

# Conceptual Fallacies Associated with the Planck's Constant $h$ Brought to Light

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**Abstract** A thorough re-examination and analyses of the conceptual fallacies and intricacies associated with the Planck's quantum equation  $E = h\nu$  and the Planck's constant  $h$  have led to a host of startling revelation concerning  $h$ . Convincing evidences have been adduced to conclusively prove that the Planck's equation,  $E = h\nu$  is not correct one a quantum equation and that there does not exists any constant like the elementary quantum of action in nature. The elementary quantum of action attribution to  $h$  has also been shown to be not in accordance with it's definition.  $E = h\nu$  equation has been proved to be inapplicable for the determination been proved to be inapplicable for the determination of energy of photons. The falsifiability of the photons possessing linear as well as angular momentum has been conclusively proven. That The categorization of  $h$  as a universal physical constant cannot be justified by physical reasonings – it is concluded.

**Keywords:** Planck's constant,  $h$ , conceptual intricacies of  $h$ ,  $h$  defies its definition,  $h$  devoid of physical reality,  $E = h\nu$  equation inapplicable for photons,  $h$ 's universal constancy unjustifiable.

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## 1. Introduction

An incontrovertible fact concerning the Planck's constant  $h$  is that the quantum physics entails such an importance on  $h$  that quantum physics is distinctly characterized by the appearance of the elementary quantum of action  $h$  in every expressions corresponding to the energy of quantum objects. The origin of such a compulsion could be traced back to the Planck's quantum equation  $E = h\nu$ , which led him to a grand success in explaining the experimental observations of the black-body (BB) radiation. The glory of success of the Planck's quantum theory has also brought along with it a general tendency of adopting a soft tendency instead of scientific rigor in adjudging the correctness of a theory on the basis of the end results that the theory yields without taking care to prove the conceptual validity of the presumed foundational concepts the theory is based on. For over hundred years the world's physicist community have taken it for granted that the Planck's quantum theory to be irrefutable and flawless. The Serious conceptual flaws and the dimensional discrepancies that the Planck's BB radiation theory suffers from, the unjustifiability of the assumed association of energy of a harmonic oscillator with it's oscillation frequency and the real identity of  $h$  are some of the serious intricacies associated with the Planck's quantum theory which have been overlooked for over hundred years.

It would be worthwhile to summarize some of the

salient findings that emerged out in some recent studies [1,2,3,4,5,6] Ghoshal [2] has conclusively proven in his study that the root cause of all the conceptual flaws and dimensional discrepancies that Planck's BB radiation theory suffers from could be attributed to be arising as a result of the faulty quantum equation  $E = h\nu$  since this quantum equation has been formulated on the basis of a conceptually incorrect assumption – the quantum of energy that a harmonic oscillator should possess is directly proportional to its oscillation frequency. It has also been shown in that study that while a simple analysis of the Planck's BB radiation formula suggests that  $h$  should possess the dimension of energy, Planck mistakenly reported it to be possessing the dimension of that of action. It has also been proven in this study that it is the power ' $P$ ' of a harmonic oscillator which should be directly proportional to it's oscillation frequency and that the equation

$$P = b\nu \quad (1)$$

to be the right kind of quantum equation, where ' $b$ ' is assumed to be the elementary quantum of energy observable in nature. A direct proof of the correctness of this newly formulated quantum equation comes from the fact that when ' $b$ ' is substituted in place of  $h$  in the Planck's BB radiation formula the equation becomes absolutely free from all the flaws and dimensional discrepancies that it suffers from. Mention may be made in this context the works of Worsley [3], Brook [4] and Mortenson [5] where all these authors successfully modeled Planck constant  $h$  as a quantum of energy.

Instead of taking into consideration the  $\nu$  number of oscillations in a time period of one second that an electromagnetic wave executes Mortenson considered the energy element  $\epsilon$  corresponding to a single cycle of oscillation of electromagnetic wave. The author envisaged the elementary quanta of light or photons are the single cycle oscillation of light and that all photons, irrespective of their oscillation frequencies, possesses the same energy, that is  $6.6 \times 10^{-34} \text{J}$ , which the author identified as the elementary quantum of energy. The Planck's action constant  $h$  thus gets a new meaning: An elementary quantum of energy observable in nature. The author of yet another recent study [6] successfully reformulated the Einstein's photoelectric equation using the newly formulated quantum equation  $P = h\nu$ . This finding also provides yet another proof for the correctness of this quantum equation.

