the general science journal

Fundamental Energy and its Fields and LC Representations

André Michaud

srp2@globetrotter.net
http://pages.globetrotter.net/srp/

Quoted from

Expanded Maxwellian Geometry of Space, 4^{th} edition

http://pages.globetrotter.net/srp/geomax2a.htm

Abstract :

It is well understood that energy at the fundamental level can be represented in more than one way. The most popular being that of interacting electric and magnetic fields that were analyzed in a previous paper **([3])** for free localized photons and massive elementary particles.

An alternate fields representation method inspired by Louis deBroglie's theory regarding the possible internal dynamic structure of a permanently localized photon's energy is that of a discrete LC system made up of half the photon's energy oscillating electromagnetically thus generating mutually inducing alternating electric and magnetic fields, while being propelled in space by the other half of the photon's energy moving unidirectionally[1]. This representation will be analyzed here (**Section 6**) after clarification of the axiomatic foundation of deBroglie's hypothesis.

These methods however are only mathematical representations of the kinetic energy that physically exists and moves at the fundamental level. **Section 7** will describe the local motion of this physically existing energy that we are more familiar with by means of the fields representations.

Table of Contents

[1] **NOTE**: To fully understand the structure of deBroglie localized photon it is recommended to first read a separate paper that describes the required underlying space geometry: **Description of the 3-Spaces Expanded Maxwellian Space Geometry ([5])**

Paper Setup

First in a series of model dependent papers describing a seamless series of clearly defined interaction sequences providing an uninterrupted path of causality from:

1) the unquantized quantities of unidirectional kinetic energy induced in particles by natural acceleration through Coulomb or gravitational interaction,
2) to the quantization in the form of free-moving electromagnetic photons of any quantity of this energy in excess of the precise amount required by the local stable or metastable electromagnetic equilibrium
3) to the creation of electron-positron pairs from the destabilization of photons of energy 1.022 MeV or more,
4) to the creation of protons and neutrons from the interaction of electrons and positrons forced into groups of three including both types in sufficiently small volumes of space with insufficient energy to escape mutual capture,
5) to the final shedding in the form of neutrino energy of momentary metastable excess rest mass (different from velocity induced extra momentary relativistic mass) as overexcited massive elementary particles are forced by local electromagnetic equilibrium into lowering their mass to their lower and stable true rest mass.

Steps 1) and 2) are however not model dependent despite belonging to the same interaction sequence and have been described in a previous paper ([7], **Sections 3 and 4**).

Before proceeding to the description of steps 3), 4) and 5) in coming papers, it is mandatory to understand the local dynamic structure of energy in a free moving localized photon as hypothesized by Louis de Broglie. We will proceed to this description in the present paper.

1 deBroglie's hypothesis regarding permanently localized Photons

In the 1930's, Louis deBroglie, whose 1924 thesis inspired Schrödinger's wave equation and earned him a Nobel prize, formulated a hypothesis on how a permanently localized photon following a least action trajectory can satisfy at the same time Bose-Einstein's statistic and Planck's Law, perfectly explain the photoelectric effect while obeying Maxwell's equations and totally conform to the properties of Dirac's theory of complementary corpuscles symmetry.

His theory revealed that the only possible dynamic structure that can comply to all of these criteria was that the photon be made up not of a single particle, but of two particles, or half-photons, that would be complementary like the electron is complementary to the positron ([1], p.277).

From his hypothesis: "*Such a complementary couple of particles is likely to annihilate at the contact of matter by relinquishing all of its energy, which perfectly accounts for the characteristics of the photoelectric effect.*"

Furthermore, "*The photon being made up of two elementary particles of spin $h/4\pi$, it must obey the Bose-Einstein statistic as the precision of Planck's law for the black body requires.*"

Finally, he concludes that "*…this model of the photon allows the definition of an electromagnetic field linked to the probability of annihilation of the photon, a field that obeys Maxwell's equations and has all of the characteristics of electromagnetic light waves.*"

1.1 Internal Electromagnetic Symmetry

These conclusions involve that photons have to be stable dynamic structures that can logically only alternate between a two components electric state with both components separating in space (an electric dipole) and a single component magnetic state that could be dipolar in only one manner, which can consist only in a spherical magnetic expansion phase as both electric state components move towards each other, followed by a spherical magnetic regression phase as both electric state components move away from each other, both magnetic phases being normal to the electric phase at all times. This involves that the magnetic aspect of the photon will be spherical at all times and can be dipolar only along the time dimension since both expansion and regression cannot possibly occur simultaneously.

Such a dynamic structure still preserves fundamental symmetry since the space-wise electric dipole is counterbalanced by a related time-wise orthogonal magnetic dipole, with both dipoles remaining orthogonal to the direction of motion of the photon in space in agreement with Maxwell's theory.

1.2 The possibility of fundamentally neutral Half-Photons

DeBroglie associated no signs to the two electric state particles of his localized photon hypothesis after having analyzed this possibility[2].

[2] This was confirmed to me at the **Fondation Louis deBroglie** upon a specific question on my part regarding this point, through a copy of a Note to Dominique Morenas from Georges Lochak, director of the Foundation and lifelong colleague and friend of deBroglie.

