REST MASS OF PHOTON CANNOT BE EQUAL TO ZERO

Kunwar Jagdish Narain [a] [b]

(Retired Professor of Physics)

Currently, the rest mass (m_0) of photons has been assumed to be = 0. Otherwise, according to expression $m_{mov} = m_0 / \sqrt{(1 - \mathrm{v}^2 / c^2)}$, the moving mass ($m_{mov}$) of photons becomes infinite, because the velocity of photons (v) has been assumed to be = c (constant) according to Einstein's postulate of theory of relativity. Since the moving mass (or any type of mass) of photons (or of any particle) cannot be infinite, their rest mass has been assumed to be = 0. But the current assumption cannot be true. Because, there are several evidences and plausible arguments to prove that the photons possess some finite rest mass. And therefore, presently a plausible solution has been determined such that the moving mass of photons may not become infinite despite they possess some finite rest mass.

[a] kjnarain@yahoo.co.in; kjn.jaiswal@gmail.com
[b] Former address: Physics Department, Govt. Bilasa Girls P.G. (Autonomous) College, Bilaspur (C.G.) 495001, INDIA

1. INTRODUCTION

Currently, the rest mass (m_0) of photons has been assumed to be = 0. Because, according to Einstein's postulate of theory of relativity, since it has been assumed that the photons move with constant velocity c and nothing can move with velocity > c, if some rest mass m_{ph} is assigned to photons (i.e. $m_0 = m_{ph}$), their moving mass (m_{mov}) becomes infinite according to expression $m_{mov} = m_0 / \sqrt{(1 - \mathrm{v}^2 / c^2)}$. Since the moving mass (or any type of mass) of photons (or of any particle) cannot be infinite because practically it can never be possible, the rest mass of photon (m_{ph}) has been assumed to be = 0.

But the current assumption cannot be true. Because, there are several evidences (see Sec. 2) and plausible arguments (see Sec. 2.2) to prove that the photons possess some finite rest mass. And therefore, presently a plausible solution has been determined such that the moving mass of photons may not become infinite despite they possess some finite rest mass (see Sec. 3).

2. EVIDENCES AND PLAUSIBLE ARGUMENTS TO PROVE THAT THE PHOTONS POSSESS REST MASS

2.1 Evidences to prove that the photons possess rest mass

1. No escaping of light from the black holes verifies the truth of the rest mass m_{ph} of photons.

   Black holes have very strong gravitational force and they do not let even the photons to escape from them means, the photons possess some finite rest mass and they are attracted by the black holes due to very strong gravitational force on them (photons). For further confirmation that the photon possesses rest mass, we can see also Sec. I D, Ref. 1.

2. Photons possess rest mass $\approx 3.38 \times 10^{-36} Kg$ (for its mathematical proof, see Sec. IV B, Ref. 1).

2.2 Plausible arguments to prove that the rest mass of photons cannot be equal to zero

As we know/assume, the photons travel as particles with velocity c, scatter electrons colliding with them in Compton scattering and eject electrons in photoelectric effect penetrating into metals etc., these phenomena can be possible only if: 1. The photons exist physically and, as photons are interpreted to be the bundles of radiation energy, their bundles of radiation energy provide physical existence and the rest mass (m_{ph}) to them, similarly as a bundle of charge (-e), which (-e) is actually a bundle of electric energy, provides particle like physical existence and the rest mass m_e to electron. 2. The photons obtain some energy from their source, i.e. the orbiting electrons, to enable them to move with velocity c, scatter electrons colliding with them in Compton scattering and eject electrons in photoelectric effect penetrating into metals etc., similarly as some energy is needed for electrons to make them to travel, e.g. in their beams etc.

The above conclusion, i.e., as photons are defined to be the bundles of radiation energy, their bundles of radiation energy provide physical existence and the rest mass (m_{ph}) to them cannot be ruled out. Because, as, according to mass-energy equivalence principle of the theory of relativity, the matter is transformed into energy in equivalence to that's mass, that's mass is not being transformed into energy, if the mass of the transformed energy somehow is measured, that shall be found to be equal to the mass of the matter. And therefore, the bundles of radiation energy of photons too should have some rest mass m_{ph} .

3. DETERMINATION OF A SOLUTION SUCH THAT THE MOVING MASS OF PHOTONS MAY NOT BECOME INFINITE DESPITE THEY POSSESS SOME REST MASS

In order that the current interpretation of photon (see Sec. 1.1.2, Ref. 2) may explain the phenomena of Compton scattering etc., the moving mass $h\nu / c^2$ has been assigned to photons. But in $h\nu / c^2$, since every term h, ν and c has finite value, $h\nu / c^2$ should also be finite, while if substituting the rest mass of photon (m_0) to be = 0 in expression $m_{mov} = m_0 / \sqrt{(1-\mathrm{v}^2 / c^2)}$, the moving mass m_{mov} of photon is obtained to be indeterminate. It means, there is some error/mistake, either in the Einstein's postulate or in expression $m_{mov} = m_0 / \sqrt{(1-\mathrm{v}^2 / c^2)}$ or in $h\nu / c^2$. Where and what is error/mistake, in order to determine that, let us try to examine the expression $m_{mov} = m_0 / \sqrt{(1-\mathrm{v}^2 / c^2)}$ [see Sec. 3.1] and the Einstein's postulate [see Sec. 3.2]

