

The Spectroscopy of the EM Field

-a predicted photonic chemistry

There appears to be a spectroscopy associated with the photon

-where the photon is part of an atomic structure, this appears to give rise to a complex interaction of atoms with any external physical structure

In other words another level of chemistry

Three basic photonic situations

(1) photon is part of an atom

(2) photon is radiating between atoms

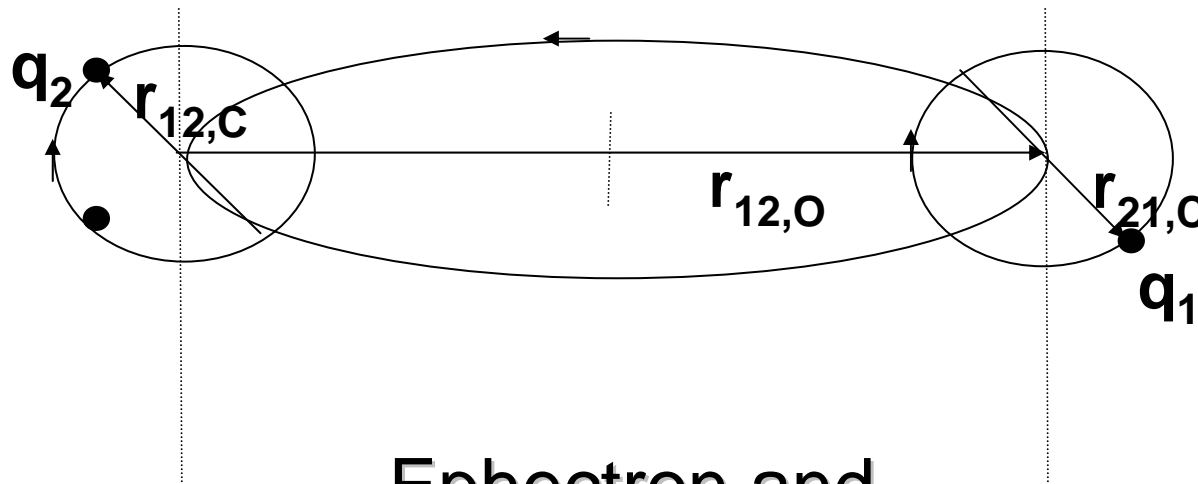
We shall examine (3) isolated photon

-this is similar to an isolated atom

which is theoretical and not found in reality

EMSFT
model of
photon

Assume there are two sub-
photonic particles of equal mass
and opposite charge



Ephectron and
phroton

This follows from study of the hydrogen atom
and from various other physical clues

-assume photon does have a finite rest-mass

Subatomic particles and EM fields
are the basis of atomic chemistry

Atomic chemistry gives us:

- (1) Spectroscopic data
- (2) Structural organization into elements
and compounds
- (3) 3D bonding data

Sub-photonic particles and EM fields
are the basis of a photonic chemistry

Photonic chemistry also gives us:

- (1) Spectroscopic data
- (2) Structural organization into elements
and compounds
- (3) 3D bonding data

EM Self-field Theory

A mathematical procedure,
like quantum mechanics,
can be used to solve hydrogen atom
and a range of problems including the photon

Unlike quantum mechanics,
solves analytically, not numerically-
no uncertainty

E- and H-fields decouple

EMSFT analytic solution of hydrogen atom
mirrors experimental data e.g. Balmer
series

$$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right) \quad n = 3, 4, \dots$$

R is the **Rydberg constant**, whose value is

$$R = 1.097 \times 10^7 \text{ m}^{-1}$$

Balmer series (1885)



656 nm is the red line

How do EMSFT and QM compare?

Hydrogen Atom

Experimental Spectroscopic data

\cong EMSFT analytic solution

\cong Bohr's analytic solution

But Bohr's model only good for Hydrogen atom,
not for higher atomic numbers.