But paradoxically, it has been understood and extensively experimentally confirmed since the 1930's that any photon of energy 1.022+ MeV, which is electrically neutral, can be destabilized to convert into an electron-positron pair (charged in opposition) when grazing a heavy particle such as an atom nucleus.

Could the sign of charges then be an extrinsic property of charges, possibly a vectorial property that would be acquired at the moment of separation of the pair? This would leave the door wide open to the possibility that the half-photons could be associated to unsigned charges, that is, fundamentally neutral charges!

The unraveling of the origin of constants $\boldsymbol{\varepsilon_0}$ and $\boldsymbol{\mu_0}$ proposed in ([2], **Chapter 11**) shows that the possibility of the existence of such neutral pairs of charges within photons is definitely worthy of consideration, which would effectively reduce the "sign" of a charge to a property acquired at the moment of decoupling by the then fundamentally neutral charges of the decoupling photon.

2 The Sign of Charges

Indeed, the new equation for free energy derived from Marmet's work in ([3], equation (11))

$$E = hf = \frac{hc}{\lambda} = \frac{e^2}{2\varepsilon_0 \alpha \lambda} \tag{1}$$

does involve by structure two charges interacting. The very form e^2 reveal that both charges in a localized photon have to be identical, and can be neutral $|e|^2$ as hypothesized by deBroglie, which leads to the logical conclusion that the opposite signs of a decoupling pair (positron + and electron -) can effectively be considered as being acquired as the pair decouples, which is obviously contrary to current axiomatic beliefs[3], but is in perfect harmony with deBroglie's hypothesis.

The remaining issues regarding these assumed neutral fundamental charges are now "What are they?" and "How do they initially come into being?"

3 Creation of new pairs of neutral charges

For example, when a half-photon pair decouples, it is experimentally confirmed that the residual energy in excess of the 1.022 MeV required to form the rest masses of the separating pair and that causes the now massive electron and positron to fly away from each other, can only be two very normal photons as analyzed in a separate paper ([3]), but instead of flying away at the

---

[3] It is a fact that all experimental research aimed at identifying charges in electromagnetic “waves” have failed to detect any in support of Maxwell's assumption of the existence of a displacement current and corresponding magnetic field as a foundation for his theory.

But Let’s consider that if electromagnetic “waves” turn out to be only a convenient mathematical representation of a macroscopic perception of a crowd effect due to the presence of countless localized photons that Planck and Einstein confirmed the physical existence of, it would indeed be these photons that would display the searched for charges and would be the local sites of displacement current versus magnetic induction activity.

There simply exists no instrument sensitive enough to detect the infinitesimal fields of individual photons, with the added difficulties that they are all moving at the speed of light and that any interception of a single photon simply incorporates it as an infinitesimal increase in kinetic energy to the material that the detector is made of.

speed of light as would be expected, are slowed down by the presence of the massive particles that they now must carry separately and whose velocity and instantaneous relativistic mass increase they now determine.

How does the new pair of electrically neutral corpuscles of each new residual carrier-photon come into being then?

All indications lead to conclude that it would be the mere presence of energy in electrostatic space that would be perceived as corresponding to a charge when observed from normal space just like the mere presence of the very same energy in magnetostatic space is perceived as a magnetic field when observed from normal space.

This would explain very simply why all of a photon's energy can completely evacuate electrostatic space at the end of its transfer process into magnetostatic space, momentarily leaving absolutely nothing behind.

The assumed "neutral" charges of a permanently localized photon in electrostatic space would then not be fixed-dimensions "corpuscles", in the generally understood sense, but simply the energy itself that makes up the equal energy half-photons during the electrostatic phase of the cycle, whatever its total amount.

The "unit charges and opposite signs" acquired by both electron and positron upon decoupling would become fixed simply because the corresponding energy stops cycling between electrostatic and magnetic states to become fixed quantities in electrostatic space now applying unidirectional and stable "pressures" in opposite directions in normal space whose intensity depends on the decoupling radius of the pair in electrostatic space, as analyzed in ([2]).

4 Transverse travel vs longitudinal travel of a photon's energy

This structural analysis highlights one more astonishing fact about electromagnetic energy, which is that its transverse integrated amplitude being subject to the speed of light as a maximum limiting velocity of the constituting energy as the latter accelerates transversally in both electrostatic and magnetostatic spaces from velocity zero at each limit, can *de facto* only be different from the classical amplitude associated to constant longitudinal velocity at c of the photon.

Rather simple calculation show that this transverse amplitude corresponds very precisely to the integrated absolute amplitude of the particle's energy ($\lambda\alpha/2\pi$) (See [3]). Interestingly, the difference is exactly equal to the fine structure constant (α), whose origin and justification has mystified the community so much for the past hundred years.

So the fine structure constant (α) can now be defined as follows:

The fine structure constant is the ratio of the transverse amplitude of transversally oscillating electromagnetic energy over the longitudinal amplitude of the same energy in the direction of its motion at the speed of light in space.

