Sjournals
Scientific Journals

Contents lists available at Sjournals

Scientific Journal of
Pure and Applied Sciences

Journal homepage: www.Sjournals.com

Original article

Sub quantum space and interactions properties from photon structure to fermions and bosons

H. Javadi[a,]*, F. Forouzbakhsh[b]

[a]*Invited professor of the Faculty of Science at Azad Islamic University, Science and Research Campuses,* 11365-4435, Tehran, Iran.
[b]*Researching professor, Office of the Vice-chancellor for Research and Technology, University of Tehran, 19466-14947, Tehran, Iran.*

Corresponding author; Invited professor of the Faculty of Science at Azad Islamic University, Science and Research Campuses, 11365-4435, Tehran, Iran.

ARTICLE INFO

ABSTRACT

This article is based on a concept; "During the conversion of energy into mass, the interaction properties between the Sub Quantum Energies (SQEs) are transferred from photon to fermions and bosons". We have accepted that nature of gravity is quantized, but according to the behavior of photons in the gravitational field, we provide a new definition of gravitons. Then we explain the relationship between gravity and electromagnetic energy. According to the experimental observations, we generalize the Maxwell equations of electromagnetism to the gravitational field. We use the pair production and decay to show that a charged particle acts like a generator, the generator input and output are gravitons and virtual photon. The negative charged particle produces positive virtual photon and positive charged particle produces negative virtual photon. A negative and a positive virtual photon combine with each other in the vicinity of a charged particle and cause the charged particle to accelerate. Although this approach to Quantum Field Theory (QFT) is presented, it has some differences. The mechanism of negative and positive virtual photons interaction is easier and more realistic than exchange particles of QFT, and it also has no ambiguities of QFT. After all, we explain the real photon and its structure by using the virtual photons. Regarding the equivalence of

mass-energy and the photon structure, structure of matter was explained. Then we will explain the relationship between speed and spontaneous symmetry breaking, when the particles linear speed is reduced, physical symmetry, one after the other is broken spontaneously.

1. Introduction

Gravity has a difference in nature with other fundamental forces, because each of the three electromagnetic, the weak and the strong nuclear forces fade, when mass is converting to energy, while the mass and energy are with gravitational effects in any situation. Now the question is; whether the mass cause's gravity or gravity produces mass?

This question helps us to reconsider the previous beliefs about the gravity. Let's assume that the gravity produces mass, with this assumption, we must provide reasons for empirical theory. Making a macroscopic examination is very ambitious and impossible, but we can review the quantum experiments, get new results and obtain the empirical evidence to prove that gravity produces mass. In addition, we can understand the equivalence of mass-energy deeper than before. If we carefully review a pair production and decay and the results of high-energy particle collisions, from the relation $E = mc^2$ this question will be raised whether in addition to being convertible of energy into mass and vice versa, the other concepts can be derived as well. Are there common rules in the energy structure and elementary particles? What relationship is there between speed and spontaneous symmetry breaking? If we continue to believe that in the Standard Model, elementary particles are point particles and unstructured, we cannot resolve ambiguities in modern physics. This is our attempt to answer these questions.

2. Theoretical formalism of reviewing

In reviewing Newton's second law, we have presented the new definition of mass-energy as follows (Javadi, H., et al., 2012):

Definition: Sub-quantum energy (SQE) is the lowest or the least rate of energy that is defined as below:

$$SQE = h\omega_{least}$$

$$\omega_{least} < \omega \ \forall \ E = h\omega \qquad (1)$$

Where ω is detectable frequency, and ω_{least} is not detectable frequency. We have to note that the minimum quantum of energy will be detectable only at least with two SQEs. The relation (1) shows that SQE in terms of energy is before than a photon with minimum quantum of energy has been formed. Every other photon consists of some SQE.

$$E = n \cdot SQE \qquad (2)$$

Where n is an integer number and the total number of SQEs. When a photon's energy is increasing, its frequency also increases. Thus there should be a logical explanation between the energy increment and frequency increment. Therefore, based on SQE definition and relation (2) we can find a relation between photon's energy, frequency and the interaction between SQEs in photon's structure. Besides the relation between SQEs and ω, we can conclude that the SQE linear speed in vacuum, relative to the inertial frame of reference, is actually the speed of light c. Since SQE in photon's structure has a linear speed equal to c and it also has nonlinear motions, the real speed of SQE is when all SQE nonlinear motions turn into linear motions and it only takes linear motion. In other words the limit speed of SQE is VSQE which is faster than light speed c, i.e. $\left|V_{SQE}\right| > \left|c\right|$; Sub-quantum energy principle: SQE is a sub quantum energy with nonzero mass (m_{SQE}) which moves at $\left|V_{SQE}\right| > \left|c\right|$ relative to inertial

reference frame and in every interaction between SQEs with other particles or fields the speed value of SQE remains constant; as in every physical condition we have:

$$\nabla V_{SQE} = 0$$
(3)

In all inertial reference frames and any spaces.