For Helium etc we can use either QM numerical
techniques,

e.g. Schrödinger's method - not relativistic - needs
approximation functions, OR use EMSFT, analytic

Bohr's Hydrogen Atom Model

Electron and proton must move so that electrostatic and centrifugal forces cancel each other

BUT since the electron is assumed to be moving in some kind of circular orbit it should radiate EM energy according to classical physics

spiral ?????????????????? 1911-2002

EMSFT

E- and H-fields can be represented as coupled rotating vectors of constant period one orbital the other cyclotron

$$\vec{\sigma}_o(r_o, \omega_o) = r_o \hat{r}_o e^{j\omega_o t}$$

$$\vec{\sigma}_c(r_c, \omega_c) = r_c \hat{r}_c e^{j\omega_c t}$$



$$\vec{r}(r_o, \omega_o, r_c, \omega_c) = r_o \hat{r}_o e^{j\omega_o t} + r_c \hat{r}_c e^{j\omega_c t}$$

'physical' spinors; unit spinors, linear independence

EMSFT

Substitute spinorial form into Maxwell's Div Equations

$$\nabla \cdot \vec{E} = \frac{4\pi}{v_q} q \quad E = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2} e^{j\phi} \hat{r}$$

The charge and centre of motion within any defined E- field may be an averaged or an instantaneous quantity depending on curvature

$$\nabla \cdot \vec{H} = 0 \quad H = \frac{1}{4\pi\epsilon_0\mu_0} \frac{q}{\sin\theta\omega r^3} e^{j\phi} \hat{\phi}$$

Each particle has both an E- and an H-field associated with its relative position and motion with respect to the other particle

The (two) motions are accelerations in orthogonal directions

EMSFT

Substitute the orbital and cyclotron spinorial forms into Maxwell's Curl Equations in sequence

$$\nabla \times \vec{E} + \mu_{ph} \frac{\partial \vec{H}}{\partial t} = \mathbf{0}$$

The E-field equation provides one scalar equation

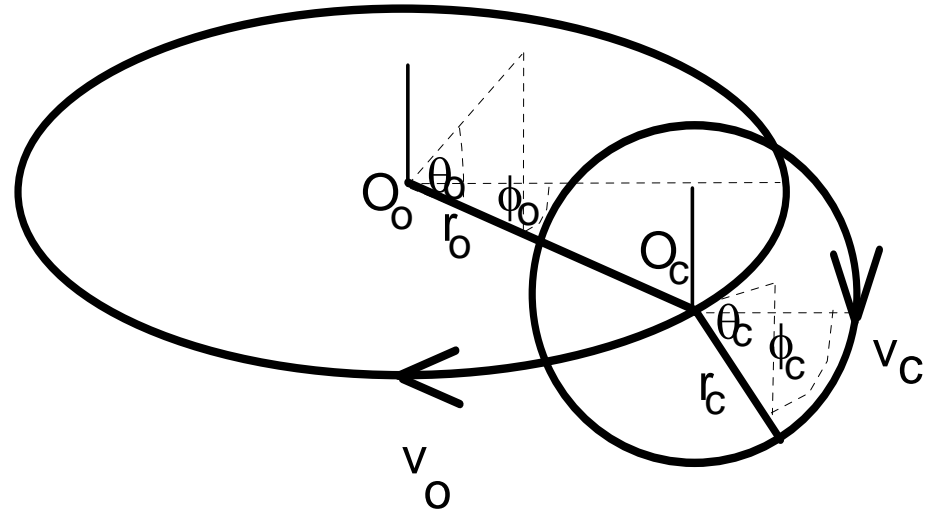
$$\nabla \times \vec{H} - \varepsilon_{ph} \frac{\partial \vec{E}}{\partial t} = \frac{\pi}{s_q} \mathbf{q} \vec{v}$$

The H-field equation provides two scalar equations

To solve analytically for the four unknowns per particle we need another relationship -
THE VIRIAL EQUATION