5 Displacement current as the source of photons' magnetic field

Now, considering the cyclic to and fro motion of the assumed neutral pair of charges involved in the deBroglie localize photon internal dynamic structure, it must be obvious that only displacement current could be at play here since no physically massive matter can be present to support in any way a conduction current.

It is well understood since Maxwell that displacement current can also act as a source of magnetic field and that a changing electric field (which would be the case with the cyclic symmetric dynamic motion of the pair of charges considered) in a region of space, will induce a magnetic field in neighboring regions, even when no conduction current and no matter are present (and in deBroglie's localized photon hypothesis, even if the charges are neutral).

Such an electro-magnetic relationship involving a displacement current, first proposed by Maxwell in 1865 was the foundation of his electromagnetic theory and provided the key to theoretical understanding of electromagnetic radiation ([4], p 625), which brings us to the behavior of LC circuits.

6 Fields generation due to energy circulation

6.1 Macroscopic LC circuits

When an inductor coil is connected to a charged capacitor with no resistance inserted in the circuit, it is well verified experimentally that the capacitor will completely discharge into the inductor as the current in the inductor establishes a magnetic field in surrounding space.

When the potential difference between the capacitor terminals reaches zero, the magnetic field that just reached maximum about the inductor coil will now start decreasing thus inducing a current in the coil that will completely recharge the capacitor in the reverse direction until the magnetic field completely disappears and the capacitor is again fully recharged.

The capacitor will now start discharging again into the coil and the process would repeat indefinitely in theory if no energy was lost, a loss that always occurs in a lab experiment in reality due to eventual heating of the coil wire. It is well understood however that if no energy was lost through heat loss from the coil wire, the total energy of the system would remain constant and be conserved, which would keep the cycle going for ever.

6.2 The Photon as a LC Oscillator

Let us note that an oscillating LC circuit requires no conduction current keep operating, and that the displacement current inherent to the structure of a charged capacitor is sufficient to initiate and maintain the continuous process[4].

The classical equation representing the maximum energy stored in the capacitor of an LC circuit at the beginning of the cycle is

$$E_E = \frac{q^2}{2C} \tag{2}$$

and the one representing the maximum energy stored in the magnetic field of the coil when the capacitor has been emptied of its charge is

$$E_B = \frac{L\,i^2}{2} \tag{3}$$

Of course, if no energy was lost in such a system through heating of the coil wire, we could equate

[4] Let us note here that the difference between an alternating current and a displacement current is that the latter involves a self sustaining oscillation, in close circuit so to speak, while an alternating current needs to be permanently maintained externally.

$$E_E = E_B \tag{4}$$

6.3 Defining the Photon Integrated Capacitance (C)

Transposing now this LC behavior to deBroglie's localized photon, which has no wire that can resist and heat up and thus can completely conserve its energy, we can now determine its integrated capacitance (C) and inductance (L), in relation to its energy.

We previously determined that only half a photon's energy cyclically oscillates between electric and magnetic states (the other half moving unidirectionally to maintain the speed of light of the first half in space). So using the energy equation (1) previously mentioned derived from Marmet's work, that is:

$$E = \frac{e^2}{2\varepsilon_0 \lambda \alpha} \tag{5}$$

let us divide it by two to separate the half of a photon's energy that electromagnetically oscillates from the unidirectional half:

$$E_{EB} = \frac{E}{2} = \frac{q^2}{2C} = \frac{e^2}{4\varepsilon_0 \lambda \alpha} \tag{6}$$

Consequently, we can isolate

$$2C = 4\varepsilon_0 \lambda \alpha \tag{7}$$

and finally

$$C = 2\varepsilon_0 \lambda \alpha \quad \text{Farad} \tag{8}$$

which allows calculating the integrated capacitance of any localized photon from its wavelength and the permittivity constant of vacuum (ε_0).

Now since $\boldsymbol{\varepsilon_0}$ is in reality a measure of ***transverse capacitance*** *per meter in vacuum* (Farad per meter), if we multiply $\boldsymbol{\varepsilon_0}$ by a length in meter, we obtain de facto a capacitance in relation with that length. So, equation (8) should fully confirm the nature of $\boldsymbol{\varepsilon_0}$ as a unit of vacuum capacitance per meter since it effectively boils down to calculating the capacitance of a photon by multiplying $\boldsymbol{\varepsilon_0}$ by a transverse wavelength (in meters).

6.4 Defining the Photon Integrated Inductance (L)

We know besides that the angular frequency of an LC oscillator is obtained from the following equation

$$\omega = \sqrt{\frac{1}{LC}} \tag{9}$$

Since we can separately calculate the angular frequency of a photon's energy from $\omega=2\pi f$, or better yet, in context, from $\omega=2\pi c/\lambda$ (since we must use here the cycling frequency calculated from the absolute wavelength a localized photon's energy which is $f=c/\lambda$), we can write

$$\omega = \frac{2\pi c}{\lambda} = \sqrt{\frac{1}{LC}} \tag{10}$$

By squaring this last equation and replacing C by the value defined with equation (8), that is $\varepsilon_o 2\lambda\alpha$, we can isolate L and define the following equation for calculating the inductance of any photon from its wavelength and the permeability constant of vacuum (μ_0)

$$L = \frac{\lambda^2}{C\,4\pi^2c^2} = \frac{\lambda}{\varepsilon_0\,2\alpha\,4\pi^2c^2} \tag{11}$$

Knowing also that $\varepsilon_o c^2=1/\mu_o$ and substituting this value in equation (11) we can finally write:

$$L = \frac{\mu_0\lambda}{8\pi^2\,\alpha} \quad \text{Henry} \tag{12}$$

We note here in reference to the definition of the permeability constant as being *a unit of inductance per meter in vacuum*, that multiplying it by a wavelength (in meters), as our last equation reveals, we obtain a very straightforward inductance.

