

---

## PHOTON STRUCTURE

**Vu Huy Toan**

Construction Machinery and Industrial Works CONINCO Joint Stock Company

No.4 Ton That Tung, Hanoi, Vietnam

Email: [vuhuytoan@conincomi.vn](mailto:vuhuytoan@conincomi.vn)

**Abstract.** *Until now, photon is considered as an elementary particle having a dimension that is the same size as its wavelength, which means it is a very big, up to hundreds or thousands of kilometers (?); however, its structure never has not been discussed. Is this unfair?*

*By another approach to the nature of inertia phenomenon on point of view “dependent each other existence”, which is caused by the interaction of potential force field between objects, the author is found that “gravitational mass” and “inertial mass” are not always the same, but determined by the kind of interaction, in which objects are involved, either gravitation, electromagnetism or nucleus. Supposed that electron and positron are fundamental particles without gravitational interaction, but only electric interaction, the author proposed a possible structure of the photon.*

*Based on this proposed structure of the photon, all its properties as well as its relation to other kinds of matter can be explained. Especially, with this structure of the photon and “Least-Action Principle”, we completely get rid of wave-particle duality, paradox of the electron’s ability of radiating or absorbing photon, which is reluctant and illogical. In addition, it also shows the unification not only the gravitational and electric interaction, but also nuclear interactions, in terms of their physical nature, not the unification in the descriptive mathematical formalism.*

**Key words:** Photon, photon structure, wave-particle duality.

### I. INTRODUCTION

Generally, the structure of elementary particles is not discussed because they are theoretically acknowledged as dimensionless particles, if they are dimensional, how can we explain their charge distribution while they have only fundamental charges themselves: either (+1) or (-1)? However, photon is considered as an elementary particle with the same size as its wavelength, which means a photon with the wavelength of  $\lambda$  cannot go through a hole with the diameter of less than  $\lambda/2$ . This means the size of the photon is comparable to that of macro objects, even very big one, up to hundreds or thousands kilometers. However, that the structure of such big object has not been discussed is abnormal.

In addition, “wave-particle duality” is one of dissatisfied issues in physics since the time of Newton. Although it has been breathed one’s last to close one’s days to accept as an abnormal “attribute” of the matter “as God created” in order to establish quantum mechanics, so many other strange “attributes” appeared, which caused physicists to prove one shelf unable to make up one’s mind, but they had no way to find “exit”. Einstein had done doubt that: “God does not play dice with the Universe” and he did not believe in its sufficiency as a theory [1].

However, a fact should be anticipated that in order to solve too old problems of physics lasting for centuries, it is necessary to get rid of the old way of thinking, cope with dogmas attached to the awareness of many generations for a long time, rather than just to solve a pure physics problem. Therefore, the methodology of thought must be given the

highest concern. Acknowledged natural phenomena must be absolutely respected; just they are evidence themselves, rather than the explanation of those phenomena from someone's viewpoint. Physical phenomena are necessary to be explained, aware of, not ones created by us, whether derived from the imagination or mathematic equations.

Moreover, because the natural world is consistent as it may be, all hypothesis proposed to develop the model of photon structure must be consistent with that natural system. It can not only explain existing phenomena, explain the presence of existing theories about them, but also give prediction of undiscovered effects. This is also the objectives of this work.

## II. FUNDAMENTAL EXPERIMENT BASE

To define which particles are candidates, it is necessary to rely on experiments of the creation and decay of the photon in the same way for proton, neutron, etc. In fact, these experiments have explain been conducted for a long time [2,3].

### 2.1. Photon decay

In the strong electric field near the nucleus of the atom, the  $\gamma$  particle can be decay into two fundamental particles, electron and positron, which is known as "particle creation". Especially, in this case, no other particles are created rather than these two fundamental particles.

### 2.2. Photon emission

when a electron and its corresponding antiparticle positron are annihilated, a photon can also be emitted, not any other particle.

The opinion that the second photon is required to be emitted and move in reverse direction resulted from Law of Conservation of Momentum; moreover, this annihilation is only considered independently of the surrounding environment, which is full of photons at various wave-lengths without any solution to eliminate them. As a result, the emission of the photon in the reverse direction does not result from those electron and positron, but the collision between them and another photon in the environment in that direction at the time of official formation of the photon.

### 2.3. Photon in electrostatic and magnetic fields

In some experiments, photon shows it is an electrically neutral particle, is not deflected in electric field as well as magnetic field. In some others, it still interact with electrons and other charge carriers within the molecule, for example photoelectric effect, emission of heated objects, etc. This demonstrates the electric nature of the photon, because it can interact with electric charge means it can have electricity.

### 2.4. Photon in gravitational field

That the light beam is deflected when going through objects with great gravitational mass is proven by direct observation using telescope, for example the deflection of the light beam crossing the Sun at the time of solar eclipse and the phenomenon of gravitational lensing.

It can't be denied that the light is affected by the gravitational field, regardless of any way of explanation for these phenomena. However, the effect is always in two directions: action – counteraction. It means the light must have any impact on the gravitational field, in other words, it must have gravitational interaction. Besides, although the moving speed of

the photon is very fast in vacuum, it's not limitless. This limitation indicates that the photon has inertial mass in gravitational field, although it has no inertial mass in electromagnetic field.

The gravitational field exists everywhere, even in vacuum, which causes energy loss of objects moving in it, including photon. However, the effect of energy loss is exhibited by the limitation of the moving speed of objects, while this limitation complies with Newton's Second Law  $F = ma$ , which means their moving speed will be different upon their inertial mass with the same action and in the same period. However, there is some discrepancies:

- Firstly, regardless of the initial force  $F$  to create photon, the final speed is the same and equals 300,000 km/s.

- Secondly, on collision, every objects with inertial mass must change the moving speed, but photon does not. In contrast, it only changes the frequency, and maintains the constant speed.

It's the reason why the inertial mass or gravitational mass of the photon has never been discussed.

### **2.5. Photon causes pressure on the surface of the obstacle.**

The phenomenon that the light in particular and the electromagnetic wave in general causes pressure on the surface of the obstacle is also reliable experiments, which is applied even in sensors of super high-frequency power meters.

To explain this phenomenon, photon is still acknowledged with its momentum  $p$ , but it is not construed as the product of inertial mass and the velocity as stated by classical mechanics [4].

### **2.6. Comments**

The above experiments suggest us the structure of photon, including two fundamental particles: electron and positron. In some way, the combination of two particles with opposite charge may result in the electric neutralization from a certain distance, like atom, molecule, etc. However, under that distance, the neutral atom, molecule still interacts with charged particles – all behaviors of the photon is the same. However, it can be observed that there is any reason for the omission of that evident similarity. In deed, the reason is observable. There are two basic factors denying it:

- a) To explain the emission spectrum of Hydrogen and then of other elements, the model of the atom energy transfer is accepted, in which, when an electron jumps from a higher energy to a lower, a photon of a specific wave-length is emitted. However, this explanation has two disadvantages:

- + This model of “energy levels” can explain only the frequency discontinuous and discontinuous of emission (or absorption) energy of matters, but it makes a contrary conclusion to the reality of spectral drift, that the higher temperature, the more the small emission energy corresponding to low frequency of emission [5], because the electrons have more opportunities to return to the state of low energy at low temperature. Therefore, emission spectrum drift is towards “red” when the temperature increases and towards “violet” when the temperature decreases.

