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- RESEARCH ARTICLE –

Planck's Constant and Equation for Magnetic Field Waves

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Abstract

The classical Planck's equation E = h ν in terms of frequency ν is applicable for all light rays including x-rays and gamma rays. A new Planck equation E = ⓗλ in terms of wavelength λ has been found for all magnetic field waves including radio waves. The new Planck constant ⓗ has been found, approximately, and a one-to-one correspondence between ν for light rays and λ for magnetic field waves has been established. This correspondence has provided an equality relation for penetrating capacities of a light ray radiation and a corresponding magnetic ray radiation. This equality relation has helped to calculate penetrating capacity of a magnetic field wave from penetrating capacity of a light wave.

Keywords:
Planck's constant, speed of light, electromagnetic waves.

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Introduction

It was Max Planck who introduced a relation connecting energy E and frequency ν of a light wave in the form E = h ν, where the constant h is called the Planck's constant. In this relation, a light wave is considered as an electromagnetic wave. The other type of electromagnetic waves is the class of magnetic field waves. The purpose of the present article is to provide a new Planck equation meant for magnetic field waves, which is similar to classical Planck's equation but it involves another constant corresponding to h and it involves wave length instead of frequency. One among the applications is to provide find harmfulness of electromagnetic waves of cell phones and cell phone towers, by comparing with harmfulness of a corresponding light wave. More specifically, one should increase the frequency of electromagnetic waves related to cell phones to

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reduce harmfulness. This interesting conclusion can be derived from a comparison with harmfulness of a corresponding light wave, for example, ultra violet ray. Comparisons can be done through energies involved in classical Planck's equation and new Planck's equation. There are recent research regarding Planck's equation, Planck's constant and other related fields. For example, one may see the following recent articles, namely, Zhu, Y. (2018), Kozmanyan et al. (2019), Räsänen & Tomberg, E. (2019), Gurzadyan & Stepanian, A. (2019), Damaceno et al. (2019), Eichenberger et al. (2011), Steiner et al. (2005), Kallosh et al. (2019), Golse et al. (2018), Steiner (2012), Dos Santos Filho & Porcelli (2019), Abbott et al. (2016), Williams et al. (1995), Steiner et al. (2005), Räsänen & Tomberg (2019), Boyer (2018), Tohma et al. (2016), Altan & Kutlu (2018), given in the list of references. The present article may also be considered as a work regarding Planck's equation and Planck's constant.

A successful new basic theory for electromagnetic waves has been developed by the authors in the articles (Moorthy et al. (2017a), Moorthy et al. (2017b), Moorthy et al. (2017c), Moorthy et al. (2017d), Moorthy et al. (2018). The present article is a continuation of them and it presents a summary of the earlier works done by the authors for readability. The velocity of light in vacuum is fixed in this article as $c = 2.9979250 \times 10^8$ m/s. Let us define an electromagnetic wave as an energy wave which can travel with the velocity c in the vacuum. The other media are not considered in this definition for propagation of waves. This definition does not include alpha rays, beta rays and microwaves in the class of electromagnetic waves. This definition includes gamma rays, x-rays, infra red rays, radio waves and gravitational waves in the class of electromagnetic waves.

An electric field wave is created from electric fields, and it travels with speed c in the vacuum. A magnetic field wave is created from magnetic fields, and it travels with speed c in the vacuum. Light waves are created, for example in a tungsten bulb, by means of electric fields of electrons, when electrons move in serial one by one, and light waves disturb electric fields of electrons in solar cells to move electrons. So, light waves are considered as electric field waves. Radio waves are created, for example, from a coil which creates magnetic fields. So, radio waves are considered as magnetic field waves.

The classical Planck's equation $E = h\,\nu$ is applicable only for electric field waves or light rays, because energy of a segment of a single light wave with length equal to the wave length is considered as a quantum-photon energy. This quantum-photon type energy is not applicable for magnetic field waves, and hence the classical Planck's equation is not applicable for magnetic field waves. So, a new Planck equation E = ⓗλ is presented in this article for magnetic field waves. The finding is based on a duality nature described in the previous articles. The value of the classical Planck's constant h is fixed as $h = 6.62607004 \times 10^{-34}$ m^2Kg/s.

