

GEM and the Constant Speed of Light

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Abstract

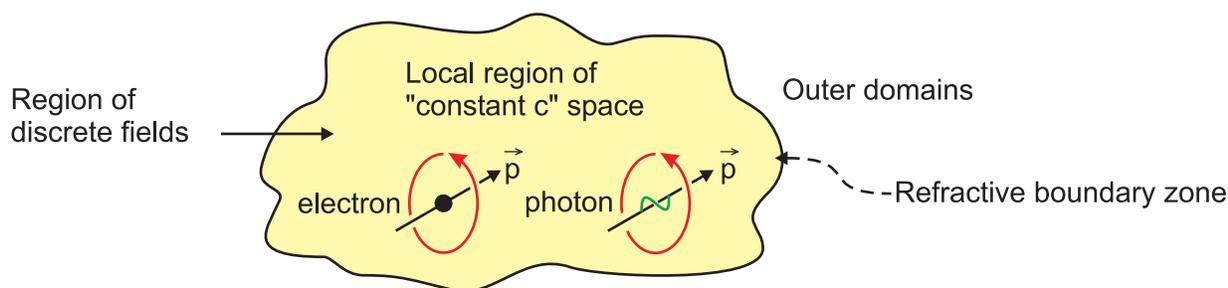
At the root of reality is the nature of *particles* and *fields*. The simplest possible physical model, *one field*, the gravito-magnetic field, self-interacts to produce mass and charge and hence the electromagnetic field. This paper focuses on the interaction of this gravito-magnetic field with the electro-magnetic field.

My recent essay¹ in an FQXi essay contest introduces a unified field theory based on a gravito-electro-magnetic field, (aka, the C-field) first postulated by Maxwell, extended by Heaviside and Lorentz and considered by Einstein as a 'weak field approximation' to General Relativity. Based upon modifying two GEM equations, I've developed a theory of cosmology and particle physics that explains a large number of current mysteries in physics. Based on reasonable assumptions, I've calculated a scale factor 31 orders of magnitude greater than the scale that Maxwell chose simply for reasons of symmetry. Of significance is the fact that Martin Tajmar has claimed to experimentally measure the field and unexpectedly finds the same 31 orders of magnitude.

The gravito-magnetic field interacts with mass, including its own equivalent mass, and I've spent most of my effort studying these interactions. Another FQXi essay² by Peter Jackson discusses electromagnetic fields and the constant speed of light. His essay explores a theory

"...that space itself is divided into discrete domains by refractive boundary zones, forming 'discrete fields' each centered on matter in relative motion."

A diagram of such a domain is shown below.



Jackson presents a convincing argument that macro space is truly divided by refractive boundaries, typically plasmas, into local 'c'-speed zones. His approach uses "physical and mutually exclusive inertial frames". I will initially ignore "*refractive boundary zones*" and focus on "*discrete fields*".

¹ <http://www.fqxi.org/community/forum/topic/799>

² <http://www.fqxi.org/community/forum/topic/803>

Willard Mittleman thanked Peter Jackson for pointing out that existence of a preferred frame is compatible with the constant speed of light, stimulating me further. Jackson said the *Big Issue*,

"the reason the 'ether' field was banished was to allow the special relativity solution to constancy of electromagnetic wave propagation speed with respect to all receivers. ...only when we find a quantum friendly version of this allowing the constant speed of light can we have a unified field back and let physics progress."

and

the 'physical and mutually exclusive inertial frames' reconnect 'locality' with realism, lacking only a quantum connection to be complete and restore the idea of a unified field.

It is this *quantum connection* that I explore in this paper.

Most of the following will be derived from the Master equation and a derived equation:

$$\begin{aligned} \vec{\nabla} \cdot \vec{G} = \vec{G} \cdot \vec{G} & \quad \text{Classical Field equation - continuum physics} \\ \Downarrow & \\ \frac{\Delta m}{\Delta t} (\Delta x)^2 = \hbar & \quad \text{Quantum Principle - physics of observables} \end{aligned}$$

and from the modified GEM equation that can be derived from the Master equation above

$$\frac{c^2}{\kappa} (\vec{\nabla} \times \vec{C}) = \frac{\vec{p}}{\mu} - \frac{d\vec{G}}{dt}.$$

If we can ignore changes in the gravito-electric field, $d\vec{G}/dt$, and we suppress constants, then we write $\vec{\nabla} \times \vec{C} = \vec{p}$, and a change in the C-field circulation

$$\frac{d}{dt} (\vec{\nabla} \times \vec{C}) = \frac{d\vec{p}}{dt}$$

produces a Lenz-Law-like force that conserves linear momentum, \vec{p} , with angular momentum conservation built in via $mvr = \hbar/2$. C-field circulation is inextricably linked to local momentum, and the C-field dipole implied by the quantum principle locks local C-field angular momentum to linear-momentum in a *frame independent* (or perhaps a *preferred frame*) fashion, appropriate to the quantum 'constant speed of light' frame.

