IOSR Journal Of Applied Physics (IOSR-JAP)
e-ISSN: 2278-4861.Volume 15, Issue 2 Ser. II (Mar. – Apr. 2023), PP 09-16
www.Iosrjournals.Org

Two Different Energies of the Photon

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Abstract: *In this research work it has been theoretically proved that the "Photon", the ray of electromagnetic radiation, in fact comprises of two different types of energies. Precisely one half of the energy carried by the Photon is the kinetic energy, the energy due to its motion and the other half of its energy is nothing but, its content; its electromagnetic energy itself. Corresponding formulae to find these two different energies of the Photon have also been discovered and are presented in this treatise.*

Key Words: *Photon, Photon Energies, Different Energies of the Photon, Frequency based kinetic energy equation, Electromagnetic Energy, Kinetic Energy, Energy, Frequency, Wave Length, Light ray, Velocity of Light;*

Date of Submission: 14-03-2023 Date of Acceptance: 05-04-2023

I. Introduction

Although the modern science is very advanced, it is unfortunate that still we are not aware of many things in the universe and one such thing is the nature of the Photon [**Ref. 1**], the ray of electromagnetic radiation and many of its related facts. The fact is that we know only few things about the Photon. The modern science knows that the Photon is a bundle of "electromagnetic energy" and the total energy of the Photon is given by E = h. f, the famous equation [**Ref. 2**] of Max Planck, where "h" is the Planck's constant and "f" is the frequency of the Photon.

But, unfortunately we don't know about the photon in full! We don't know what the Photon constitutes of? Does the Photon carry more than one kind of energy? If so, what are the different types of energies carried by the Photon? It is well known that an object under motion certainly has kinetic energy. So, what is the share of the kinetic energy of the Photon in its total energy? Given that "the Photon is a bundle of electromagnetic energy", what is the share of the electromagnetic energy carried by the Photon in its total energy? First of all, is it possible to differentiate these different energies carried by the Photon, precisely? How to measure or find these different energies on the Photon using mathematical equations or otherwise? These are the few basic questions among the many unknowns to us. This research work is aimed at these basic questions and will try to answer some of these age old questions, which are still unsolved.

Before we proceed to discuss on this research work, let's briefly see some more facts on the modern understanding of the "Photon"; "what the Photon is and what it constitutes". According to the modern scientific knowledge, the photon [**Ref. 1**] is the "quanta of light", the smallest part or particle of light; it is a bundle of energy, specifically electromagnetic energy that has the maximum and constant velocity in the Universe and in free space as per the postulates of special relativity. The speed of the photon in free space, usually represented by the symbol "c" is nearly equal to $3*10^8$ meters per second. The conventional wisdom is that the Photon exhibits *dual nature*, it behaves like a particle, as well as a wave.

Although the "photon" has no rest mass, it has momentum due to its high speed, the modern Physics believes. The energy of the Photon could be determined by the famous equation [**Ref. 2**] defined by Max Planck, which has been mentioned already. He predicted that the energy of the photon is directly proportional to the frequency of the photon. Again Einstein had proved that the rest mass of an object or a particle could be converted to energy [**Ref. 3**]. It implies that the mass could be converted to "photons" of electromagnetic radiation and the reverse is also possible.

The conventional Physics believes that the energy of the Photon could be represented by the famous equation of Max Planck, E = h. f. But, till today there is no scientific evidence to show that the energy of the "photon" has different kinds or shades in it, although it is believed that the Photon has some kinetic energy as well, mostly due to its very high speed apart from its electromagnetic energy but, this belief hasn't been proved until now. In fact, this belief has been proved in this research work at last.

Fortunately, this research work fulfils this task by theoretically proving that the energy of the "photon" is of two distinct kinds. Half of the photon's energy has been proved to be its kinetic energy and the other half energy is its content; the electromagnetic energy of the Photon itself. Mathematical equations are also presented in this treatise to find these two different energies of the photon precisely.