6.5 Photon Maximum Displacement Current (*i*)

Knowing now how to calculate L for a localized photon and that the electromagnetically oscillating energy involved (equation (6)) amounts to half of the photon's energy (E_{EB}), we can determine the maximum current (*i*) involved from the equation giving the maximum energy momentarily stored in the magnetic field. So, from

$$E_B = \frac{L\,i^2}{2} \tag{13}$$

we derive

$$i = \sqrt{\frac{2E_{EB}}{L}} = \frac{2\pi\,ec}{\lambda} \quad \text{Ampere} \tag{14}$$

6.6 The Photon General LC Equation

One final consideration before establishing a general dynamic equation for localized photons is that the sum of both E_E and E_B is permanently constant and since both values concern the very same amount of energy transferring form one form to the other. The sum of both can thus never exceed the maximum energy of either E_E or E_B. Consequently, we can write

$$E_{EB} = E_E + E_B = \left[2\left(\frac{e^2}{4C}\right)_Y \cos^2(\omega\,t) + \left(\frac{L\,i^2}{2}\right)_Z \sin^2(\omega\,t)\right] \tag{15}$$

where t is the time for one cycle to be completed and corresponds to $1/f$, or when defined as a function of λ as required here, $t=\lambda/c$, and where the electric aspect of course splits into two equal quantities moving in opposite directions.

Since this energy corresponds to only half of the energy of a photon, we must finally add the other half which is the permanently unidirectional kinetic energy that propels the oscillating half at the speed of light. Let's now introduce the correct set of directed unit vectors to completely represent the various directions of motion of the energy within the photon structure:

$$E\,\vec{\mathbf{I}}\,\vec{\mathbf{i}} = \left(\frac{hc}{2\lambda}\right)_X \vec{\mathbf{I}}\,\vec{\mathbf{i}} + \left[2\left(\frac{e^2}{4C}\right)_Y (\vec{\mathbf{J}}\,\vec{\mathbf{j}}, \vec{\mathbf{J}}\,\overleftarrow{\mathbf{j}}) \cos^2(\omega\,t) + \left(\frac{L\,i^2}{2}\right)_Z \overleftrightarrow{\mathbf{K}} \sin^2(\omega\,t)\right] \tag{16}$$

We have here the most detailed and general equation, all terms of which being function of the single variable **λ**, that can possibly be established for the energy of a localized photon, and where indices X, Y and Z respectively represent the three mutually orthogonal spaces into which the associated energy is in motion in the 3-spaces model ([2]).

Note that the vector combination (**Ii**) representing the final motion of the total energy of the photon is exactly equal to the vector combination associated to the unidirectional half of the photon's energy located in normal space (X-space) since both **Jj** vectors of electrostatic space (Y-space) cancel each other by structure and that the **K** vector of magnetostatic space (Z-space) represents energy moving omnidirectionally as it expands and then regresses within that space.

All that is required now to observe how the energy oscillates between electric and magnetic states is to cyclically vary t from 0 to λ/c.

This equation allows clearly understanding why the Poynting vector is totally stable when deBroglie's hypothesis is taken into account, at a value equal to the averaged out value of this vector in classical Maxwell. This stability is due to the fact that at any given moment, the sum of capacitance energy and inductance energy is always exactly equal to half a photon's energy, which means that the electromagnetic oscillation behaves very precisely like a simple harmonic oscillator.

7 Underlying Kinetic Energy Circulation

7.1 Differentiating between fundamental energy and EM fields

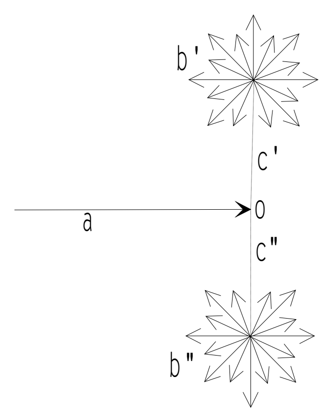
We just clarified how the energy of a localized photon can be represented as a cyclically oscillating magnetic and electric fields state (involving a displacement current) in accordance with deBroglie's internal photon structure hypothesis. This allowed defining a general LC equation for photons of any energy (**Equation (16)**).

We will now describe how a photon's fundamental energy needs to move to generate these two fields. This description however is model dependent and requires prior understanding of the expanded space geometry that underlies deBroglie's hypothesis. This space geometry is explained in a separate paper ([5]) and should be read before going further.