- + Atom has the size of  $10^{-10}$ m, while the photon it emits or absorbs has a “huge” size – from  $10^{-7}$ m to  $10^{-6}$ m and even bigger, which means it is ten thousands time bigger than its “boss”, but no one can explain why it can take such unfeasible action.

b) In terms of mass, the photon cannot be composited by those two particles, because they have mass while the photon doesn't, or it is said that the photon has no rest mass. Because the mass of an object is defined as "amount of matter in an object" [6], it is known that there is the conversion from matter into energy. Let's see how such energy is.

c) The rest energy of an object with the mass of  $m$  is calculated by Einstein's formula:

$$E = mc^2 \quad (1)$$

Therefore, the rest energy of initial electron and positron is:

$$2m_e c^2 \approx 2 \times 9.1 \times 10^{-31} \times 9 \times 10^{16} = 1.64 \times 10^{-13} \text{ (J)},$$

while the energy of the photon is calculated by Plank's formula [2]:

$$E_\phi = h\nu. \quad (2)$$

in which  $\nu = c/\lambda$ . Therefore, for ultraviolet photon with wave-length of  $\lambda = 0.4 \times 10^{-6}$  m for example, we have:

$$E_\phi = h\nu = hc/\lambda \approx 6.63 \times 10^{-34} \times 3 \times 10^8 / 0.4 \times 10^{-6} = 49.72 \times 10^{-20} \text{ (J)}$$

which is approximately 1/330.000 times as small as the initial energy (even including the second photon in the reverse direction, it's inconsiderable). So, where is the initial "huge" energy? Is the Law of Conservation of Energy not true any more? Or we must have obtain not only two photons, but about 165,000 ones?

In short, it is concluded that the photon can not have the so-called "structure" totally formed by such two particle, they are only first "ingredients" for "God" to make a trick of transforming "matter into a small energy":  $E_\phi = h\nu$ , the remaining part is kept for himself. Is there any other explanation of modern physics?

However, from the viewpoint of dialectical materialism, it is impossible and against the natural principle: Matter cannot be created or destroyed. Energy or any other is only the properties of matter, not replace the matter itself. From this viewpoint, instead of based on "metaphysical forces", the first issue to be clarified is the concept of the mass  $m$ , which has been always unknown quantity of the science for long [7, 8, 9].

### III. PROPOSAL SUPPOSITIONS

#### 3.1. The nature of the inertial mass

As stated above, the key point to resolve the conflict between the existence or disappearance of the mass of electrons and positrons during the photon creation, and vice versa, the creation of particles with the mass as electrons and positrons from a massless particle during the photon decay is that the nature of the mass should be found out. If this conflict is resolved, it not only reaffirms the correctness of the Law of Conservation and Transformation of Energy in the physical aspects, but also reconciles the world of dialectic materialism with the outcome of recognizing the natural law of physics. The direct consequence is that electron and positron can be defined as compositions of the photon.

In a research on the nature of the inertial mass [10], the author indicates that from the viewpoint of "dependent each other existence" of all kinds of matters, the inertial mass of an object is not one of its attributes, but the consequence of its interaction with other physical objects due to the potential force field between them. If an object is totally free from any potential force field, there is no binding for it to keep its existing state, or there is no inertia.

To characterize the inertia, a quantity directly related to this interaction should be given, which is called “inertial mass” and symbolized  $m$ . The author will present briefly the method of defining inertial mass based on the opinion of “dependent each other existence” [5]; it is opposite to the opinion of “self-existence”, which has been the basis of physics since the time of Newton [11], whose consequence is that the ability of fighting against external effects of each object is acknowledged, and it corresponds to the inertial mass (self-existence).

In detail, consider 2 objects **A** and **B**, which are considered relatively “isolated from” other objects, interacts in accordance with Newton’s law of universal gravitation by the force:

$$F = -\gamma \frac{M_A M_B}{R^2}, \quad (3)$$

in which  $\gamma$  – gravitational constant;  $M_A$  – gravitational mass of the object being considered in the gravitational field of the object with gravitational mass of  $M_B$ ;  $R$  – distance between two objects centre. That the system of two above objects is considered “isolated” is construed that their interaction in (3) is much stronger than other interactions with other objects (such as the system of freely-falling body and the Earth, the body system in the free space between galaxies with the distance from the nearest sky body of tens million of light year, etc.). At that time, the findings will have error corresponding to such interactions which is considered to be ignorable.

Gravitational field intensity between two objects upon existing physics may be calculated as follows:

$$g = g_A + g_B = -\gamma \frac{M_A + M_B}{R^2}, \quad (4)$$

where,  $g_A$  and  $g_B$  – are gravitational field intensities of object **A** and object **B**, respectively:

$$g_A = -\gamma \frac{M_A}{R^2}; \quad g_B = -\gamma \frac{M_B}{R^2}. \quad (5)$$

From formulas (3) and (4), the following ratio:

$$\frac{F}{g} = \frac{M_A M_B}{M_A + M_B} \quad (6)$$

is constant and dependable only on gravitational mass of interactive objects and have dimension of [kg]. It can be seen that:

- Firstly, because of being a problem of two “isolated” objects, there is only mutual interaction between them. The result of interaction causes both two objects to move at acceleration of  $a$ . Go from whether reference frame of object **A** or **B**, measured movement accelerations of those are the same and equals to  $a$ , but different in direction.

- Secondly, because of being a problem of two “isolated” objects, at the same active force  $F$  determined upon formula (3) and acceleration  $a$ , the ratio:

$$\frac{F}{a} = const, \quad (7)$$

is constant to both two objects.

- Thirdly, in case that gravitational mass of **A** is much less than that of **B** as in the Galileo's experiment of freely-falling body, acceleration does not depend on the gravitational mass of **A** (all objects fall at the same rate) and equals to gravitational field intensity of **B**:

$$a \approx g_B = -\gamma \frac{M_B}{R^2}, \quad (8)$$

formula (8) has been tested with experiment and has error of  $10^{-12}$  [12]. However, when comparing to the formula (4), it is found that formula (8) is the special case when  $M_A \ll M_B$ . In contrast, when  $M_A \gg M_B$ , the formula (4) remains it valid while the formula (8) does not, but the formula of gravitational field intensity of **A**:

$$a \approx g_A = -\gamma \frac{M_A}{R^2}, \quad (9)$$

In other words, movement acceleration of objects generally equals to gravitational field intensity calculated in formula (4), so:

$$a = g. \quad (10)$$

Apply these three conclusions above, replace formula (10) into formula (7), then identify two formulas (7) and (6), we have:

$$\frac{F}{a} = \frac{M_A M_B}{M_A + M_B}. \quad (11)$$

But the ratio between Force and movement acceleration ( $F/a$ ) is the inertial mass  $m$  currently used in mechanics. Therefore, basing on formula (11), formula of inertial mass may be formed as follows:

$$m = \frac{M_A M_B}{M_A + M_B}. \quad (12)$$

Therefore, according to the opinion of “dependent each other existence”, inertial mass is one of parameters that is specific for the interaction, not the any thing owned by the object itself. Therefore, it depends on interactions or not independent rather than it did as in the past concept until now. According to formula (12), the following formula may be applied to any experiments conducted on the Earth:

$$m \approx M_A, \quad (13)$$

It means that inertial mass  $m$  of an object equals to its gravitational mass  $M_A$ , or people call it “the principle of equivalence” – it is not the accidental coincidence, but occurs for a true reason. However, it should be remembered that this conclusion is right with error of:

$$\delta m = \frac{M_A - m}{M_A} \approx \frac{M_B}{M_A}. \quad (14)$$

### 3.2. Electron and positron – fundamental particles

Assuming a following postulate:

*Electron and positron are two fundamental particles, of which action of positron is active and conventionally call as “positive charge”, while action of electron is passive and*

conventionally call as “negative charge”; these particles have only electric interaction rather than gravitational interaction.

