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What is a photon?
And how and why are photons massless?

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Abstract

The electromagnetic and aetherometric theories of the photon are succinctly compared. Experimentally and theoretically, photons are shown to be massfree particles devoid of electric charge or structure. The fundamental types of photons – ionizing and blackbody, and amongst the latter, high and low frequency ones – are distinguished by their physical fine structure, and their chemical and biological effects. Production of photons is shown to always be local and referenced to the inertial frame of the emitter (massbound charge), even when photons display significant ballistic-like displacement, as is the case with ionizing photons. The theorized mass of photons is functionally found to be the amplitude wavelength for the displacement of the photon energy flux, and the latter analyzed by the particularities of its Space- and Time-manifolds. Photons are shown to have a globular wave envelope. The energy flux of all photons obeys a universal timing constant, but because the globular envelope of blackbody photons is a composite one, the duration of the formation of a complete blackbody envelope is given by the reciprocal of the quantum frequency of its light and energy.

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COMMUNICATION

I – AETHEROMETRIC vs ELECTROMAGNETIC THEORIES OF THE PHOTON: A SUCCINCT COMPARISON

1. Basic conventional definition of the photon

"Photon" is a term introduced by quantum-mechanics into electromagnetic theory to designate a particle of light, or a quantum of electromagnetic energy. The particulate aspect of the photon was correlated to the expression of a constant quantized angular momentum (Planck's constant h, usually divided by 2π), and its energy was given by the product of that constant of angular momentum with a frequency term - the quantum electromagnetic frequency. The accepted physical and geometrical representation of the photon involves a mathematical description of a fiber of light, forming bundles or packets that are stochastically represented by a ray.

2. Short note on the historical development of the concept of Light particles

Isaac Newton was the first physicist or philosopher to think that Light could be conceptualized as having a particulate structure, and his view became known as the corpuscular theory of Light, most often set, a century later, against the opposing theory of the undulatory nature of Light (Young's, Fresnel's, Maxwell's). With the advent of quantum-mechanics, the corpuscular nature of light was rediscovered through Einstein's introduction of the modern concept of the photon. Light then became conceptualizable by two antinomic functions and treatments for its two distinct behaviours - undulatory and particulate. To this day, these two treatments are accepted as a form of fundamental and unresolvable dualism present at the core of the physics of electromagnetism.

3. Basic aetherometric definition of the photon

Aetherometry claims to resolve the particle-wave dualism of the photon by its treatment as a massfree energy multiplicity. The term "particle" is, in fact, loosely used even by modern-day particle physics. And the term "photon" can be even more vague, now denoting the electromagnetic momentum, next the constant quantum of electromagnetic moment, and still at other times designating a distinct unit of electromagnetic energy. In effect, in its quality of distinct unit of electromagnetic energy, the photon is already all of those physical manifestations - a form of momentum, a constant of moment and a wave-packet of energy. The momentum and moment manifestations of the photon are, in fact, properties of the conjunction of waves that defines both the energy of the photon and its

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rate of flux. Its "immediate" particulate aspect relates to its linear momentum (its existence as a particle) and the pressure its "impact" or incidence exerts upon exposed Matter. Its quantization relates to its constant of moment or angular momentum, and its quantized energy forms two distinct spectra - blackbody and ionizing. As we shall see, with reference to the inertial frame of the emitter, the waves of every photon always abide by the speed constant c - irrespective of the existence of linear and angular Doppler effects in its detection [1].

Originally, our aetherometric theory of photons suggested that blackbody photons are local productions that actually do *not* travel through space, nor have a fibrous structure. As we shall see below, specific caveats *must* be placed on this view: while *blackbody photons* do not travel through space and practically "live and die on the spot", their globular wave envelope turns out to have a fasciculated structure formed by a "string of successive photons"; conversely, *ionizing photons* are not bundled together, but engage in substantial displacements through space that smear their globular envelope. But before we may get this far, we must understand what is aetherometrically meant by "photon": it is a unit of energy that has the wavelength and frequency properties of Light, a quantized angular momentum and a discrete linear moment characteristic of a particle. In their quality of units of electromagnetic energy, photons have a globular wave envelope.

Under conditions of tight atomic or molecular packing, blackbody photons can be absorbed and re-emitted resonantly and coherently - as in lasers or masers. However, even then blackbody photons do not travel - the transmission of Light across space always involving the communication of a kinetic state from molecule to molecule. More fundamentally, the transmission of Light in vacuo involves the propagation of massfree (ambipolar) electric fields responsible for the excitation wave(s), and whose energy can be "punctually" captured by massbound charges (and thus atoms or molecules) to sustain kinetic states. Light (ie blackbody photons), then, is only generated locally when these kinetic states of massbound particles decay by energy shedding.

The concept and functions of "Light rays" are simply a probabilistic way of approximating the physical reality of the phase or excitation wave that transmits 'across space' the indirect stimulus for the production of Light. In the case of blackbody photons, a mediating term must always intervene between the phase wave and the production of photons, or light; the mediating term is always a massbound charge.

4. Basic differences between the conventional and aetherometric conceptions of the photon

4.1. On the nature of photons:

Currently, conventional mainstream physics holds that solar radiation consists of mostly blackbody photons. Implied in this is the notion that these photons travel through space, like fibers

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of light, with analogy to ballistic models for the projection of material particles - as if the photons were hurled across space. This view is, in fact, still the legacy of Newton's ballistic theory of Light corpuscles.

It is the view of aetherometric theory that solar radiation does not consist of photons, but of the massfree electrical charges that compose the scalar electrical field [2] . Moreover, it is also the view of aetherometric theory that blackbody photons are "punctual" and local productions, that they do not travel through space but rather occupy a "globular space" (or part thereof) where they are created and extinguished [1]. No blackbody photons, IR or otherwise, reach the Earth from the Sun. What reaches the Earth is electrical radiation of massfree filamentary charges. Blackbody photons are always and only produced as a residual of the interaction of this radiation with massbound charges, ie with electrons, protons and molecular ions.

As we shall elaborate in part II below, the great dispute regarding the nature of photons refers to whether or not they have inertial characteristics or bear mass. Whereas conventional particle physics is split as to whether photons are massless or not, aetherometric theory holds that photons are free of mass or inertia.

4.2. On the nature of the transmission of electromagnetic energy

If blackbody photons do not travel through space, what is it that travels through space and is the cause of the transmission of the Light-stimulus, and ultimately of any local production of photons?