SQE principle shows that in every condition, the speed value of SQE remains constant and only the linear speed of SQE converts to nonlinear speed or vice versa. Thus, according to the equivalence of mass-energy E=mc2, all particles have been made of SQEs

3. Reviewing Dirac's equation by SQE

The equation relating to energy-mass and momentum in special relativity is (Mayeul, 2006):

$$E^2 = p^2 c^2 + m^2 c^4$$
(4)

In the special case of a particle at rest (i.e. p=0), the above equation is reduced to E2=m2c4, therefore, the correct equation to use to relate energy and mass in the Hamiltonian of the Dirac equation is:

$$E = \pm mc^2 \rightarrow E_+ = +mc^2, E_- = -mc^2$$
(5)

Here the negative solution was used to predict the existence of antimatter as the positron. The high-energy photon (γ) with 10.2 MeV energy loses its entire energy when it collides with nucleus. Then, it makes a pair of electron (e^-) and positron (e^+) :

$$\gamma \rightarrow e^- + e^+$$
(6)

According to the relations (2) and (6) we can write;

$$\gamma = n \cdot SQE = 2k \cdot SQE \rightarrow e^- + e^+ \ , \quad n = 2k$$
(7)

$$k \cdot SQE \rightarrow e^- \text{ and } k \cdot SQE \rightarrow e^+$$
(8)

In relation (8), there are two ks numerically equal, but the pair production process shows there two $k \cdot SQE$ are not physically identical, because a $k \cdot SQE$ converts to e^- and another to e^+. Maybe we simply pass this issue, but with careful study of the properties of SQE s in the photon structure we can get some interesting results. We have chosen k_+ , k_- for the SQE S constituent, e^+, e^- relation (8) is given by

$$k_+ \cdot SQE \rightarrow e^+ \ , \ k_- \cdot SQE \rightarrow e^-$$
(9)

In pair annihilation, e^- and e^+ combine with each other and annihilate. So;

$$e^- + e^+ \rightarrow k_+ \cdot SQE + k_- \cdot SQE = 2\gamma$$
(10)

Consider to definition of Sub-quantum energy (relation (1)), a photon is a quantum of energy, but a SQE is a sub quantum of energy.

Relations (7) and (10) show a photon converts into two kinds of SQEs and vice versa. So, an electron is formed of $k_- \cdot SQE$ and a positron is formed of $k_+ \cdot SQE$. We will show the minimum of $k_- \cdot SQE$ by ◁ and the minimum of $k_+ \cdot SQE$ by ▷ , so that;

$$k_- \cdot SQE = k \triangleleft$$
(11)

$$k_+ \cdot SQE = k \triangleright$$
(12)

Therefore, generally a real photon is given by;

$$k \triangleleft + k \triangleright = \gamma$$
(13)

A photon has no charge and it carries electric and magnetic fields. These properties will be acceptable only when two opposite charged sub energies form a photon.

Such an approach to photons and charged particles is accompanied by some questions which have to be answered. A charged particle as an electron has been formed of the same $\triangleleft$, but why does it not decay? What are the interactions between components of the photon? For studying the photon structure, we cannot split or bombard it by other particles. But for explaining photon structure we can offer a model that is consistent with laboratory experiments and the experience.

