ENERGY DISPOSITION OF PHOTON

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In the documents [1-3], the author only refers to the photon's ability to form the structure in order to solve its "mystery" (Wave-particle duality, immaterial nature, etc.), but does not mention in detail the energy dissipation as well as energy conversion process of the photon as a particle involved in both gravitational and electric interactions, also known as combined electrtic-gravitational interaction. This type of interaction has not been studied, and in [2], the author also raised the issue as one of the backlog of book. If this combined interaction is reviewed in the traditional method as mentioned therein, it will encounter the difficulties, which can not be resolved.

In this article, the author wants to approach total energy of the photon in a different method based on its particular property, which is able to escape completely from the electric interactions, but only involved in the gravitational interaction. Meanwhile, the total energy of the photon must be also preserved as it is in the combined electric-gravitational interaction, because the gravitational interaction is, after all, just "residual electric interaction" of the photon, which is called with a new name – the gravitational interaction. In other words, a photon is formed from electron and positron with the total energy of each individual particle, which is the conservative quantity, because all their impact radius reaches to ∞ – no matter where or no matter how, all the universe is always "completely inside" it, so only the inter-conversion between the components of total energy of such particles in the photon, respectively as it comes from the combined electric gravitational field to the pure gravitational field, also known as vacuum, and vice versa, from the pure gravitational field into the electric field of the environment, which is composed of matter's atoms and molecules. As being combined together, due to the addition of energy from outside such two particles to form dipol DQ, DQ's total energy including this added energy will be the total energy of the photon in the future; it will still be conserved quantity, because while it does not interact with the charges outside the effect radius R_T, it still has the gravitational interaction with all other physical objects, including the physical objects, which have provided more energy for electron and positron so that dipol DQ is

formed. So, on that basis, the energy components can be calculated for each specific case and interaction.

In [2], we would have known the total energy of electron in electric field of charge Q with the form as follows:

$$W_{e-} = m_e c^2 + 2U_d(R_k), \quad (1)$$

with:

$$U_d(R_k) = k_c \frac{Qq_e}{R_k}, \quad (2)$$

where $m_e \approx 1{,}6\text{x}10^{-19}$ kg – is a inertial mass of electron; $q_e \approx 1{,}6\text{x}10^{-19}$ C – is a charge of electron; $k_c \approx 9\text{x}10^{-9}$ Nm^2/C^2; R_k – is the critical distance at which the internal energy of the electron is balanced with its external energy, then it can be written as follows:

$$U_d(R_k) = \frac{m_e c^2}{2}. \quad (3)$$

Replace (3) to (1), we have:

$$W_{e-} = 2m_e c^2. \quad (4)$$

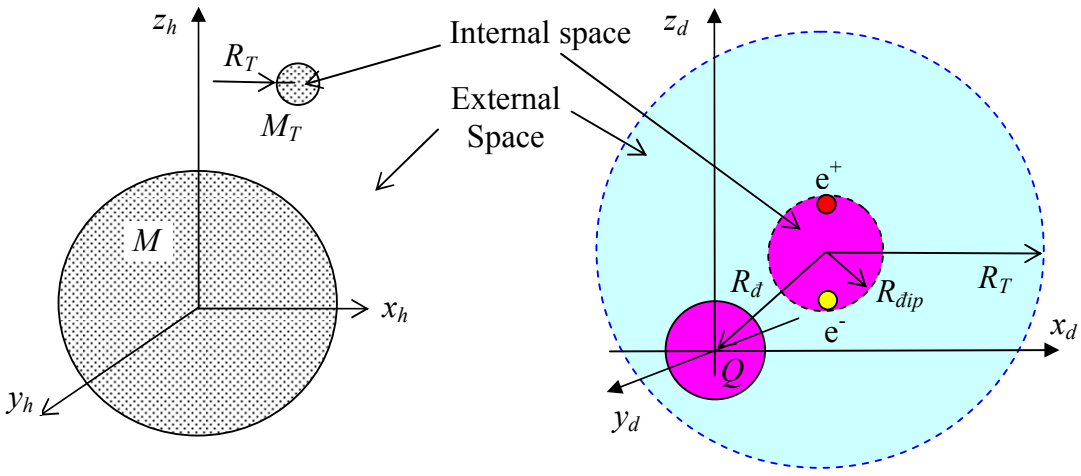
Similarly, we also have the total energy of the positron $W_{e+} = W_{e-}$. Thus, upon being not combined with each other, the total energy of electron and positron in the electromagnetic field is just pure electric energy and equal to their total energy:

$$W_{e+e-} = W_{e-} + W_{e+} = 2W_{e-} = 4m_e c^2. \quad (5)$$

After combined into dipol DQ, thanks to the addition of energy from outside these two particles, their total energy can be only larger than the value calculated by (5) and more, this dipol is also involved in the gravitational interaction. To fully visualize this complexity, let analyze the energy disposition of the photon in the combined electric-gravitational interaction, that is, at the same time the photon involves in both interactions: electric interaction with the charges within the effect radius R_T upon colliding or going through other objects and gravitational interaction, which is always present wherever and whenever in the endless universe.