There are some experimental evidences proving the point above.

+ Firstly, mass of electron ( $e^-$ ) and positron ( $e^+$ ) having through experiment as follows:

$$m_{e^+} = m_{e^-} = m_e \approx 9.109548 \times 10^{-31} \text{ kg} \quad (16)$$

that may be determined single in a manner is applying their inertia phenomenon in electromagnetic field, then only their *inertial mass*, but not gravitational mass, is determined! Whereas, some elementary particles, including proton, neutron, etc. may be theoretically applied with indirect measurement rather than their movement to identify gravitational mass, for example, gravitational mass may be identified basing on atomic mass and the Avogadro number. Assuming that  $e^-$  and  $e^+$  particles have gravitational mass is made basing on the Newton’s concept, which indicates that everything attracts each other (Newton’s law of universal gravitation), and more then why is all the time that inertial mass equals to gravitational mass? – That is called “principle of equivalence” as mentioned above (see formula (13)). However, as shown, these concepts are currently wrong; therefore, no any reason hinders they have inertial mass in electromagnetic field, rather than in gravitational field. In other words, they don’t interact by the gravitational force!

According to experiments for measuring inertial mass of  $e^-$  and  $e^+$ , the value resulting from formula (16) is their inertial mass measured in reference frame of laboratory. In addition, in case of two insolated objects, their inertial mass may be identified as in formula (12).

+ Secondly, the so-called “gravitational mass” itself, if it exist (?), may only cause “gravitational” interaction between them as in formula (3):

$$F_N = \frac{6.67 \times 10^{-11} \times 9.1^2 \times 10^{-62}}{R^2} \approx \frac{5.28 \times 10^{-69}}{R^2} \text{ (N)}. \quad (17)$$

Whereas, electric interaction with charge  $q_{e^+} = q_{e^-} \approx 1.6 \times 10^{-19} \text{ C}$  according to Coulomb’s law equals:

$$F_C = k_c \frac{q_{e^+} q_{e^-}}{R^2} = \quad (18)$$

$$= \frac{9 \times 10^9 \times 1.6^2 \times 10^{-38}}{R^2} \approx \frac{2.3 \times 10^{-28}}{R^2} \text{ (N)}. \quad (19)$$

It means that electric interaction between them is  $F_C/F_N \approx 4 \times 10^{40}$  times stronger than supposed gravitational interaction; therefore, gravitational interaction, of which error (if any) is  $10^{-40}$  at most, may theoretically be ignored. The supposed gravitational interaction between them and the Earth equals to  $9.1 \times 10^{-31} \times 9.8 \approx 9 \times 10^{-30} \text{ (N)}$  that can be ignored too, while true electric interaction between  $e^-$  and  $e^+$  on atomic scale equals to  $2.3 \times 10^{-8} \text{ N}$ ,  $10^{21}$  higher.

+ Thirdly, inertial mass of  $e^-$  and  $e^+$  is the smallest among inertial mass of elementary particles measured in experiments. That mass of neutrino is less than  $10^{-35} \text{ kg}$  is theoretically concluded, and has not been proved through any reliable experiments, and in fact, it can not be identified, because neutrino electrically neutralizes, neither electric field nor magnetic field is used for this purpose, and the measurement is impossible.

+ Fourthly, among high energy collision, only these two particles are not decay. Supposed quarks hide inside hadron, and are not in free state to be recognized (it is said that quarks in free state have been discovered; however, is the reality of this information the same as “the discover of pentaquark”, which has been recently revealed?). In addition, mass of assumed quarks is very large. And more then, the  $e^-$  and  $e^+$  particles may mysteriously “disappear” and become so-called “energy” of “nothing!”(?) – particle annihilation, or combine with some elementary particles to creation other elementary particles, but absolute leaving no just “debris”.

### 3.3. Inertial mass in electrostatic field

All these set forth points in item 3.1 may be repeat for electrostatic field between the charges  $q_A$  and  $q_B$ , if should be paid attention that the Coulomb’s law:

$$F_C = k_C \frac{q_A q_B}{R^2}, \quad (20)$$

with  $k_C = 1/4\pi\epsilon_0 \approx 9 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$ , may be rewrite in form similar to Newton’s law of universal gravitation (3), we have:

$$F_C = \chi_C \frac{M_{qA} M_{qB}}{R^2}, \quad (21)$$

where

$$M_{qA} = @ q_A \text{ (kg)}; \quad M_{qB} = @ q_B \text{ (kg)}; \quad (22)$$

and

$$@ = \frac{m_{e^+}}{q_{e^+}} \approx \frac{9.1 \times 10^{-31}}{1.6 \times 10^{-19}} \approx 5.69 \times 10^{-12} \text{ (kg/C)}; \quad (23)$$

$$\chi_C = \frac{k_C}{@^2} \approx 2.78 \times 10^{32} \text{ (Nm}^2/\text{kg}^2\text{)}. \quad (24)$$

$M_{qA}$  and  $M_{qB}$  in formula (21) play roles similar to gravitational mass in formula (3), which means they are quantities specifying interaction in potential force field with dimension of [kg]. Now the gravitational constant  $\gamma$  in formula (3) is replaced by  $\chi_C$ . The ratio  $\chi_C/\gamma \approx 4 \times 10^{42}$  indicates the size of electric interaction in comparison with gravitational interaction.

According to new concept of inertial mass, we can define inertial mass of charges in electrostatic field absolutely like that according to formulas (12) and (13). Specifically, if the total charge of  $e^-e^+$  equals to  $q_A$ , and charge of charged objects creating electric field in a laboratory equals to  $q_B \gg q_A$ , we have:

$$m_{e^-e^+} = \frac{M_{qA} M_{qB}}{M_{qA} + M_{qB}}. \quad (25)$$

Because  $q_B \gg q_A$ , then in accordance with formula (22) we have  $M_{qB} \gg M_{qA}$ , and therefore, we can approximatively rewrite expression (25) as follows:

$$m_{e^-e^+} \approx M_{qA} = @ q_A, \quad (26)$$

Therefore, if  $q_A = 0$ , then  $m_{e^-e^+} = 0$ ! The thing we expect has become true: when the  $e^-$  and  $e^+$  are combined in the state of electric neutralization with respect to external electric field, they are not be affected by electric field anymore. It means that they do not have

inertia in either electric field or magnetic field. In other words, when combining  $e^-e^+$  particles into photon, there is no inertial mass!