II. Two Different Energies of the Photon

As it has been mentioned already, the conventional belief is that the Photon carries some energy, specifically electromagnetic energy, as predicted by the famous equation of Planck, E = h. f; where "h" is the Planck's constant and "f" is the frequency of the photon. But, until now, there is no scientific (mathematical or empirical or otherwise) evidence to show that the "photon" could comprise of more energy types. Interestingly, this theoretical research work throws new light on the different energies of the energy packet, "Photon". This research work proves that the "photon" carries two different types of energies on it as it has been guessed and believed all these days. One half of it is kinetic energy, the energy due to its tremendous speed and the other half of it is nothing but, its content, its electromagnetic energy itself. Now, let's move on to explore and prove these photon's energy types in the following sections by means of mathematical and logical analyses as well.

Recently, a novel kinetic energy equation has been discovered and reported in the scientific literature [**Ref. 4**], which doesn't contain any of the terms: mass, velocity and momentum of the body under motion. That novel kinetic energy equation is based upon the ***frequency*** of the body under motion and it has been discovered by Indian researcher ***Mr. Bhargava Kotur***, recently. The ***frequency based kinetic energy (K. E) equation*** is given below; here, "h" is the Planck's constant and "f" is the frequency of the particle or body under motion.

$$\mathbf{K.\,E = (h.\,f)/2}$$

This current research work uses the above novel *kinetic energy equation based upon frequency* in order to differentiate the energies of the Photon. Hence, we will take a look at the derivation of the above novel equation in order to make the concepts of this work easier to present and understand as well. The following derivation is taken from that published research work [**Ref. 4**] with minor changes.

II. 1 Frequency Based Kinetic Energy Equation:

De Broglie had discovered a famous equation *eq.1*, which describes the wave length of a particle under uniform motion, now known on his name as the de Broglie wave equation [**Ref. 5**]. This equation predicts that if a particle is under uniform motion, then it should move as a wave rather than following a straight line path. De Broglie had derived his equation, eq. 1 to predict the wave length of such a particle. The ʎ - in the equation represents the wave length of the particle in motion, m is its mass, v is the velocity of that particle and h is the famous Planck's constant. The de Broglie's equation follows.

$$\lambda = h / m.v \qquad \textbf{EQ. 1}$$

The following figure *fig. A* depicts the path of a moving particle under uniform velocity as claimed by de Broglie. The dark circular point on the right side is the ***particle*** under motion, the arrow mark indicates its direction of motion, the dark ***wave like path*** is the path traced by the moving particle and the straight line is a hypothetical line that passes through the mean points of the ***wave***. Note that this figure is not to scale.

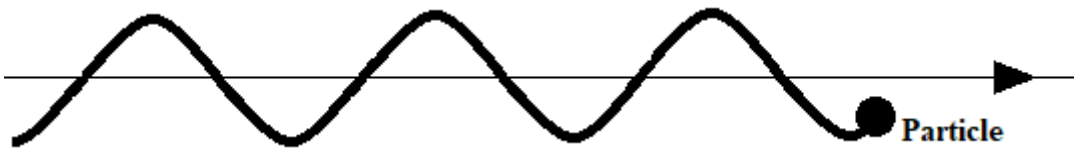

Fig. A - Particle Under Uniform Motion

On the other hand, the velocity of a wave under uniform motion with velocity "v", having wave length "**ʎ**" and frequency "f" is given by the following equation [**Ref. 6**].

$$\mathbf{V = f.\,\lambda} \qquad \textbf{EQ. 2}$$

The above equation is equally valid for a particle moving like a wave (*fig. A*) or to a moving particle (*fig. A*) in general (this is because, a moving particle moves not in a straight line, but like a wave according to the above

said de Broglie wave equation) under uniform motion with velocity v, frequency f and having wave length ʎ given by the de Broglie wave equation, already mentioned before.