3.1 Examination of expression $m_{mov} = m_0 / \sqrt{(1-\mathrm{v}^2 / c^2)}$

The expression $m_{mov} = m_0 / \sqrt{(1-\mathrm{v}^2 / c^2)}$ is true. But in this expression, m_{mov} is not the moving mass of particle having rest mass m_0 and moving with velocity v, as currently being defined. The m_{mov} is actually the effective mass of particle generated as the consequence of superposition of the effect of spin motion of the particle on that's rest mass. Because, as we know, electrons (for which the truth of expression $m_{mov} = m_0 / \sqrt{(1-\mathrm{v}^2 / c^2)}$ has been verified), protons etc. all the matter particles possess spin motion along with their linear motion, they possess spin energy (E_S) and spin momentum (p_S) corresponding to their spin motion as they possess kinetic energy (E_K) and linear momentum (p_{LIN}) corresponding to their linear motion, and hence possess motional energy E_M = E_K + E_S and motional momentum p_M = p_{LIN} + p_S (for detail, see Sec. 2, Ref. 3). In the expressions E_M = $E_K + E_S$

and $p_M = p_{LIN} + p_S$, if superposing the effects of E_S and p_S of the particle on its E_K (= $m\mathrm{v}^2/2$) and p_{LIN} ($= m\mathrm{v}$) respectively (where m and v respectively are the mass and the linear velocity of the particle) we try to write down the expressions for E_M and p_M of the particle in terms of its kinetic energy and linear momentum respectively, the expression shall be as: $E_M = m_{eff}\mathrm{v}^2/2$ and $p_M = m_{eff}\mathrm{v}$ respectively. The energy $m_{eff}\mathrm{v}^2/2$ and the momentum $m_{eff}\mathrm{v}$ shall produce the same effects as the energy E_M and the momentum p_M respectively shall produce. The term m_{eff} is the effective mass of particle. The effect of the spin motion of particle in fact does not increase the mass of the particle but increases the effect of that's mass m to $m_{eff} = m_{mov}$. The relativistic kinetic energy E_K = $[m_e c^2/\sqrt{(1-\mathrm{v}^2/c^2)}] - m_e c^2$ and the relativistic linear momentum $p_{LIN} = m\mathrm{v}/\sqrt{(1-\mathrm{v}^2/c^2)}$ of electrons are actually their $E_M = m_{eff}\mathrm{v}^2/2$ and $p_M = m_{eff}\mathrm{v}$ respectively obtained as the consequence of superposition of the effects of E_S and p_S of electrons on their E_K and p_{LIN} respectively. [How these are obtained, see starting from the last but one paragraph (column-1, page-69) to the end of Sec. IV C, Ref. 1.]

3.2 Examination of Einstein's postulate

If we look at the graph of Bertozzi[4] between v^2/c^2 and $kinetic\,energy/mc^2$ (= E_K/mc^2) of electron, Fig.1, on the basis of which the truth of Einstein's postulate has been confirmed, no doubt, the rate of increase in v^2/c^2 goes on decreasing as E_K/mc^2 increases. After $E_K/mc^2 = 5$, the tendency of the rate of increase in v^2/c^2 becomes very slow, and after $E_K/mc^2 = 25$, the tendency becomes very-very slow, and beyond that, the tendency may become extremely slow, can say $\to 0$. But it does not lead to confirm that v^2/c^2 can never be > 1. It (v^2/c^2) can be > 1. Because the rate of increase in v^2/c^2 can never be = 0 as long as E_K/mc^2 goes on increasing. It is possible that v^2/c^2 may become > 1 at very-very large or can say at extremely large E_K/mc^2, but the possibility of becoming v^2/c^2 >1 cannot be ruled out.

Secondly, electrons and photons both possess spin motion and their velocity varies as their frequency of spin motion varies (for verification of its truth for electrons, see Sec. I A, Ref. 1; and for photons, see Sec. IV B, Ref. 1). And hence, as, after attaining relativistic velocity by the electrons when the rate of increase in their v^2/c^2 starts decreasing, their frequency of spin motion starts increasing in order to conserve E_M, p_M and L_S of electrons, their mass does not start increasing in order to conserve their E_K and p_{LIN}, because electrons possess E_M, p_M, L_S and hence E_M, p_M, L_S of electrons should be conserved, not only their E_K and p_{LIN} (for detail, see Sec. 5.4.1, Ref. 2). Similarly, in order to conserve E_M, p_M, L_S of photons, their frequency of spin motion (ν) should start increasing. (The ν is in fact the frequency of spin motion of photons, not frequency of their wave nature. For its confirmation, see Sec. I A, Ref. 1.) As we know, the frequency of spin motion of photons increases, and therefore, in order to conserve E_M, p_M, L_S of photons, the velocity of photon cannot remain constant, i.e. v^2/c^2 cannot be = 1. It should increase, though the tendency of the rate of increase may be extremely slow, can say $\to 0$. The increase in v^2/c^2 can be possible, because c is the velocity of photons of visible light, and the velocity (v) of photons of ultraviolet rays, X-rays and γ-rays may be greater than c. The tendency of the rate of increase in v^2/c^2 of their photons may be extremely slow, can say $\to 0$.