4. Maxwell equations and gravitons

At first we need to leave our ideas of point particles and zero rest mass particles. In this conception a particle such as a photon or an electron has structure and volume, also a photon is a non-zero rest mass particle (Javadi, H., et. al., 2012). Graviton has mass and does not have structure. An immediate consequence of the Einstein's Equivalence Principle is the gravitational blue or red shift. Let's consider a photon with energy $E = h\nu$ which falls from the position $r + \Delta r$ to the position r with energy $E' = h\nu'$ in the earth gravitational field (same as The Pound-Rebka experiment (Maluf J. W., al., 20090)), so according relation (13) we can write;

$$E = h\nu = k \triangleleft + k \triangleright \qquad (14)$$

$$E' = h\nu' = k' \triangleleft + k' \triangleright \qquad (15)$$

$$a = k' - k \Rightarrow \Delta E = a(\triangleright + \triangleleft) \qquad (16)$$

There, a is a natural number. a=1 is defined as the minimum unit of electromagnetic energy (the longest wavelength detection). So,

$$E_{min} \Rightarrow \triangleright + \triangleleft \qquad (17)$$

Equation (17) shows that even a photon with minimum energy is a carrier of electric field. Interaction between photon and the gravitational field is in a way that can change the photon electrical and magnetic fields (Javadi, H., et. al., 2007). Summarized in a simple conclusion:

$$\text{Gravitational energy} \Leftrightarrow \text{Electromagnetic energy} \qquad (18)$$

$$\text{Eelectromagnetic energy} \Leftrightarrow \text{Matter} + \text{anti-matter} \qquad (19)$$

For identifying and understanding the mechanism of physical relationship between the two sides (18), and converting gravitational energy into electromagnetic energy and vice versa, we must use the equations of Maxwell's electromagnetic theory to explain gravitons. For understanding the mechanism of relation (19), using pair production and decay mechanisms, we investigated the production of virtual photons. When a photon in a gravitational field as Δr falls, graviton's density in the vicinity of the photon electric field changes the value of ∂G_E, because the intensity of electric field changes as E_G (E is the electric field arising from gravitons). In fact gravitons enter the structure of photon, and the intensity of electrical and magnetic fields which depends on photon increases. Two types of gravitons should enter the photon structure, so that they are able to increase the intensity of photon electric field without any charge effect. Thus the interaction between gravitons and photon, negative and positive G^-, G^+ gravitons are produced and enter the photon structure. The photon moves in the same direction as the increasing intensity of the gravitational field does, and the photon electric field is perpendicular to the photon movement direction that is compatible with the following equation:

$$\nabla \times E_G = -\frac{\partial G_E}{\partial t} \qquad (20)$$

By changing the photon electric field, magnetic field also changes. In this case also, the gravitons are converted into magnetic carrier particles G^m and enter the structure of photon that is given by;

$$\nabla \times B_G = \mu_0 \varepsilon_0 \frac{\partial E_G}{\partial t} \qquad (21)$$

Considering the relations (10) and (17) around of $k \triangleleft, k \triangleright$, the G^m s move in two different directions, magnetic field is a flow of G^m s without any starting point. Relations (20) and (21) indicate the process of converting gravitational energy into electromagnetic energy (relation (16)). The inverse of this process is gravitational redshift that gravitons leave photon structure. Gravitons move with linear speed c in the photon structure, and since they are also forming components of electric and magnetic fields, they have a non-linear speed, as well. That is always as follows:

$$\left|v_G\right|, \left|v_{G^-}\right|, \left|v_{G^+}\right|, \left|v_{G^m}\right| > |c| \tag{22}$$

For gravitons we can present the following equation:

$$\nabla V_G = 0 \tag{23}$$

Equation (2) shows, a SQE moves with the constant speed $\left|V_{SQE}\right| > |c|$ and according to equation

(23), the components of the *SQE* always move with constant speed $\left|V_G\right| > \left|V_{SQE}\right|$.

These are the best reasons for the constant speed c, the creation of particles, spontaneous symmetry breaking and general laws governing the universe (Javadi, H., et. al., 2007).

This attitude can explain zero-point energy (ZPE) (Guang-jiong Ni, 2005 and Setterfield, B. 2010). Under the terms of SQE, any space that has the gravitational effects can produce electromagnetic energy, and here the

photon in the conversion of gravitons into G^-, G^+, G^m and electromagnetic energy acts only as a catalyzer. When intensity of gravitational field increases or interfere gravitational fields of two massive bodies that are moving adjacent each other, gravity produces the electromagnetic energy. In this case the relation (20) becomes as follows, but the relation (21) remains the same.

$$\nabla \times E_G = -\frac{\partial G}{\partial t} \tag{24}$$

In equation (24), ∂G shows that even without the electric field, when density of gravitons increases, gravitons take the electrical properties. The energy produced in space is a function of the graviton's density changes in

space. If we suppose the variation in graviton's density in the sample space is $\rho_{\partial G}$, then integral on the volume V of space, will be equal to the electromagnetic energy that is given by

$$E = \iiint_V \rho_{\partial G} dx dy dz \tag{25}$$

Relations (20) and (21) have been completed by equation (25). Things mentioned above, are logical explanation for relation (18). If we analyze the three relations (18), (19) and (22) carefully, the relationship between the emergence of pair electron-positron (generally fermions and bosons) and speed reduction can be understandable. In high energy physics one of the key parameters is speed, because accelerate particles can reach the conditions of before spontaneous symmetry breaking conditions (Brauner T., 2010).