In addition to all the aforementioned conceptual problems concerning the Planck's quantum equation  $E = h\nu$  and its associated quantum constant  $h$  there has revealed through critical review a host of unanswered questions related to both the quantum equation  $E = h\nu$  and  $h$ . The questions are as follows: Whether the elementary quantum of action attribution to  $h$  is compatible with its own definition, how relevant it would be to correlate  $h\nu$  is and  $\hbar\omega$  in the determination of energy of quantum objects, whether the quantum equation  $E = h\nu$  is applicable for the determination of the energy quanta of photons, do photons really possess linear and angular momentum, does there exist any justification for adjudging  $h$  as the universal physical constant. Thorough analyses have been carried out in this work to find out whether quantum physics is capable of providing any satisfactory answer to these questions.

## 2. Exploring the Compatibility of the Elementary Quantum of Action Attribution of $h$ with the Definition of Action

An unsatisfactory aspect concerning the Planck's constant  $h$  is that even though  $h$  is imbued with so much importance in quantum physics and playing a crucial role in the advancement of quantum physics for over hundred years, we are still nebulous about the real physical identity of  $h$ . Leave alone the vast published literature related to quantum physics, the creator of  $h$ , Max Planck, never elaborated on  $h$ . While commenting on  $h$  he, however, described this most minute action quanta variously on several occasions: "An essential element of my theory", "the mysterious ambassador from the real world", "I should level it the 'quantum of action' or the 'element of action' because it has the same dimension as the quantity to which the principle of least action owes its name". An attempt has been made in the following through simple analysis to find out the extent to which the elementary quantum of action attribution to  $h$  is in conformity with the definition of action with the expectation that a new finding will emerged out.

In theoretical physics action is an abstract quantity that

describes the overall motion of a Physical system. Action is defined as twice the average kinetic energy of the system multiplied by the time interval between the initial and final positions under study. Since the concept of quantum of action is associated with the oscillatory motion of harmonic oscillators, we need to find out the results of application of the definition of action specifically for harmonic oscillators. We consider a simple harmonic oscillator of mass  $m$  oscillating with a frequency  $\nu$  and a time period  $\tau$ , describing on amplitude of oscillation  $a$ . We assume that the oscillator assumes a velocity  $v$  when it crosses the equilibrium point. The oscillator will then be possessing a kinetic energy  $\frac{1}{2}mv^2$  and a momentum  $mv$  at this point. Now if we choose one of the two extreme points of oscillation and the equilibrium point to be the two positions then the action possessed by the oscillator between these two positions could be evaluated making use of the defining parameters of action. Thus, the expression for the action  $A$  corresponding to the oscillator in question could be written as:

$$A = \left( \frac{\frac{1}{2}mv^2}{2} \right) \tau / 4 \quad (2)$$

Now a proof of existence of an elementary quantum of action  $h$  is that the Eq ( 2 ) yields a specific numerical value of  $h$  (that is,  $6.6 \times 10^{-34} \text{Js}$ ) when some specific minimum values of  $v$  and  $\tau$  are substituted in it. This, however, requires an a-priori knowledge of such specific minimum values of  $m$ ,  $v$  and  $\tau$ . Determining such an extremely small quantity like  $h$  by making use of the expression which defines action could prove to be an impossible task to carry out, particularly, in the case of atomic or subatomic quantum, oscillators in the BB cavity, since the determination of specific minimum values of  $v$  and  $\tau$  for such oscillators would be both conceptually and mathematically intractable ones. Conversely, it is also not possible to determine the specific values of  $v$  and  $\tau$  by substituting the value of  $h$  and solving the equation for  $v$  and  $\tau$ . since mathematically it is not possible to solve a single equation for two unknowns. Thus, the compatibility of  $h$  with the formal definition of actions cannot be verified by any means.

