential in Maxwell' s theory)

Intensity of electric field results in

$$\mathbf{E} = -\mathrm{grad}\varphi_{(E)} = -\frac{\mathrm{grad}\varphi'_{(E)}}{1-\frac{2}{c^2}\varphi_{(g)}} \qquad (22-3)$$

If $\frac{2}{c^2}\varphi_{(g)} \ll 1$ is allowed, formula (22-3) yields

$$\mathbf{E} = -\mathrm{grad}\varphi'_{(E)}\left(1+\frac{2}{c^2}\varphi_{(g)}\right) \qquad (22-4)$$

Putting $\mathbf{E}_0 = -\mathrm{grad}\varphi'_{(E)}$ which is the intensity of electric field in Maxwell' s theory, the result is

$$\mathbf{E} = \mathbf{E}_0\left(1+\frac{2}{c^2}\varphi_{(g)}\right) \qquad (22-5)$$

In case of magnetic field also is obtained the following similar formula.

$$\mathbf{H} = \mathbf{H}_0\left(1+\frac{2}{c^2}\varphi_{(g)}\right) \qquad (22-6)$$

Consequently, the intensities of electric field and magnetic field are increased by $2\varphi_{(g)}/c^2$ in static gravitational field when $\frac{2}{c^2}\varphi_{(g)} \ll 1$.

(2) Variation of gravitation by electromagnetic field.

As shown in formula (19-12) also is varied gravitational force which acts on charge placed in electromagnetic field. It is named *variation of gravitation by electromagnetic field.*

Now, let us estimate roughly to how much gravitation is varied in electric field. For this, we consider a system which consists of two plates A and B. applying voltage to the two plates and making electric potential of one plate B become zero, one can consider the plate, A only. For better consideration we present following assumption; firstly, the plates are metal material which consists of identical atoms only; secondly, the ions and free electrons which constitutes metal material interact individually with external field and are considered as point particles.

Now, let us consider the variation of effective gravitational mass of plates A, B. First of all, total mass of A in the absence of external electric field is

$$\bar{M} = Nm_+ + nm_e \qquad (22-7)$$

where N is total number of ions and n total number of free electrons, m_+ mass of a positive ion and m_e mass of a free electron.

Next, in case of being external electric field (when electric source is supplied), let us calculate total effective mass of plate A, referring to $\bar{m}_{0g}$ of formula (5-12). The effective mass of a positive ion is

$$\bar{m}'_+ = \frac{m_+}{1 + \frac{2q}{m_+ c^2}\varphi} \approx m_+(1 - 2\alpha_+\varphi) \qquad (22-8)$$

and the effective mass of a free electron,

$$\bar{m}'_e \approx m_e(1 + 2\alpha_e\varphi) \qquad (22-9)$$

where

$$\alpha_+ = \frac{q}{m_+ c^2} = \frac{eZ}{m_+ c^2}$$

Z is valence and $\alpha_e = |e|/m_e c^2$. Thus, total effective mass of plate A is

$$\bar{M}' = N\bar{m}'_+ + n'\bar{m}'_e \qquad (22-10)$$

where n' is total number of electrons varied by external electric field. Consequently, the variation of total effective mass of plate A.

$$\Delta\bar{M} = \bar{M}' - \bar{M} = N(\bar{m}'_+ - m_+) + n(\bar{m}'_e - m_e) + \Delta n \frac{2e}{c^2}\varphi + \Delta n m_e \qquad (22-11)$$

where $\Delta n = n' - n$ and $\Delta n m_e$ is the variation of mass occurred by movement of free electrons (This term has no significance).

If one calculates formula (22-11) and arranges, the result is

$$\Delta\bar{M} = -NZ\frac{2e}{c^2}\varphi + n'\frac{2e}{c^2}\varphi + \Delta n m_e = \frac{2e}{c^2}\varphi(n' - NZ) + \Delta n m_e \qquad (22-12)$$

On the other hand, $Q = |e|(NZ - n')$ is the total charge of plate A and can be written as

$$Q = |e|(NZ - n') = c_0 u \qquad (22-13)$$

where c_0 is the electric capacity of condenser consisting of the two plates and u the voltage between the plates A and B.