Also for understanding and giving the super symmetric (Trigiante M., 2012), we should know the interaction of photon and gravitons. The gravitons move at higher speed than the speed of light (relation (22)), and the first symmetry is broken when gravitons enter to photon structure and they are converted to electromagnetic energy.

Gravitons have the same properties as fermions and bosons have. So while G^-, G^+, G^m behave like fermions, bosons also have a role in interaction with other particles. In relation (7) a photon is converted into a pair of matter-antimatter, and an additional symmetry is spontaneously broken, so the different behavior of fermions and bosons can be observed.
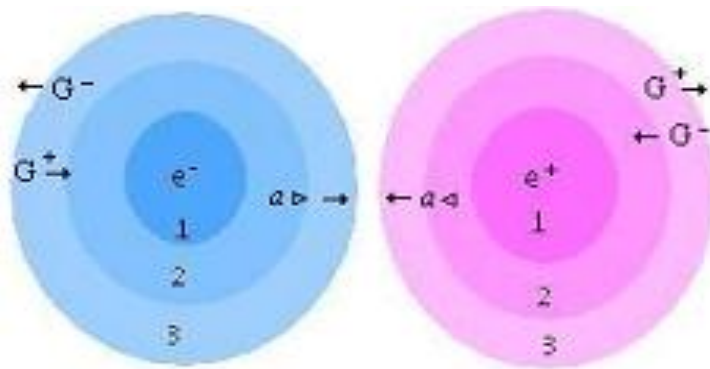
In addition, electron and positron (generally all particles) are drowning in a sea of G and G^-, G^+, G^m that move faster than light speed. They also have the role transferring information, so details of each event in space are transmitted faster than the speed of light.

5. Sub quantum electrodynamics fields (SQED)

In quantum electrodynamics (QED) a charged particle emits exchange force particles continuously. This process has no effect on the properties of a charged particle such as its mass and charge. How is it explainable? In theoretically a pure steady state spin current without charge current can induce an electric field (Sun Qing-feng, et. al., 2003). If a charged particle as a generator has an output known as a virtual photon, what will be its input? Now we will explain the mechanism of electrodynamics fields around the electron and positron.

Look at the electron and positron given by relations (11) and (12). Electron is in the centre of a spherical space (Figure 1-A). This rotational sphere-like (electron spinning) is in a look into gravitons. The electron has two opposite interactions on gravitons around itself, and converts them to G^-, G^+ (relation (20)), so there is a lot of G^-, G^+ in area 3 (Figure 1-A), G^- s escape from electron's locality and G^+ s move toward the electron and enter the area 2, near the magnetic field of electron spinning. Magnetic field (electron spinning) compresses positive gravitons (G^+ s) and repels them. By comparing the coupling coefficient of electromagnetic α and coupling coefficient α_G, the gravitational force of the compression level G^+ can be shown:

$$\frac{\alpha}{\alpha_G} \approx 10^{39} \qquad (26)$$

A. Electron
Area 3: G convert to
G^-, G^+ G^- moves to far
G^+ moves to area 2
Area 2: Spinning electron, magnetic field compacts G^+ and repels virtual positive photon $a \triangleright$

B. Positron
Area 3: G convert to
G^-, G^+ G^+ moves to far
G^- moves to area 2
Area 2: Spinning positron, magnetic field compacts G^- and repels virtual positive photon $a \triangleleft$

Fig.1. Around charged particles.

Now we can define an operator for the production of positive electric force particle. Let's show this operator by $\triangleleft s$ per time that acts on the electron and produces positive electric force, it is given by;

$$\frac{d}{dt} \triangleleft s = a \triangleright \qquad (27)$$

There, a is a natural number.

Operator $\triangleleft s$ compresses G^+ s and pushes them, a magnetic field which contains G^m s is formed around G^+ s set according to the Larmor (cyclotron) radius can be prevented from scattering (De Guillebon L., et. al. 2013). Each process in the laboratory is feasible, realistic and easier to occur in nature.