### 3.4. Inertial mass of photon in gravitational field

There is no gravitational interaction between  $e^-$  and  $e^+$  particles as in postulate on fundamental particles in item 3.2; however, in case of their combination into photon, they are affected by gravitational field, and caused pressure on the solid objects' surface as indicated in experiments 2.4 and 2.5. In other words, it is possible to affirm that photon has a gravitational mass  $M_\phi$ , and inertial mass  $m_\phi$  in gravitational field, if two "abnormal" problems in item 2.4 are solved, these are the speed of photon is a constant regardless its initial action on it, when photon is creation, or is collided any way.

In fact, after being carefully considered, it is found that these "abnormal" points will become normal provided that the photon has gravitational interaction and a corresponding gravitational mass. Why?

There is a fundamental difference between structure of photon and structure of other objects that is other objects are constituted by elements already having a certain gravitational mass and gravitational interaction; therefore, their gravitational mass only depends on gravitational mass of constituents in accordance with known principle of superposition. Whereas, photon is constituted by fundamental  $e^-$  and  $e^+$  particles having no gravitational interaction, therefore, as called "gravitational mass" of photon is the new factor resulting from the electric neutralization, but never been before. Its initial speed can not defined by the second Newton's law. However, for the fact that the as called "gravitational interaction" is just resulting from the electric neutralization between  $e^-$  and  $e^+$  in form of "remnant" interaction, therefore, this gravitational interaction intensity does not depend on any preexisted "gravitational mass", but the condition of charge neutralization and intensity of gravitational field in this position.

Finally, when being collided, there is a change in energy of photon resulting not from change in kinetic energy as in other objects with preexisting gravitational mass, but the changes in revolving frequency of  $e^-$  and  $e^+$ , does not changing its own gravitational mass.

## IV. FORMATION OF PHOTON STRUCTURE

### 4.1. Overview

- Therefore, on considering the constituents of photon, it can be assumed that photon is constituted from  $e^-$  and  $e^+$  particles.

- In nature, assuming that there is the existence of  $e^-$  and  $e^+$  particles independent from other charges, how do they move? Do they form a structure which is similar to a binary star in astronomic? It is fundamentally impossible, because  $e^-$  and  $e^+$  particles can only freely falling to each other when being affected by Coulomb force, if their initial speed equals to zero. In case that their initial speed is different of zero that is there is a certain initial kinetic energy, chance to form an orbit similar to binary star is very small. Therefore, like the creation of atoms, a large amount of these opposite particles in a limited volume is required, and then they are off the direction of Coulomb force between a pair of opposite charges due to their collide. Finally,  $e^-e^+$  particles are made to revolve around a inertia center similar to the binary star above.

However, there is a fundamental difference from the formation of binary star, in which inertial mass of the binary star equals to total inertial mass of each star included when the

binary-star system is formed; whereas, with this  $e^-e^+$  “binary-star” system the inertial mass disappears when it is formed, because there is the electric neutralization in the system as mentioned above – there is no electric interaction between surrounding charges, inertia in electric field don’t exist either no more.

It is just about mass, how about energy? Does it disappear, too? – No, it is not at all! All that initial Energy instead of containing in each separate  $e^-$  and  $e^+$  particles is converted into the total energy of both particles like a “isolated” system in the form of “internal energy” of  $(e^-e^+)$  system. Although measured radiant energy complies with Planck’s formula (2); however, what is “measured energy”, if photon is considered a particle? For example, in movement of billiard balls, exchange energy between them is mainly kinetic energy; concurrently, internal energy remains unchanged.

In addition, in fact that is internal energy (rest energy) is always much higher than kinetic energy of object, although, it can not be measured no way, but can only determined by unique method basing on the Einstein’s formula (1). However, this formula is applied to objects with non-zero rest mass, not that for photon. In other words, radiant energy calculated according to Planck’s formula (2) is only a part of external energy of photon, but the total energy. This is the reason why photon’s energy according formula (2) is much less than energy of  $e^-$  and  $e^+$  constituents! Anyway, total energy of photon must equal to at least total energy of two initial  $e^-$  and  $e^+$  particles and it may increase because they may be added with energy thank to external effect on  $e^-e^+$  system during the formation process as mentioned above. However, in common interactions and collides mentioned in items above, there is nearly no change in internal energy of  $e^-e^+$  system.

Therefore, photon is not emitted by atoms when its conversion in energy occurs as in hypothesis accepted for a long time, but it simply interact with atoms.

#### 4.2. Shape of photon

Because photon only exists in motion, its shapes are combined by rotary motion around the common inertia centre of charges  $e^-e^+$  and linear motion of this center in gravitational field as described in Figure 1a.

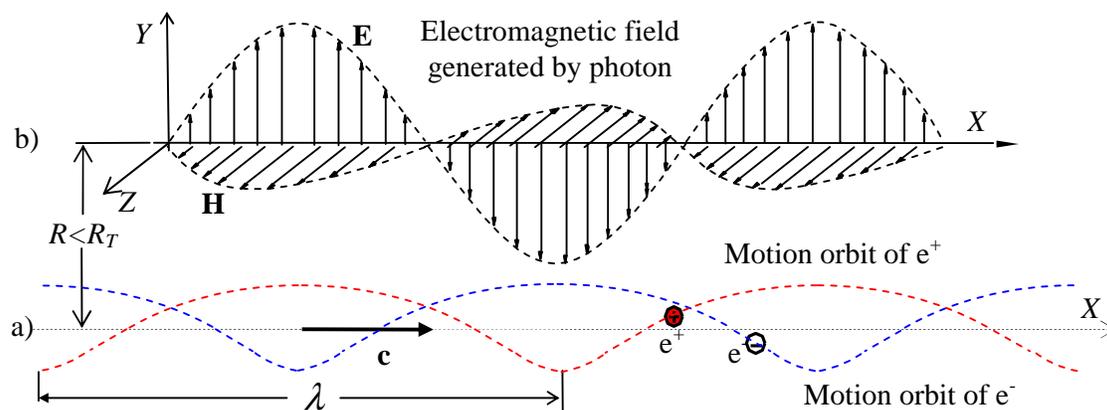


Fig. 1. Motion of photon PARTICLE forming “electromagnetic wave”

When photon moves within radius of effect  $R_T$  near other charges, there exists an interaction among them which is called “electromagnetic field force” in the language of current physics (electrodynamics Maxwell) and characterized by magnetic field intensity vector  $\mathbf{H}$  perpendicular to electric field intensity vector  $\mathbf{E}$ . Then, it is necessary to take into

account  $e^-e^+$  structure of photon, and therefore, within this radius of effect  $R_T$ , beyond curves describing motion orbit of  $e^-$  and  $e^+$  in gravitational field, but also describe field section variation of the charges in reference frame  $XYZ$ , in motion direction of photon as in Fig 1b.