This is completely compatible with a 1952 remark of Einstein's:

"The concept of space as something existing objectively and independent of things belongs to pre-scientific thought, but not so the idea of the existence of an infinite number of spaces in motion relative to each other."

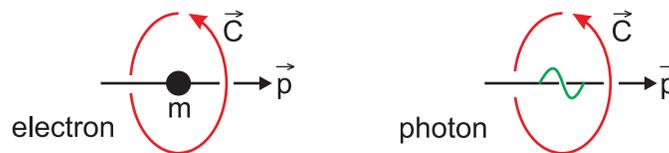
According to Jackson:

"We view Cartesian coordinates as a 'frame', and refer to inertial frame, yet Einstein referred to a body, or coordinate system rigidly connected to a body."

Local C-fields take the form of induced circulation 'rigidly connected to a body' with momentum.

The connection is the '=' sign connecting the C-field circulation to momentum: $\vec{\nabla} \times \vec{C} = \vec{p}$.

Momentum allows us to treat entities that have zero rest mass, such as photons. Two such entities forming 'discrete fields' each *centered on matter in relative motion* are shown below.

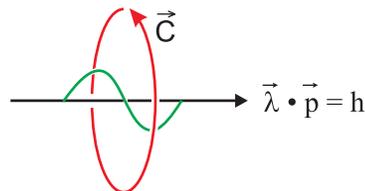


We now search for the desired quantum link to the *discrete fields*.

Recall that the *discrete fields* were each "centered on matter in relative motion" and this implies non-zero momentum. But non-zero momentum always induces a C-field circulation, so there is then always a *discrete field* centered on mass in relative motion.

At this point we wish to focus on just such a discrete field, centered on a photon, as a local entity subject to local laws of physics. Recall the relations governing a photon's energy, frequency, momentum and wavelength:

$E =$ energy
 $\nu =$ frequency
 $\vec{p} =$ momentum
 $\lambda =$ wavelength



$$\vec{p} = \frac{\hbar\nu}{c} = \frac{E}{c} = \frac{\hbar}{\lambda}$$

Although we've dropped a vector on the right, we know that the wavelength has the 'direction' of propagation, so we can write the wavelength as a vector

$$\vec{p} = \frac{\hbar\vec{\lambda}}{\lambda^2} \quad \Rightarrow \quad \vec{\lambda} \cdot \vec{p} = \hbar$$

If we substitute for the photon's momentum in the C-field equation

$$\vec{\nabla} \times \vec{C} = \vec{p} \quad \Rightarrow \quad \vec{\nabla} \times \vec{C} = \frac{\hbar}{\lambda}$$

This is a new linkage of the electromagnetic field to the gravito-magnetic field, connected through Planck's constant \hbar . Equivalently we use the dot product to transform the equation

$$\vec{\lambda} \cdot \vec{p} = \hbar \quad \Rightarrow \quad \vec{\lambda} \cdot (\vec{\nabla} \times \vec{C}) = \hbar$$

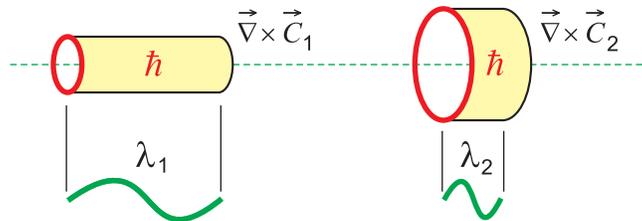
The product of the wavelength of the light and the circulation of the C-field is (proportional to) Planck's constant of action, so as the wavelength decreases, circulation increases, whereas when wavelength lengthens the C-field decreases. Since shorter wavelength corresponds to higher momentum, this is the expected behavior.

A new physics equation is born:

$$\vec{\lambda} \cdot (\vec{\nabla} \times \vec{C}) = \hbar$$

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electro- magnetic wavelength	gravito- magnetic circulation	universal quantum of action

Thus we have the desired quantum link between the two discrete fields, the electro-magnetic field and the gravito-magnetic field. To visualize this we illustrate the C-field circulation as a cylinder of length λ



This should be frame independent, and seems to answer the question:

Does a photon move in an inertial field, or does a photon "carry its inertial field with it"?

The obvious answer in our theory is that a photon carries its inertial field with it.

