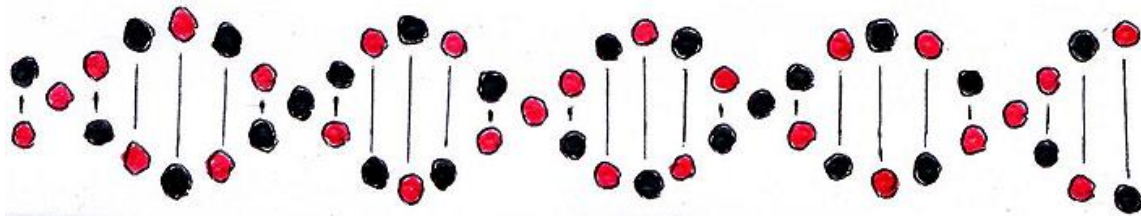


The Apparent Dual Nature of Electromagnetic Waves

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Abstract. The Planck-Einstein relation, $E = hf$, relates the energy of discrete pulses of black body radiation, X-rays, and gamma rays to their wave frequency. This relationship appears to contradict the wave theory of light. An investigation will now take place regarding whether the Planck-Einstein relation, and Planck's constant itself, lie in the domain of the medium for the propagation of light, or in the vestibule of the atom, or in both.



The Planck-Einstein Relation

I. In the case of black body radiation, X-rays, and gamma rays, the electromagnetic waves are emitted and absorbed in discrete quanta known as photons. Black body photons and X-ray photons are believed to be tied up with a transition between two different energy states within the electron orbital configurations of the atoms or molecules of the source or receiver. This is expressed by the Planck-Einstein relation,

$$E = hf \tag{1}$$

or,

$$E = hc/\lambda \tag{2}$$

where E is the energy of the photon, f is its frequency, λ is its wavelength, c is the speed of light, and h is Planck's constant. The fact that these discrete pulses possess a frequency and a wavelength at all, is indicative of their more fundamental wave nature, and indeed, during a continual emission of photons from a source, the frequency of emission is the same as the frequency that comes with the wave nature of the ray.

However, the fact that the energy of a photon should be related to the wavelength contradicts classical wave theory, unless the energy is exclusively due to the emission and absorption processes going on within the vestibule of the atomic or molecular sources and receivers themselves. And this is what we might conclude if Planck's constant were to be merely a constant of proportionality without possessing any physical significance in its own right.

Planck's constant first arose in the context of Planck's law of black body radiation, and so at first glance this fact would tend to weigh in favour of its origins lying in the vestibule of the atom. But an interesting equation was drawn to my attention some years ago by Portuguese physicist Antonio Saraiva. This equation, $h = cke$, links Planck's constant to three other fundamental constants of nature, those being the speed of light, c , the Boltzmann constant, k , and the charge of an electron, e . With Planck's constant now being directly related to the speed of light, it makes it more difficult to deny the idea that it bears any relationship to the elasticity of the medium for the propagation of light. It is therefore starting to look as though, that while the energy, E , in the Planck-Einstein relation lies in the vestibule of the atom, Planck's constant on the other hand, is perhaps a property of the elasticity of the luminiferous medium.

Planck's Constant and Fine-Grained Angular Momentum

II. Planck's constant has the dimensions of angular momentum and so it is proposed that it is closely related to angular momentum. The special case of the tiny rotating electron-positron dipoles that make up the medium for the propagation of light waves will now be examined. For more information on this medium, see "*The Double Helix Theory of the Magnetic Field*", [1], [2].

We know that a gamma ray photon with a wavelength of 1.213 picometres, this being half of the Compton wavelength of an electron, contains the minimum energy required to split an electron-positron dipole apart. See "*The Positronium Orbit in the Electron-Positron Sea*", [3]. If we equate this wavelength to the circumference of one of these tiny rotating dipoles, the frequency of the gamma photon will be equal to the frequency of the rotating dipole itself, hence giving rise to resonance, and the reduced Planck's constant, \hbar , which is Planck's constant divided by 2π , can then be written as an angular momentum in the form,

$$\hbar = 2mcr \tag{3}$$

where m is the mass of the electron, and also of the positron, c is the circumferential speed, equal to the speed of light, and r is the radius of one of these tiny rotating dipoles.

If we substitute equation (3) into equation (2), we obtain,

$$E = 4\pi mc^2 r/\lambda \tag{4}$$

and since $\lambda = 2\pi r$, this reduces to,

$$E = 2mc^2 \tag{5}$$

this being the 1.02MeV of energy associated with a gamma ray photon of wavelength 1.213 picometres, which is the minimum energy needed to split an electron-positron dipole in the vicinity of an atomic nucleus, [3].