Operator $\triangleleft s$ shows a magnetic field which presses the positive gravitons G^+ s around electron (spinning electron) and makes a virtual positive particle of electric force continuously that we show by γ^+.

In general, a charged particle is a generator that its input is gravitons and its output is virtual exchange particles that form the electric field. So, for electron we can write:

$$\frac{d}{dt} \triangleleft s(G^+) = a \triangleright = \gamma^+$$

(28)

Same as electron, positron's behavior is like a generator, but spinning positron produces and emits negative virtual particles continuously. So;

$$\frac{d}{dt} \triangleright s(G^-) = a \triangleleft = \gamma^-$$

(29)

When $a \triangleright = \gamma^+$ from the electron reaches to area 2 around the positron, it combines with $a \triangleleft = \gamma^-$ and they form a quantum energy, so that;

$$a \triangleright + a \triangleleft = \gamma^+ + \gamma^- = \gamma$$

(30)

This quantum energy is transferred to the positron, and positron accelerates toward the electron. Let's zoom at the positron and its area 2 (Figure 2), when γ^+ reaches to area 2, what happens there? Area 2 is full of G^- s that acts as reporters are affected on every other particle. (Remember $|V_G| > |c|$).

1-   Two opposite virtual particles γ^+ and γ^- attract each other and magnetic fields effect on γ^- cancels gently.

2-   Positron and γ^+ repel each other by the F_{1e}.

3-   Positron and γ^- absorb each other by the F_{2e}.

4-   Positron gets energy $\gamma^- + \gamma^+ = \gamma$ and accelerates by force $F_e = F_{2e} - F_{1e}$ toward the electron.
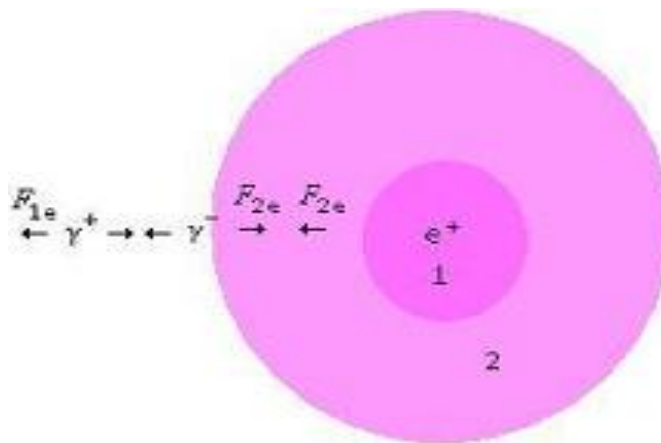
Fig. 2. Interactions between two exchanging particles (virtual positive and negative particles) and positron.

Look at this phenomenon as electric fields which affect on the positron. Positron feels two electric fields of γ^+ and γ^- that is given by;

$$F_{1e} = \frac{E(\gamma^+)e^+}{r_1^2}, \; F_{2e} = \frac{E(\gamma^-)e^+}{r_2^2}$$

$$r_1 > r_2 \Rightarrow F_{2e} > F_{1e}$$

$$F_e = F_{2e} - F_{1e} = m_{e^+} a \tag{31}$$

The same process repeat, when next γ^+ reaches to area 2, and positron accelerates again toward the electron, and so on.

The same process happens for the electron, in fact a γ^- reaches to area 2 of electron, it combines with γ^+, and real quantum energy appears and it is transferred to electron, then electron accelerates toward the positron.

Note1: With the discovery of charged particles and electric fields, it was assumed that the charged particle and the surrounding fields are the same. Our examination shows that the electron produces positive virtual photon, emits and pushes the negative charges, because each negative charged particle behaves on the other, the same as electron and produces positive virtual particle. Likewise, positive charged particles such as positron, also provides a negative electric field that drives the positive virtual photon.

Note2: Other forces, including the influence of the moment magnetic or magnetic positron have been ignored, although they are effective.