In case where plate A is charged with positive value, the following formula is obtained.

$$\Delta n = -\frac{c_0 u}{|e|} \qquad (22-14)$$

Therefore, the variation of total effective mass of plate A is

$$\Delta\bar{M} = -2\frac{c_0 u^2}{c^2} - c_0 u\frac{m_e}{c} \qquad (22-15)$$

where $\varphi = u$ was used. In the static gravitational field, (earth gravitational field) the variation of gravitational force is proportional to variation of effective gravitational mass and accordingly, the result is

$$\Delta F = \Delta\bar{M}g \qquad (22-16)$$

where g is gravitational acceleration.

The variation of gravitational force by electric field further suggests necessity of study relevant to possibility of anti-gravitation and teleportation. Total effective gravitational mass of plate A can be written as (see formula 22-10).

$$\bar{M} = \frac{Nm_+}{1+\frac{2eZ}{m_+c^2}\varphi} + \frac{nm_e}{1-\frac{2e}{m_ec^2}\varphi} \qquad (22-17)$$

Now, in formula (22-17) we suppose that the following condition is allowed

$$\left|\frac{2e}{m_+c^2}\varphi\right| \approx 1, \quad \left|\frac{2e}{m_ec^2}\varphi\right| > 1 \qquad (22-18)$$

In this case as second term of the right-hand side of formula (22-18) has the negative value and much larger value than first term, $\bar{M}$ has negative value and consequently, arrives at the conclusion that a system of the two plates results in rising upward by anti-gravitation. But in terms of non-quantum theory or classical physics, condition (22-18) cannot be allowed. It is relevant to what if condition (22-18) holds, the effective inertial mass has complex value and formula (5-18) for energy of matter results in loss of meaning. But considering in the view of quantum theory the situation is, to some degree, changed. In terms of quantum theory can be considered some probability that as if particles happen to come out of potential well by tunnel effect associated with uncertainty of energy, it may be in state satisfying condition (22-18). Of course, this is nothing but a hypothesis. This problem needs further deeper theoretical study associated with experimental verification. If anti-gravitation subject to condition (22-18) is actually manifested, it goes without saying that there will make the great revolution in practical regions.

(3) Nonlinear effects of interaction.

Maxwell's theory and the traditional quantum electrodynamics are linear theories which are subject to principle of superposition. But our theory is nonlinear, which bring about nonlinear character of interaction (see sect. 5 and sect. 17). Many effects concerning this nonlinearity should be studied and verified by experiments.

Here, let us consider briefly effects of nonlinear interaction. In classical theory of field, when $A_\lambda = \sum_{i=1}^{n} A_{\lambda(i)}$, $\mathbf{E} = \sum_{i=1}^{n}\mathbf{E}_{(i)}$ are given, the electric force which external electric field acts on the effective charge is as follows:

$$\mathbf{F} = \bar{e}\mathbf{E} = \frac{e\left(\mathbf{E}_{(1)} + \cdots + \mathbf{E}_{(n)}\right)}{\left[1 + 2\alpha\left(\sum_{i=1}^{n} A_{\lambda(i)}\right)u^\lambda\right]} \qquad (22-19)$$

For simplicity, we will neglect the fact that $\mathbf{E}_{(i)}$ is dependent on other external electric fields in formula (22-19). Expanding formula (22-19) as a power series with $2\alpha\left(\sum_{i=1}^{n} A_{\lambda(i)}\right)u^\lambda \ll 1$ and taking to terms of first order of $2\alpha\left(\sum_{i=1}^{n} A_{\lambda(i)}\right)u^\lambda$, the result is

$$\mathbf{F} \approx e\sum_{i=1}^{n}\mathbf{E}_{(i)} - 2e\alpha\sum_{i=1}^{n}\mathbf{E}_{(i)}A_{\lambda(i)}u^\lambda \qquad (22-20)$$

or

$$\mathbf{F} \approx e\left(\sum_{i=1}^{n} \mathbf{E}_{(1)} - 2\alpha \mathbf{E}_{(1)} \sum_{i=1}^{n} A_{\lambda(i)} u^{\lambda}\right) + \cdots + e\left(\sum_{i=1}^{n} \mathbf{E}_{(n)} - 2\alpha \mathbf{E}_{(n)} \sum_{i=1}^{n} A_{\lambda(i)} u^{\lambda}\right) \quad (22-21)$$

