Understanding EM confinement forces

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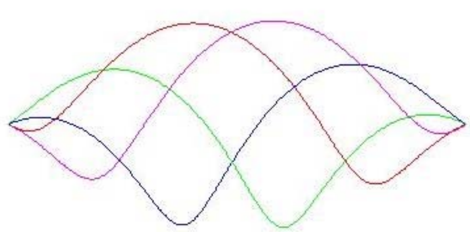
For this confinement force study we ignore Maxwell's equations and use simple geometric models and momentum to find field forces for the photon. Returning to first principals here, to see if there needs to be an extension to our understanding of Maxwell's equations at the particle level, and to help derive another means to make such corrections if necessary. We use the photon to understand and derive the forces that are present in the EM wave of the photon, to demonstrate that sufficient confinement forces for the electron model presented exist in nature.

a. Forces inside photons

We don't generally think about the forces inside a photon. But a photon has momentum and spin, as well as E and M fields, so there are likely a set of balanced forces which preserve the integrity of the photon. To model the reaction of spacetime to electromagnetic fields we need to be able to express the fields geometrically in units of length, and we need to be able to convert these length units to energy, and eventually force. The expression E=hf, energy in joules equals Planck's constant times frequency, can give us some insight into a solution which allows us to express the fields in units of distance. Photon topology and geometry can be generalized by understanding that a spin one photon will make one revolution about the longitudinal axis in one wavelength. This requires an angle θ of helical rotation at 45°. So that the ***dimensional*** RMS value of the total field may be estimated using the expression $r_p = \frac{\lambda}{2\pi}$. Where $\lambda = wavelength = \frac{E}{h}$. So in this photon model, the photon helix is moving forward at the velocity c and spinning about the longitudinal axis at radius r_p at the velocity c. The wavefront velocity internal to the photon is therefore $\frac{1}{\cos(\theta)}$ c which is equivalent to the velocity $\sqrt{2}$ c.



If we calculate the 'centripetal' force from momentum, that is to say, separate the longitudinal momentum and the angular momentum components of the photon, and then calculate the centripetal force of the angular momentum component, we can know the twisting force for photon spin force and therefore find the total forces for the photon EM fields. The twist will lead us again to E=hf.

The twist force must act against EM wave momentum to cause the helix topology described above. Since the angle of rotation θ is 45°, the angular force will be the twist force at r_p. Then the twisting force times $\sqrt{2} = \frac{1}{\cos(\theta)}$ will yield the total photon mutual EM field force. In this manner we can create expressions which allow us to relate the mutual force between the fields to spatial dimensions.

First let us find the momentum L that the twist force must act against:

$$L = \frac{h}{\lambda} \qquad (1)$$

Now let us calculate the twist force required:

$$F_{tw} = \frac{L\,c}{r_p} \qquad (2)$$

Total mutual force F_{tp} between E and M fields is then $\frac{1}{\cos(\theta)} F_{tw} = \sqrt{2}\, F_{tw}$.

Radius rp is the action distance for this field force F_{tp}.

Due to the spatial distribution of the fields and the fact they are perpendicular, there will be an RMS value for rp. These are not point charges or infinitely small fields so the action distance will not be zero but will be rp. In our analysis the field vector units are chosen so that we can represent them in the geometry of the photon. The values are an RMS approximation expressed in units of distance. Therefore the RMS action distance for the photon would be:

$r_p = \frac{\lambda}{2\pi}$ Where $\lambda = wavelength = \frac{E}{h}$

b. Confinement force for the electron

In the electron model, preserving the wavefront velocity $\sqrt{2}$ c, the action distance for the force would then be found as follows: We will set the energy in this gamma photon to the electron energy.

$E =$ 8.18710478684500E-14J

$E = hf$ and $\lambda = wavelength = \frac{E}{h}$ so the frequency of the confined photon is:

$f =$ 1.23558997290369E+20Hz

And the wavelength at c is: $\lambda =$ 2.42631022082086E-12m

So the helical radius of the photon is: $r_p = \frac{\lambda}{2\pi} =$ 3.86159265118028E-13m

And the electron transport radius: $r_e = \sqrt{2}\,\frac{\lambda}{4\pi} =$ 2.73055834982987E-13m

This r_e is a smaller action distance than that of the photon r_p since the electron is a spin ½ particle. If we assume that the total mutual force follows the inverse square rule, which seems reasonable, we can estimate the E and M confinement forces for the electron model by using the ratio of the square of the photon radius over the square of the electron radius: $\frac{{r_p}^2}{{r_e}^2}$

$F_E = \frac{F_{tp}}{2} \frac{{r_p}^2}{{r_e}^2}$ And $F_m = \frac{F_{tp}}{2} \frac{{r_p}^2}{{r_e}^2}$. Where F_E is the electrical contribution to the force, and F_m is the magnetic contribution.