First, let back to the photon's structure as shown in Figure 1. Photon is also a physical object, so it must have an internal space and an external space [3]. However, the distinction between "internal" and "external" must be based on the type of interaction. Photon is involved in both interactions: electric interaction at near distance within interval $R_{đip} < R_đ < R_T$, and gravitational interaction at far distance $> R_T$.

Therefore, photon will have different structures depending on which interaction it participates.



a) Structure of photon in gravitational field with the mass of M

b) Structure of photon in eletric field of electric charge Q

Figure 1. Structure of photon depends on force field

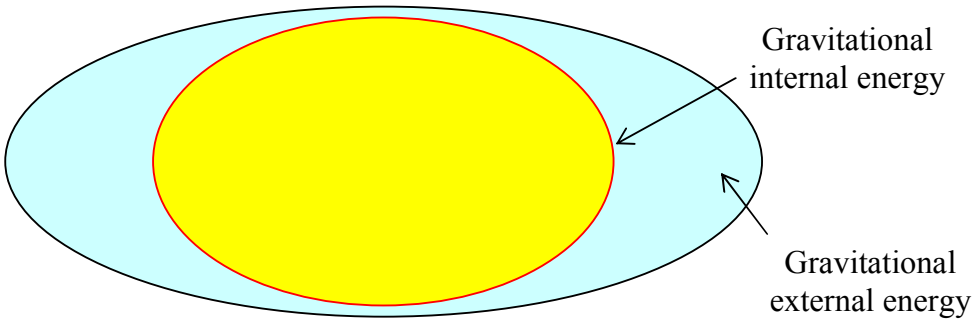
- If there is no charge in the range < R_T, the photon only participates in the gravitational interaction. Figure 1a shows the photon's structure in the gravitational field of mass M with the internal space within the effect radius R_T of the photon while its external space extends to infinity. Then the concept of "gravitational interaction" is apparently meaningful only from the range R_T or further; in the range < R_T there is just the pure electric interaction between electron and positron. Therefore, in this case, the photon is simply represented as a sphere of the same gray with the gravitational mass (M) and has a mass exactly equal to a quantum of mass M_T.

- In the electric field of the charge Q, the photon's structure takes the form as shown in Figure 1b: its internal space that is the area inside the radius R_{dip} (but not R_T as the gravitational interactions) is marked pink as same as the color of the charge Q, including dipol e^+-e^-; and the green-marked area with radius R_T (it was enlarged five times for a good look in the figure) is its external space in this interaction. However, because the gravitational field always fully occupies the universe, it is impossible to study the photon even in the electric interaction independently.

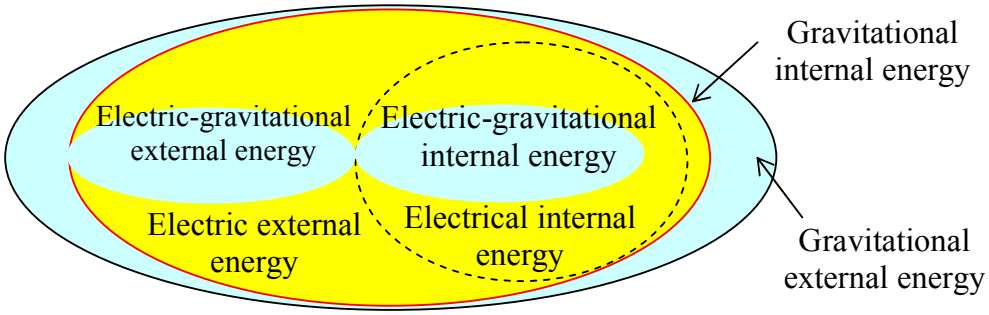
- In the combined electric-gravitational interaction, the normal gravitational field intensity is so small (about 10^{-40} times) compared to the gravitational field intensity, so the photon's gravitational potential energy is very small, but its gravitational kinetic energy is not small, because the photons always move at the critical speed c.

Moreover, the internal space of the photons in the gravitational interaction "contains" full space (both internal and external) of the photons in the electric interactions, so this interaction has particular properties, which have never been known in both classical and modern physics.

Thus, corresponding to the "internal space" and "external space" of the photon, we will also have the concepts of its "internal energy" and "external energy", depending on the type of interaction that it participants [2]. The diagram in Figure 2 shows the energy disposition of the photon in the combined electric-gravitational interaction – a way of describing the interdependent existence of physical objects and the unity of electric and gravitational interactions.



a) Photon energy in pure gravitational interaction



b) Photon energy in combined electrical-gravitational interaction

Figure 2. Energy disposition of photon

Here, the gravitational external energy of the photon is represented by the blue area; the gravitational internal energy is the whole inside oval area surrounded by red lines; the electric gravitational internal energy W_{ndh} is the yellow circle surrounded by dashed lines; electric gravitational external energy W_{ngdh} is the whole same yellow area lying between the red and dashed lines. The kinetic energy ΔK_h of gravitational external energy transferred into the gravitational internal energy is shown as two blue ellipses: ½ ΔK_h is combined with the electric internal energy W_{nd} to form the electric

gravitational internal energy W_{ndh}, and ½ ΔK_h is combined with the electric external energy W_{ngd} to form the electric-gravitational external energy W_{ngdh} (these blue ellipses are intentionally connected with each other). The largest ellipse's area represents the total energy of the photon – it is conserved quantity when the photon moves from the gravitational field into the electric field, or vice versa – all energy transformations only occur within the components inside such ellipse. In this transformation process, it should have to include the conversion of gravitational potential energy U_h but under normal conditions in the Earth or the stars, including neutron stars, this potential energy is very small, so the conversion of potential energy can be ignored compared to other energy components.