It can be seen that electric intensity vectors  $\mathbf{E}$  are perpendicular to “magnetic field intensity vectors”  $\mathbf{H}$  in reference frame  $XOY$  that is put  $R < R_T$  far from motion axis of photon. It is not difficult to see that at planes perpendicular to motion direction of photon, intersecting with intersection  $A$  of motion orbits of  $e^-$  and  $e^+$ , electric intensity  $\mathbf{E}$  shall be canceled out, and when the orbits are furthest from each other – electric intensity  $\mathbf{E}$  are maximum. We should note that vector  $\mathbf{E}$  directs from charge (+) to charge (-). On the other hand, it is their varied electric field part that accompanies with body part of  $e^-$  and  $e^+$  as a unified physical entity. Moreover, motion of the charges can be considered as electric currents, and furthermore, are closed electric currents that are isolated by intersections with  $X$  axis, “electromagnetic field” generated by them are therefore absolutely similar to electromagnetic field of conductive ring with electric currents. Then, magnetic field intensity vector  $\mathbf{H}$  is of course perpendicular to motion orbit plane of charges, and to each others as described by Maxwell equations.

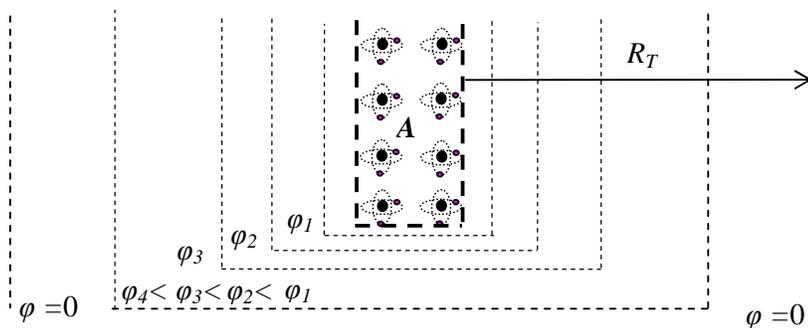
However this electromagnetic wave is different from electromagnetic wave of Maxwell, actually it does not exist independently with fundamental particles  $e^-$  and  $e^+$  during its propagation, whereas it is only field part accompanying with the particles when they combine together to form photon as above mentioned, and the so-called “electric intensity vectors  $\mathbf{E}$ ” or “magnetic field intensity vectors  $\mathbf{H}$ ” in that reference frame is still virtual, if there are no charges within radius of effect. On the other hand, “accompanying” with this  $e^-e^+$  – photon pair is only a “potentiality” of an “electromagnetic wave”, which is only available when charges exist there. Therefore, Maxwell equations are just a tool calculating conveniently fixed parameters of electromagnetic phenomenon, it is however not model of specific physical reality as in Newton Mechanics.

## V. EXPLANATION FOR ABNORMAL BEHAVIOR OF PHOTON

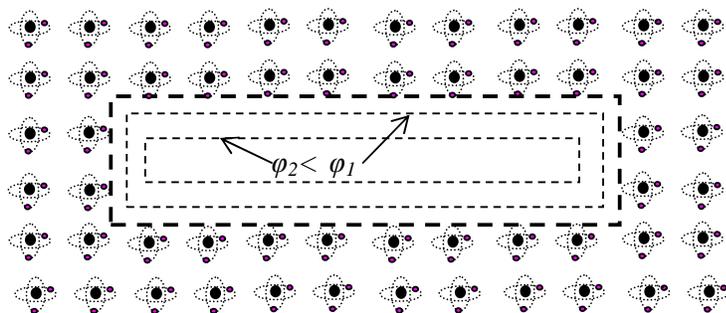
### 5.1. Scattering of photon through a slit

We must first revise that photon is only electrically neutral at distance that is more than radius of effect  $R_T$  of  $e^-e^+$  pair forming it, and when charges appear among this area and if the least-action principle is satisfied [13], photon shall appear electric interactions among them that diverts the motion direction of photon. This is true for edges of screen ( $A$ ) made of some material, and just the molecules or atoms of this material created an electric field near that screen’s edge with a radius of effect, although it is at further distance with this radius, this electric field may be still neutralized (see fig. 2a).

If there are slit or small hole inside screen as described in Fig. 2b, that electric field can be more strengthened, so there may have stronger interactions with photon. In principle, the nearer screen edge is, the more greater electric field is – the more it diverts motion direction of photon, and vice versa, the further that edge is – the weaker electric field is – the less it diverts motion direction of photon. However, deflection angle of photon impacted by this electric field complies with least-action principle [13], so it may be limited and completely defined. Therefore, this electric field can be described as a “concave lens”, and more exactly a concave lens formed from some “lenses” having different focuses, that is respective to deflection angle of photon when passing through slit  $\alpha_1 < \alpha_2 < \alpha_3$  as mentioned in Fig 3.



a) Electrical field at the screen proximity



b) Electrical field at the slit

Fig. 2. Electrical field at screen proximity or slit

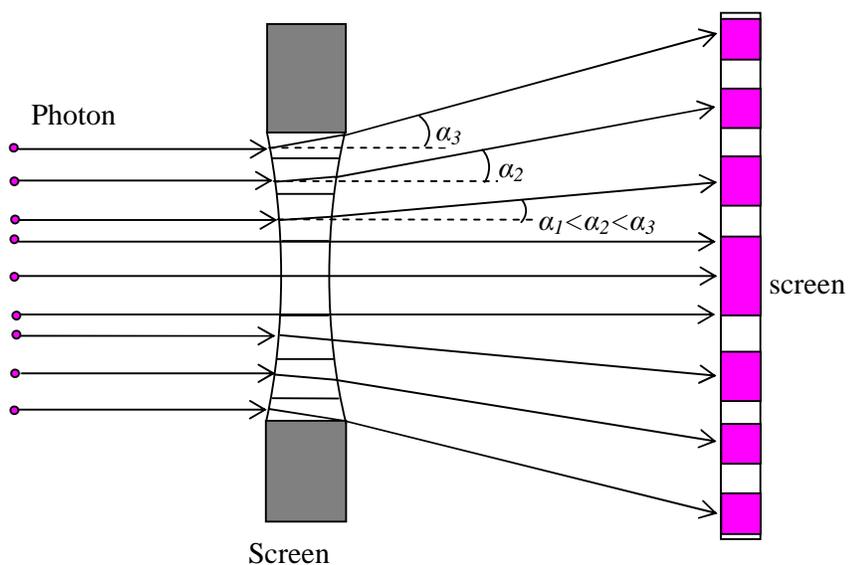


Fig. 3. “Concave lens” model of electric field at slit

The deflection angles shall be concretized for slit edge in the following form:

$$\sum_{n=1} S_{kn} \sin^2 \alpha_{kn} = n \frac{h}{m_{ph}c} = n \frac{h}{p_c} = n\lambda, \tag{27}$$

In which,  $\lambda$  is the wave-length of photon. Therefore  $\alpha_{kn}$  may be written as function of “wave-length”  $\lambda$ :

$$\alpha_{kn} = F(\lambda, d, \dots), \quad (28)$$

### 5.2. Behavior of photon through two slits

If two slits are not too far from each other, photon is both impacted by electric field of each slit and mutual impact of two electric fields. The problem is that when one photon passes through any slit and is deflected with an angle, electric field of that slit will be changed in equivalent to an impact on photon generated from the electric field in compliance with action-counteraction law. However this change immediately causes “chain reaction” on molecules of material, and the weakest point is strip between two slits, and the electric field of adjacent edge also changes accordingly. In other regions, because there is large volume of molecules of forming materials, therefore there are no foresaid impacts.

