

Self-Field Theory: Analytic Spectroscopy of the Photon

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Abstract: Self-field theory (SFT) provides deterministic eigensolutions to the Maxwell-Lorentz equations for the hydrogen atom where Planck's constant $\hbar = \frac{q^2}{4\pi\epsilon_0 v_e}$ is the energy per cycle of the principal eigenstate [1]. Based on a composite (hydrogenic) photon, an analytic expression for photon mass is obtained $m_\gamma c^2 = \frac{\hbar \omega_\gamma v_e}{4c}$, where ω_γ is a discrete photon transition frequency within each cycle of the electron. This expression is compatible with the fine-structure constant $\alpha = \frac{v_e}{c} = \frac{4m_\gamma c^2}{\hbar \omega_\gamma}$, where $m_\gamma = 0.396 \times 10^{-55} \text{ kg}$ ($0.221 \times 10^{-19} \text{ eV}$). Thus there is a series of eigenstates within individual photons, like the atom, that vary with the ambient energy density or temperature. Within atoms and molecules, photon substructure introduces a previously unknown mechanism by which binding energies can vary between strong and weak structures in variation with the ambient energy density, or temperature. A range of physical and biological examples support photon substructure with its associated photon spectroscopy.

Keywords. Self-field theory, quantum field theory, Planck's constant, fine structure constant, composite photon, photon mass, photon spectroscopy, Schumann resonance, atomic structure, molecular structure.

1. Introduction

Like quantum mechanics (QM) and quantum field theories (QFTs) in general, SFT is both an analytic and a numerical method for solving field-particle equations. Unlike QFTs however, SFT does not involve probabilistic inner products, but rather uses the Lorentz equation and the virial relationships in addition to Maxwell's equations to solve for the periodic dynamic motions. SFT uses the E- and H-fields directly rather than any derived potential functions and hence gauge and a necessity for any quadratic functional form is avoided a priori; the field equations are first order rather than second order. Importantly the E- and H-fields within SFT are not ubiquitous throughout space as in classical electromagnetics (EM), but are discrete and particulate, albeit of minute size compared with particles such as electrons, neutrons and protons. The atomic binding field is not assumed to permeate all space out to infinity or even within the atom, but it is stream-like, the photons all following each other performing helical spirals while transiting to and fro between the electrons and the nucleus. The photon, rather than being a single point particle with a dual wave/particle nature termed a matter-wave, is assumed to have an internal structure, i.e. is composite, perhaps fractal in nature. It is also assumed to move in two orthogonal directions. This leads to important mathematical differences to quantum methods and with classical EM. In SFT mass-point particles are non-singular as they are assumed to always move as physical spinors¹ never residing at their origins, unlike QFTs where probabilistic renormalization is necessary. Uncertainty is seen as a numerical factor due to the way the photon is modeled and not, as described by Heisenberg, as a limitation to our knowledge. SFT can be used in situations where dynamic balances hold between interacting particles as in the hydrogen atom [1-2].

¹ Dirac spinors can be described as mathematical unitarian spinors whereas SFT spinors are actual motions. SFT spinors are based on the analytic form of Heinrich Hertz's original potential functions [3].

In the physical world SFT may be able to provide solutions to questions such as how snow flakes form in such myriad different forms and the reason for the layering seen within the atmosphere. In biophysics, the shape of the DNA protein varies with the ambient energy inside a cell. SFT was recently used to examine possible internal structures of the photon [4-5]. One possible structure of the ordinary photon is hydrogenic as shown in Fig. 1; two sub-photonic particles termed the ephlectron and the phroton have equal mass and opposite charge. This provides Einstein's photoelectric energy $E = h\nu$ and gives the proper continuous energy-frequency response unlike the discrete physics of the atom where the electron and proton have differing masses. The sub-photonic E- and H- fields for the two interacting particles are calculated using a SFT formulation similar to that applied to the hydrogen atom. Except for the equal masses forming the composite photon, SFT applies to the photon in a similar way it applies to the hydrogen atom. Hence there is a strong similarity between the photon's eigenstates and those of the hydrogen atom. The main parameter in the analytic spectroscopy of the ordinary photon is its mass, similar to the principal mode of the hydrogen atom where the electron mass specifies the spectroscopy. If the photon mass is known, the spectroscopy of photons can be examined in detail. The transition frequencies are expressed in terms of a continuous series,