Aetherometry contends that what travels through space and transmits the light impulse is electrical radiation composed of massfree charges and their associated longitudinal waves (the true phase waves), not electromagnetic radiation composed of photons and their transverse waves. The wave transmission of electromagnetic signals in the blackbody portion of the spectrum ultimately depends on the propagation of nonelectromagnetic energy, specifically the propagation of electric massfree charge energy (the propagation of "the field"). *In vacuo*, this propagation of nonelectromagnetic energy is made by the wave displacement of ambipolar energy; but that is not the only form of propagation for the Light-stimulus, nor a sufficient element for the conversion of this energy into electromagnetic energy by photon emission. In effect, propagation of ambipolar fields by itself cannot sustain local emission of blackbody photons. A third term must intervene - and that is the kinetic state of a massbound charge that has been accelerated by the field and thus has captured kinetic energy from "the field". Literally, then, the transmission of (blackbody) electromagnetic signals depends directly upon the propagation of the corresponding kinetic states of the photon-emitter massbound charges. In the absence of an ambipolar field, the kinetic states can still be transmitted from massbound charges to massbound charges that are in close neighbourhood, by absorption and re-emission of blackbody photons. Light production indirectly depends upon the field propagation

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or the displacement of ambipolar energy, but directly depends upon the communication of kinetic energy states, the loss of which being what permits emission of blackbody photons.

Material particles or massbound charges accelerate when an electrical, magnetic, or electrical-cum-magnetic field is applied to them. Aetherometry contends that, in nature, the fields that are indirectly responsible for blackbody photon production consist of massfree electric radiation, the electrical effect of the radiation of massfree charges upon Matter being the acquisition of their energy by the massbound charges they encounter (ergo the addition of a kinetic energy term to the energy associated with the rest mass of a material particle), and thus the acceleration of these massbound charges [3]. In summary, Aetherometry claims that 'radiation' of massfree charges is directly responsible for the acceleration of massbound charges, whereas it is the deceleration of the latter which converts the lost kinetic energy into a local generation of blackbody photons.

4.3. On the fundamental types of photons

There are two fundamental "physico-chemical" types of photons with distinct biological effects: ionizing and nonionizing (blackbody) photons. Aetherometry recognizes this accepted distinction, but suggests that it is still more profound than accepted physics holds, in that the two spectra are different as to the very conditions necessary for the production of one or the other type of photons. The physical characteristics of photon radiation vary with photon energy or frequency, whereas the chemical and biological effects depend on energy or frequency ranges.

4.3.1. Blackbody photons

Aetherometry claims that nonionizing or blackbody photons are locally generated whenever material particles that act as charge-carriers decelerate and lose their kinetic energy. Thus, "in space", blackbody photons "form rays" because they mark the trail of deceleration of massbound particles. This punctual generation of photons that marks the trails of decelerating massbound charges, combined with the decay in the kinetic energy of these charges, its release and scattered reabsorption by other adjacent massbound charges (causing so-called conversion of electromagnetic energy into longer wavelength radiation), is what accounts for (1) the dispersion of energy through conversion into electromagnetic radiation and for (2) the approximate suitability of the stochastic model for the dispersion of a ray and the scatter of Light.

Yet, as explained in the previous subsection, the production of blackbody photons indirectly depends upon the acceleration of potential emitters - the massbound charges - by an ambipolar field, all the more so as the kinetic energy acquired by these charges modally reflects the energy and potential characteristics of the accelerating field. Accordingly, the energy of blackbody photons indirectly reflects the energy of the accelerating field.

Blackbody radiation is composed of nonionizing, thermal (forming what is called "radiative sensible heat" or "radiant heat") and optical 'electromagnetic' (photon) radiation. In essence, *black-*

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body or optothermal photons form a smooth distribution of emission discontinuities - the so-called "continuous" spectrum of Light and radiative heat that has, aetherometrically, a lower wavelength cut-off of 47 nm. In turn, the "continuous" optothermal spectrum is divided into two subspectra, those with wavelength $>\lambda_q = 47$nm but <300nm, and those with wavelength >300nm [2, 4]: high-frequency and low frequency, respectively, with their photons being designated by the terms HFOT (High Frequency Opto-Thermal photon) and LFOT. Since, generally, the accelerating field is ambipolar, the two optothermal photon subspectra correspond to two subspectra of the (low energy) ambipolar spectrum [2], which we have identified as the "orgone" and "DOR" subspectra. Ambipolar "orgone" radiation indirectly gives rise (through the intermediacy of electrons) to LFOT blackbody radiation with Light wavelengths >300 nm. Ambipolar "DOR" radiation indirectly gives rise to HFOT blackbody (Hallwacks) photons in the UV-B and UV-C ranges, up to the shortest $\lambda_q = 47$nm wavelength of blackbody radiation (end of the blackbody spectrum). Light, then, qua blackbody radiation, is the byproduct of the interaction between ambipolar radiation and massbound charges, a mere marker generated upon deceleration of these charges, when they scatter. Without the acceleration caused by the interaction of massfree and massbound charges, no blackbody photons are generally produced.

LFOT photons, which include the high-energy UV-A photons, are essential for all terrestrial life - their absorption being one of the basic methods of energy acquisition employed by photosynthetic and respiratory lifeforms. LFOT photons are therefore biological sources of energy and radiant heat. A variety of biological reactions exist that rely upon absorption of their energy. In contrast, HFOT photons, which comprise only UV-B and UV-C photons, are inducers of free-radical chemical reactions that result in the *homolytic photodissociation* of molecules and are generally inimical to most lifeforms. Biochemical absorption of HFOT photons typically leads to the formation of free-radicals that are destructive of biological structures. Yet, HFOT photons have long been shown to play a fundamental role in the development of synthetic prebiotic soups, suggesting that their absorption by nitrogenous carbon-scaffolded molecules played a fundamental role in biopoiesis - in particular, in the formation of essential amino and nucleic acids. Technically, therefore, the photobiology of HFOT photons should not be subsumed under the radiobiology of ionizing photons.

