

Self-field theory: the analytic spectroscopy of the photon

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Abstract: Based on the motion of the photon within the hydrogen atom, self-field theory (SFT) is used to obtain an analytic expression for m_γ the mass of the photon and provide a theoretical rationale for α the fine-structure constant. Recently, SFT was used to derive actual motions of the electron and proton within the hydrogen atom in the form of eigensolutions to a system of partial differential equations based on the Maxwell-Lorentz equations. The atom was modelled mathematically via two point-mass particles, the electron, and the proton, an extension to the Bohr model.

Planck's constant $\hbar = \frac{q^2}{4\pi\epsilon_0 v_e}$ is found to be the energy per cycle of the principal eigenstate that depends on the motions of the electron, proton, and photon, all involved in the dynamic balance of the atom. The photon performs many relativistic transitions back and forth between the proton and electron within each cycle of the electron and proton that rotate coherently about their centre of mass. The phase length of the photon each time it transits $\pi/2$ maintains the overall coherency of the atom's periodicity providing a method for analytically comparing the energy of the

photon with that of the electron $m_\gamma c^2 = \frac{\hbar\omega_\gamma v_e}{4c}$, where ω_γ is the collision frequency of the photon. Assuming a polygonal motion circumscribes a circle representing the Bohr magneton, the photon collision frequency is estimated as 54 from the known value of the Landé g-factor. Thus m_γ evaluates to $0.396 \times 10^{-55} \text{ kg}$ ($0.221 \times 10^{-19} \text{ eV}$).

The analytic expression for the photon mass is compatible with the expression for the fine-structure constant $\alpha = \frac{v_e}{c} = \frac{4m_\gamma c^2}{\hbar\omega_\gamma}$. The numerical value for m_γ is also

compatible with the most recent experimental estimates for the lower limit of the photon mass listed by the Particle Data Group. Since the photon performs a discrete number of transits per cycle this suggests collisional based polygonal rotations for both the electron and proton rather than the assumed circular rotations given by spinor theory used by both SFT and quantum field theory. This suggests a way to check more detailed SFT models of the hydrogen atom that include a structured nucleus. Inside the hydrogen atom photon substructure introduces no new physics beyond that given by quantum mechanics. Within molecules however, photon substructure introduces a previously unknown quantum number by which molecular bonds can range between strong and weak structures. This photon mechanism appears involved in a number of energy/temperature dependent molecular processes. The cell cycle and other biological processes may well depend on the various hydration structures found within DNA and other biological protein structures. There are also physical phenomena that show dependence on hydrogen bonding, or on the innate spectroscopy of the ordinary photon.