The Figure 3 is given in the form of diagram to explain the energy distribution of the photon in the combined electric-gravitational interaction when its speed reduced from c to u.

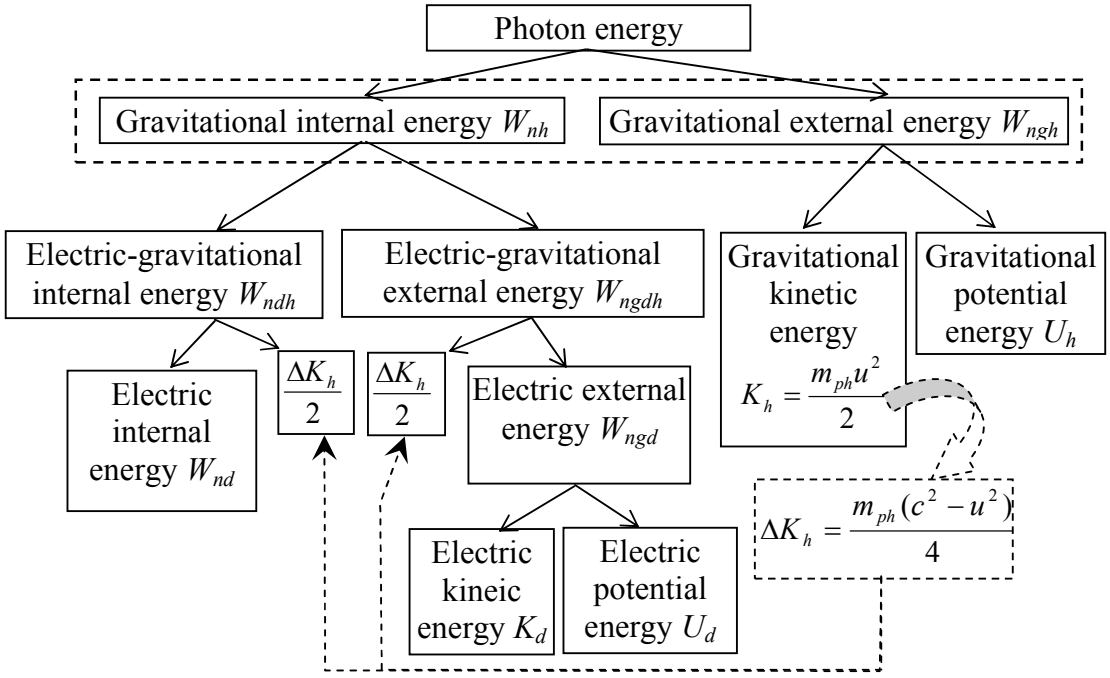


Figure 3. Distribution diagram of photon energy in electric-gravitational interaction

From this, you can visualize the reverse transformation process; when the photon flies from the environment to vacuum: the energy components will transform back to have the distribution diagram of energy as shown in Figure 2a or the inside dashed rectangle in Figure 3. Specifically:

- The electric external energy W_{ngd} is no longer available, but ½ W_{ngd} is combined with the electric internal energy W_{nd} (so-called "transformed" into the

gravitational internal energy W_{nh} although it is essentially still the electric energy), which make the rotational kinetic energy as well as the potential energy of the electron and positron increased respectively;

- Both gravitational kinetic energy ½ ΔK_h and electric external energy ½ W_{ngd} are transformed back and combined with gravitational kinetic energy that makes photon fly with the same speed c as before.

This makes implications for the energy transformation when dipol DQ with the speed $u = 0$ becomes photon with the speed c. Specifically, the photon's kinetic energy K_{hc} is generated from two equal parts: one half from the dipol's electric gravitational external energy W_{ngdh} and another half from its electric-gravitational internal energy W_{ndh}. This transformation does not change the dipol's electric internal energy W_{nd} as seen on Figure 3. However, the rest of the electric-gravitational external energy of the dipol, that is also its electric external energy:

$$W_{ngdh} - \frac{\Delta K_h}{2} = W_{ngdh} - \frac{m_{ph}c^2}{8} = W_{ngd}$$

will be transferred into the photon's gravitational internal energy W_{nh}, causing both rotational kinetic energy K_{ec} and the potential energy $U_{ec}(R_c)$ of the electron and positron in the photon to be increased respectively. As a result, the rotational frequency v_c and radius R_c of the photon will be determined from the equilibrium conditions of new energy, if it is previously assumed that the rotational frequency and radius of the photon are just $v_o < v_c$ and $R_o > R_c$.

References

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