4.3.2. Ionizing photons

Ionizing photons – with wavelength $< \lambda_q = 47$ nm – do not generally form a smooth distribution, rather they constitute the line or discontinuity markers of characteristic nuclear (such as x-rays characteristic of each element) or subatomic (such as gamma ray production by pair annihilation) processes that generate photons of energy too high for chemical or biological absorption, and which typically result in the ionization (*heterolytic radiodissociation* or charge separation) of molecular substrates. Effectively, ionizing photons are life-threatening forms of electromagnetic radiation. Their emission, or transmission, does not require the primary interaction of an ambipolar field with massbound charges (more on this on section 8 below). Pair-production is, in this respect, the production

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of a gamma-ray photon by the melding of two identical mass-energies (negatron and positron) that, frequently, have no associated kinetic energy components. In general terms, ionizing photons are produced either by valence electrons or by nuclear electrons, corresponding to the technical designations of x-rays and gamma-rays.

"Continuous" spectra of x-rays are obtained by bombardment of anode targets with electrons accelerated by various field voltages. The distribution presents a modal peak that, with increasing voltage, shifts towards shorter wavelengths; but irrespective of the voltage the edge of the distribution approaches and eventually hits the Compton-electron wavelength (λ_{ce}) as its lower wavelength limit. The "continuous" distribution of x-rays reflects the scatter, reabsorption and re-emission from atomic targets.

X-rays may be produced by *Bremsstrahlung* ("braking radiation"), when a negative beta particle grazes an atomic nucleus and undergoes deceleration. The kinetic energy lost by the beta particle is then converted into the x-ray photon that it emits, and this may include the entirety of the beta particle's kinetic energy. X-rays or gamma-rays may also interact with massbound particles by the photoelectric effect, the Compton effect and pair-production. In the photoelectric effect, "collision" of the x-ray or gamma-ray photon with a valence electron results in complete energy absorption by the latter and consequent ion pair formation (ionization). In the Compton effect, "collision" of the x/gamma-ray photon with a valence electron also results in ionization, but the ejected valence electron (called "recoil electron") retains only part of the absorbed photon energy, giving off most of it in the form of another (secondary or scatter) x/gamma-ray photon. Finally, above the threshold energy of 1.022 MeV, the "collision" (or absorption) of gamma rays by an atomic nucleus results in pair production.

Clearly, as with blackbody photons, x-ray emission depends upon the kinetic state of emitters but, in contrast to blackbody photons, this kinetic state does not have to be the result of an acceleration by an ambipolar field - and, the Compton effect produced by electron bombardment aside, it generally is not. However, the aetherometric conceptualization of the photon as a local production that does not behave ballistically *seems* to run into trouble when accounting for the propagation of ionizing photons (more on this below, in section 8). Their emission is still dependent on the kinetic states of the emitters and their deceleration (as when a beta particle grazes an atomic nucleus), but the very notion of "collision" implies a ballistic model of ionizing photons that propagate across space. Could ionizing photons have a fibrous structure, rather than a globular one? That is a question that we will solve below, for its answer depends on whether or not ionizing photons have a fundamental physical difference towards blackbody photons. For instance, it may be that ionizing photons effectively deploy mass. This may well be the case, in particular, with gamma rays of >1.022 MeV, as their ballistic properties could be due to the transport of the joint inertial mass of a negatron/positron couple or stack of anticharged electrons. In this twofold scenario, blackbody photons and ionizing pho-

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tons of less than 1.022 MeV would be massfree, while ionizing photons of >1.022 MeV would deploy inert mass in a latent state - whether because one mass has antimatter properties that cancel the other mass, or because the photon is no longer globular but the result of an intercalated, ordered superimposition of two toruses with opposing directions of flux, etc.

5. What are electromagnetic, and electric and magnetic waves?

(the photon versus the electron)

Modern electromagnetic theory only accepts the existence of radiation that is electromagnetic. Strictly speaking, radiation means propagation of energy across space in the form of waves, and the term "radiation" is therefore confined by electromagnetic theory to mean the propagation of electromagnetic waves through space with the velocity of light. With the advent of quantum theory, and the realization that such "true radiations" also have a corpuscular nature, it was assumed that "Light particles" or photons differ fundamentally from "material" particles, not by whether they carry inertia or not (have mass or not), but by the empirical fact that they are not deflected by electric and magnetic fields, as massbound charges are.

Still, it remained that photons were conceptualized as having an electric field vector transverse to the direction of wave displacement, coupled to a magnetic field vector H transverse to both the electric field and the direction of wave displacement (because solar radiation is believed to consist of photons, it is also said to be electrical, since photons have an electrical field). This kind of conceptualization of the photon lends itself to easy amalgamations and poor reductions. For example, the fact that photons are not deflected by electric and magnetic fields could be supposed to mean that their electric charge is, like what Aetherometry claims for ambipolar charges, made latent by a phase oscillation of polarity; and the aetherometric argument of the existence of massfree ambipolar charges could further lead to the notion that, if photons are massless (as Aetherometry does contend), then they and ambipolar charges must surely be the same physical entity. Yet, as we shall see, this notion of an identity of the photon with the ambipolar charge is totally erroneous - and an important pitfall for those who found empirical evidence for the existence of radiant energy in nonelectromagnetic forms.

Consider what is actually the aetherometric theory of the photon. Aetherometry argues that photons, in their energy structure, do indeed possess two transverse 'fields' or, more properly, waves or wave functions, each of which deploys at the speed of light. It acknowledges that the two 'fields' have been assimilated - from Faraday and Maxwell to Lorenz and present-day conceptions - to the concept of transverse electric and magnetic fields. However, it contends that these 'fields' are elements derived from defined wave functions, and that these wave functions only belong to charged particles, not to photons which, as "particles of light", *lack electrical charge*. In other words, these 'fields' or their

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functions belong to nonelectromagnetic waves, rather than to the electromagnetic waves of the photon. In passing, we should note that the only exception to the statement that "photons lack electrical charge" would then be the existence of ionizing photons of energy >1.022 MeV which, still unlike massfree ambipolar charges, could (1) carry cancelled inertial masses and (2) produce an apparent electrical neutrality, not by phase oscillation of polarity, but by charge cancellation resulting from "true" charge bipolarity (the immediate analogue of the gamma-ray-equivalent positronium atom is not ambipolar charge, but the electrically neutral free-radical atomic hydrogen). However, the reader should note that Aetherometry agrees with conventional physics in this respect - gamma-rays must be distinguished from "positronium atoms", as only the latter carry mass and have "true" electric bipolarity.

But let's continue - for, indeed, one problem is that the electric and magnetic fields are first of all properties of the emitters of photons, rather than of the photons themselves. They belong, in fact, to electric and magnetic wavefunctions that are constitutive of the kinetic energy of massbound charges. And we shall shortly see how this works energetically and algebraically. The other problems are: how the photon wavefunctions proper are derived, and whether or not photons (at least of less than 1.022MeV) have mass.

