A NEW INTERPRETATION OF PHOTON

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The present interpretation of photon is as: A photon = a quantum of radiation energy + energy $h\nu$, where the quantum of radiation energy constitutes the photon and provides the particle like physical existence to it, similarly, as the quantum of charge (-e) constitutes the electron and provides the particle like physical existence to it. And the energy $h\nu$ enables the photon to travel with velocity c, spin with frequency ν (which the photon obtains from the orbiting electron, from which the photon is emitted), scatter electron in the Compton scattering, and eject electron penetrating into metals in the photoelectric effect. The present interpretation of photon enables us to give very clear and complete explanation of all the phenomena related to photons, including the phenomena of interference and diffraction

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1. INTRODUCTION

As we know, the concept of quantum came across the floor after the Planck's quantum theory to explain the energy distribution in radiation chamber. In his theory, instead of assuming the radiation chamber to be filled with radiation in continuous form, he assumed the radiation chamber filled with radiation in quantized form (i.e. in the form of bundles). These quanta (bundles) of radiation were later on interpreted as photons.

1.1 The current interpretation of photon

As photons suffer the phenomena of interference and diffraction, the photons were reinterpreted as: The photons are discrete quanta of radiation energy given by $h\nu$, which involve the frequency ν of radiation. These, unlike the light corpuscles of Newton, include in their very concept the wave nature also of radiation, because this alone and not the other quantum idea can account for the phenomena of interference and diffraction.

1.2 Faults in the current interpretation of photons

In the current interpretation of photons (Sec. 1.1), there are actually two statements:

1. The photons are discrete quanta of radiation energy given by $h\nu$, which involve the frequency ν of radiation.
2. These, unlike the light corpuscles of Newton, include in their very concept the wave nature also of radiation, because this alone and not the other quantum idea can account for the phenomena of interference and diffraction.

As the concept of the wave nature of electrons, nucleons, photons, and so forth, cannot be true (for verification of its truth, see Sec. 1.1, Ref. 1), and the phenomena of interference and diffraction of electrons and photons cannot take place due to their wave nature (for verification of its truth, see Sec. 1.2, Ref. 1), the second statement is ruled out.

And in the first statement, the portion "The photons are discrete quanta of radiation energy given by $h\nu$" is faulty and incomplete. It gives rise to question: The energy $h\nu$ is whether of the amount of radiation contained in photon, or of photon, that enables the photon to travel as a particle with velocity c, scatter electron colliding with that in Compton scattering, and eject electron penetrating into metals in photoelectric effect, and so forth?

As we know, photon travels as a particle with velocity c, scatters electron colliding with that in Compton scattering, and ejects electrons penetrating into metals in photoelectric effect, and so forth, for photon, two things are necessary:

1. As electron exists physically as a particle, and the bundle of charge -e (which is actually the electrical energy) provides physical existence to electron, similarly, photon should also exist physically as a particle, and there should be a bundle of something (e.g. radiation energy) that provides physical existence to photon.
2. Photon should possess some energy that enables the photon to travel as a particle with velocity c, scatter electron colliding with that in Compton scattering, and eject electrons penetrating into metals in photoelectric effect.

If the energy $h\nu$ is of the bundle of radiation that provides physical existence to photon as a particle, then where is the energy that enables the photon to travel as a particle with velocity c, scatter electron colliding with that in Compton scattering, eject electrons penetrating into metals in photoelectric effect, and so forth? And if $h\nu$ is the energy that enables photon to travel as a particle with velocity c, scatter electron colliding with that in Compton scattering, and so forth, then where and what is the energy of bundle of radiation that provides physical existence to photon as a particle?

1.3 Current solution to counter the faults in the current interpretation of photon

Currently, to counter the above faults (Sec. 1.2) in the current interpretation of photon, the moving mass $h\nu / c^2$ and momentum $h\nu / c$ have been assigned to photon. The $h\nu / c^2$ and $h\nu / c$ although succeed to explain the phenomena of Compton scattering, photoelectric effect, and so forth, but $h\nu / c^2$ and $h\nu / c$ give rise to further several very fundamental questions. For example:

1. What is the physical interpretation of moving mass?

2. Does the moving mass of photon $h\nu / c^2$ provide physical existence to photon as a particle? And if provides, how? Otherwise, photons cannot collide with electrons in Compton scattering and penetrate into metals in Photoelectric effect.