This implies that for a particle under uniform motion, the wave length "ʎ" represented by the equation eq. 2 is the same as the wave length "ʎ" represented by the equation eq. 1. So, now, substitute the ʎ present in the equation eq. 1 in the eq. 2 as follows. Please note that both, the "V" and "v" represent the velocity of the ***particle – wave*** in these equations hence, both imply the same.

$$\mathbf{V = f. \{ h / m. v \}}$$

Rearrange the terms in the above equation as follows;

$$\mathbf{m. v. v = h. f}$$

Divide both sides of the above equation by "2" as given below;

$$\mathbf{(m. v. v) / 2 = (h. f) / 2}$$

Now, the left hand side of the above equation is nothing but, the equation for kinetic energy [**Ref. 7**] of a body under uniform motion. Hence, the below given equation follows, where K. E is the kinetic energy.

$$\mathbf{K. E = (h. f) / 2 \quad OR \quad K. E = 1 / 2 . h. f \quad EQ. 3}$$

The above equation is a novel and different equation for the kinetic energy of a body or particle under uniform motion. This novel kinetic energy equation is based upon the frequency of the body or particle under motion. It is interesting to note that the above equation defines and predicts the kinetic energy of a particle without involving mass and velocity of the particle or body under motion. More on this novel kinetic energy equation is available in the research work [**Ref. 4**] already published by Indian researcher ***Mr. Bhargava Kotur***.

II. 2 Kinetic Energy of the Photon:

Having derived the novel equation for the kinetic energy of a particle under uniform motion based upon its frequency of motion, in the above section, now we will proceed with our task of differentiating the energy carried by the Photon using the above derived equation.

The above novel kinetic energy equation based upon frequency of motion is applicable in general to any particle or body under uniform motion with a defined frequency. In this context it should be noted that the electromagnetic rays or "Photons" exhibit dual nature; they are both waves and particles as well according to the modern science. The great scientist Albert Einstein had proved the particle nature of photons in his famous work on the photo-electric effect. Hence, there is no doubt that the photons are also particles moving under uniform velocity and defined frequency. So, the novel kinetic energy equation derived above is applicable not only to moving matter particles but, it is equally applicable to the photons as well without any exception.

Speaking in a different way; the way in which 1 / 2 * m * v * v - is related to the material (matter) objects and particles, in the same way, h * f / 2 - is related to wave like moving particles. The former formula describes the kinetic energy of the moving material (matter) objects and particles and the later, the kinetic energy of wave like moving particles. So, the later one is applicable to the Photons as well.

Now, the famous Planck's equation [**Ref. 2**] for the total energy (E) of a "photon", the ray of electromagnetic radiation is given by the following equation.

$$\mathbf{E = h. f \quad EQ. 4}$$

In the above equation, "f" is the frequency of the Photon, "h" is the Planck's constant and E is the energy of a single "photon". From the above equations, eq. 3 and eq. 4 it follows that;

$$\mathbf{K. E = 1 / 2 * E \quad EQ. 5}$$

From the above equations eq. 4 and eq. 5 it follows that, the energy of a photon that is not kinetic energy, the non – KE is given by the following equation.

Non – KE = 1 / 2 * E EQ. 6

The above equations eq. 4, eq. 5 and eq. 6 simply indicate that there are two different halves in the energy of the "photon", on every single particle of the electromagnetic radiation. One half is the kinetic energy, KE and the other half is "unknown" type, it is the "other energy" of the photon. The other energy that is not part of the kinetic energy, we call this simply as "non – KE" or non – kinetic energy.

From the eq. 3 and eq. 4 we know that the KE is one half so, it follows that the other half, non – KE should be equal to the KE from the eq. 4 that gives the total energy of the Photon. Already, the KE has been defined in the equation eq. 3. Hence, the non – KE is as given by the equation below.

Non - K. E = 1 / 2 * h. f

Please note that, in the previous section, the kinetic energy, KE has already been proved as;

KE = 1 / 2 * h. f

So, the total energy E of a single "photon" is the addition of the above TWO different halves of energies as given below.