On Fig. 4, electric fields are represented in two slits by equipotential lines. It can be seen that electric field intensity at band proximity is completely smaller than electric field intensity at other three sides of slit edge. On the other hand, when each photon passes through a slit and is deflected with a defined angle, it leaves a trace on both two slits via molecules of materials forming band between two slits, therefore picture on screen seems to be one picture formed by two photons passing through 2 slits – photon seems to be “replicated” when passing through two slits. Therefore, regions surrounding two slits *A* and *B* and band between them are circled on the figure and called “domain of influence”. Because the impact of electric field on photon and vice versa, only imposes one bare least effect that causes photon to divert from initial motion direction on just a “angle quantum”, so it is understandable that all efforts to see which slit the photon passes through (*A* or *B*) make the “interference” picture vanish. This intervention accidentally disables interactions of photon with slits, diverts motion direction of photon without complying with angle of deflection assigned by electric field of slit to photon...

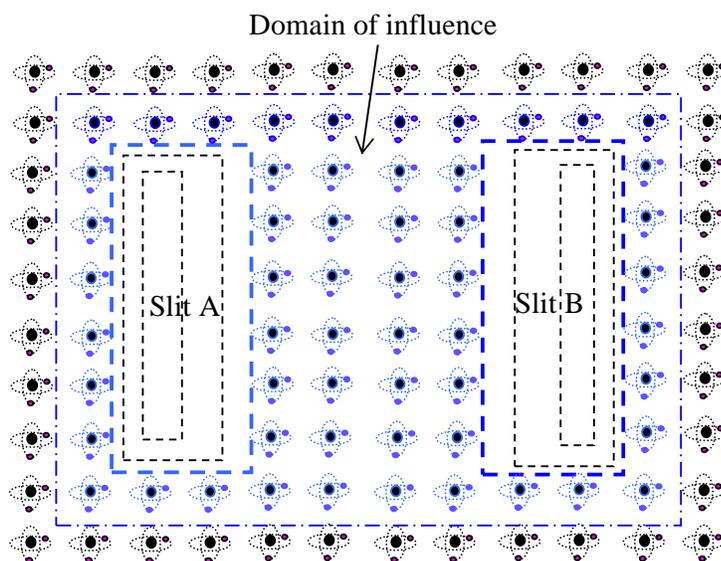


Fig. 4. Electric field at two slits of screen

### 5.3. Photon can pass through a hole smaller than its wave-length

An experimental evidence affirms the correctness of this model of photon is the phenomenon in which light can pass through a hole with the diameter smaller than its wave-length that has been accidentally discovered recently (in 1989) on nano screen made of

gold. First of all, according to theory of photon structure as mentioned in [5], diameter of photon itself is  $R_{dip} \approx \lambda/\pi$ , so it is possible for it to pass through a small hole with diameter  $< \lambda/2$ , provided that electric field of the hole must be weakened in some way without diverting direction of photon. And in this case, it is hole creation on nano screen that forms small bands among holes, produce this phenomenon, also reduce radius of effect of hole edge on photon when photon passes through it. And it shall be more explained that if radius of influence is  $< \lambda/12$ , one photon with wave-length of  $\lambda$  can pass through a hole with diameter of  $\lambda/2$  without any “diffraction” as described in Fig. 5.

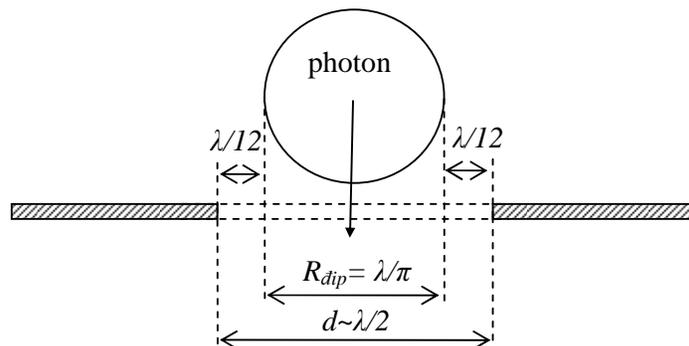


Fig. 5. Photon passes through a slot whose diameter is smaller it wave-length

We have not used mathematics to simulate electric field in this hole edge, as well as in two slits yet, this fact does not affect the correctly understanding on nature of physical process happenings here, and we hope that this problem will be solved in near future.

#### 5.4. Cosmic background radiation

Comic background radiation in correspondence of  $2.7^0\text{K}$  measured the same in all directions, is deemed as “fossil” evidence of Big Bang. However in view of photon structure, this is only thermodynamic equilibrium of cosmos.

In cosmos, photon exists everywhere in wide range of spectrum from some Hz to  $10^{18}\text{Hz}$  in which it is equivalent to wave-length of thousands km to less than  $0,1\text{nm}$  and it combines with graviton (ray  $\gamma$  and neutrino) to form the so-called *radiation*, they can penetrate in all ins and outs, exist in different kinds of matter (event in internal space of any physical object). It is impossible to completely separate one any region from this radiation “sea” (event in vacuum chamber of particle accelerator) because, as we see that, distance among atoms of any substance is about  $10^{-9}\text{m}$  whereas dimensions of atom is small – about  $10^{-11}\text{m}$ , therefore, for photon (mean all possible wave-lengths),  $\gamma$  ray and neutrino, material world is almost “transparent” – a state of matter may prevent some certain wave-lengths but become “transparent” to others – the result is that there are always some radiation passing through “walls” that is seem to “imprescriptible” thing. When evacuating, we can only remove gaseous atoms and molecules out of tank, but radiations are not “evacuate” out of tank no way and they still exist there. Radiation quantity and its energy completely depend on thermodynamic equilibrium of environment and the tank. Some photon with great energy (short wave-length) can penetrate through tank cover, however then it looses its energy (longer wave-length) and is kept in tank (or “greenhouse effect”), so it is pointless to “evacuate absolutely”.

Fig. 6 describes this phenomenon qualitatively in which  $\gamma$  ray or neutrino can pass through easily; some photons go in tank and then reflect like X ray; some can not pass through tank cover so they reflect like visible light or infrared ray; and some can go into

tank, they however lose their energy and can not get out, like ultraviolet ray; and some photons can loop the tank such as radio wave, etc., So, in thermodynamic equilibrium of a physical entity particularly and the whole cosmos generally, photon and  $\gamma$  ray as well as neutrino play an intermediate role that transfers energy from this object to another and forms a thermodynamic equilibrium state in equivalence to frequency energy spectrum of photon – this spectrum is nearly the same in all directions except for those, which coincide with some star in the radius of action  $R_m$ , because all radiations out of  $R_m$  are all absolutely disintegrated before reaching us.