$$\nu_\gamma = R_\gamma \left(\frac{1}{m^2} - \frac{1}{n^2} \right) \quad (1)$$

where, $m = 1, 2, 3, \dots$ $n = 2, 3, 4, \dots$ The photon Rydberg number

$$R_\gamma = \frac{q_\gamma^4 m_\gamma}{8 \epsilon_0^2 h^3 c} = \frac{m_\gamma (8^2 \pi^3) \epsilon_0 v_o^2}{r_o q_\gamma^2} \quad (2)$$

is a photon-specific function of mass and charge. These frequencies may be related to the well-known Schumman frequencies whereby the ionosphere is layered during sunlight. Other physical applications of photon substructure may include snowflake design and the buildup of avalanches. These and other phenomenon may enable mathematical investigation, hopefully empirical support for photon substructure.

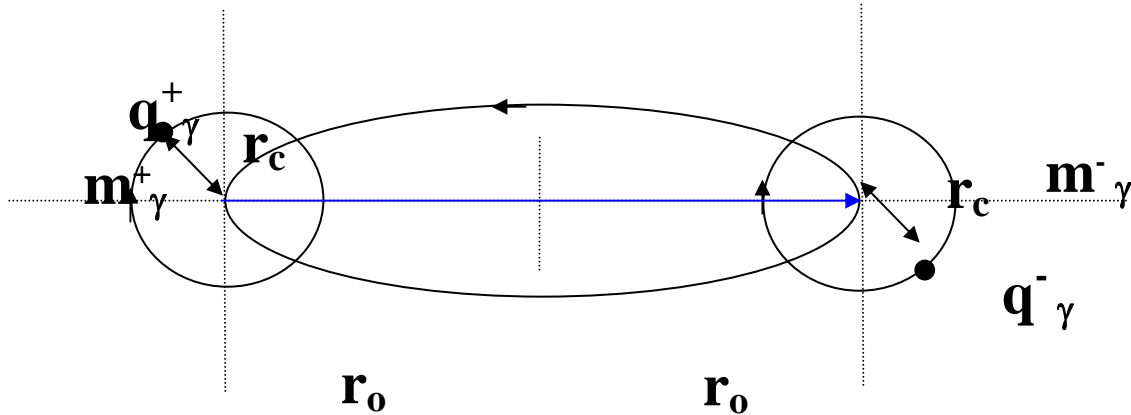


Figure 1. Photon sub-structure consists of two particles, the ephlectron, and the phroton, of equal mass $\frac{1}{2} m_\gamma = m_\gamma^+ = m_\gamma^-$ and

opposite charge $\frac{1}{2} q_\gamma = q_\gamma^+ = -q_\gamma^-$. Each has two spinorial motions like the electron and proton in the hydrogen atom.

2. Mass of the Photon

The issue of photon mass has remained unanswered during the past century [6]. Moreover since the early days of QM, molecular structure has been studied using QM primarily as a numerical tool [7]. At the same time important theoretical problems such as the theory of the covalent bond of H₂ remain. In the SFT analysis of the hydrogen atom, the atom was modelled mathematically via two point-mass particles, the electron, and the proton, an extension to the early Bohr model [1]. The eigenstructure of the hydrogen atom forms into two balanced halves, one is a balance between the electron and the E- and H-fields as shown below in Eq (3); another half, not shown, but identical in form, balances the proton with the fields. The overall structure thus involves the electron and the proton on the left hand side, with the photon on the right hand side. It is seen that the sides consist of moving particles and hence the concept of elastic collisions emerges between the electron with a stream of photons, and the proton with the same stream of photons.