The aetherometric argument picks up the fundamental relationship which de Broglie proposed as necessary for integrating the quantum-mechanical treatment of the photon:

$$E = m_0 c^2 = h\upsilon \qquad (1)$$

where m_0 denotes the inertial mass that one should associate with the photon when considered in its rest frame (ie the electromagnetic frame of reference), h is Planck's constant and υ the light frequency which is also the quantum frequency. The conclusion that photons have an electromagnetic linear momentum given by $p = m_0 c$ is inherent to this relation. For equation #1 to hold, the photon must have a very small but finite inertial or rest mass, as given by m_0, and cannot therefore be classified as a massfree particle. Now, note that the function c^2 indicates the square superimposition of two waves having the same value. The question then becomes whether these electromagnetic waves are formed and described by electrical and magnetic field vectors. To answer it, we must look for an indication of comparable waves in the structure of the "material" particles that serve as emitters. Here, also, consideration of an electron, for example, in its rest frame, indicates that it has energy equal to

$$E = m_e c^2 = h\upsilon \qquad (2)$$

where the quantum frequency υ is the Compton electron frequency $\upsilon_{\delta e}$. It would therefore appear at first that one would have to concur with the *electromagnetic nature of matter*. However, Aetherometry

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claims to have identified the fine structure of "material" particles or massbound charges such as the electron [5], and argues that this structure is not directly electromagnetic, even if it has an electromagnetic equivalence.

If we imagine an ionizing photon of 0.511 MeV, with form

$$E = m_0 c^2 = h\upsilon_{\delta e} \quad (3)$$

– and thus equivalent to the electron not just with respect to its mass-energy but also in the magnitude of its (theorized) mass function

$$E = m_0 c^2 = h\upsilon_{\delta e} = m_e c^2 \quad (4)$$

– this does not mean that this photon, qua photon, has the same energy fine structure as the electron mass-energy, despite the fact that both the photon energy and the electron mass-energy *appear* to have the same wave structure and the same magnitude of mass. Effectively, only the 0.511 MeV photon - the maximal X-ray photon emitted from an electron by the Compton effect, with wavelength equal to the Compton-electron wavelength - has an electromagnetic structure, in the sense that its two wavefunctions square the velocity of light *because each wave deploys at that velocity*. But precisely this is not what happens in the case of the electron: neither for the structure - the electrical structure - of that electron rest energy, nor for the kinetic energy that may be associated with this rest energy.

Aetherometry has advanced a new mathematical and physical analysis of the fine structure of the electron mass-energy. Fundamentally, it suggests that the topogeometric structure of the electron is that of a torus composed by the superimposition of two electrical waves (one 'electrical', W_v, and directly obtained from the voltage of the electron mass-energy, and the other 'magnetic', Wk), where mass is equivalent solely to a multiple of W_v's wavelength, or the number of W_v waves composing, as flux rings, the electron torus. Aetherometry has proposed exact values for these wave functions, which provide an *alternative explanation* for de Broglie's theory of "Matter Waves" [6-7], *and* the phenomenology of mass-increase with acceleration that is central to the theory of Special Relativity.

The master equation that Aetherometry has proposed for the electron mass-energy is

$$E_{\delta e} = \lambda_e W_k W_v \quad (5)$$

which is algebraically equivalent to the energy of the electron rest mass described by

$$E_{\delta e} = m_e c^2 \quad (6)$$

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so that we may equate the last expression to the former – via the mass-to-wavelength transformation [7-9] – and write the equation as:

$$E_{\delta e} = m_e\, c^2 =\!\int\!= \lambda_e\, c^2 = \lambda_e\, W_k\, W_v \qquad (7)$$

where λ_e is the wavelength-equivalent of the rest mass of the ordinary electron. Physically, this means that the structure of an electron is finite (has defined volume, temporal and wave characteristics), and that it is an electric structure. A short formal demonstration of this assertion is that the same mass-energy can be written with reference to the elementary electrical charge q [10], as:

$$E_{\delta e} = \lambda_e\, W_k\, W_v =\!\int\!= q\, V \qquad (8)$$

where, since W_v results from a direct conversion of the "electric potential" or voltage V of the electron mass-energy (511 kV) into the meter-second system of units, the charge of the electron is given by what is effectively an "electrical linear momentum" expressed as p_e with dimensions of meter squared per second [9]

$$q =\!\int\!= \lambda_e\, W_k = p_e \qquad (9)$$

For inertial purposes, or with respect to the local electromagnetic frame, this electrical structure ("the rest energy") manifests the inertial property described by $m_e\, c^2 =\!\int\!= \lambda_e\, c^2$.

Conversely, if we consider an ionizing photon with energy of 0.511 MeV, it lacks, like all non-ionizing photons, the charge property. Moreover, in aetherometric theory, the mass property depends upon the circularization of the mass-energy flux that prevents its dispersion or dissipation, and this structure is held together precisely by its electrical properties. Absence of the charge property in photons condemns them, in the wake of emission, to dissipate locally their energy. In this context, Aetherometry has speculated that, in the production of x-rays by electron bombardment, x-ray photons with energy of 0.511 MeV, and thus with exactly the Compton-electron wavelength as their light wavelength, are only produced when photoelectrons are generated by the destruction of impacting electron mass-energies and by the loss, therefore, of their charge property. If the electron rest energy is effectively transformed into an ionizing photon (by collisional impact, to generate the limit x-ray, or by pair-annihilation, to generate a gamma-ray), the electrical structure of that electron is dissolved, and its inertial or rest energy equivalent becomes effectively transformed into electromagnetic energy (a 1:1 electron:photon quantum conversion) in conformity with the physical conversion described in principle by

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$$E_{\delta e} = m_e\, c^2 \Rightarrow m_0\, c^2 = h\upsilon_{\delta e} \quad (10)$$

where the hypothetical photon mass m_0 would have the same magnitude as the electron mass m_e.

The fact that, irrespective of any occurrence of such conversion of mass-energy into electromagnetic energy, the quantum equivalence of one to the other remains – which we may write aetherometrically as

$$E_{\delta e} = m_e\, c^2 = h\upsilon_{\delta e} =\!\!\int\!\!= \lambda_e\, c^2 = \lambda_e\, W_k\, W_v \quad (11)$$

– is sufficient to demonstrate that the rest energy frame of a particle or a body is also its electromagnetic frame.