When simplified, this expression shows that the **total mutual confinement force** of the electron F_{te} is:

$$F_{te} = 2F_{tp} = 0.59966525068799 \quad (3)$$

Then we find the **required confinement force** F_{ce} for the electron model using the photon angular momentum L at the velocity $\sqrt{2}\, c$.

Preserving wavefront velocity $\sqrt{2}c$, the momentum for the confined photon in the electron model is:

$$L = \sqrt{2}\, \frac{h}{\lambda} = 3.86211004218299E\text{-}22 \quad (4)$$

So the **binding force required** is: $F_{ce} = \frac{L\sqrt{2}\, c}{r_e} = 0.59966525068799$ (5)

Which equals the calculated confinement force providing a stable balance of forces.

c. Relating photon forces to energy

Twist force F_{tw} at the photon confinement radius is related to energy in Joules in the following manner:

$F_{tw} = \frac{2\pi E^2}{c\, h}$ Where E is energy in joules, *c* is the speed of light, and *h* is Planck's constant.

Total mutual force F_{tp} between E and M fields in the photon at the photon confinement radius is then:

$$F_{tp} = \frac{1}{\cos(\theta)} F_{tw} = \sqrt{2}\, F_{tw} = \frac{2^{\left(\frac{3}{2}\right)} \pi E^2}{c\, h} \quad (6)$$

d. Relating electron forces to energy for the electron at rest

Confinement force in the electron model is then:

$F_{te} = \frac{2^{\left(\frac{5}{2}\right)}\pi E^2}{c\,h}$ Where E is energy in joules. (7)

In this brief exercise, starting by simply calculating the forces required in a photon to satisfy spin and momentum, we have found an EM field binding force for the electron at rest, which exactly equals the required binding force.

e. Relativistic treatment for binding force

To begin, we will substitute an updated version of the relativistic energy for the electron $E = \gamma mc^2$ where γ is the result of the updated Lorentz equation: This new Lorentz equation is based on the wavefront velocity we found in the section "The Photon Model" and is clearly an implied velocity with any spin 1 photon model.

$\gamma = \frac{1}{\sqrt{1-\left(\frac{v^2}{{v_{wf}}^2}\right)}}$ Where v is the particle velocity and v_{wf} is the wavefront velocity.

$E_e = \gamma mc^2$ (8)

Then we will compute a Compton frequency for the electron: $f = \frac{E_e}{h}$

Next we find the resultant wavelength: $\lambda_e = \frac{v_{wf}}{f}$ (9)

Then we find the transport radius: $r_e = \frac{\lambda_e}{4\pi}$ which is for the spin ½ electron.
(34)

The electron momentum is then: $L_e = \frac{\sqrt{2}\,h}{\lambda_e}$ (10)

Now we model a photon with the same energy and compute the photon forces:

The photon frequency is: $f_p = \frac{E_e}{h}$ and wavelength is: $\lambda_p = \frac{c}{f_p}$ (11)

We find the photon radius: $r_p = \frac{\lambda_p}{2\pi}$ (12)

And we find the photon longitudinal momentum: $L_p = \frac{h}{\lambda_p}$ (13)

Now we are ready to calculate the photon force at the photon radius: $F_p = \sqrt{2}\,\frac{L_p\,c}{r_p}$ (14)

So for a photon with energy E_e which is the relativistic energy of our confined photon, F_p is the total EM force at the photon radius.

Let us now calculate the **binding force** for the relativistic electron at the electron transport radius:

$$F_e = F_p \frac{{r_p}^2}{{r_e}^2} \tag{15}$$

We can now calculate the required force to bind and confine the photon:

The electron momentum is found by finding the total momentum of the photon which is:

$$L_t = \sqrt{2}\,\frac{h}{\lambda_p} \tag{16}$$

The required total EM field force for confinement at the electron radius is therefore:

$$F_b = \sqrt{2}\,\frac{L_t v_{wf}}{r_e} \tag{17}$$

And we find that: $F_e = F_p \frac{{r_p}^2}{{r_e}^2} = \sqrt{2}\,\frac{L_t v_{wf}}{r_e} = F_b$ (18)

Which provides for balanced confinement forces from rest through the velocity c.

The modified Lorentz factor $\gamma = \frac{1}{\sqrt{1-\left(\frac{v^2}{{v_{wf}}^2}\right)}}$ is apparently only valid for the internal terms, inside the particle.