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} V_e \\ T_e \end{bmatrix} = \begin{bmatrix} \hbar\omega \\ \hbar\omega \end{bmatrix} \quad (3)$$

Planck's constant $\hbar = \frac{q^2}{4\pi\epsilon_0 v_e}$, the energy per cycle of the principal eigenstate, depends on the motions

of the electron, proton, and photon; all are involved in the atom's dynamic balance. 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. Since the photon must perform a discrete number of transits per cycle for the atom's energy to be preserved this suggests collisional based polygonal rotations for both the electron and proton rather than the assumed circular rotations given by spinor theory and used by both SFT and QFTs. The phase length of the photon each time it transits $\frac{\pi}{2}$ will maintain the overall periodicity of the atom 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 mageton, 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

compatible with the experimental estimates for the lower limit mass listed by the Particle Data Group [8].

3. Discussion: The Role of the Photon in Microbiology

Cells are fundamental building blocks of tissues and operate in concert with a range of other tissue-specific components. The extra cellular matrix (ECM) can comprise structural and connection fibres between and within cells. Cells are a community of individual entities sharing their energies via cell dynamics and cell-to-cell communication of photons and in addition to the ECM, other short-range mechanisms. Cells thus adapt their individual energy states as the cell cycle proceeds; some cells die while others replicate. The state of a cell at any time depends in part on the health of the surrounding tissue. The photon mechanism investigated within this report reveals that the energy of the EM binding field within DNA may well control the strength and elasticity of the protein that is observed to vary across the cell cycle. As the energy of the intracellular medium changes, the bond becomes more rigid, less able to coil. Metaphase is one point in the cell cycle where the bonds across the bases are ready to become disassociated in forming the two daughter

chromatids. Part of DNA's structure involves hydration between bases across its internal core. The continuous nature of the photon's energy creates a precipitous reaction as the energy finally reaches a point where the photon's internal dynamics changes abruptly from one spin state to another resulting in the bond being wrenched apart. These hydration states of DNA may be fundamental to the cell cycle. The photon transition energies may act as 'triggers' within the cell cycle. At the same time as this binding energy reaction process occurs in chromosomes, surrounding cells polarize causing proteins to diffuse within the cell membranes allowing electrostatic fields to form within the cell and an electric gradient between the spindle poles, similar to a capacitor. Energy is pumped into the cell via this polarization mechanism. Under the electric gradient, the chromosome begins to stretch out to its full molecular reach. This may be due to the photon states gradually causing the hydration bonds to assume a form akin to a liquid crystal. This represents a major difference between in vivo and in vitro cell reactions. At the same time, this photon mechanism may be responsible for the observed efflux of photons from DNA strands [9].

Motions of proteins within the cell membrane in part control the energy state of the DNA. The dielectric response of cells is a polarization process of diffusing proteins within the membrane, and also a rotation of these same proteins. The dielectric response of tissues is predominantly dipolar at ELF frequencies when most of the cells align in a similar direction without many rotations occurring. As the external frequency of a perturbing field is raised to RF for instance, rotational motions within a cell's membrane increase and the average polarization across a tissue decreases due to these rotational diffusions. These frequencies can be related to the complex dielectric constants. External EM fields thus perturb the endogenous cell dynamics.

No single photon energy or frequency drives all cells in a tissue. A set of frequencies maps out how a tissue can remain viable, or conversely fall into disrepair, depending on the overall management of the cells over the entire tissue. As each cell develops, it has a specific set of frequencies that are associated with the bases of the DNA code within the cell cycle. As the energy in the cell drops, each specific frequency is engaged. In apoptosis the cell frequency becomes chaotic. So each cell is in a particular state at any time. The overall tissue frequency is a weighted average over the complete tissue. This is a macroscopic quantity whereas the DNA in each cell has a specific photon frequency state, or binding energy state.

In time a degenerative action (aging) may occur via hydration states. In keeping with the cellular mechanisms discussed above, both the intracellular and extracellular components of tissues operate within certain energies or frequency bands causing hydration binding to become important aging factors if the energy associated with the tissue diminishes over time. Stiffening of joints and limbs may be related to a lowering of the photonic energy states within the hydration bonds associated with proteins and the ECM.

4. Conclusion

This report gives insight of the role of the photon as the binding energy of atoms and molecules. Discussed is a previously unknown discrete process by which the photon transits between electron and nucleus. This photon transit mechanism appears related to a number of energy or temperature dependent processes where bonds range between strong and weak structures. Physical processes such as the ionospheric layering and biological processes such as the cell cycle may well involve photons of specific energy states.

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