7.2 Energy Circulation Trough the Trispatial Junction

7.2.1 Energy transfer from electrostatic to magnetostatic space

Referring to the local cyclic oscillation of a photon's energy in the 3-spaces geometry (**[5], Section 15**), let us consider the pair of half-photons of deBroglie's hypothesis (neutral electric charges) as they reach the farthest distance they can possibly reach on either side of their junction in electrostatic space, that is, the maximum electrostatic amplitude of their cyclic motion.



Given the assumed attraction exerted on them by the central junction, they will immediately start accelerating back in free-fall back towards this junction, according to the inverse square law. [5]

Since Coulomb force free-fall acceleration increases progressively the kinetic energy in bodies accelerating towards each other in normal space, and assuming that the same fundamental law applies in

[5] In the accompanying drawing, vector **a** represents the quantity of kinetic energy in unidirectional motion in normal space required to maintain the speed of the photon in that space. We will present proof in a coming paper (See also **[2], Chapter 13**) that for the speed of light of the photon to be maintained, this quantity needs to be at all times exactly equal to the quantity permanently oscillating between electrostatic and magnetic spaces, so it is made up by structure of exactly half the energy of the photon.

Dotted lines **c'** et **c"** represent the occurrences of attraction that permanently seek to attract half-photons **b'** and **b"** towards trispatial junction **o** within electrostatic space.

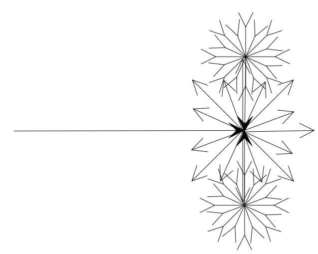
electrostatic and magnetostatic spaces, it can be expected that kinetic energy would also increase locally between the half-photons accelerating towards each other in electrostatic space.

It could also be intuitively expected that when both half-photons finally come together, they would form a mathematically punctual single quantity possessing an infinite amount of energy, as is assumed from Maxwell's theory and Coulomb interaction in dipoles ([6], p.199). There seems to exist no other possibility in traditional 3-dimensional space. See accompanying drawing.

However, referring to verified behavior of photons, we know that any given photon's energy is stable as perceived from normal space, and never peaks to infinity in this manner. Consequently, if deBroglie's hypothesis on the internal mechanics of the photon matches reality, Nature has found a way for this not to occur. And this is precisely what the 3-spaces expanded geometry allows!

Instead of piling up at the junction point as would intuitively be expected in traditional 3-dimentional space, the energy simply starts crossing over to magnetostatic space as both charges start moving towards each other. Since there is ample reason to believe that fundamental energy behaves as an incompressible fluid (see **Section 7.3** further on), it logically is easier for it to flow through the junction than to pile up in electrostatic space.

Once engaged into the junction, it might be expected that the energy would indiscriminately flow into both normal and magnetostatic space. But since photons already are moving at the speed of light in normal space and that it has been verified that electromagnetic energy can move at no other speed in vacuum, we emphatically know that none of this energy will flow into normal space, since the slightest such inflow in that space would result in an increase in the speed of the photon, which is experimentally verified never to happen!



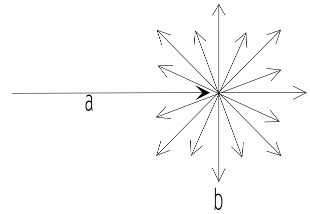
Certainty is thus established in this expanded geometry that all of the photon's energy initially present in electrostatic space will flow into the only other space available to it at that moment, which is magnetostatic space, which happens to locally not be saturated at that precise moment.

Since we know that magnetic fields cannot be split into opposite quantities, we can expect that the photon's energy will gather into a single quantity in magnetostatic space. So, irrespective of the fact that both half-photons had opposite directions of motion towards each other in electrostatic space, it seems reasonable to expect that the half-photons' energy will fuse together as it flows into magnetostatic space, diffusing omnidirectionally in spherical expansion about the junction point, as if the material was metaphorically attempting to get away from the junction in all possible directions. [6]

Note that the representation of half-photons **b'** and **b"** as two vectorial spheres is only an ad hoc metaphor that will help visualizing later their conversion into an electron/positron pair, the decoupling of which we will analyze in a coming paper for photons of energy 1.022+ MeV. The energy of each half-photon would no doubt be much more precisely represented in context by a vectorial arrow pointing away from the junction, during its expansion phase, and pointing towards the junction in its return phase.

[6] Sphere **b**, which is localized in magnetostatic space, is thus made up of the combined sum of the energies of **b'** and **b"** during the brief moment of the cycle when that energy has completely evacuated electrostatic space.

Such omnidirectional expansion being perfectly symmetrical by very nature, perfectly balances the also perfectly symmetrical bi-directional resorption of the half-photons that are in the process of leaving electrostatic space.



As both half-photons are leaving electrostatic space, their interaction whose intensity had been increasing according to the inverse square law as they were approaching the junction. But instead of its strength increasing to infinity as both half-photons reach the junction, will gradually decrease in intensity as the quantity of substance of both particles present in electrostatic space progressively leave this space, to finally have completely evacuated this space when all the energy has momentarily crossed over into magnetostatic space.