EMSFT

- E- and H-fields are measured between centres of motion
- Fields are NOT spherically isotropic and ubiquitous but STREAM-LIKE point-to-point beads on a string



EMSFT Fields are NOT CLASSICAL
but discrete – in QED and QCD fields
are classical while method is quantum

EMSFT

$$\frac{\mathbf{q}}{4\pi\epsilon_0 r_o^3} + \frac{\mu_0 \omega^2 \mathbf{q}}{4\pi r_c} = \mathbf{0}$$

$$\frac{c^2}{2\pi r_c^4} \mathbf{q} = \frac{1}{2s_c} \mathbf{q} \omega r_c$$

$$-\frac{c^2}{2\pi r_o^4} \mathbf{q} - \frac{c^2}{2\pi r_o^4} \mathbf{q} = \frac{1}{2s_o} \mathbf{q} \omega r_o$$

EMSFT

virial equations relate kinetic and potential energies

$$\frac{1}{2} m_e \omega_o^2 r_o e^{j\omega_o t} = \frac{-1}{8\pi\epsilon_0} \frac{q^2}{r_o} e^{j\omega_o t}$$

$$\frac{1}{2} m_e \omega_c^2 r_c e^{j\omega_c t} = \frac{1}{8\pi\epsilon_0} \frac{q^2}{r_c} e^{j\omega_c t}$$

Note the potential energies are negative and positive

This is related to the orbital and cyclotron directions of rotation and this is why the structure can have a stable dynamic equilibrium $\hat{\omega}_o = -\hat{\omega}_c$

EMSFT EQNS for electron in hydrogen atom

$$\frac{1}{4\pi\epsilon_0} \frac{\omega^2 q}{r_o} - \frac{1}{4\pi\epsilon_0} \frac{\omega^2 q}{r_c} = 0$$

$$m_e v_o^2 = 2\hbar\omega$$

$$m_e v_c^2 = 2\hbar\omega$$

Notice the presence of Planck's constant on the RHS of the bottom two equations

EMSFT

Empirically, the value of the variable h , where

$$\hbar = \frac{q^2}{8\pi\epsilon_0 v_0} = \frac{q^2}{8\pi\epsilon_0 v_c}$$

can be calculated from the solution,

$$v_0 = r_0 \omega_0 = v_c = r_c \omega_c = 5.469222 \times 10^5 \text{ m/ sec}$$

and equates to the known value of

Planck's constant

within an accuracy of 7 significant figures.