From above formula, in quantum theory of field, interactional Hamitonian H_{ξ} becomes

$$H_{\xi} \sim \bar{e} \int dx^4 \bar{\psi} \gamma_{\lambda} A^{\lambda} \psi \approx e\left(\int dx^4 \bar{\psi} \gamma_{\lambda} A^{\lambda} \psi\right)\left(1 - 2\alpha \int dx^4 \bar{\psi} \gamma_{\lambda} A^{\lambda} \psi\right)$$

or

$$H_{\xi} \sim \left[\int e dx^4 \bar{\psi} \gamma_{\lambda} A^{\lambda}_{(1)} \psi - 2\alpha \int dx^4 \bar{\psi} \gamma_{\lambda} A^{\lambda}_{(1)} \psi \left(\sum_{i=1}^{n} \int dx^4 \bar{\psi} \gamma_{\lambda} A^{\lambda}_{(i)} \psi\right)\right] + \cdots$$

$$+ \left[\int e dx^4 \bar{\psi} \gamma_{\lambda} A^{\lambda}_{(n)} \psi - 2\alpha \int dx^4 \bar{\psi} \gamma_{\lambda} A^{\lambda}_{(n)} \psi \left(\sum_{i=1}^{n} \int dx^4 \bar{\psi} \gamma_{\lambda} A^{\lambda}_{(i)} \psi\right)\right] \quad (22-22)$$

Second terms in each bracket of formula (22-21) and (22-21) are interference terms by interrelation of fields. The experimental verification of this interference effects is essential to confirm validity of this theory. The closer distance of particle is, the more notably this effect is manifested (especially, in neighborhood of electron radius r_0).

Next, let us consider briefly interaction between nucleus and electron. In this case electrostatic field of nucleus is regarded as classical field and motion of electron only is considered in view of quantum theory. In our theory occurs the nonlinear term because the effective charge of electron is dependent on field of nucleus and effective charge of nucleus is dependent on the field created by an electron. From formula (11-9) and (5-9) electrostatic field potential of nucleus and effective charge of electron can be written as follows.

$$A^0_{(X)} = \varphi_p = \frac{Ze}{4\pi r\left(1 + 2\alpha_p \varphi_e u^0\right)} \quad (22-23)$$

$$\bar{e} = \frac{e}{1 + 2\alpha_e \varphi_p u^0} \quad (22-24)$$

where $\alpha_e = e/mc^2$, $\alpha_p = Ze/Mc^2$ and φ_p electrostatic potential of nucleus , φ_e electrostatic potential of electron. Therefore, potential energy of electron is as follows.

$$U = \bar{e}\varphi_p \approx \frac{Ze^2}{4\pi r\left(1 + 2\alpha_e \varphi_p\right)\left(1 + 2\alpha_p \varphi_e\right)} \approx \frac{Ze^2}{4\pi r\left(1 - Z\frac{r_0}{r}\right)} \quad (22-25)$$

where r_0 is radius of electron, $u^0 \approx 1$ and $\alpha_p \ll \alpha_e$.

In case where scattering of electron and radiation reaction, etc. are considered, it is important to get new effects produced by term $(1 - Zr_0/r)$ and verify it through experiments. Here, we don't give the detailed calculation about this. On the other hand, Formula (22-25) yields singular point in $r = Zr_0$. As showed in discussion about formula (21-3), at just this point is drawn the conclusion that capture of electron by proton occurs. This follows from requirement according to which scattering matrix of particle should have finite value even in singular point.

Until now we discussed the several main things of the unified theory of field and quantum electrodynamics. In modern physics Maxell's theory, Einstein's GR and quantum electrodynamics have been recognized as "incarnation of absolute cult". The criterion that judges validity of new theory does not consist in cult of ready-made theory but objective experiments and, based upon it, strict logical rules and basic principles for building of consistent theory.

References

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