7.2.2 What happens to the neutral charges of the two half-photons

At this point, one will definitely wonder what happens to the two charges, presumably neutral that must be related to the two half-photons. What happens to them when all of the oscillating energy has completely left electrostatic space? What are they really to start with? Are they yet identifiable entities, energyless to start with when they were farthest away from the junction point, to then accumulated kinetic energy as they accelerate towards the junction? Do they cease existing when all of their energy has completely crossed over to magnetostatic space?

These issues have already been addressed in **Sections 1, 2 and 3** of the present paper.

7.2.3 Required Electro-Magnetic Equilibrium

One could now wonder what happens in magnetostatic space once both half-photons have completely left electrostatic space.

We have already reflected on the fact that within electrostatic space, the attraction between both half-photons is of necessity an extrinsic property of kinetic energy due to the simple fact that it acts <u>between</u> separate quantities of kinetic energy and a 3-spatial junction. It is thus a relative characteristic whose intensity varies with the distance between these separate quantities of energy.

The situation is different in magnetostatic space. We are locally dealing here with a single quantity of kinetic energy, and to explain the state of equilibrium of the photon, this unique component located in magnetostatic space must succeed on its own in symmetrically complementing the two components that mutually interact in electrostatic space.

Since the electromagnetically oscillating energy is now regrouped as a single quantity in magnetostatic space, its dual-component counterpart in electrostatic space having momentarily completely ceased to exist; it is now impossible that a relative property could be involved in magnetostatic space in the restricted reference frame of the existence of the photon itself to force the energy to return to electrostatic space, since there momentarily exists no other component to interact with.

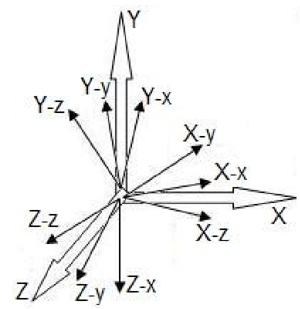
Three possibilities then come to light: 1) the kinetic energy now totally transferred into magnetostatic space has an intrinsic property that will then force it to return to electrostatic space without external help; or 2) the three spaces structure itself acts as a set of communicating vessels through the central junction offering zero resistance at the junction to the passage of energy and that always allows the energy of the photon to maintain electromagnetic equilibrium; or finally 3) a combination of the first two possibilities.

This is of course just a hypothesis at this point, but the second possibility seems more simple and logical and will turn out to be the most productive when we address the decoupling mechanics of photons of energy 1.022 MeV or more into pairs of electron-positron in a coming paper.

On the other hand, if kinetic energy possessed an intrinsic property that could force the magnetic quantity to return to electrostatic space, it could only be a property of self-repulsion of the kinetic energy itself, a property not incompatible with the idea that the kinetic energy would locally spread in spherical expansion about the tri-spatial junction within magnetostatic space as it enters it. That is, a property such that kinetic energy, by its very nature, would constantly tend to divide since each of its parts would be behaving as if it repelled all other parts.

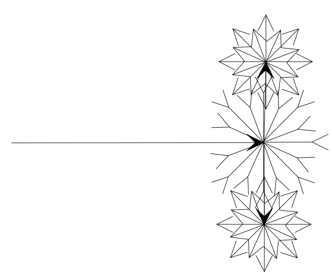
7.2.4 Energy transfer from Magnetostatic to Electrostatic space

So, from the moment when all of the energy has completely crossed over into magnetostatic space, given that the total quantity of energy involved is fixed and incompressible, it must be concluded that the previously expanding energy sphere in magnetostatic space will have no other possibility but to stop growing. The length of the vectorial representations of the motion of all its parts previously in spherical expansion will have no other choice then but to fall to zero in all directions at that precise moment.



In the perspective that electrostatic and magnetostatic spaces would act as communicating vessels, all of these vectors should now naturally orient towards the central junction and consequently, the photon's energy will have no other way to go but to start crossing in reverse direction the junction which by structure is located at the geometric center of the local magnetic sphere towards the now empty electrostatic space.

We can now visualize the energy sphere decreasing in volume in magnetostatic space as two half-quantities begin to move away from each other and from point zero in diametrically opposite directions on the Y-y/Y-z plane within electrostatic space, thus maintaining perfect equilibrium[7].



Having already explored the behavior of half-photons in electrostatic space, it is easy now to understand that an interaction will begin to exist between the two budding half-photons as they start growing into that space, and that when they reach again the farthest point from the junction that their energy allows, they will once again locally free fall accelerate back towards the central junction, thus initiating the next cycle.

To summarize the complete oscillating cycle, doesn't it look like the photon's energy behaves exactly like a perfectly normal and totally stable discrete LC oscillator as described in the first part of this paper?

7.3 Energy Behavior as an Incompressible Material

The frequency of a photon depending solely on the amount of energy that it carries, the simple fact that a photon possessing twice the energy of another, requires a distance twice shorter in normal space to complete its cycle, is sufficient in and of itself to demonstrate that the photon's

[7] Referring to the accompanying dimensions drawing, remember the 3-ribs umbrella metaphor representing the opening from 0° to 90° of the inner dimensions of each space to allow easier visualization.

energy locally behaves as a totally incompressible material. It can thus be said that the quantity of energy carried by a photon is inversely proportional to the distance it must travel in vacuum for one cycle to be completed, which can be represented by the following relational equation:

$$E = \frac{1}{\lambda}$$, meaning that product λE is constant.