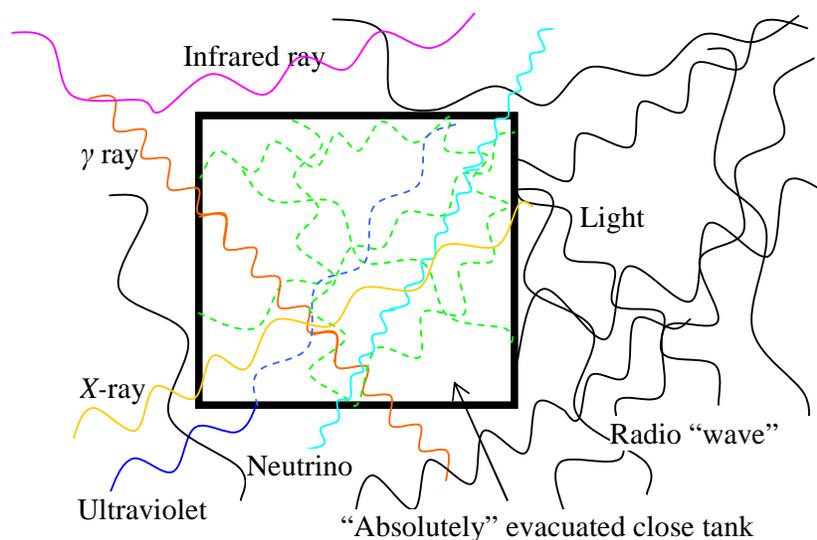


Fig. 6. It is impossible to completely separate a region from this photon “sea”

This “photon sea” can be described successfully by Bose-Einstein statistics as mentioned in [2], accordingly we can establish relation between Planck  $h$  constant and thermodynamic equilibrium parameters. Then, in view of indefinite cosmos, this is “background radiation” that people following Big Bang theory consider it one of three convincing “experimental evidences” of that theory.

### 5.5. Red shift

Experimental evidence of “red shift” can be also explained properly by  $e^-e^+$  structure of foresaid photon. Let’s imagine that we are sitting in an incandescent ball, we can measure the radiation in proportion to the temperature of that ball in all directions. Now we assume that radius of that ball increases gradually to  $R \rightarrow R_m$ , the “red shift” phenomenon shall appear – received radiation in proportion to temperature shall be decrease gradually, because energy of photon shall be lost step by step due to motion in gravitational field. This loss does not change speed of photon, it however causes frequency to decrease (red shift). Meanwhile, gravitational mass, that is a parameter of gravitational interactions, don’t change because  $e^-e^+$  structure of foresaid photon has a specific property that is from the distance far more than effect radius  $R_T$  they become electric neutralization and by which “remnant electric interaction” appears – it is just gravitational interaction. All photon having the same  $e^-e^+$  structure, then they differ from each other by only size of effect radius due to their rotation speeds are different: The greater rotation speed is (e.g. the greater photon frequency), the smaller effect radius is, and on the contrary, the smaller rotation speed is

(e.g. the smaller photon frequency), the greater effect radius is. However, because of size of effect radius  $e^-e^+$  structure too small compared with the action radius of their “remnant electric interaction” ( $\rightarrow\infty$ ), then the change of effect radius  $R_T$  (it is influence of rotation frequency too) not depends on intensity of “remnant” electric interaction creating by them. Meanwhile, gravitational mass of photon  $m_{ph}$  is specific for intensity of “remnant electric interaction-gravitational interaction”. For this reason, gravitational mass of photon  $m_{ph}$  not depends on its frequency: every photon having the same gravitational mass by which all photon identically deflect when passing nearly from strong gravitational field (as Sun, for example). It is absolutely according to observed reality.

From the former viewpoint on inertia mass, when photon has a mass, that its mass may be is defined by formulas:  $E = m_{ph}c^2$  và  $E = hv$ , and that mass must be not constant, that is:

$$m_{ph} = \frac{h}{c^2} v$$

It means that mass of photon to seem depends on its frequency, so influence of gravitational field on it, if any, depends on its frequency too. In result the “red shift”, that is caused by gravitational field, shut have depended on frequency of photon? But photon in all wave-lengths moves similarly – this completely matches to actual observation. And just this argument causes accepted ignore of possibility that the photon is absorbed by the gravitational field. And they only rely on Dopler effect.

Therefore, if that ball as mentioned above is absolutely empty, then when its radius reaches  $R_m$ , temperature is measured at ball’s centre must be  $0^\circ\text{K}$ , because photons deflecting from inner side of the ball to center loose all their energy. Therefore, the so-called “background radiation” in proportion to temperature  $2.7^\circ\text{K}$  are formed by all space objects in celestial sphere with radius of  $R_m$  – radiations out of the celestial sphere with that radius can not reach us. On the other hand, “background radiation” does not relate to “Big Bang”.

## VI. UNKNOWN PHOTON EFFECT

### 6.1. Gravitational diffraction phenomenon in Astronomy

Interactions of photon with space objects having huge gravitational mass cause to divert its directions as mentioned above. However, like direction deflection of photon in electric field as mentioned above, deflection angle of motion of photon in pure gravitational field (without electric interaction) can not be continuous, and it must follow definite angle quantum  $\alpha_1 < \alpha_2 < \alpha_3$ .

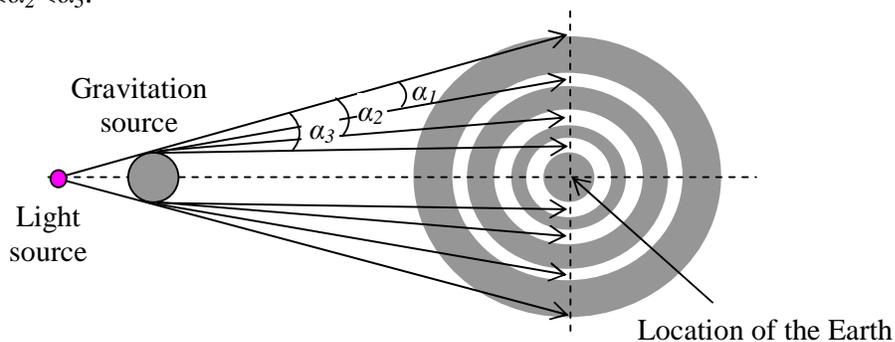


Fig. 7. Gravitational diffraction phenomenon in Astronomy

Therefore, we can receive one diffraction image like photon passing through a shield (see Fig. 7). This effect does not belong to scope of quantum mechanics and general theory of relativity. Observation of this phenomenon from the Earth, when gravitational source (such as black hole) crosses view direction from the Earth to light source, we can see the “skip” phenomenon of light source from one position to others on celestial sphere (of course it suffers some blur).

**6.2. Vertical Doppler effect**

This is the effect drawn from the Theory of Relativity when there is a mirror moving with velocity  $V$  perpendicular to the mirror plane in frame of reference associated with the Earth and making an incident angle with the incident ray indicated as on Figure 8a, on which the wave-length incident photon is denoted as  $\lambda$  and the wave-length of reflected ray is denoted as  $\lambda'$ .