Furthermore, these new algebraic physical functions led aetherometric theory to claim that, likewise, the photon relation ($E = m_0\, c^2 = h\upsilon$) proposed by de Broglie has a massless or massfree equivalent that can be written as

$$E = \lambda_0\, c^2 = h\upsilon \quad (12)$$

This simple expression highlights the aetherometric argument that, whereas the structure of electronic matter on a nanometric scale is electrical and forms a recognizable geometric object, a torus, the energy fine structure of a photon is not electric and, given its wavefunctions, cannot be toroidal [5] and thus cannot manifest inertial mass (that being the reason why none has ever been detected empirically). In the electromagnetic frame of the emitter, no photon can have any other wavefunction than c. All apparent propagations with speeds greater or slower than c are the result of Doppler shifts [1].

Photons, then, are particles formed by the electromagnetic wave structure given by c^2, not elements of Matter or electrons, anymore than they are ambipolar charges. Conversely, electrons, qua primary elements of Matter, are only "perceived" as having a rest energy with wave structure equivalent to c^2 when they resist acceleration by high-voltage fields, but even then, their rest energy structure remains electrical, described by the wave-product ($W_k\, W_v$) rather than electromagnetically by c^2. While photons have a globular (spherical) wave envelope composed of two identical waves (more on this below), the finite geometry of electrons is toroidal and composed of two different waves, one "truly electrical" and the other "truly magnetic". Accordingly, the waves of photons are only geometric-product-equivalents of the real electric and magnetic waves that compose the rest mass of a material particle, or, most frequently (and exclusively in the case of blackbody photons) of those that compose its kinetic energy. Photons do indeed possess two transverse fields, but the two fields or their vectors are organized such as to describe a local globular vortex, each vector relating a sine wave, and each wave described by c. For electron-emitted photons, the process of emission can be formulated direct-

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ly in terms of the conversion of kinetic energy. The electrokinetic energy (or "kineton") of the electron, too, takes the electric fine-structure form

$$E_k = \lambda_e W_k W_v \quad (13)$$

for as long as the kinetic voltage is practically the voltage of the accelerating field (typically, <~0.3 MeV) [7, 11]. The conversion of kinetic energy to produce blackbody photons then takes the general aetherometric form

$$E_k \alpha^2 = (h/p_e) W_k W_v = \lambda_x W_k W_v =\int=> \lambda_0 c^2 = h\upsilon \quad (14)$$

It follows that the voltage wave W_v in the above expression *is* the electric potential of the kinetic energy of the emitter at the time of the emission,

$$W_v = E_k \alpha^2/(\lambda_x W_k) = E_k/(\lambda_e W_k) = \lambda_0 c^2/(\lambda_x W_k) = h\upsilon/(\lambda_x W_k) \quad (15)$$

and *not* the voltage wave of the emitted photon – ie the voltage potential which, *upon being absorbed by an electron*, the energy of a photon will correspond to - which is instead given by

$$W_{vFOT} = \lambda_0 c^2/(\lambda_e W_k) = h\upsilon/(\lambda_e W_k) = h\upsilon/p_e \quad (16)$$

This concise aetherometric presentation of the physico-mathematical analysis of the energy relations of the electron and the photon suggests that photons do not really have electrical or magnetic fields, nor carry inertial mass; this is in accordance with the facts that photons do not present electrical charge and that one does not mistake them for electrons! What deploys electrical and magnetic fields are charges, whether massfree or massbound. The latter, furthermore, possess such fields as are associated with their rest energy and not just with the energy of their motion.

6. Physical traits of photons versus those of electric charges, ambipolar or monopolar

Consistent with the preceding, Aetherometry claims that solar radiation is electrical. It is not composed of photons, but consists of propagating massfree ambipolar charges. Unlike massbound charges, massfree charges are not monopolar but ambipolar, as they have no fixed spin orientation with respect to forward propagation. In other words, their polarity phase changes with time. They can be thought of as net spin 0 charges, but at any time, they may have an effective spin that "will be" either -1/2 or +1/2 (actually, that is -1 or +1, as spin, in Aetherometry, is a number property of

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angular momentum, not of the number of 'hyperdimensions' attributed to states of polarization, as it is in Quantum Electrodynamics, QED). Ambipolar charges also have transverse, or near-transverse, electrical and magnetic fields, waves and field wave-vectors. But whereas the waves composing a photon are analogous to the transverse waves that propagate in water and limited to quasi-circularized motion, the waves composing a massfree charge are analogous to the longitudinal pressure waves responsible for the forward propagation of sound. Massfree charges cannot be described as occupying or forming a globular space, or even a toroidal one, but as occupying or forming forward-moving cycloidal-helicoidal flux "tubes".

Both types of massfree waves - ambipolar and electromagnetic - are involved in the propagation of the Light-stimulus and the generation of Light ("local production of photons"): longitudinal electric waves with their transverse magnetic waves, in the propagation of the Light-stimulus by ambipolar radiation; and transverse vibrations, in the quanta of the kinetic energy released from massbound charges - ie in the local production of blackbody photons. But these two sets of waves belong to two distinct physical objects - massfree charges (the ambipolar energy units) and the photons formed when massbound charges decelerate.

Photons and massfree charges also differ in their physical effects. As we said, photons are not deviated, displaced or disturbed by electrical or magnetic fields. Yet one can magnetically polarize the transmission of Light. This is because the transmission of Light is effectuated, not by photons and their transversal vibrations but by the propagation of massfree charges and their longitudinal waves, and involves the local absorption of their energy by massbound charges and subsequent conversion into kinetic energy. So-called plane polarization of light is, in effect, a magnetic filter; and the application of a magnetic field - and its rotation or movement - will gate the wave function and the twist of the longitudinal field wave and massfree charge transmitting the Light-stimulus.

Unlike massbound charges, *photons cannot charge an electroscope*. This is a most important and well established fact, and it applies to both ionizing and blackbody photons. However, as we experimentally discovered and reported nearly a decade ago [12], nonionizing photons with wavelengths greater than 300nm (ie of the LFOT variety) *can arrest the spontaneous electroscopic discharge irrespective of polarity* (please note that blackbody photons with wavelengths less than 300nm discharge electroscopes, as per the Hallwacks or photoelectric effect). All blackbody photons trigger photoelectric cells [13]. Photons are not detected by Tesla antennas [14] connected as unipolar inputs to Geiger-Muller circuits [13].