## 3. Revelation of the Intricacies associated with the $E = h\nu$ equation in the Energy Determination of Photons

Quantum physicists envisage a photon to be a discrete energy packet of electromagnetic radiation that possesses a linear momentum as well as a quantum of angular momentum and capable of moving with an ultimate speed  $c$  in free space. However, as it will be seen in the paragraph to follow that the applicability of the quantum equation  $E = h\nu$  for the determination of energy of photons is questionable and that the falsifiability of the concept of photons possessing a linear as well as an angular momentum.

Positing the Planck's quantum equation to be the correct one a quantum equation it would be interesting to see the kind of conceptual intricacies that this equation

posses when it is applied for the determination of energy of photons. Even a glance at this equation tells us that it is not concerned with what it is oscillating within a photon attributable to be the energy of photons ( $E_p$ ) but only with the frequency with which the photon is executing oscillations. Thus, we are left with two options: According to this equation the energy of a photon could either be interpreted as a result of an action quantum undergoing oscillatory motion with frequency  $\nu$ , or as if, a photon to be composed of a pack of  $\nu$  number of action quanta. Evidently, both of these interpretations are conceptually absurd. Another obvious absurdity associated with the quantum equation  $E = h\nu$  for the energy determination of photons is that this equation demands, in a subtle way, to take into consideration all the large number of oscillations that a photon will be executing in a time period of one second – stretching over a distance of  $3 \times 10^8$  m. This is directly in contradiction with the quantum discretization of energy as well as space of photons. The particle nature of photons, however, implies that a photon is expected to occupy a very small space determined by a single cycle of oscillation of the photon

Quantum physics entails a photon to possess both an energy  $E_p = Pc$ . This relationship is derived from the following relativistic relation with  $m_0 = 0$  keeping in view a photon to be mass-less.

$$E^2 = P^2c^2 + m_0^2c^4 \quad (3)$$

This equation, in turn, is deduced from the Einstein's mass-energy equivalence equation  $E = mc^2$ . It may be noted, however, that the equation  $E^2 = P^2c^2 + m_0^2c^4$  cannot be applied in the case of photons since it is essential for the derivation of the equation  $E = mc^2$  that a particle in question should possess a rest mass  $m_0$ . Moreover, it has been conclusively proven in a recent study [6] that the derivation of the  $E = mc^2$  to be the incorrect one both conceptually and mathematically. Thus, the validity of the concept that a photon should possess a linear momentum cannot be justified by any means.

That a photon also carries a spin angular momentum (SAM) which has been ascribed by quantum physicists to be related to the photon polarization. A beam of circularly polarized light exhibit the property described as the orbital angular momentum of light. On the basis of this observation it is assumed that each of the photons in a circularly polarized light must also be carrying a SAM of  $\pm \hbar$  (should this SAM is directed parallel to the beam axis it is +ve, if antiparallel it is -ve). The angular momentum of a photon has been ascribed to possess two possible values  $+\hbar$  or  $-\hbar$  in accordance with the two possible states of the circularly polarized beam of light.

However, there remains several unsatisfactory points concerning the crux — the purported SAM for all kinds of photons in general. How one could account for photons of unpolarized or strictly plane polarized light to be possessing SAM? In order that a photon to be possessing a SAM it must also possesses a mass. Where does mass comes from in photons? Moreover, since the components of SAM  $+\hbar$  or  $-\hbar$  are vector quantities, how would we account for the relationship  $\frac{h}{2\pi} = \hbar$  that is, a scalar divided by  $2\pi$  is equal to a vector quantity? When a

photon is get emitted from a source its planes of oscillations of its electric and magnetic fields remains the same for an indefinite period of time in free space then how one can assume a photon should possess SAM?

Thus, a photon can neither be justified to possess a linear momentum nor the SAM by any physical reasonings.

#### 4. Does the Categorization of $h$ as a Universal Physical Constant done on the Basis of Scientific Criteria?

In quantum physics the importance of  $h$  has been raised to such an extent that it has now been characterized as a universal physical constant. It would be of considerable interest to analyze whether there exist good reasons for justifying such a characterization of  $h$ .

