Open Access Journal of Physics
Volume 3, Issue 4, 2019, PP 1-3
ISSN 2637-5826

Role of Photon Space in Quantum Electrodynamics

Andrey N. Volobuev*

Department of Physics, Samara State Medical University, Samara, Russia

***Corresponding Author:** Andrey N. Volobuev, Department of Physics, Samara State Medical University, Samara, Russia, Email: volobuev47@yandex.ru*

ABSTRACT

Some problems arising at the theoretical solution of a problem of a photon and a mass particle interaction are considered. It is shown that calculation of such interaction cannot be executed if the photon and a mass particle are in different reference systems. It is marked that the approximated way offered by R. Feynman assumes translation of a photon in the reference system connected to a mass particle. Other approximated way of the solution of the problem suggesting translation of a mass particle to the reference system connected to a photon or in photon space is shown. The exact solution of this problem can open new ways of development of a physical science.

Keywords: *a photon, a mass particle, reference systems, a diagram method, photon space.*

INTRODUCTION

The modern theoretical physics has the big successes in the description of natural phenomena. Practically completely in the final state there are such sections of physics, as mechanics, thermodynamics, classical electrodynamics, etc. However a line of the physical sections are obviously unfinished and demand the further theoretical development. Among them despite of a centenary way of development there is quantum electrodynamics. In particular the problem of the theoretical description of photons and substance interaction is solved not completely.

Let's consider a simple task of interaction of electromagnetic radiation quantum with a mass body for example an electron, a proton or any other body having a mass.

Let the mass particle initially is immovable. The law of an impulse preservation at absorption of a photon by a motionless particle looks like $\frac{\hbar\omega}{c} = mV$ where V there is a particle velocity after absorption of a photon, m - its relativistic weight, ω - a photon frequency, c - velocity of light in vacuum.

The law of energy conservation in the relativistic form can be written down as:

$$\hbar\omega = mc^2 - m_0c^2 = mc^2\left(1 - \frac{m_0}{m}\right) = mc^2\left(1 - \sqrt{1 - \frac{V^2}{c^2}}\right),$$

where m_0 there is rest mass of particle.

Having divided the law of energy conservation on the law of impulse preservation we shall receive $\frac{V}{c} = \left(1 - \sqrt{1 - \frac{V^2}{c^2}}\right)$, i.e. $V = c$. Thus after absorption of a photon the particle starts to move with light velocity. The absurd result is received at first sight.

In the nature there is a perpetual absorption of photons by mass particles. For calculation we used the laws which are not causing any doubts. In what the mistake consists in calculations?

The answer in our opinion can be received taking into account the received result. It as though speaks: the mass body for accuracy of the solution should move with light velocity.

The matter is that at the solution of a task of a photon and a mass particle interaction it has not been taken into account one more condition: the photon and mass particle should be in uniform reference system.

However it is impossible since the photon moves with light velocity, and the mass particle is rests or moves in Euclidian space. It cannot move with light velocity. Under the Euclidian space we understand finite-dimensional vector space with positively certain scalar product [1]. In a reality there is three spatial coordinates and time. The Riemann's curvature of space can be not taken into account since the problem has no gravitational character.

Thus to unit two reference systems in uniform system it is essentially impossible.

For the solution of a problem of a photon and mass particle interaction actually two ways of overcoming of the given difficulty now are used.

The first way was in details developed by R. Feynman [2]. In 1949 he has offered so-called “a diagram method” of the solution of a problem of a photon and a mass particle interaction for example electron. At that the electron it is described by Dirac’s equation. The solution is carried out with the help of the perturbation theory when the solution of the Dirac’s equation written as expansion into a series on small parameter – fine structure constant. Thus in the first order of expansion quite satisfactory results are obtained. However in higher orders at high energies of cooperating particles are observed divergence [1]. Thus the Feynman's method does not allow solve precisely a problem of a photon and a mass particle interaction.

It is connected by that in the Feynman's method the translation of a photon from of it reference system in the reference system of a mass particle actually is carried out, i.e. in the Euclidian space. But in the Euclidian space an informative description of a photon is impossible.

On modern representations the photon is simultaneously a wave and a particle. However such representation does not give an opportunity to estimate, first of all, a size of a photon in space. According to intuitive representations any material object in space should have a location and the size.

If examine a photon from the point of view of a particle the size of a photon is equal to zero. Really according to the special relativity theory all particles moving with speed ***V*** decrease in sizes under the law [3] $l = l_0\sqrt{1 - \frac{V^2}{c^2}}$ where l there is the size of a moving particle, l_0 - the size of the particle at rest in the given reference system. Formally the photon if it to examine as a particle moving with light velocity $V = c$ in Euclidian space has the length equal to zero $l = 0$.