Massfree charges, as we discovered, can positively charge a proximal electroscope by stripping valence electrons, but in general (in 'distal positions') they accelerate the spontaneous electroscopic discharge of negatively charged electroscopes, but not of positively charged ones [13]. Massfree charges do not trigger photoelectric cells [2] and are easily detected by Tesla antennas connected as unipolar inputs to Geiger-Muller circuits [13].

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Lastly, we should mention that our concept of ambipolar radiation, even though sharpened in specifically aetherometric ways, is connected to the concept of nonelectromagnetic radiation enunciated by other scientists: Tesla spoke of 'nonordinary electricity', 'primary electricity', 'ether electricity', 'longitudinal electric waves distinct from electromagnetic radiation', manifestations that have fallen under the rubric of Tesla waves or Tesla radiation; Reich spoke of his massfree "orgone" energy and "orgone charges"; Cerenkov spoke of a pilot or phase wave that transmitted 'potential', or its 'envelope', at speeds greater than c, but did not transport electromagnetic energy; Maximo Aucci described massless electrons associated with longitudinal electric field propagation; Harold Aspden has described cosmological charges ("quons") that escape the constraints of mass-based relativity, as elements of a dynamic Aether of space. Each of these scientists or physicists was, of course, expressing the same general reality of a massless form of electric charge but with different analytical and theoretical frameworks. Yet, the fact remains that, according to our aetherometric findings - analytical and theoretical, but no less experimental - none of the approaches proposed by these researchers succeeded in characterizing physically and mathematically the domain of massfree electricity, let alone in integrating it with massbound electricity, particle physics and electromagnetism. It would take Aetherometry to identify the exact spectra of ambipolar radiation emitted by natural (eg solar radiation) or man-made (eg Tesla coil) sources. Thus, we came to contend that the exact energy functions and spectrum of (low energy) Tesla radiation are, ultimately, the physical functions behind the transmission of the Light-stimulus.

II – SOLVING THE PROBLEMS OF THE PHYSICAL NATURE OF THE PHOTON

7. Are photons *massfree* particles or *massbound* particles?

Many, if not most, particle physicists today believe that photons are spin 1 and 2 particles that have zero rest mass, and thus that they are massfree. But there is no consensus or certainty either way in the subject, which is not so much controversial as it is ignored. Operationally, if photons have mass, it is so small that one 'feels permitted' to disregard it. But disregard is not proof of zero rest mass. And smallness is not a characteristic that impugns the physical properties of an object.

Moreover, Louis de Broglie himself (so taught A.P. French and E. F. Taylor) began by assuming that "every particle of light, whatever its quantum energy, has a certain rest mass m_0" [15]. Originally, de Broglie suggested that the mass of the photon could not be more than 10^{-50} grams, but later revised his estimate to less than 10^{-44} grams. A.S. Goldhaber and M.M. Nieto later placed strict upper limits on the rest mass of photons [16], but to this day there is no experimental evidence that indicates that the rest mass of a photon is anything but zero. The introduction of gauge theories, and

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the analytical "observation" that gauge symmetry is "generally restored at sufficiently high temperature" has led to the speculation that, at temperature sufficiently low for symmetry-breaking, the photon may acquire a non-zero mass [17]. The suggested critical temperature was placed at <2.7 K, and the mass-energy at about 0.0001 eV, when, effectively, the photon would have a λ_0 wavelength on the order of 10^{-15} m (or a mass-equivalent that would be a billionth of the electron mass, on the order of 10^{-37} grams or less; this constitutes what today is called a "massive photon"...). Following the symmetry-breaking interpretation, Ryan et al had, by 1985, pushed this mass down to 10^{-42} grams. Based on the notion that photon mass is sourced on a galactic (vector) potential, the Particle Data Group gives an upper bound on the photon mass that is even lower (for photon energies $<2*10^{-16}$ eV), but arguments based on the notion that photon mass arises from a Higgs effect either suggest this limit is invalid, or that (given Proca electrodynamics) an even lower bound ($<10^{-26}$ eV) must be the case [18]. A plethora of wild arguments for the mass of photons has piled up in publications over the past decades, to the point that the range of the new upper bound on photon mass returned to the neighbourhood of de Broglie's original "intuition", some 10^{-53} grams [19]...or, even lower, at 10^{-65} grams, but on the basis of totally abstruse arguments - or should we say guesses - as to the radius and age of the universe [20]; and even worse, on the basis of false experimental claims that misconstrue the timing of gamma ray components, or invoke blazar emission and a small residue of dark energy involved in mCBR suppression [20]. One might say that physics is grasping at straws.

Of course, in this context, Aetherometry immediately asks: Why would inertial mass make itself manifest in the photon only when such low photon energies were reached, other than to satisfy the somewhat abstruse notion of "a condensation of energy" under symmetry-breaking low temperatures? Moreover, why would photons of the same energy (or same "intrinsic temperature") not indicate the presence of that inertial mass at higher ambient temperatures, or even under STP conditions? In what way would increasing ambient barometric pressure detract from the manifestation of inertial mass as an intrinsic characteristic of a particle? If we had evidence that Light was a solid, one may at least begin to understand how these notions had some justification. It seems, rather, that the way in which the problem of the photon mass is posed is a hindrance to its solution. For, in effect, if the energy of every photon ultimately dissipates, there is nothing conservative, to begin with, about its supposed mass, and the simplest assumption is that it has none, at all ambient temperatures and photon energies (or of, at least, <1.022 MeV).

Instead, Aetherometry contends that the relationship ($m_0 c^2 = h\upsilon$) proposed by de Broglie, is a fictional relationship; that, effectively, the photon has no rest energy or mass-energy; no inertia. But it also proposes that there is some physical truth to the de Broglie relation, because the structure of the photon, being massfree, is what should be written as ($\lambda_0 c^2 = h\upsilon$). Thus, if we designate the wavelength of Light by the relation

$$\lambda_{quantum} = c/\upsilon \qquad (17)$$

the general aetherometric expression for the energy fine structure of photons becomes:

$$E = \lambda_0\, c^2 = \lambda_0\, \lambda_{quantum}^2\, \upsilon^2 = h\upsilon \qquad (18)$$

where Planck's quantum is given by:

$$h = \lambda_0\, \lambda_{quantum}^2\, \upsilon = E/\upsilon \qquad (19)$$

and where the supposed mass of the photon becomes replaced by its aetherometric equivalent wavelength λ_0. The question immediately arises as to what is this wavelength function, since, if the photon is massfree as Aetherometry contends is the case, λ_0 cannot be a functional equivalent of mass, and evidently is also not the wavelength of light (which *de facto* is $\lambda_{quantum}$). Moreover, let's note that if all photons have energy described by a function that invokes a wave superimposition constant given by c^2, then photon energy varies directly and proportionately with λ_0. The longer the wavelength λ_0, the greater is the photon energy. Since energy also varies proportionately to quantum frequency υ, we can indeed say that both photon energy and frequency increase with increasing λ_0.