Total energy of a photon, E = K. E + non – KE EQ. 7

The above equation in its expanded form is given by the following equation;

E = 1 / 2 * h. f + 1 / 2 * h. f = h. f EQ. 8

This is nothing but, the Planck's energy equation, E = h. f, as it has been already mentioned in the equation, eq. 4 earlier, which describes the total energy of the Photon.

From the eq. 5 it follows that the total energy of the photon, E is as follows.

Total Energy, E = 2 * K. E EQ. 9

So, the above equation simply implies that the total energy "E" of a single photon is TWICE of its kinetic energy, but, what does it mean?

The above equations imply that, on the ray of light; that is on the single "photon", the energy due to its motion, the kinetic energy (KE) is one half of the total energy of the Photon and the other half energy on the "photon", the non - KE is simply not defined by the ***mathematical part of this research work***. At this point, we are not sure, what this second half [non - KE] of the photon's energy is, unfortunately. It could be (*due to*) its content (mass, might not be rest mass) or something else. The above equations give no clarity on this point.

Although we know the Photon carries *the electromagnetic energy*, here, we can't simply equate the second part of the photon's energy to the "electromagnetic energy". This is due to the fact that, we are not sure that there ***only*** two types of energies on the Photon. If we could decipher that there are only two energy types on the Photon, then our task would have been very easy because, in this case the second half should be the *electromagnetic energy*. We find no such information or even no clue from the above equations, unfortunately. Note that the Planck's equation eq. 4, simply describes the total energy of the Photon and not about the types of energies carried by the Photon.

Stressing again, this first part, the mathematical research work merely indicates this; on the (*single*) Photon there are two different halves of energies, one half is the kinetic energy (KE) and the other half is just "unknown" and it is not addressed by the mathematical part of this research work, unfortunately.

One important point to note in this context is that the *non- kinetic energy* part present on the "photon" might be or might not be of a single type. It could have many different types or shades in it and we are not sure of it, at this point. We don't have any scientific evidence or clue on this issue in a mathematical or empirical manner to make conclusion on the second half of the energy of the Photon that it is of a single type. Still it remains unanswered here but, we will explore and resolve this issue in the next section.

But, it is obvious that the second half of the energy of the "Photon" should be related to its "*electromagnetic energy*". This is because, according to the conventional Physics, the "Photon" is a bundle of electromagnetic energy. Hence, the photon's energy can't be without it. It is highly probable that the second half of the photon's energy or ***a part of it*** – at least should be its content, the ***electromagnetic energy*** itself. The next section will explore this issue in detail and will make a conclusion finally.

But, this mathematical research part is successful in finding out that there are two different halves of energies on the Photon itself. As it has been stated already, one half of the energy is due to its velocity, in the form of kinetic energy and the other half of it is simply "we don't know" or it is unknown. Only one side of the moon is explored and the other half still remains to be explored! But, it will be explored in the next section.

However, if you could prove that there are not any more than two types of energies on the Photon, then our work is done and thereby it would be proved that the photon carries *only* two energy types, kinetic energy and electromagnetic energy, both being equal in magnitude. This will be explored in the next section.

Apart from the logic presented earlier, we could prove the above fact in a different way by using the logic presented below and using the novel equation eq. 11 given below. Again the derivation of the equation eq.11 is taken from the work on the *kinetic energy equation based on frequency* [**Ref. 4**], which we had discussed already.

When the velocity "v" of the particle under consideration is equal to the velocity of light "C", then the earlier equation eq. 2 could be written as follows [**Ref. 8**].

$$\mathbf{C = f.\ \lambda} \qquad \mathbf{OR} \qquad \mathbf{f = C / \lambda} \qquad \mathbf{EQ.\ 10}$$

Using the equation, EQ. 10 in the equation EQ. 3, we get the following equation;

$$\mathbf{K.E = 1/2 * h.C/\lambda} \quad \Rightarrow \quad \mathbf{K.E = 1/2\{h.C/\lambda\}}$$

$$\Rightarrow \quad \mathbf{K.E = h.C/2.\lambda} \qquad \mathbf{EQ.\ 11}$$

The above equation eq. 11 could be used to prove the same fact derived earlier (in section II. 2, regarding *the two different energies of the photon*) but, of course the above equation is similar to the equation eq. 3, which has been used in the earlier explanation. But, it uses the wave length of the "photons" rather than their frequency. Hence, the equations will involve the wave length rather than the frequency of the photon.