Refractory boundary zones

At this point we return to Peter Jackson's "refractory boundary zones". We begin by using John David Jackson's *Classical Electrodynamics* and recall that Gauss's Law tells us:

$$(\vec{E}_2 - \vec{E}_1) \cdot \hat{n} = 4\pi \sigma$$

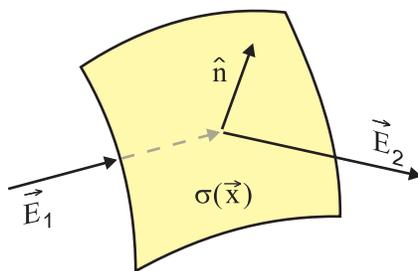
The above equation is later used in several places to give induced surface charge of conductors:

$$\vec{E}_1 = 0 \quad (\text{field inside conductor})$$

$$\vec{E}_2 \cdot \hat{n} = -\vec{\nabla} \phi \cdot \hat{n} = -\frac{\partial \phi}{\partial n} = 4\pi \sigma$$

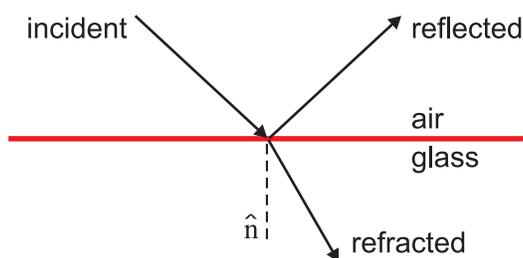
$$\sigma = -\frac{1}{4\pi} \frac{\partial \phi}{\partial n}_{r=a}$$

In general, this means that there is a discontinuity of $4\pi\sigma$ in the normal component of electric field in crossing a surface with a charge density σ (cross from 'inner' to 'outer' surface).



At this point we recall a few facts about the propagation of light in media. Begin with refraction:

The law of refraction $\frac{\sin \theta_1}{\sin \theta_2} = n_{21}$ where $n_{21} = \frac{v_1}{v_2}$ and v_i is the speed of light in media i .



The key point is that *wavelength changes on refraction*. And the wavelength of light in a material medium is less than the wavelength of light in free space. So there is a maximum wavelength of light, *the wavelength of light in free space*.

$$\vec{\lambda} \cdot (\vec{\nabla} \times \vec{C}) = \hbar$$

This amazing relation is the key we were looking for. It clearly couples the electromagnetic field and the gravito-magnetic, or C-field, in a quantum connection that represents 'new physics'.

The Constant Speed of Light

But the relation $\vec{\lambda} \cdot (\vec{\nabla} \times \vec{C}) = \hbar$ also indicates that the constant speed of light is a consequence of the fundamental constant of action. To see this, we refer to our original C-field equation

$$\frac{c^2}{\kappa} (\vec{\nabla} \times \vec{C}) = \frac{\vec{p}}{\mu} - \frac{d\vec{G}}{dt}$$

Ignoring only two parameters, μ and dimensionless κ , we find that our key relation becomes:

$$c^2 \vec{\lambda} \cdot (\vec{\nabla} \times \vec{C}) = \hbar$$

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 CSL EM GEM Quantum of Action

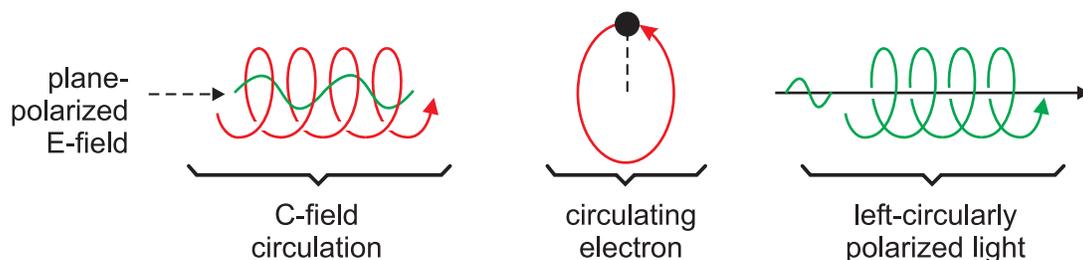
Logic indicates that either c^2 is inversely proportional to the EM and GEM fields, or the value of c^2 is constant. Physical measurements seem to vouch for the latter. By this logic,

the value of the constant speed of light depends on the quantum of action.

This is preferred, since the scale invariant nature of the Master field equation implies a motion invariance that makes c meaningless, until the quantum of action induces a symmetry-breaking event that enables time, momentum, and hence c .

Are there any specific predictions that our theory can make?

The circular C-field accompanying a photon through space is 'clean and simple' as long as the photon is in 'free space', but if the photon interacts with electrons, either free or bound, then the C-field interaction with the mass of the electron is more complex. It seems to suggest that if the E-field of the photon moves the electron 'up and down', the C-field will tend to drag the electron in a circle. This effect should be more pronounced for shorter wavelengths.



Of course the polarizing filters used in entanglement and other experiments use long chain molecules to select a polarization, but the above effect should be seen in plasma.

Other aspects of this linkage of electro-magnetism and gravito-magnetism are being written up.