6. Structure of photon

The attention inside the photon structure is very useful and important for understanding QCD phenomena. Equivalence relation of matter-energy conception is beyond converting matter into energy and vice versa. Because what is at the core of the interaction between quarks in the proton structure occurs is the logical result of interaction between the SQEs or $\lhd, \rhd$ in photon structure. When you convert that energy into matter, the properties of interaction between SQEs are also transferred from the photon to particle–antiparticle. In relation (9) we saw that the amount of the positron mass is equivalent to energy $k_+.SQE$ and according to relation (9) $k_+ \cdot SQE = k \rhd$. Now we will see that how the electrical properties of $\rhd$ s (which are positive), stay together in the photon's space. This phenomenon is explainable by using Ampere's law. As the two wires carrying electrical flow due to magnetic flux around the wires, they attract or repel each other, the same charged particles (or particles carrying the same electric field) affected by their own magnetic fields, then they interact with each other.
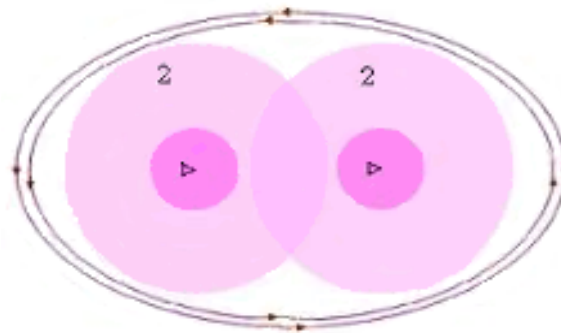
A. Magnetic field around two same *SQEs.*
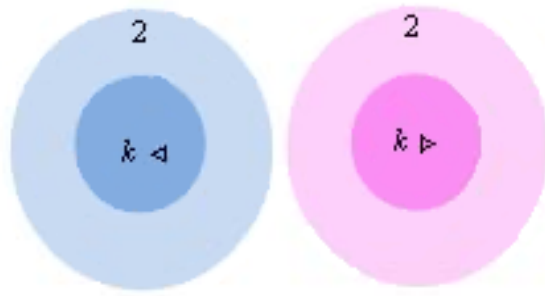
B. A photon is formed of $k \triangleleft + k \triangleright$, but magnetic fields around $\triangleright$ (s) and $\triangleleft$ (s) prevent them from this combination.

Fig. 3. A set of *SQEs.*

We assume that two particles $\triangleright$ (s) are in a position that the magnetic fields of these two particles cause them to attract each other (Figure3-A). In this case, a number of magnetic loops are formed around the particles $\triangleright$ (s) and prevent them from being dispersed and a quantum positive particle is formed. But a photon is not formed of $\triangleright$ (s); there are equal numbers of $\triangleright$ and $\triangleleft$ in the structure of photon (Figure 3-B). As two opposite charged particles interact with each other, these two particles also tend to combine together, but magnetic fields around $\triangleright$ (s) and $\triangleleft$ (s) prevent them from this combination. With this approach, let's look at pair production and decay (relation (9)) which is given by;

$$k_+ \cdot SQE = k \triangleright \rightarrow e^+$$

$$k_- \cdot SQE = k \triangleleft \rightarrow e^-$$

For two photons:

$$k \triangleright + k \triangleleft = 2\gamma = (\frac{k}{2} \triangleright + \frac{k}{2} \triangleleft) + (\frac{k}{2} \triangleright + \frac{k}{2} \triangleleft) \qquad (32)$$

For three photons:

$$k(\triangleright + \triangleleft) = 3\gamma = \frac{k}{3}(\triangleright + \triangleleft) + \frac{k}{3}(\triangleright + \triangleleft) + \frac{k}{3}(\triangleright + \triangleleft)$$

This approach to photon is a useful step to explain the real-photon processes and the quantum chromo dynamic. In $p\overline{p} \rightarrow \gamma\gamma$ annihilation in QCD (Freund A., 2002), compare decay of electron-positron (relation (32)) and proton-antiproton using the SQEs:

$$p + \overline{p} \rightarrow \gamma + \gamma \qquad (33)$$

Charges of proton and anti-protons with positrons and electrons are equal. But the mass of proton is about eighty times greater than the sum of the rest masses of the quarks that make it up, while the gluons have zero rest mass. Quark's charge in relations (9), (11) and (12)) that is given by

$$k_+ \cdot SQE = k \triangleright = e^+ , \ k_- \cdot SQE = k \triangleleft = e^- \Rightarrow$$

$$u = \frac{2}{3} k \triangleright, \ d = \frac{1}{3} k \triangleleft$$

$$\overline{u} = \frac{2}{3} k \triangleleft \ , \ \ \overline{d} = \frac{1}{3} k \triangleright$$

In general, relation (33) is given by;

$$p + \overline{p} = (uud + n_1 g) + (\overline{uud} + n_2 g) \rightarrow \gamma + \gamma = n(\triangleright + \triangleleft)$$

Where, n1 and n2 are integer numbers and g is symbol of gluon.