We are quite familiar with a few of the universal physical constants — the universal gravitational constant  $G$ , the universal gas constant  $R$ , the Coulomb constant  $k_e$  i.e.,  $1/4\pi\epsilon_0$  and the universal speed of light  $c$ . The universal laws corresponding to these universal constants

are: Newton's law of universal gravitation ( $F = G \frac{m_1 m_2}{r^2}$ ),

the universal gas law ( $PV = RT$ ), the Coulomb's law

( $F = k_e \frac{q_1 q_2}{r^2}$ ) and the Maxwell's equation ( $c = \frac{1}{\epsilon_0 \mu_0}$ ),

respectively. Here all the terms appearing in these expressions have their usual meanings. The scientific basis for categorizing these physical constants as universal physical constant are well-established. All these universal laws have been derived either theoretically or, on the basis of experimental observations, which have all been successfully tested experimentally. The accurate values of each of these constants could be determined experimentally, in terms of the variable each exclusively in terms of the variable parameters constituting the expression of the universal law in question, following standard procedures. Categorizing  $h$  as an universal physical constant implies that  $h$  should be in conformity with all the basic criteria for adjudging a physical quantity to be an universal physical constant.

However, in sharp contrast,  $h$  can neither be associated with any theoretically deduced universal law nor it could be ascribed to be based on any experimental observation, but born out as a result of Planck's ad hoc hypothesis — the energy of a harmonic oscillator to be directly proportional to its oscillation frequency — a conceptually incorrect assumption. Moreover this equation is far from representing an equation of general validity, since this equation is limited in its application for the determination of energy of harmonic oscillators only. Furthermore, unlike those of the other universal laws, the Planck's equation does not permit us to determine the value of  $h$  exclusively from the constituent parameters of this equation. Mention may be made in this context the work of Ralston [7] who reported to have failed to determine the value of  $h$  by any means making use of the Planck's equation. Since  $h$  fails to conform with any of the well-established criteria for adjudging such constant of scientific importance, it would be a mistake to

characterize  $h$  as a universal physical constant.

## 5. Conclusion

Brought to light in this article are a host of startling findings concerning the conceptual fallacies and intricacies associated with the Planck's quantum equation  $E = h\nu$  and the Planck's constant  $h$ . Convincing evidences have been adduced to conclusively prove each of the findings reported here.

It is shown that the equation  $E = h\nu$  to be conceptually incorrect one a quantum equation and that there does not exists anything like the elementary quantum of action in nature. The elementary quantum of action attribution to  $h$  has also been proved to be not in accordance with the definition of action. It is shown that there does not exists an elementary quantum of energy ' $b$ ' observable in nature and that the quantum equation  $P = b\nu$ , which relates the power ' $P$ ' of a quantum oscillator with its oscillation frequency  $\nu$ , to be the right kind of quantum equation. In contrast to the quantum equation  $P = b\nu$ , the equation  $E = h\nu$  has been found to be inapplicable for the determination of energy of photons. The falsifiability of photons

possessing linear and angular momentums has also been proven. That the categorization of  $h$  as a universal physical constant cannot be justified by any physical reasonings — it is concluded.

## References

- [1] Planck, Max, on the law of distribution of energy in the normal spectrum, *Annalen der physik* **4**,553-563 January (1901).
- [2] Ghoshal, S.K., Formulation of a more realistic quantum equation for rectifying the hidden flaws in Planck's black-body equation, *Physics Essays* **33**,27-30, March (2020).
- [3] Brooks, J., Einstein's hidden variables: The elementary, quantum of light and quantum chemistry, *Material Science and Technology Conference* 2009.
- [4] Worsley, A., The formulation of harmonic quintessence and fundamental energy equivalence equation, *Physics Essays*, **23**, 311-319 June (2010).
- [5] Mortenson, J., the Fundamental Physics of Electromagnetic waves, *Intech Publication*, London, U.K. June 2011).
- [6] Ghoshal, S.K., Reformulation of the Einstein's photo electric equation on the basis of newly emerged quantum concepts, *International J. Physics*, **13**, 202-205 (2024).
- [7] Ghoshal, S.K., Serious mistakes associated with Einstein's  $E = mc^2$  equation are brought to light, *Physics Essays*, **38**, 107-111 April (2025).



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