7.4 Distance Related Counterpart to Planck's Time Related Constant

It was determined in a former paper (**[3], Equation (11)**) that this constant, not currently in use as such in physics, and that we will temporarily name the ***electromagnetic intensity constant***, is equal to a very precise set of well known traditional fundamental constants that allow spherical integration of the energy of a photon:

$$H = \lambda E = \frac{e^2}{2\varepsilon_0 \alpha} = 1.98644544E-25 \ J \bullet m \quad (17)$$

Interestingly, if we divide this constant by c (the speed of light), we have the surprise to obtain Planck's constant (6.626068759E-34 J•s)! So this new constant turns out to be the distance based counterpart (or more precisely the transverse amplitude based counterpart, as we will see further on) of time based Planck's constant (whose symbol is **h** and whose units are J•s (Joules second) as opposed to J•m (Joules meter) and that we will study more closely in a coming paper. So it seems appropriate to define this new constant for the needs of the current analysis since this model is distance based, and to symbolize it with capital **H**, by similarity with Planck constant's lower case **h**. So:

$$H = hc = \lambda E = \frac{e^2}{2\varepsilon_0 \alpha} = 1.98644544E-25 \ J \bullet m \quad (17a)$$

Then, if the energy of a photon is the known factor, its wavelength can easily be obtained by dividing this constant by energy E; that is by isolating λ in equation (17):

$$\lambda = \frac{hc}{E} = \frac{H}{E} \quad (18)$$

or if the photon wavelength is the known factor, obtain its energy by dividing constant H by its wavelength, that is by isolating E in equation (17):

$$E = \frac{hc}{\lambda} = \frac{H}{\lambda} \quad (19)$$

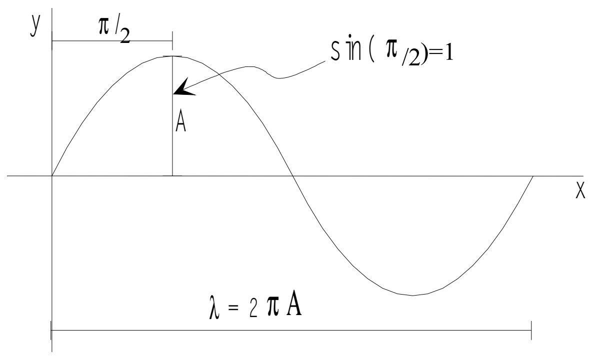
7.5 Transverse Travel of Photon Energy in Electrostatic Space

As to the transverse distance traveled within electrostatic space at right angles with respect to normal space (the transverse amplitude) by the half-photons of a photon whose energy is double that of another, the simple harmonic motion equations (which are obeyed by light) show that the transverse distance reached in electrostatic space will be half that of half as energetic a photon.

In this regard, real scatterable electromagnetic photons seem to often be confused with the virtual photons of QED, and it seems to be the norm to treat real photons with the wave function, as is done with electrons in atoms. Is there any need to emphasize the major difference between electrons, that have a fixed amount of rest mass energy and can only occupy discrete quantum levels in atoms and true photons, whose total complement of energy typically progressively drifts as they red shift or blue shift in reaction to gravitational interaction.

So it may well be that treatment with the wave function is not ideal for photons, since this treatment implies that photons cannot be localized as they move, which is contradicted by the simple fact that starlight reaching us allows analyzing the composition of the matter making up the stars, and that such information could not possibly reach us if photons did not continuously exist during transit to carry that information to us. We will thus proceed to a classical analysis of the internal motion of the energy of real photons and we will see where this leads us.

Regarding transverse amplitude A of our photon, that is its amplitude within electrostatic and magnetostatic spaces, we will derive an equation that will allow obtaining it from a fundamental equation of light, that is $\lambda f = c$, where λ is the wavelength of the photon considered, f is its frequency also symbolized by ν (the Greek letter ***nu***), and finally c is the speed of light.



Since any cyclic motion can be graphically represented by a sine wave, a photon's wavelength λ can be equated to $2\pi A$. Substituting in the previous equation, we can thus isolate A:

$$A = \frac{c}{2\pi f} \text{ or } A = \frac{c}{\omega} \quad \text{(where } \omega \text{ (omega) is the angular velocity)} \tag{20}$$

We observe from the drawing that maximum amplitude is reached at a quarter of the cycle, and also when a quarter of the time to complete a cycle has elapsed. Consequently, we can derive

$$A = \frac{c}{\omega \times 1} = \frac{c}{\omega \sin(\pi/2)} = \frac{c}{\omega \sin(2\pi f \times 1/4f)} = \frac{v}{\omega \sin(\omega t)} \tag{21}$$

the latter being the standard equation for obtaining the amplitude of simple harmonic motion as can be verified in any basic textbook.