3. If the moving mass $h\nu / c^2$ and momentum $h\nu / c$, which depend upon the frequency ν of the wave nature of photons, have been assigned to photons, such moving mass and momentum should be assigned to electrons too, depending on the frequency of their wave nature. But no such moving mass and momentum have been assigned to electrons. Why is this double standard?

4. In $h\nu / c^2$, since every term h, ν and c has finite value, $h\nu / c^2$ should also be finite. Whereas, if substituting in expression $m_{mov} = m_0 / \sqrt{(1 - \mathrm{v}^2 / c^2)}$ [where m_0 and m_{mov} respectively are the rest and the moving mass of the particle moving with velocity v] the rest mass m_0 of photon to be = 0 (because m_0 of photon has been assumed to be = 0), the m_{mov} of photon is obtained to be indeterminate. Why is this discrepancy?

5. The term ν, used in $h\nu / c^2$, $h\nu / c$ and $h\nu$, is assumed as the frequency of the wave nature of photon (i.e. ν is the characteristic of the wave nature of photon), while it is believed that the phenomena of Compton scattering, Photoelectric effect, and so forth, take

place due to the particle nature of photons. Further and most importantly, then how do $h\nu / c$ and $h\nu$ succeed to explain these phenomena?

2 PRESENT INTERPRETATION OF PHOTON

As the electrons possess spin motion too along with their linear motion, they possess energy $= E_K$ (kinetic energy) + E_S (spin energy) = E_M (motional energy) (for detail information, see Sec. 2.2, Ref. 2). And therefore, the orbiting electrons possess energy = E_K + E_S + P.E. (potential energy) = E_M + P.E.

When an orbiting electron is excited, during its excitation, the radiation energy is filled in the orbiting electron. And reaching at its excited energy state E_f, the orbiting electron suddenly contracts (shrinks), and emitting the radiation energy, which was filled in it during its excitation, collectively all together at a time in the form of a bundle (or quantum) the electron transits back to its lower energy state E_i (for detail information, see Sec. III B, Ref. 3). The emitted bundle of radiation energy (i.e. photon) happens to be $\equiv$ P.E. of the orbiting electron at its energy state E_f - P.E. of the orbiting electron at its energy state E_i (for detail information, see Sec. III F, Ref. 3). And the energy = E_M of the orbiting electron at its energy state E_f - E_M of the orbiting electron at its energy state E_i is imparted to the emitted bundle of radiation energy as its energy E_M $(= h\nu)$ [for detail information, see Sec. III E, Ref. 3]. The energy $h\nu$ enables the bundle of radiation energy to travel with velocity c, spin with frequency ν, scatter electron in the Compton scattering, and eject electron penetrating into metals in the photoelectric effect, and so forth.

Therefore: a photon = a quantum of radiation energy + energy $h\nu$,

where,

● **Quantum of radiation energy:** It constitutes the photon, and provides the particle like physical existence and the rest mass $m_{ph}(\approx 3.38\times 10^{-36}Kg)$ to photon. (For mathematical proof of $m_{ph}\approx 3.38\times 10^{-36}Kg$, see Sec. IV B, Ref. 3. And for verification that the photons possess rest mass (m_{ph}), see Ref. 4.]. It provides intensity, in accordance as the amount of radiation energy contained in quantum, to the spectral lines (see Sec. III F, Ref. 3) and the fine lines of the fine structure of spectral lines (see Sec. III K, Ref. 3) in the spectroscopic phenomena, to the bright interference fringes (see Sec. 3.2, Ref. 1) and the bright diffraction bands (see Sec. 3.3, Ref. 1) in the phenomena of interference and diffraction respectively.