EMSFT

$$\nabla \cdot \vec{E} = \frac{4\pi}{v_q} q_q$$

$$\nabla \cdot \vec{H} = 0$$

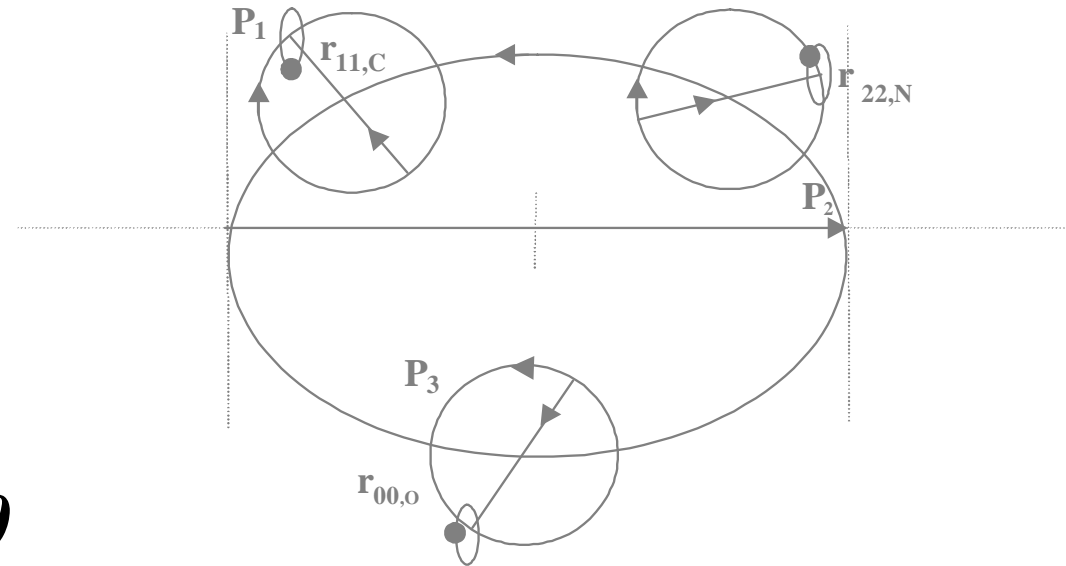
$$\nabla \cdot \vec{N} = 0$$

$$\nabla \times \vec{E} + \mu_n \frac{\partial \vec{H}}{\partial t} = 0$$

$$\nabla \times \vec{H} - \varepsilon_0 \frac{\partial \vec{E}}{\partial t} = \frac{\pi}{s_q} q_q \vec{v}$$

$$\nabla \times \vec{N} + v_n \frac{\partial \vec{E}}{\partial t} = 0$$

Strong force



EMSFT

STRONG FIELDS

$$\nabla \cdot \vec{E} = 4\pi q$$

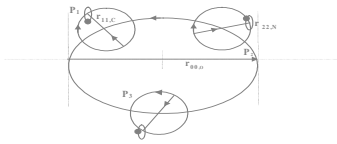
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$$\nabla \times \vec{E} + \mu_0 \frac{\partial \vec{H}}{\partial t} = 0$$



Nuclear self fields
quark-quark-quark
strong coupling

EM FIELDS

$$\nabla \cdot \vec{E} = 4\pi q$$

$$\nabla \cdot \vec{H} = 0$$

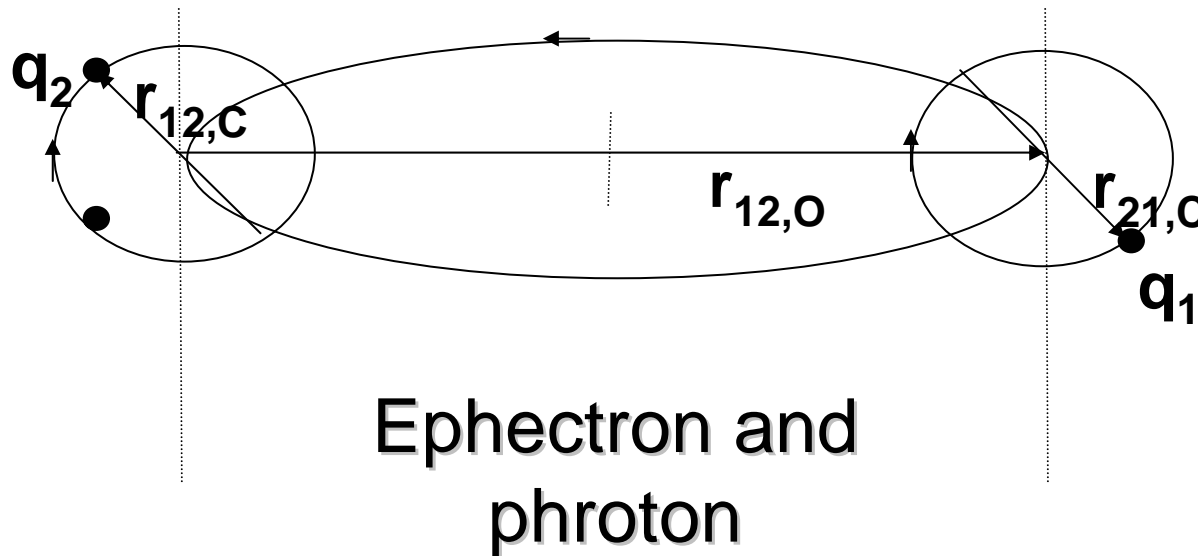
$$\nabla \times \vec{E} + \mu_0 \frac{\partial \vec{H}}{\partial t} = 0$$

$$\nabla \times \vec{H} - \epsilon_0 \frac{\partial \vec{E}}{\partial t} = 4\pi q \vec{v}$$