These basic remarks, however, only serve to highlight the importance of answering the question of exactly what, then, is the function of this wavelength λ_0. This is the question we shall address below and, as will be shown, its answer is full of consequences. Nonetheless, it is plain to see that, if λ_0 were in fact a mass-equivalent wavelength, or, indistinctly, if m_0 in de Broglie's equation were a real mass, then the mass of photons should increase with increasing energy. This simple constatation throws a basic spanner into the illogical view that only very low energy photons would carry mass. A 0.511 MeV photon would have to have the same mass as the electron. Such a mass could hardly be experimentally missed.

Lastly, on a sidenote, Aetherometry does not need to take recourse to the notion that an alternative to General Relativity must posit massbound photons subject to deviation by local gravitational fields. Since all blackbody photon production is local and the result of decelerating massbound charges, the scatter of the latter and its relative direction (caused by the relative motion of emitters) are sufficient to explain observed redshift distributions, as well as the much reviled or ignored distributions of blueshifts, without any need for an invocation of the bending of light by spacetime or a gravitational field.

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8. The fine structure of photon energy and of the power of its flux

8.1. The photon function for the amplitude wavelength λ_0

We have demonstrated above that photons, at least with with <1.022 MeV, must be massfree because (1) their energy lacks electric fine-structure (no electric charge); (2) their energy fine structure cannot be toroidal and must deploy a globular wave envelope; and (3) there is no experimental evidence for a photon mass. Then, we were led to paraphrase de Broglie's enunciation of the fundamental equation for photon energy, by suggesting that his supposed mass term m_0 is, in effect, the massfree wavelength λ_0. Immediately arose another question: what is the function of this wavelength, if it does not play the role of a mass-equivalent function, nor can it be the wavelength of Light or the quantum wavelength of the photon?

We have before presented in some detail the globular geometry of the photon wave envelope [1, 5]. We argued there that inertial mass is only a subfunction of the more general function which we called the *amplitude wavelength*. The more general function applies to both massfree and massbound energy forms, the amplitude wavelength of the mass-energy of the electron effectively being the physical meaning of its inertial mass – that its superimposed waves run a finite toroidal path, which happens to be closed and the equivalent of the total length of α^{-2} torus rings or electrical wavelengths.

As we showed then [5], no flux rings exist in globular photons, and the topogeometry of the photon must be constructed differently from the toroidal topogeometry of the electron mass-energy. We proposed that the wave structure of photons is conformed by two identical wavefunctions that superimpose transversely to one another but co-centrically to form a globular, spherical envelope as the waves synchronously deploy, each along its own perimeter; the globule, or the envelope formed by its two waves, shares the inertial frame of the emitter, and in this frame each wave describes a ring of flux or wave of motion; the two transverse wavefunctions then simply denote the relative "on the spot" gyration of the globular photon, as it rotates in one plane with one wave, and transversely to that plane with the other wave in another plane. What then, in this context, is the role of the photon amplitude wavelength λ_0?

Since the photon is massfree, the ratio $\lambda_0/\lambda_{quantum}$ does not describe the mass-effect of a circularized, torus-like flux, or the equivalent of this mass-effect as a closed flux path (λ_0) made up of so many quantum wavelengths. Instead, it only expresses the relative displacement path of the photon (or of its open flux) in the direction of deceleration of the emitter in terms of the number of photon quantum wavelengths. *Only one photon in the entire electromagnetic spectrum possesses an amplitude wavelength identical to the quantum wavelength of "its Light"*, for which alone, therefore, that ratio is unity. This is the 340 eV weak x-ray photon (see column 3 of **Table 1**) with energy given by

$$E = h \{[(\alpha^{-1}\ 10^{-1})\ (\eta\ 10^{-1})]^{0.5}\ \upsilon_k\} \qquad (20)$$

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where υ_k is the quantum frequency of the Hartree energy, ie $6.433*10^{15}$ sec^{-1} [21-22] and the proportionality constant $\eta = (\alpha^{-0.5}\ 10)$. This 340 eV ionizing photon has a nanometric displacement length of the same exact size as the perimeter of either of the two globular waves, set at 3.64 nm.

The $\lambda_0/\lambda_{quantum}$ ratio permits us to further refine our distinction between blackbody and ionizing photons. The ratio expresses the curved, overall displacement path of a single photon unit (the path is planar on some plane, but volumetric for the whole wave envelope) in terms of fractions or multiples of the curved length (the quantum wavelength) of the globular waves. For all blackbody photons, the condition $\lambda_0<\lambda_{quantum}$ applies, so that the displacement path (of the third wave, see below) is always a fraction of the wavelength of the globular waves – thus, never quite forming a complete 'ring'-size path (in its total length). A photon with, say, $\lambda_0 = 0.5\ \lambda_{quantum}$ would only traverse a path equivalent to half a globular (quantum) wavelength. Conversely, an x-ray photon with $\lambda_0 = 2\ \lambda_{quantum}$ would have a displacement path equivalent to two globular wavelengths, and likely describe either two ring-like segments (if pictured at all times in the inertial frame of the emitter) or two cycloidal segments (if pictured relative to another inertial frame taken as defining the state of rest), each ring or cycloid being equivalent to one globular wavelength. Accordingly, a strong x-ray photon with the ratio

$$\lambda_0/\lambda_{quantum} = \lambda_e/\lambda_{ce} = \eta^5\ 10^{-4} \tag{21}$$

and thus with energy of 0.511 MeV (see column 1 of **Table 1**), would describe a total displacement path equivalent to 2.26 million globular wavelengths.