Maxwell derived wonderful equations for electromagnetic theory and two wave differential equations were derived from these equations, one for electric field and another one for magnetic field. These two wave equations are the same equation. So, both fields oscillate in the same manner at the sources of production, but orthogonally. The authors agreed with all these historical findings. The authors observed that the mathematical wave equations derived from Maxwell equations can assure periodic oscillations of both fields, but they cannot assure propagation. This is purely a mathematical part, and mathematicians can understand this difference. Physicists never noticed this difference while giving interpretations for wave differential equations because the differential equations were just called wave equations, and they just observed that all solutions of all wave differential equations should lead to solutions giving wave propagation, that is, movement of energy to an infinite distance. Since this difference was noticed, a new theory was proposed and a careful analysis was carried out. Although physicists claim that electric field waves and magnetic field waves move (not mere oscillations) simultaneously, there is no *actual* physical evidence to justify this simultaneous movement. This peculiar fact was observed. Then two local conditions were fixed in terms of movements of electrons which are necessary for existence of electric field waves and magnetic field waves. These conditions are applicable irrespective of the methods of production and materials for production of waves. Two suitable well known expressions for local conditions in terms of movements of electrons were noticed. Those two expressions gave a reason for non coexistence of electric field waves and magnetic field waves because electric field waves are produced when two electrons move in serial and magnetic field waves are produced when two electrons move in parallel.

Physicists already verified experimentally the following two well known expressions. The electrostatic force between two electrons with charge e and with distance x is given in the first expression. This first expression is:

$$\frac{e^2}{4\pi\varepsilon_0 x^2},$$

where ε_0 is the classical electric constant. The second expression is:

$$\frac{\mu_0 e^2 v^2}{4\pi x^2},$$

where μ_0 is the classical magnetic constant. This second expression is the magnetic force between two electrons, when x is a constant perpendicular distance between parallel straight line paths of the electrons moving in parallel in same direction with a constant velocity v, and when x is also the distance between the moving electrons. Let us observe that the speed of light c in vacuum coincides with the electrodynamic constant $1/\sqrt{\varepsilon_0\mu_0}$. If these electrons moving in parallel attain the constant velocity c, then the second expression becomes:

$$\frac{\mu_0 e^2 c^2}{4\pi x^2} = \frac{\mu_0 e^2}{4\pi x^2 \varepsilon_0 \mu_0} = \frac{e^2}{4\pi\varepsilon_0 x^2}.$$

So, the electrostatic force between two stationary electrons coincides with the maximum possible magnetic force between the electrons moving in parallel, when the electrons have distance x between them, because the maximum possible value of v is c. Thus the energy which may be released by the electrostatic force corresponds to the energy which may be released by the maximum possible magnetic force, and dual changes happen. The electrostatic forces mentioned above are *repelling* forces, when the maximum possible magnetic forces mentioned above are *attracting* forces. If one electron goes near to another electron in *serial* against the *repelling electrostatic force* in the first case, then energy may be released in the form of *electric field waves*. Similarly, if the distance between two electrons moving in *parallel* in same direction is increased against *attracting magnetic force* in the second case, then energy may be released in the form of *magnetic field waves*. These dual changes imply the conclusion that the *maximum (or supremum)* of the wavelengths of electric field waves should coincide with the *minimum (or infimum)* of the wavelengths of magnetic field waves. Let us use the notation w for this common value. This value w separates the spectrum of electromagnetic waves into two classes in the following way. All electromagnetic waves with wavelength less than w are electric field waves and all electromagnetic waves with wavelength greater than w are magnetic field waves. So, the authors observed a duality in the nature of electric field waves and magnetic field waves around this length number w. The minimum temperature of the cosmic microwave background was used as the temperature limit to stop electric field radiations and the Wien's displacement law was also used in the same manner and the value of w was found approximately as $w = 1.063022744 \times 10^{-3}$ m. It should be mentioned again that this theory does not contradict the Maxwell equations and the wave equations derived from the Maxwell equations. This theory does not disagree with any existing data.