The wave description of a photon in the Euclidian space approximately can be received with the help of Schrodinger’s equation. Using the formula for the Hamiltonian of a photon as $H = ck$ where *k* there is module of the photon impulse, we can find the operational form of the Schrodinger’s equation as $\hat{E}\psi = c\hat{k}\psi$ where ψ - photon wave function, $\hat{E}$ - the operator of a photon energy. Using the following designations of operators [4]: operator of energy $\hat{E} = i\hbar\frac{\partial}{\partial t}$ where *t* there is a time, and operator of impulse $\hat{k}_X = -i\hbar\frac{\partial}{\partial X}$ (for example, for the photon propagating along an axis *X*) we shall find $\frac{\partial\psi}{\partial t} + c\frac{\partial\psi}{\partial X} = 0$.

The found wave equation as well as relativistic Dirac’s equation is the equation of the first order. Information value of the found wave equation is very small since the solution of this equation can be any function of a kind $\psi = \psi(X - ct)$. For example, it is impossible to carry out normalization of this wave function and to estimate length and a location of a photon.

Actually for a photon after its translation in the Euclidian space we can set only its energy $\hbar\omega$, and impulse $\frac{\hbar\omega}{c}$. The coordinate parameters of a photon necessary for the solution of a problem of its interaction with a mass particle we cannot set.

Other way of the solution of a problem namely translation of a mass particle to the reference system connected to a photon arises. In works [5, 6, 7, 8] this reference system is named a photon space. In the given works this way of the solution of a problem is in detail investigated. In photon space it is possible to receive the detailed description of a photon in coordinates of vector-potential. However the mass particle can be very badly submitted in photon space. It is impossible indicate a mass of a particle since at movement with light velocity the mass aspire to infinity. It is impossible to use Euclidian coordinates of a mass particle. However in this space it is possible indicate a density of ring currents, and hence the magnetic moment which represent in this space an electron, atom or other mass particle. This information is frequently sufficient for calculation for example wave function of a mass particle and wave function of process of a photon and a mass particle interaction.

Thus till now there is an irresistible barrier between two reference systems accordingly connected with a mass particle, and with a photon or between the Euclidian, and the photon spaces. This barrier is determined by Einstein's prohibition of movement of a mass particle with light velocity. Till now this barrier somehow theoretically is not overcome; the exact solution of a problem of a photon and a mass particle interaction is impossible. We shall note that in the nature this barrier is absent since it apparently is not connected with Einstein's prohibition but as it occurs the modern theoretical physics cannot explain.

Conclusion

In conclusion it is possible to tell that the created situation with calculation of a photon and a mass particle interaction is very similar to a situation in physics of the end XIX and the beginnings of XX centuries. At that time absolutely transparent from the point of view of a deduction the Rayleigh –Jeans' formula [1] for thermal radiation resulted in completely absurd result at the big frequencies of radiation. We shall note that despite of this overwhelming majority of physicists of that time have been completely satisfied with a condition in theoretical physics. The correct and revolutionary approach to the description of thermal radiation by M. Planck has led to creation of the quantum theory.

We can only guess to what will result the exact solution of a problem of a photon and a mass particle interaction.

References

[1] Mathematical Physics, Edit. L D. Faddeev. Large Rus. Encyclopedia, Moscow, 1998, p. 201, 494, 516.

[2] R P Feynman. Quantum Electrodynamics. A Lecture Note. W A Benjamin, 1961.

[3] L D. Landau, E M Lifshits. Theory of Field. Science, Moscow, 1967, 460 p.

[4] L D. Landau, E M Lifshits. Quantum Mechanics. FIZMATLIT, Moscow, 2004, 800 p.

[5] Volobuev A N. Photon Space. Theoretical Physics. **3**. 3. September. 2018, pp. 59-82.

[6] A N. Volobuev, A P. Tolstonogov. On the Possibility of Visualization of an Electromagnetic – Radiation Quantum. Journal of Surface Investigation. X-ray, Synchrotron and Neutron Techniques, **11**, 6, 2017, pp. 1289 –1295.

[7] A N. Volobuev, S V. Lukachev, A P. Tolstonogov, I V. Kolomin. Interaction of Photons with Electrons of a Metal during the Irradiation of Its Surface in Vector-Potential Space. Journal of Surface Investigation. X-ray, Synchrotron and Neutron Techniques, **13**, 4, 2019, pp. 658 – 666.

[8] A N. Volobuev. Quantization of Field. Raleigh, North Carolina, USA: Open Science Publishing, 2019, 99 p.

Citation: *Andrey N. Volobuev, "Role of Photon Space in Quantum Electrodynamics", Open Access Journal of Physics, 3(4), 2019, pp. 1-3.*