THE ORIGIN OF PLANCK CONSTANT

THE MASS - FREQUENCY RELATION

by Dezso Sarkadi, Hungary
February, 2017

Planck's law describes the spectral density of electromagnetic radiation emitted by a black body in thermal equilibrium at a given temperature *T*. The law is named after *Max Planck*, who proposed it in 1900. It is a pioneering result of modern physics and quantum theory. Planck showed that the spectral radiance of a body for frequency ν at absolute temperature *T* is given by

$$dE_{\nu} = \frac{2h\nu^3}{c^2}\frac{1}{\exp(h\nu/kT-1)-1}d\nu,$$

where *k* the Boltzmann constant, *h* the Planck constant, and *c* the speed of light in vacuum.

In 1905, *Albert Einstein* suggested that electromagnetic waves could only exist as discrete wave-packets. He called such a wave-packet the light quantum. The name photon derives from the Greek word for light. Finally most scientists accepted that light quanta have an independent existence, and the term *photon* was accepted. A photon is a particle of light (*electromagnetic radiation*), which provided also shows a wave properties. The photon particle characterized by single parameter; with its frequency. The energy of the photon is proportional to its frequency, the proportionality factor is the Planck constant:

$$E_{photon} = h\nu_{photon} \equiv \hbar\omega_{photon}, \quad \left(\hbar = h/2\pi,\ \omega_{photon} = 2\pi\nu_{photon}\right).$$

Some years ago the present work's author assumed that light frequency square can be ordered to the physical mass:

$$E = mc^2 = mr^2\omega^2 = K\omega^2,$$

where *E* is the rest energy of the mass *m* and ω is an unknown light frequency (*electromagnetic radiation frequency*) depending on the unknown constants *r* and *K*. The small change of the rest energy (mass) can be written:

$$\Delta E \cong \pm 2K\omega\Delta\omega.$$

We can assume that a minimum value of the light frequency change exists in the nature:

$$\omega_{\min} = Inf(\Delta\omega) = const., \ \Rightarrow \ Inf\left(2K\Delta\omega\right) \equiv 2K\omega_{\min} = \hbar = const.$$

From these simple considerations we get the Planck - Einstein formula:

$$\Delta E = E_{photon} = \pm\hbar\omega.$$

Conclusion: The energy of the photon emitted or absorbed is equal to the change of the rest energy (rest mass) of the particle. The light frequency square associated with the mass is proportional to any mass.