In this section, we had left unanswered and unexplained, the second half of the energy of the photon. But, in the next section a solution is proposed to this unsolved mystery using meticulous arguments in a logical way, but not mathematically as it has been done earlier. This is due to the fact that there are no available mathematical tools or equations in order to handle and complete this task, unfortunately.

II. 3 Non – Kinetic Energy of the Photon:

Note :- the words - *properties, traits, behaviours – are used in a similar sense* in this section; here, no strict discrimination is possible!

In the preceding sections, we have left without throwing any light on the second half of the energy of the photon, due to lack of suitable and sufficient mathematical equations. However, it is possible to find answers to the questions; "*what the second half of the energy of the photon could be*?" and *"are there more than two kinds of energies on the Photon?";* by means of intelligent logic and hopefully accurately as well. This section tries to answer these baffling questions using logical assumptions but, not using precise mathematical equations, unfortunately - due to lack of such facility, as mentioned already.

At this juncture it is interesting to note that, if we could prove that the Photon has only two types of energies, then our work is done; we get answer to both of the above questions, in a single shot. This is because, if the photon has only two kinds of energies and already one kind has been proved to be the kinetic energy (KE), it is obvious that the second kind of the energy of the photon should be its "electromagnetic energy". This is due to the fact that the photon is a bundle of electromagnetic energy – according to the modern understanding of Physics and hence, the photon can't be without it.

Stressing again, what all we have to do is this: If we could prove that there are ONLY two types of energies on the Photon then we are done with the kinds of energies of the photon. Otherwise, if we could prove that there is no possibility for the presence of third kind of energy on the Photon, it implies that the photon has only two

kinds of energies and our work is done. Also with this we are done with the measurement of these two different kinds of energies as well, from the two different and similar equations we had derived already, one for the KE and the other one for the non – KE of the Photon.

As it has been mentioned already, the modern science believes that the photon is a bundle of *electromagnetic energy*. Interestingly this research work is successful in making a differentiation of the energy of the Photon. One part of it, the kinetic energy part of the photon, evidently has no "electromagnetic" energy. Hence, the non - kinetic energy part of the "photon" should be related to the *electromagnetic energy* and this is obvious. Here it should be noted that, at least a part of the second half of the energy of the Photon should be (or should be related to) the electromagnetic energy, if not the entire second half. This will be explored below.

In the conventional physics, it is a well-known fact that the matter particles, the particles having rest mass, while in motion have only two kinds of energies. I. e., the ***matter wave*** has two kinds of energies like this;

ONE - is the ***Energy due to its motion***, the kinetic energy defined by the equation, $KE = 0.5mv^2$

TWO - is the ***energy due to its content*** (mass); rest mass specifically; given by the Einstein's equation, $E = mc^2$;

Of course, these two might demand the relativistic factor [**Ref. 9**] at high velocities.

Please note that, a particle, having rest mass, has these TWO types of energies ***only***, while in motion and it has no other kind of energy on it. Here, the KE includes the rotational energy (if any) as well.

If a similar logic applies to the "photons" as well, then the Photon too has ***only*** two types of energies as follows.

ONE – ***energy due to its motion***; Kinetic Energy, given by the *frequency based kinetic energy equation*, eq. 3.

TWO – ***energy due to its content***; of course, here *content* is not *mass* (not rest mass specifically) unlike in the case of the matter particles;

If the above logic is true, then there might not be a "third" kind of energy on the "Photon" and this restricts the different kinds of energies carried by the Photon to just two and this seems highly probable.