● ***ν* :** It is the frequency of spin motion of photon. As the photon is emitted from the orbiting electron (which possesses spin motion), the photon derives spin motion from that orbiting electron (for verification of its truth, see Sec. I A, Ref. 3). The frequencies of spectral lines (see Sec. III E, Ref. 3), fine lines of the fine structures of the spectral lines (see Sec. III I and III K, Ref. 3), and interference fringes (see Sec. 3.2, Ref. 1) are happened to be the frequencies of the spin motion of photons.

● ***hν* :** It is the motional energy E_M $(=E_K+E_S)$ of photon (see Sec. III E, Ref. 3). It enables the photon to travel with velocity c, spin with frequency ν, scatter electron in the Compton scattering and eject electron in the Photoelectric effect penetrating into metals, and so forth.

● **a quantum of radiation energy + energy *hν* :** It is the total energy of photon (for detail information, see Sec. III G, Ref. 3).

Further,

● ***hν*/c associated with photons:** It is the spin momentum (p_S) of photon, not the linear momentum of photon (p_{LIN}). Because, the spinning particles possess p_S (for confirmation of its truth, see Sects. I C and I D, Ref. 3), and further, as photons possess spin motion and the momentum $h\nu/c$ varies as ν of photon varies, $h\nu/c$ should be the p_S of photon. However, in all the phenomena, $h\nu/c$ is used as the linear momentum of photon, and it succeeds to explain all the phenomena. Why and how, that is as follows:

As the photons possess spin motion, because of the first property generated in them due to their spin motion, they travel always along the directions of their respective L_S (for detail information, see Sec. 2.1, Ref. 2) And because of the second property generated in them due to their spin motion, they possess always the motional energy E_M $(= E_K + E_S)$ and the motional momentum p_M $(= p_{LIN} + p_S)$ (for detail information, see Sec. 2.2, Ref. 2).. But, as the photon moves always with constant velocity c (according to the postulate of the theory of relativity), the E_K and p_{LIN} of photon become constant. And further, as the rest mass of photon (m_{ph}) happens to be extremely small, and the frequency of its spin motion (ν) increases very rapidly as its energy increases, in p_M $(= p_{LIN} + p_S)$ of photon, the p_{LIN} $(= m_{ph}\, c)$ of photon probably becomes negligibly small as compared to its p_S. And consequently, wherever the momentum of photon is needed to use, $h\nu/c$ (i.e. p_S of photon) is used, and it succeeds to explain all the phenomena. But, in E_M $(= E_K + E_S)$ of photon, the E_K $(= m_{ph}\, c^2/2)$ of photon probably does not become negligibly small as compared to E_S of photon because of having c^2 in $m_{ph}\, c^2/2$, And hence, wherever the energy of photon is needed to use, $h\nu$ .is used.

3. IMPORTANCE OF THE PRESENT INTERPRETATION OF PHOTON

The present interpretation of photons enables us to give very clear and complete explanation of all the phenomena related to them. Below is a list of some of the related important phenomena included in this study: 1. Phenomena of interference and diffraction (see Sec. 3.1, Ref. 5); 2. Phenomena of spectroscopy (see Sec. 3.2, Ref. 5).

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REFERENCES

1. Kunwar Jagdish Narain, Understanding interference and diffraction of photons and electrons: A new approach, vixra: 1709. (Quantum Physics), http://vixra.org.
2. Kunwar Jagdish Narain, Why electrons and nucleons possess persistent spin motion, vixra: 1512.0331 (Quantum Physics), http://vixra.org.
3. Kunwar Jagdish Narain, A new interpretation to quantum theory, Phys. Essays 22 (2009) p. 47. Also available at http://physicsessays.aip.org.
4. Kunwar Jagdish Narain, Rest mass of photon cannot be equal to zero, vixra: 1601.0152 (Quantum Physics), http://vixra.org.
5. Kunwar Jagdish Narain, A new quantum theory, vixra: 1512.0327 (Quantum Physics), http://vixra.org.