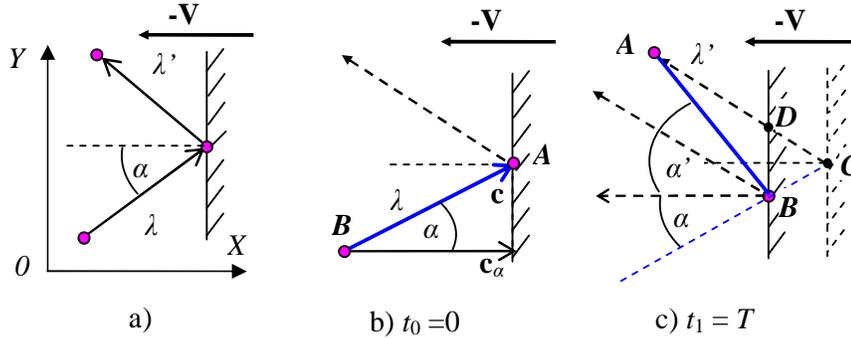


Figure 8. Vertical Doppler effect with movable mirror

Frequency of reflected photon  $f''$  as per [4] is:

$$f'' = \frac{1 + \beta^2 + 2\beta \cos \alpha}{1 - \beta^2} f . \tag{29}$$

The expression (29) is drawn directly from Lorentz transformations without posing any restrictions to the relation between  $\alpha$  and  $\beta$ . It can be immediately seen that if  $\alpha = \pi/2$ , or  $\cos \alpha = 0$ , i.e. the light “glances” over the mirror without colliding with it, from (29), there must be:

$$f'' = \frac{1 + \beta^2}{1 - \beta^2} f , \tag{30}$$

but this is impossible because there is no reason for the frequency of  $f'' > f$ , however the correct result shall be  $f'' = f$ , so it is just the same photon?

It can be considered this phenomenon in perspective of structural photon. It is supposed that in Earth frame of reference, photons move toward the mirror with the velocity component of  $c_\alpha = c \cdot \cos \alpha$  and at the time of  $t_0 = 0$ , “node”  $A$  collides in the mirror as shown in Figure 8b. After a period of cycle  $T$  of photon, “node”  $B$  in turn will collide in the mirror while “node”  $A$  has left the mirror with the same velocity of  $c_\alpha$  as before colliding (see Figure 8c) under the law of reflection, if satisfying condition of  $c_\alpha > V$ , i.e. the velocity component of photon in the motion direction of the mirror surface (under  $OX$  axis) must be greater than the motion velocity of the mirror itself, because if  $c_\alpha = V$ , photon shall “glide”

along the mirror surface without colliding in the mirror; and if  $c_\alpha < V$ , photon cannot catch up with the mirror, obviously there is no collision occurring. It is inferred as follow:

$$\alpha > \arccos \beta. \quad (31)$$

In principle, this can be completely tested by experiment.

It can be easy to calculate the total displacement of the “node” **B** and the mirror under the X-axis in the period of time as shown below:

$$c_\alpha T + VT = \lambda_\alpha = \lambda \cos \alpha. \quad (32)$$

Meanwhile, because the “node” **A** has left the mirror with the same motion direction of the mirror; therefore, it is only far away from the “node” **B** under X-axis with a distance of the difference as follow:

$$c_\alpha T - VT = \lambda'_\alpha = \lambda' \cos \alpha \quad (33)$$

with the assumption that the reflected angle is still equal to the incident angle  $\alpha$ . This means that after reflecting from the mirror, the distance between two nodes **A** and **B** is shortened but this distance is the wave-length of reflected photon denoted as  $\lambda'$  with its projection in the same dip angle of  $\alpha$  on the X-axis of  $\lambda'_\alpha = \lambda' \cos \alpha$ .

From expressions (32) and (33), it can be drawn the relation between wave-length of reflected photon and incident photon as the following:

$$\lambda' = \frac{\cos \alpha - \beta}{\cos \alpha + \beta} \lambda, \quad (34)$$

Here, it is denoted as  $\beta = V/c$ . See the above expressions, we can write the relationship expression for frequency as below:

$$f' = \frac{\cos \alpha + \beta}{\cos \alpha - \beta} f. \quad (35)$$

Only the result obtained from the expression (35) is reasonable. Only this result also proves that the expression (30) received from the theory of relativity is less accurate than the expression we have just received when considering photon a particle rather than wave.

## VII. CONCLUSION

1- Photon is a particle with structure of a pair electron-positron revolving around its common inertia center with frequency of  $\nu$  to reach a charge neutralization and motion with light velocity of  $c$ ; therefore, its so-called “wave-particle duality” has been eliminated as well as we can explain all “anomaly” behaviors of photons without reference to quantum mechanics.

2- Electron does not radiate or absorb photons but only interacts with photon in proper conditions.

3- Photon is a particle with gravitational interaction so it has gravitational mass and has to be subject to influence of gravitational field. However, unlike other gravitational-mass particles, the gravitational interaction of photon is not an attribute available from constituent elements but formed as a “remnant interaction” of electric interaction between two elementary particles of electron and positron. This opens a capability of unifying

electric interaction with gravitational interaction, judging from its physical nature, but not unifying in form of descriptive mathematical formalism.

### REFERENCES

- [1]. A. Einstein, L. Infeld. *The evolution of physics*. Translated from English. Hanoi Science and Technique Publishing House, 2005.
- [2]. Б. М. Яворский А. А. Детлаф. *Справочник по физике*. Физматлит. “Наука”, Москва, 1996.
- [3]. David Haliday – Robert Pensnick – Jearl Walker. *Fundamentals of Physics, Volume 6, Optics and quantum physics*. Translated from English. Education Publishing House, 2002.
- [4]. В. А. Угаров. *Специальная теория относительности*. Издат. “Наука”, Москва, 1977.
- [5]. Vu Huy Toan. *The New Way for Physics*, Hanoi Science and Technology Publishing House, 2007.
- [6]. А. Ейнштейн. *Собрание научных трудов*, Т. I, II, III. 1965.
- [7]. D. Acosta. *The Inertial Mass*, 2003, <http://www.arrakis.es/~dacosta/masai.htm>
- [8]. M. Chown. *A Mass of Inertia*. 2001.
- [9]. Max Jammer. *Concepts of mass in classical and modern physics*. Harvard University press. Cambridge -Massachusetts. 1961.
- [10]. Vu Huy Toan. *Inertial mass and mechanical-dynamics* . Report in National Conference on Theoretical Physics, Sam Son, 2003.
- [11]. Tai L. Chow, *Classical mechanics*. John Wiley & Sons, Inc. New York, 1995.
- [12]. H. Dittus and C. Lämmerzahl. *Experimental Tests of the Equivalence Principle and Newton’s Law in Space* ZARM, University of Bremen, Am Fallturm, 28359 Bremen, Germany.
- [13]. Vu Huy Toan. *Least – action Principle and quantum Mechanics*, Proceedings of IMFP-2005 – International Meeting on Frontiers of Physics, Kuala Lumpur, Malaysia, 2005.