Here, in fact we use a "reverse logic" that is similar to the logic, which de Broglie had employed in order to postulate the *wave nature of matter particles* under motion. De Broglie had assumed that "*matter particles under motion might exhibit some (certain) properties or behaviours of the Photons"*. Specifically, he claimed that "*moving matter particles too could exhibit wave nature, a property of the photons*" and later on, he was proved correct.

Here, I'm proposing its reverse logic. *Photons too might exhibit some (certain) properties of the matter particles in motion*. Specifically, *the kinds of energies they carry*. If the above mentioned de Broglie's logic is correct then this reverse logic could ***also*** be correct. This is because these two logics are very near and are connected. Moreover, matter waves and electromagnetic waves have many common traits as proved by the modern Physics.

Hence, it seems that the Photon has two kinds of energies only. This implies that the second half of the energy of the Photon should be the electromagnetic energy only. This is because, already in the last section it has been proved that the one half of the energy of the Photon is kinetic energy and the modern science claims that the Photon is a bundle of electromagnetic energy. Hence, all these facts lead to the conclusion that the second half of the energy of the Photon is nothing but, the electromagnetic energy alone.

In this context it should be noted that, in the last section it has already been proved that one half of the energy of the Photon is KE and it is equal in magnitude to the second half of the energy. Just above it has been proved that there are ONLY two kinds of energies on the Photon. Hence, it is obvious that the *first kind* of the energy of the Photon should be equal in quantity [magnitude] to the *second kind* of the energy of the Photon.

Please also note that, now we could use this sentence; "first kind of energy equal to second kind of energy". But, in the last section we used "first half of the energy equal to the second half of energy". This is because, in the last section we were not sure (*even we had no indication or clue*) whether the second half of the energy is of only one kind and it has no other energies involved in it.

Hence, just like the matter particles under motion (matter waves), "photons" too might have ***only*** two types of energies as per the above logic. One kind of the photon's energy, one half of it is the ***kinetic energy*** due to its motion and the second kind, second half of its energy is its content. Here, it should be noted that in the case of the photon, its content is nothing but, its ***electromagnetic energy*** itself and nothing else. But, this is different in the case of the matter particles (*under motion*) and their energy due to their content is latent or hidden, we call it as "mass", more precisely as the "rest mass". Of course, it is convertible to other (electromagnetic, etc.,) forms of energy as proved by Albert Einstein's mass – energy equivalence principle.

Please note that the logic employed before is in fact the "reverse" - "logic of de Broglie". Around a century back, de Broglie postulated that, like the photons of light, the matter particles might also exhibit wave nature while in motion. This meticulous postulate, in fact, lead to the birth of *wave particle duality*, the concept of *matter waves* and subsequently it gave birth to the *de Broglie wave equation*, mentioned in the equation *eq.1* earlier.

What I had proposed earlier is similar to the logic of de Broglie but, it is a "reverse logic" to that of de Broglie. De Broglie extended the property (or behaviour or trait) of photons (*the wave like motion of photons*) to the moving matter particles. In this work, we are going in the other way, in reverse direction to de Broglie; the trait of the moving matter particles has been extended to the Photons.

The trait of "the matter particles under motion" carrying "two different kinds of energies" is extended to the Photons, the particles of electromagnetic energy. In other words, the trait of "the matter waves", carrying "two different kinds of energies" is extended to the Photons, the electromagnetic waves.

If matter particles carry *only two types of energies* while in motion, then the same might be true for the "Photon" particles as well. So, the photons too should carry only two types of energies; might not be more. In this way, logically it has been proved that the presence of third or higher (4^{th}, etc.,) kinds of energies on the Photon simply seems absurd.

In the modern physics, it has been established that the matter particles could take birth from the "Photons" and the reverse is also possible and proved, the photons could take birth from matter particles as well.

Hence, from the above fact(s), it is quite possible that both of them, the *matter particles under motion* or the ***matter waves*** and the ***electromagnetic waves*** are related and could share (have) some common properties (or behaviours or traits) as well at the basic level. One such property, the commonality of the ***wave nature*** of their motion has been discovered by de Broglie. Another common property of these two ***carrying two different types of energies*** is brought into light in this research work.