An interpretation for the Planck's equation

Let us consider a single light ray with frequency ν and a line segment of this light ray with length 2.9979250×10^{8} m. If this segment of the light ray collides with a fixed material and releases all its energy, then let E denote the total energy released. That is, E is the total energy released by the light ray in one second. Then the relation $E = h\nu$ is true, for ν and E mentioned above and for the classical Plank's constant $h = 6.62607004 \times 10^{-34}$ m^2Kg/s. Here E is directly proportional to the frequency ν, and hence E is *inversely proportional* to the corresponding wavelength. This interpretation is to be modified for magnetic field waves by means of the duality nature around the number $w = 1.063022744 \times 10^{-3}$ m. More precisely, the phrase "inversely proportional" is to be replaced by the phrase "directly proportional".

New Planck equation for magnetic field waves

Let us consider a magnetic field wave with wavelength λ as a single ray. Let us consider a line segment of this ray with length 2.9979250×10^{8} m. Let E be the total energy released during a collision of this entire segment with a fixed material exactly in one second. Because of the duality discussed previously, the following can be concluded. E is *directly proportional* to the wavelength λ. That is, E = ⓗλ, when ⓗ is a universal constant for magnetic field waves. There is a procedure to find the value of ⓗ. The duality implies the following at the limit point $w = 1.063022744 \times 10^{-3}$ m. For λ = w, and ν = (c/λ) = (c/w), it is true that h ν = ⓗλ. On substituting the values for λ = w, ν = (c/w) and h in h ν = ⓗλ, the value of ⓗ is found as ⓗ = 17.57889908 m Kg/s^2, approximately. Thus the relation E = ⓗλ is true for this value of ⓗ, and this relation is the new Planck equation for magnetic field waves.

Penetrating capacity

If the energy (for one second collision) of an electric field wave with frequency ν is equal to the energy of a magnetic field wave with wavelength λ, then the penetrating capacities of these two waves may be considered as equal ones. In this case, the relation h ν = ⓗλ is true. From this relation, for given λ of the magnetic field wave one can find ν of the corresponding electric field wave, and vice versa. For example, if the wavelength of an electric field wave is 10^{-10} m (i.e. with $\nu = 10^{10}c$), then the corresponding wavelength λ of a magnetic field wave with equal energy is 11300 m, approximately. In general, if the wavelength of an electric field wave is 10^{-10-n} m (for n satisfying $0 < 10^{-10-n}$ m < w), then the corresponding wavelength of a magnetic field wave with equal energy is 11300×10^{n} m, approximately. Since the penetrating capacity of an x-ray with wavelength 10^{-10} m and the penetrating capacity of a magnetic field wave with wavelength 11300 m are almost equal, they may be considered as equally harmful single waves. A light ray with wavelength 10^{-8} m and a magnetic field wave with wavelength 113 m are almost equally harmful. Thus, one can infer harmfulness of magnetic field waves from harmfulness of corresponding light waves.

Conclusions

The value of ⓗ should be refined by using experiments. The penetrating capacity of a single ray (measured by energy for one second collision) increases for an electric field wave when its wave length decreases. The penetrating capacity of a single ray increases for a magnetic field wave when its wave length increases. The harmfulness of a collection of waves depends on the penetrating capacity of a single ray, the number of rays, and time. That is, the harmfulness depends on the energy of a single ray (for one second collision), the number of rays, and time. One can do calculations based on the theory mentioned above and find that the frequencies which are being used in many cell phones are somewhat safe in terms of penetrating capacity, which can be observed by means of comparisons that can be done with the corresponding wavelengths for ultraviolet rays. To save our mankind from radiations, efforts should be taken to reduce the wavelengths of magnetic field waves and increase the wavelengths of light rays, which are being used in instruments related to radiations. More specifically, efforts should be taken to avoid production of magnetic field waves with very long wavelengths continuously for long periods.

Applications and Future Scope

Since there is no direct method to detect harmfulness of magnetic field waves, both formulas E = h ν and E = ⓗλ should be compared as if they have common energy, and the harmfulness corresponding to λ should be considered as the harmfulness corresponding to ν. This theoretical calculation gives earlier prediction regarding harmfulness and mankind can escape from radiation problems.

Electromagnetic waves play a vital role on communication fields (See: Tohma et al. (2016)) in their magnetic field wave network and performance activities can be enhanced with certain theoretical calculations by using the value of ⓗ and it can be verified in future. One of the main future scopes is biological field (See: Altan & Kutlu (2018)), and here also the value of ⓗ deals with the effects of electric field waves and magnetic field waves for the instrumentation analysis of brain, heart, lungs etc..

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