

Planck's 'Constant'

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Planck's constant comes directly from electromagnetic self-field theory (EMSFT) and its application to the hydrogen atom. Empirically the value of \hbar , is

found to be $2\hbar\omega = \frac{q^2}{8\pi^2\epsilon_0}$ so $\hbar = \frac{q^2}{8\pi\epsilon_0\nu_0} = \frac{q^2}{8\pi\epsilon_0\nu_c}$ is calculated from the solution

of the Bohr radius and the resonant frequency of hydrogen atom. To see the

relationship between Planck's constant and velocity, let $\hbar = \frac{E_0}{\nu_0} = \frac{q^2}{8\pi\epsilon_0 r_0} \frac{1}{\nu_0} = \frac{q^2}{8\pi\epsilon_0 \nu_0}$

where ν_0 is the frequency and E_0 is E-field potential energy. Hence since $\nu_0 = r_0\omega_0 = \nu_c = r_c\omega_c = 5.469222 \times 10^5$ m/sec we can compare with the known value of Planck's constant with our estimate to an accuracy of 7 significant figures.

Obviously this raises an issue at the heart of quantum theory. Condon and Odabasi [1] discuss the acceptance of Planck's constant in the pre-quantum era, 1900, as a fundamental concept in that quantities associated with the description of atomic phenomena assumed only a discrete set of allowed values that incorporate Planck's constant. After failing to find a classical framework for the thermodynamic equilibrium of matter, otherwise known as *black-body radiation*, Planck in an 'act of desperation' solved the problem by assuming only certain analytic frequencies could exist for the radiation. At that time Planck and his contemporaries thought of the solution as a mathematical artifice and not a defining point in the evolution of quantum physics. He numerically solved a two-variable problem in \hbar Planck's constant, and k Boltzmann's constant, using empirical data and thus established the groundwork for the photoelectric relationship $E = \hbar\nu$ Einstein verified in 1905.

EMSFT does appear to be the theoretical framework that Planck and many others including Einstein sought. That Planck's 'constant' represents a variable in EMSFT demonstrates the fundamental nature of EMSFT. This finding follows from the assumption that the speed of light is not proscribed from being variable in EMSFT. Empirical measurements, no matter how wide spread their physical reach, cannot determine whether any quantity, no matter how cherished, is a constant or variable until a theoretical framework has been established. EMSFT is an eigenvalue problem and its solution consists of 4 eigenvalues. The constitutive parameters of free-space, ϵ_0 , the permittivity, and μ_0 , the permeability, are also called 'constants' where deep space is being considered. These parameters are constants where the universe is considered homogeneous and isotropic. In reality, there are variations, for example the outer boundary of the universe, or inside the nuclei of atoms. This means there are 6 degrees of freedom in total in EMSFT where the fields are EM fields, leaving aside nuclear forces and weak gravitational forces. This corresponds with the 6 degrees of freedom indicated by the equipartition theorem $3kT$ [2].

Where does the self-energy of the system come from? EMSFT theory suggests that photons supply the energy to the electron and the proton and vice-versa. That discrete quanta of Planck's energy are involved in the particle-field interactions strongly implicate the photon as the energy provider/mediator for the atomic system. The dynamics of the atomic system can be written as an inhomogeneous system where the rhs contains the photon energy. In addition to representing Planck's quanta, these are derived directly from the current densities of Maxwell's equations. This suggests two interfacing systems of motion at differing scales each supplying the other's energy; two interfacing inhomogeneous systems of equations. The stability of the field/particle system, may also be reflected in a similar equation as seen from the

perspective of the photon, hence a state of balance between the motions and interactions of the proton, electron and photons may exist.

That Planck's constant exists in the analytic eqns given by EMSFT on the right hand side demonstrates empirically that the source terms of the E- and H-fields of the electron are indeed photons as is the case for quantum field theory [3].

Looking at the matrix structure of EMSFT, the fields (photons) represent the source terms on the right hand side for the electron's motion. Vice versa, the motion of the electron (and proton) can be written as source terms for the photons if they were written as the particles. The 'fields' and 'particles' are thus interchangeable in the

mathematics of EMSFT. The source term variable $\hbar = \frac{q^2}{8\pi\epsilon_0 v_0} = \frac{q^2}{8\pi\epsilon_0 v_c}$ on the right

hand sides in this case will be identical in both cases yielding Planck's energy. A most fundamental finding indeed and an insight into self-fields and their balance inside atoms. Not only are the particles, in this case the proton and electron, locked in a dynamic balance but the photons are demonstrably part of this balance. As well as the electron, an EMSFT application concerning the internal dynamics of the photon can be examined.

The E- and H-fields of classical physics are continuously differentiable 'objects' in space-time, as waves moving through a ubiquitous *ether*. In EMSFT, the fields are represented as photon *streams*. Thus EMSFT is not a classical field theory, but like quantum field theories, Maxwell's equations and a *quantization* are incorporated [3]. In EMSFT quantization is not heuristic but an outcome of the solution. There are two photon streams, from proton to electron and electron to proton, flowing at a constant rate (photons/sec). Each photon's motion is similar to that of the electron and proton but of different magnitude and overall shape. Whereas

the electron or proton circles along its orbital path, each photon either moves out from the proton to the electron or vice versa, spiral in overall orbital form.

References

[1] E.U. Condon and H. Odabasi, *Atomic structure*, (Cambridge University Press, Cambridge, 1980)

[2] W.H. Cropper, *Great Physicists*, (Oxford University Press, N.Y, N.Y.2001)

[3] W. Heitler, *The quantum theory of radiation*, (Dover, New York, NY, 1984)