3.3 Determination of solution

When m_{mov} is not the moving mass but it is the effective mass, secondly, the velocity of photons varies with the frequency of their spin motion (see Sects. IV A and IV B, Ref. 1.), and thirdly, the velocity of photons of ultraviolet rays, X-rays and γ-rays may be greater than c, in the expression $m_{mov} = m_0 / \sqrt{(1 - \mathrm{v}^2 / c^2)}$, c can be replaced by c_1, where c_1 is a highest possible hypothetically assumed value of velocity of any particle, very-very close to c but > c and also > the velocity of photons of γ-rays. If c is replaced by c_1, all the problems are resolved.

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FIGURE CAPTION

Fig. 1: Variation of v^2 / c^2 of electrons with respect to their $kinetic\, energy / mc^2$.

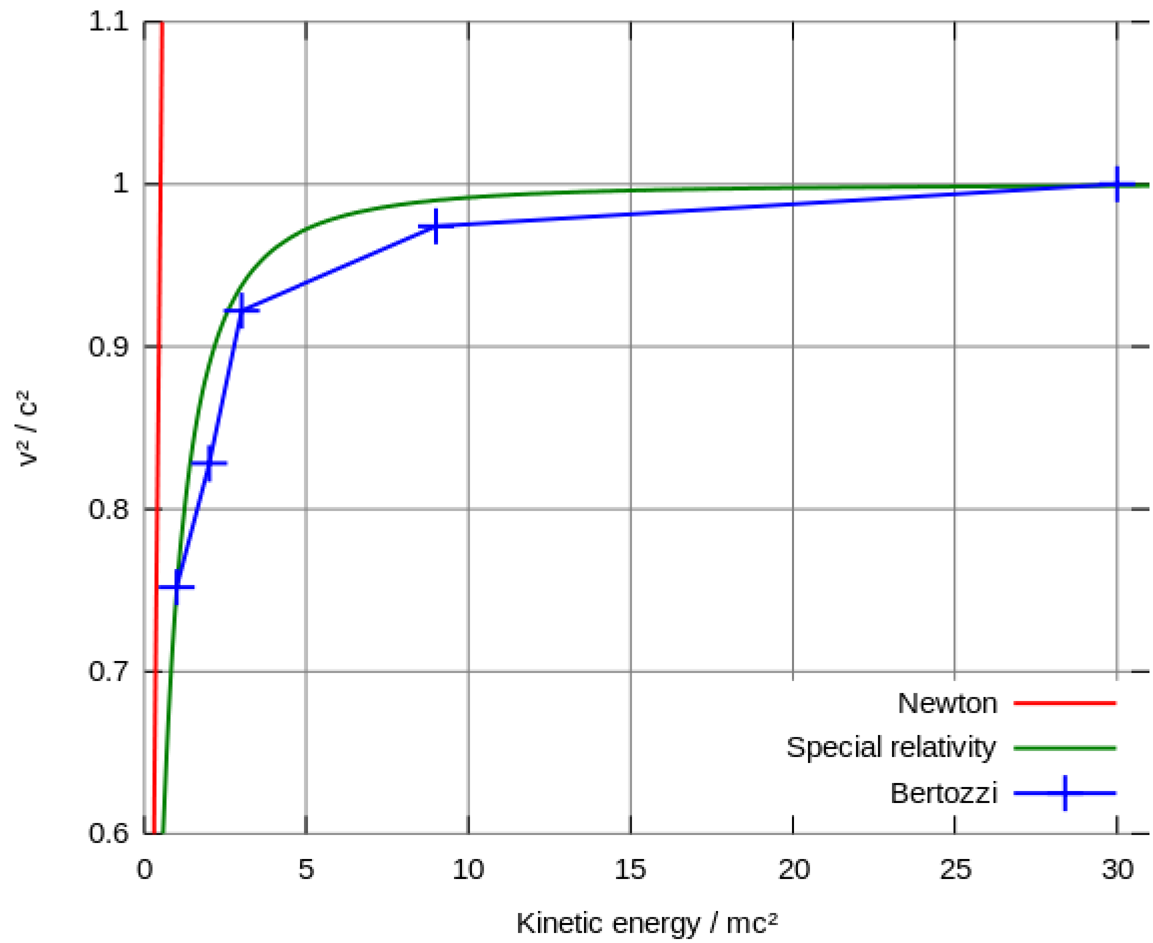
1.1
1
0.9
0.8
0.7
0.6
0
5
10
15
20
25
30
v² / c²
Kinetic energy / mc²
Newton
Special relativity
Bertozzi

Fig. 1