The reverse process can occur in space, far from any atomic nuclei, and this gives the superficial impression that the electron and the positron have annihilated each other, rather than having merely bonded back into the luminiferous medium again.

Conclusion

III. The full physical meaning of the Planck-Einstein relation, $E = hf$, has been exposed in the context of electron-positron pair production and annihilation. While the general context of the Planck-Einstein relation is that of the energy state transitions that occur within systems of naturally orbiting electrons, due to resonant interactions with electromagnetic waves, the particular case of electron-positron pair production and annihilation employs the special circumstance where the normally separate domains of the atom and the luminiferous medium overlap. This is because the latter itself constitutes a dense sea of rotating electron-positron dipoles. The reduced Planck's constant, $h/2\pi$, known as h -bar and written as, \hbar , is in general an angular momentum within the electron orbitals of an atom, while in the special case of the luminiferous medium, it is a fine-grained angular momentum which is very closely related to Maxwell's displacement current, [4]. Planck's constant therefore resides in both the atom and the luminiferous medium. See "*The Apparent Dual Nature of Cathode Rays*", [5].

At the other extreme, in the case of radio waves, the emission sources and receivers do not involve energy transitions in any naturally occurring electronic orbital systems, and so the Planck-Einstein relation does not apply. Electromagnetic radiation is primarily a wave propagating through a dense sea of tiny dipolar vortices that pervades all of space, [6], [7], [8], [9], [10]. Each individual vortex will have a diameter of around 0.3863 picometres, and hence it will be in the order of one thousandth the size of an average atom of ponderable matter.

The Poynting vector, $\mathbf{S} = \mathbf{E}_K \times \mathbf{H}$, is a measure of the rate of flow of energy density in a wireless electromagnetic wave, as measured at a point in space where the wave is passing through, [11]. It is not frequency dependent. As per classical wave theory, the magnitude of the Poynting vector depends on the wave amplitudes of the Faraday time-varying electric field, \mathbf{E}_K , and the magnetic field, \mathbf{H} , that are involved in the cross product. The Faraday electric field is expressed in the form, $\mathbf{E}_K = -\partial\mathbf{A}/\partial t$, where $\nabla \times \mathbf{A} = \mu\mathbf{H}$, and where \mathbf{A} is the electromagnetic momentum, better known as the magnetic vector potential. The Poynting vector, $\mathbf{S} = \mathbf{E}_K \times \mathbf{H}$, does not contradict the Planck-Einstein equation, $E = hf$, since the latter is only measuring packages of energy in relation to the emission or absorption processes inside atoms and molecules. The Poynting vector, on the other hand, being a rate of flow, bears no relationship to the specific amount of energy emitted or absorbed during a single quantum leap in energy within an atomic orbital.

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“All space, according to the younger Bernoulli, is permeated by a fluid aether, containing an immense number of excessively small whirlpools. The elasticity which the aether appears to possess, and in virtue of which it is able to transmit vibrations, is really due to the presence of these whirlpools; for, owing to centrifugal force, each whirlpool is continually striving to dilate, and so presses against the neighbouring whirlpools. - - -”

[9] Lodge, Sir Oliver, “*Ether (in physics)*”, Encyclopaedia Britannica, Fourteenth Edition, Volume 8, Pages 751-755, (1937)

The quote below is in relation to the speed of light,

“The most probable surmise or guess at present is that the ether is a perfectly incompressible continuous fluid, in a state of fine-grained vortex motion, circulating with that same enormous speed. For it has been partly, though as yet incompletely, shown that such a vortex fluid would transmit waves of the same general nature as light waves— i.e., periodic disturbances across the line of propagation—and would transmit them at a rate of the same order of magnitude as the vortex or circulation speed”

The article then goes on to cite Lord Kelvin, “*The Vortex Theory of Ether*”, *Phil. Mag.* (1887) and *Math. and Phys. Papers*, vol. iv. and passim; also G. F. FitzGerald, *Proc. Roy. Dub. Soc.* (1899), or *Collected Papers*, pp. 154, 238, 472.

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[10] O’Neill, John J., “***PRODIGAL GENIUS, Biography of Nikola Tesla***”, Long Island, New York, 15th July 1944, Fourth Part, paragraph 23, quoting Tesla from his 1907 paper “*Man’s Greatest Achievement*” which was published in 1930 in the Milwaukee Sentinel,

“Long ago he (mankind) recognized that all perceptible matter comes from a primary substance, of a tenuity beyond conception and filling all space - the Akasha or luminiferous ether - which is acted upon by the life-giving Prana or creative force, calling into existence, in never ending cycles, all things and phenomena. The primary substance, thrown into infinitesimal whirls of prodigious velocity, becomes gross matter; the force subsiding, the motion ceases and matter disappears, reverting to the primary substance”.

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