Hence, the "Photon" might be carrying just *two types of energies*, not any more. Just like their counter parts, the matter waves, the material (matter) particles in motion. But, the only exception is that, in the case of the Photons both these kinds of energies are exactly equal in quantity [magnitude] and this need not be true in the case of matter waves or matter particles under motion, in general.

Other than these two kinds of energies, it seems that there might not be any possibility for the existence or presence of third kind of energy on the photon. Hence, the possibility of any other (fourth, etc.,) kind of energy on the photon could safely be excluded as well.

So, the above arguments lead to this conclusion. ***The non-kinetic energy (non-KE) of the "photon" is nothing but, the "electromagnetic energy" of the photon; it is the content of the photon itself. In fact, this is the parcel or bundle of energy that a photon has and this is what basically a "photon" is; otherwise, it makes the photon actually.***

Here, it is interesting to observe that the two kinds of energies of the photon, the electromagnetic energy part and the kinetic energy part are equal in magnitude [quantity]. This fact is obvious from the equations we had derived already. As a theoretical assumption, if a photon could be at *rest* like the material particles [ex. Electron or Proton] then the only possible energy of the Photon could be its non-kinetic (the electromagnetic) energy part alone and there could be no kinetic energy part at all. Hence, it could have only half of its present energy. But, due to its motion, it seems the photon has or gains twice its "rest energy".

From the earlier section, we are already sure of the first type of energy carried by the Photon, the kinetic energy type but, the second type is a logical extension from the matter waves hence, we are not sure of the second type

completely. Nonetheless, it might not be wrong, as it implies from the above arguments and discussions. This fact is again supported by the fact that "apart from these two energy types, there seems no possibility or proof [logical or otherwise] or any other indication for the existence of a third or other kind of energy on the Photon".

Hence, the outcome of this research work is this. The Photon carries two different kinds of energies. The kinetic energy of the photon is one half of its total energy and the non – kinetic energy part is equal in magnitude to the kinetic energy. On the other hand, as it has been logically proved above the non – kinetic energy of the photon is nothing but, its "electromagnetic energy" itself. As represented by the mathematical equations these are as follows; "h" and "f" present below are the Planck's constant and the frequency of the Photon, respectively.

Kinetic Energy of the Photon = (**h. f) / 2**

Electromagnetic Energy of the Photon = (**h. f) / 2**

Non – K. E of the Photon = Electromagnetic Energy of the Photon

II.4 Scope for Further Work:

The preceding sections give birth to some interesting questions. Why the two different energies of the photon are exactly equal in magnitude? What makes them have such an equal share of energy? Is it by chance or is the photon designed precisely with such equal share of energies? Can't the photon sustain, if it has different shares of these two different energies? (*Here, C is the velocity of light in free space, as usual*) Would these two energies of the photon differ if its velocity varies in free space (not exactly C)? That is, for example, if the photon's velocity is less than the velocity of light in free space (< C), then would the two energies of the photon be the same as it was proved earlier in this research work? Or would these two energies differ? If at all they differ, which would be more; the kinetic energy or the electromagnetic energy? If they differ, why do they differ? What brings out that difference in its two kinds of energies? In such differing cases, how to compute these two energies mathematically? How the equations derived in this work will change in such cases?

On the other hand, if the velocity of the "photon" changes (not in free space, in other light media) would these two energies of the photon change in general? As it has been mentioned already, what could be the energy of the Photon if it could be at rest? Would it be just half of its energy while in motion at the velocity of C? Beside others, these are some of the interesting questions open to debate and research further.

III. Conclusions

This theoretical research work proves that the electromagnetic energy packet "photon", in fact comprises of two different kinds of energies and not just only one energy type as predicted by the Planck's equation. Exactly one half of the total energy of the photon has been proved to be its kinetic energy and the other half has been proved to be its electromagnetic energy itself. Mathematical formulae are also presented here in order to estimate these two different kinds of energies, precisely.

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