Atomic EM self fields
proton-electron
EM coupling

EMSFT
model of
photon

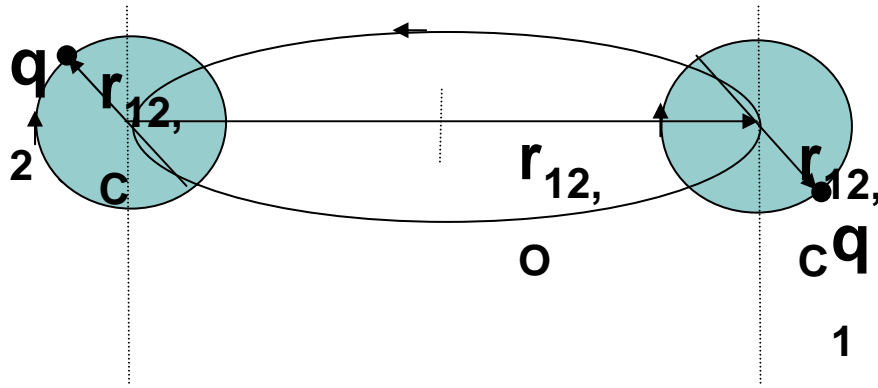
Assume there are two sub-
photonic particles of equal mass
and opposite charge