We are now able to calculate the transverse amplitude of the energy of any photon. If this sine wave was used to describe the harmonic oscillation of a particle submitted to a force acting transversally to its direction of motion, the transverse velocity of the particle would of course be zero when amplitude reaches maximum in either opposite direction on the Y-y/Y-z plane, and would be at maximum when the amplitude equals zero ([6], p.352).

But given that we are describing the pulsating motion of incompressible energy translating cyclically between two maximum limits, the velocity of the transversally moving energy will be zero at maximum amplitude in both spaces as expected, but it will also be zero when amplitude reaches zero in either space on account of the transverse velocity of the energy tending towards zero as its amplitude tends towards maximum in the other space.

This allows understanding that maximum transverse velocity will be reached when half of the energy has left either electrostatic or magnetostatic space, which means that it is reached at 1/8th the time it takes for one cycle to be completed.

This means also that maximum transverse velocity will be reached 4 times during each cycle of the sine wave representation of the cyclic motion of the photon's energy, that is at 1/8th, 3/8th, 5/8th and 7/8th. In physical reality however, only two such velocity peaks are possible since 3/8th and 5/8th will coincide, as well as 7/8th and 1/8th of the next cycle due to the incompressibility of the fundamental material. We will calculate that velocity in a coming paper.

We can also see that the product of the wavelength **λ** by frequency ***f*** is a constant, known to be the speed of light:

$$\lambda f = c \tag{22}$$

8 The Electrostatic Recall Constant

Why not now do some verifying with a real wavelength to clarify the last remaining hanging threads? We will use the electron Compton wavelength (λ_C=2.426310215E-12 J) since it exactly coincides with the absolute wavelength of a photon of same energy as is captive in an electron rest mass, and that all related data are well known and verified.

Let us first determine the ***electrostatic recall constant*** (k) for the LC transverse oscillation for the Compton wavelength related energy (which is of course $E_C/2$= 4.09355207E-14 Joules). From Hooke's law, E= $-kA^2/2$, where A is the related amplitude $\lambda_C\alpha/2\pi$, and E is the energy related to the oscillation E= $E_C/2$. Consequently:

$$K = \frac{2E}{A^2} = \frac{4\pi^2 E_C}{\lambda_C{}^2\alpha^2} = 1.031019177\text{E}16 \ \ \text{N/m} \tag{23}$$

Now, since F = -k x (x being a distance in meter), the recall force at maximum transverse extent will be

$$F = kA = k\lambda_C\alpha/2\pi = 29.05350473 \text{ Newton} \tag{24}$$

Now how can we verify that this figure is correct?

Since F is proportional to kA, if we multiply the equation by α, we get the corresponding force for the longitudinal Compton wavelength

$$F\,\alpha = k\lambda_C\alpha^2/2\pi = 0.212013666 \text{ Newton} \tag{25}$$

We know also that the energy induced at the Bohr rest orbital is equal to the electron rest mass energy multiplied by α^2. Since force is proportional to energy, we can further find the force associated with a photon of same energy as the Bohr rest orbital energy by further multiplying by α^2

$$F\,\alpha\,\alpha^2 = k\lambda_C\alpha^4/2\pi = 1.12900148\text{E-5 Newton} \tag{26}$$

Now, this is the force for a photon of same energy as is induced at the Bohr rest orbital, but that photon is obviously moving at c. We know also that force is proportional to velocity. And we further know that the velocity at the Bohr rest orbital is equal to c multiplied by α. Consequently, a final multiplication by α should give us the well known force associated with the Bohr rest state

$$F\,\alpha\,\alpha^2\,\alpha = k\lambda_C\alpha^5/2\pi = 8.238721808\text{E-8 Newton} \tag{27}$$

Which is the well known force associated to the Bohr rest orbital.

Doesn't this confirm that the Force / Energy / K / C / L / *i* / ω parameters of the double-particles photon LC equation of deBroglie's hypothesis are mathematically self consistent?

9 References

[1] Louis deBroglie. **La physique nouvelle et les quanta**, Flammarion, France 1937, 2nd Edition 1993, with new 1973 Preface by L. deBroglie

[2] André Michaud. **Expanded Maxwellian Geometry of Space**. 4th Edition, 2004, SRP Books, http://pages.globetrotter.net/srp/geomax2a.htm.

[3] André Michaud. **Field Equations for Localized Individual Photons and Relativistic Field Equations for Localized Moving Massive Particles,** International IFNA-ANS Journal, No. 2 (28), Vol. 13, 2007, p. 123-140, Kazan State University, Kazan, Russia.
http://www.gsjournal.net/ntham/michaud.pdf

[4] Francis Sears, Mark Zemansky & Hugh Young**. University Physics**, 6th Edition, Addison Wesley, (1984).

[5] André Michaud, **Description of the 3-Spaces Expanded Maxwellian Space Geometry,**
The General Science Journal 2010: http://www.gsjournal.net/ntham/michaud9.pdf

[6] Robert Resnick & David Halliday. **Physics**. John Wyley & Sons, New York, 1967.

[7] André Michaud. **The Corona Effect**, The General Science Journal 2009:
http://www.gsjournal.net/ntham/michaud6.pdf

10 Other papers by the same author

http://www.gsjournal.net/ntham/michaud10.pdf