Pairs in the decay of electron-positron and proton-antiproton (quarks, anti-quarks and gluons) are converted into energy. In high energy physics, input particles accelerate. As a result of this acceleration the number of SQEs increases and the heavier particles are produced with different properties. The reactions $e^+e^- \to \pi^+\pi^-$ and $e^+e^- \to N\overline{N}$ with N=p, n are studied in a non-perturbative quark model (Freund A., 2002). In relation $e^+e^- \to \pi^+\pi^-$ two fermions convert into two bosons.

In all these processes there is a physical reality that must be considered. The fact is that in high energy physics, from energy, the particles with different physical properties are produced. Interaction between the SQEs or interactions between the collections of them together, in the photon structure create phenomena and its existence before spontaneous symmetry breaking (Javadi, H., et. al., 2007).

Physicists in high energy physics are trying to create conditions which have existed before spontaneous symmetry breaking. The same existing condition in the photon structure hasn't been considered enough yet, unfortunately.

7. Conclusion

To date, there is no way to explain the process that describes how particles produce exchange particles in modern physics. According to the results of our years-long research we can definitely say that the best way for unifying the interactions is generalizing interaction between charged particles to photon structure and vice versa. This new view on photon means that we can redefine the graviton and electromagnetic energy. Electromagnetic energy converts to matter and anti-matter such as charged particles. Charged particles use gravitons and generate electromagnetic field. This way of looking at the problem shows how two opposite charged particles repel each other in far distance and absorb each other at a very small distance.

There are many ambiguities in modern physics that standard model is not able to answer them (Kane, G., 2003). For solving these ambiguities we need to change our approach to fundamental particles. One of the greatest scientific achievements in the history is E=mc2. Is it logical that we have accepted an unstructured photon with zero rest mass is convertible to two fermions with non-zero mass and different charges? As long as we do not change our view on the photon, solving physics problems seems very unlikely.

Attention to photon structure and using new definitions for graviton, charged and exchange particles, will change our perspective on modern physics. It also provides us with a new tool to be able to overcome physics problems in a better way. This approach will show us how particles are formed and when physical symmetries are broken spontaneously.

Acknowledgment

References

Brauner T., 2010, Spontaneous Symmetry Breaking and Nambu–Goldstone Bosons in Quantum Many-Body Systems, arXiv: 1001.5212v2, hep-th

De Guillebon L., et. al. 2013, A gyro-gauge independent minimal guiding-center reduction by Lie-transforming the velocity vector field, arXiv: 1211.5792v2, physics.plasm-ph.

Freund A., 2002, Exclusive annihilation p pbar to gamma gamma in a generalized parton picture" arXiv: 0208061v1, hep-ph.

Guang-jiong Ni, 2005, Zero-point energy of vacuum fluctuation as a candidate for dark energy versus a new conjecture of antigravity based on the modified Einstein field equation in general relativity, arXiv: 0506017v1, physics.gen-ph.

Javadi, H., et. al., 2007, Unification and CPH Theory, the general science journal, online available: http://gsjournal.net/Science-Journals/Essays/View/948

Javadi, H., et. al., 2012, Discoveries and the necessity of Reconsidering the Perspectives on Newton's Second Law, Journal of Nuclear and Particle Physics, vol. 2(3), p.31-35.

Maluf J. W., al., 2009, The Pound-Rebka experiment and torsion in the Schwarzschild space time, arXiv: 0903.2565v2, gr-qc.

Kane, G., 2003, The dawn of physics beyond the standard model, Scientific American, vol. 288(6), p.68-75.

Mayeul, A., 2006, Dirac equation from the Hamiltonian and the case with a gravitational field, arXiv: 0512046v2, gr-qc

Setterfield, B. 2010, Reviewing the Zero Point Energy", Journal of Vectorial Relativity, JVR 2 (3), pp.1-28 .

Sun Qing-feng, et. al., 2003, Spin-current-induced electric field, arxiv: cond-mat/0301402v1, cond-mat.mes-hall.

Trigiante M., 2012, Fake super symmetry versus Hamilton–Jacobi, arXiv: 1203.3194v2, hep-th.