Following from study of the hydrogen atom
we assume photon has finite rest-mass

EMSFT

Solutions for photonic and atomic sub-particles are identical in form



Ephectron and
phroton

Electron and
proton



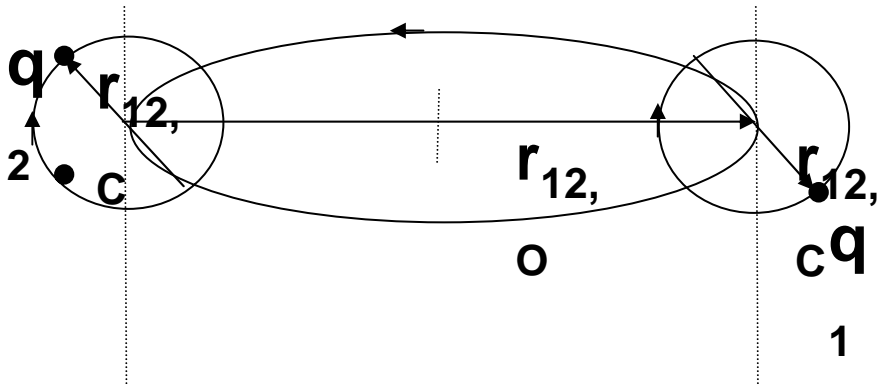
EMSFT

Solutions for photonic and atomic sub-particles are identical in form

EXCEPT

Electron and photon masses are EQUAL

Electron and proton masses are UNEQUAL

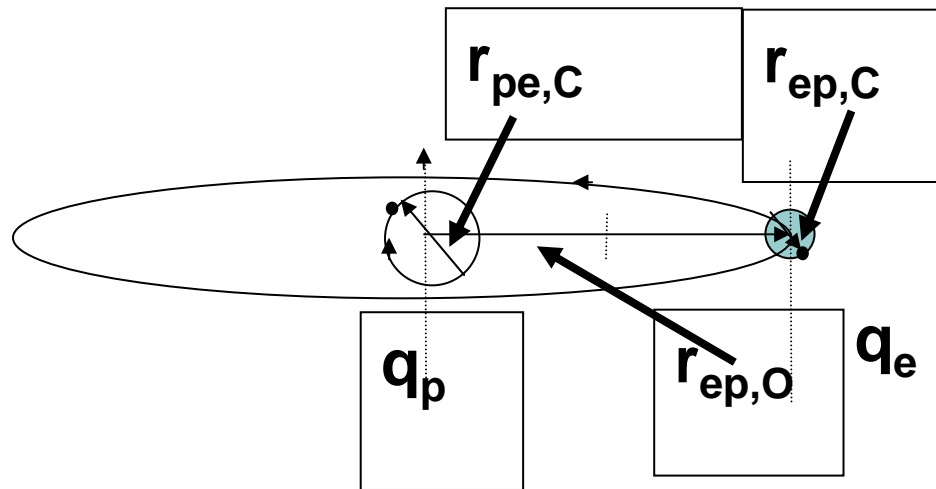


Quantum Physics

EMSFT

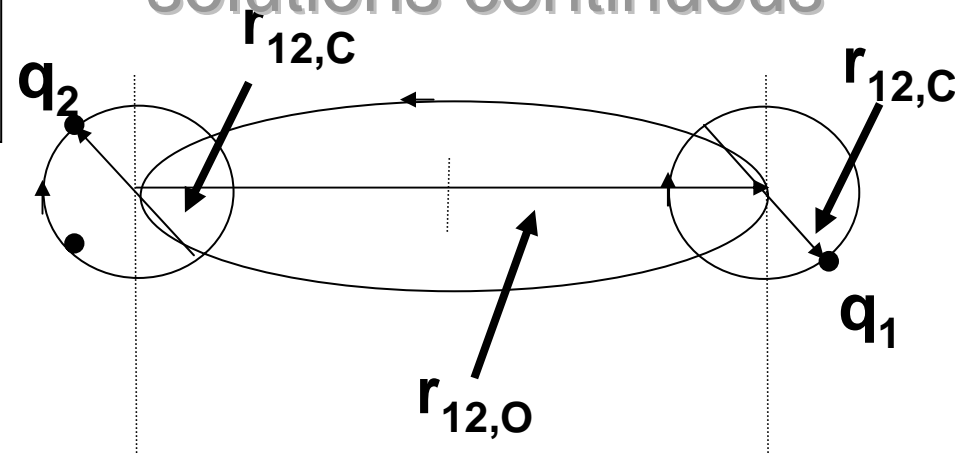
Continuous Physics

Atom has discrete energy spectrum



As masses are unequal only certain radii and velocities valid

Photon has continuous energy spectrum-solutions continuous



As masses are equal ALL radii and their associated velocities are valid

Atomic Physics

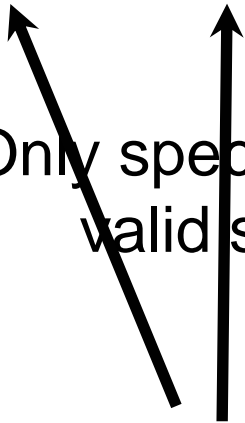
EMSFT

Photonic Physics

Balmer series (1885)



Only spectral lines
valid states



Energy states cannot occur
between lines

Balmer-like series (2004)



Entire spectrum valid



BUT precipitous changes
in state occur
as energy changes
across lines

PHOTONIC CHEMISTRY



Precipitous changes
in state occur
as energy changes
across lines

H₂O bonding

Many biologically important
macromolecules involve some degree
of hydrogen bonding e.g. DNA

DNA - slow changes of energy within cells
control the triggering of different structural states
that induce sudden changes of the EM fields
within the bonds across DNA's base pairing

Conclusions

(1) assuming (isolated) photon has finite rest-mass and doing EMSFT study we find BALMER-LIKE analytic but continuous frequencies

(2) where the photon is part of an atomic structure, this may give rise to a complex interaction of atoms and its photons with any external physical structure

In other words another level of chemistry