Thereby, with a single stroke, we have also resolved what appeared above to be the inconsistent aetherometric treatment of the photon as a local production when applied to ionizing photons: locality in "local production" means not just that the frame of reference of all photons is the inertial frame of the emitter, but also that its span (domain or "localization") is a function of *the amplitude wave-path* of the photon. *With blackbody photons*, their formation and dissipation appears to occur nearly literally "on the spot", since the amplitude of their path is so small – whereas *with very high energy photons*, ie *ionizing* photons, one encounters between their formation and dissipation a substantially sized path of displacement, so that, literally and consequently, formation and dissipation no longer occur "on the spot"; rather, the globular wave envelope now appears to travel through substantial distance. Thus, x-ray photons, for instance, do not depend for the transmission of their signal - over sizable paths given by λ_0 - on the propagation of an underlying ambipolar field, as blackbody photons most generally do. Very high energy gamma-rays will have very long paths. In other words, *ionizing photons can effectively propagate through (abstract) space*, which is how the ballistic model can carry some physical truth when applied to these photons. Since most ionizing photons

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Table 1 - **The structure of photon energy**

Paratmeters	1 x-ray	2 x-ray	3 x-ray	4 HFOT Hartree Photon	5 LFOT	6 LFOT
$h\upsilon$ ($m^3\ sec^{-2} =\int= eV$)	$4.93 * 10^{11} =\int=$ $=\int= 510{,}999eV$	$4.19 * 10^{9} =\int=$ $=\int= 4{,}340.7eV$	$3.2789 * 10^{8} =\int=$ $=\int= 339.83eV$	$E_H = 2.567 * 10^{7} =\int=$ $=\int= 26.6eV$	$2.567 * 10^{5} =\int=$ $=\int= 0.266eV$	$2.18065 * 10^{5} =\int=$ $=\int= 0.226eV$
λ_0 (m)	λ_e	λ_q	$3.6483 * 10^{-9}$	λ_x	$\lambda_x/10^2$	λ_{ce}
$\lambda_{quantum}$ (m)	λ_{ce} (0.024Å)	λ_x (2.8Å)	$3.6483 * 10^{-9}$ (3.6nm)	λ_q (47nm)	$\lambda_q * 10^2$ (4,700nm)	$\lambda_e = \eta\ \lambda_q$
υ (sec^{-1})	$\upsilon_{\delta e}$	$1.0496 * 10^{18}$	$8.2173 * 10^{16}$	υ_k	$\upsilon_k/10^2$	$\upsilon_p = c/\lambda_e =$ $= 5.46488 * 10^{13}$
$\lambda_0/\lambda_{quantum}$	$2.26 * 10^{6} =$ $= \eta^5 * 10^{-4}$	$163.14 =$ $= \alpha^{-1.5} * 10^{-1}$	1	$(163.14)^{-1} =$ $= (\alpha^{1.5} * 10)$	$6.1295 * 10^{-7} =$ $= (\alpha^{1.5} * 10^{-3})$	$(2.26 * 10^{6})^{-1} =$ $= (\eta^5\ 10^{-4})^{-1}$
υ^{-1} (sec)	$8.0933 * 10^{-21}$	$9.5276 * 10^{-19}$	$1.2169 * 10^{-17}$	τ_k	$\tau_k * 10^2$	$\upsilon_p^{-1} =$ $= 1.8299 * 10^{-14}$
Voltage Wave of photon $W_{vFOT} = \lambda_0 \varepsilon_k =>$ $=> h\upsilon/p_e = \lambda_x\ \upsilon$ ($m\ sec^{-1}$)	$\lambda_0 \varepsilon_k => \lambda_x\ \upsilon_{\delta e} =$ $= W_x =\int= 511kV$	$\lambda_0 \varepsilon_k =>$ $\lambda_x(1.05 * 10^{18}/sec) =$ $= c =\int= 4.34kV$	$2.3471 * 10^{7} =\int=$ $=\int= 339.83V$	$W_H = \lambda_0 \varepsilon_k => \lambda_x\ \upsilon_k =\int=$ $=\int= 1.8376 * 10^{6} =\int=$ $=\int= 26.6V$	$1.8376 * 10^{4} =\int=$ $=\int= 0.266V$	$1.5609 * 10^{4} =\int=$ $=\int= 0.226V$
$c^2\ W_{vFOT}$ ($m^3\ sec^{-3}$)	$3.1719 * 10^{27} =\int=$ $=\int= 526$ watts	$2.6944 * 10^{25} =\int=$ $=\int= 4.4741596$ watts	$2.10946 * 10^{24} =\int=$ $=\int= 0.35028$ watts	$1.6515 * 10^{23} =\int=$ $=\int= 0.027424$ watts	$1.6515 * 10^{21} =\int=$ $=\int= 2.7424 * 10^{-4}$ watts	$1.40287 * 10^{21} =\int=$ $=\int= 2.3295 * 10^{-4}$ watts
Quantum equivalent of $c^2\ W_{vFOT}$	$(\lambda_{ce}\upsilon_{\delta e})^2 * \lambda_x\ \upsilon_{\delta e} =$ $= \lambda_{ce}^2\ \lambda_x\ \upsilon_{\delta e}^3$	$(\lambda_x\ \upsilon)^2 * \lambda_x\ \upsilon =$ $= \lambda_x^3\ \upsilon^3$	$(\lambda\upsilon)^2 * \lambda_x\ \upsilon$	$(\lambda_q\ \upsilon_k)^2 * \lambda_x\ \upsilon_k =$ $= \lambda_q^2\ \lambda_x\ \upsilon_k^3$	$(\lambda\ \upsilon)^2 * \lambda_x\ \upsilon$	$(\lambda_e\ \upsilon_p)^2 * \lambda_x\ \upsilon_p =$ $= \lambda_e^2\ \lambda_x\ \upsilon_p^3$
E	$\lambda_e(\lambda_{ce}\ \upsilon_{\delta e})^2$	$\lambda_q(\lambda_x\ \upsilon)^2$	$\lambda_0(\lambda\upsilon)^2 = \lambda^3\ \upsilon^2$	$\lambda_x(\lambda_q\ \upsilon_k)^2$	$\lambda_0(\lambda\ \upsilon)^2$	$\lambda_{ce}(\lambda_e\ \upsilon_p)^2$
$\frac{W_{vFOT}}{\lambda_0} = \frac{\lambda_x\ \upsilon}{\lambda_0}$	$W_x/\lambda_e = \varepsilon_k = \upsilon_k$	$c/\lambda_q = \varepsilon_k$	$W_{vFOT}/\lambda = \varepsilon_k$	$W_H/\lambda_x = \varepsilon_k$	$W_{vFOT}/\lambda = \varepsilon_k$	$W_{vFOT}/\lambda_{ce} = \lambda_x\ \upsilon_p/\lambda_e =$ $= \varepsilon_k$

have $\lambda_0/\lambda_{quantum}$ ratios >>1 (energy greater than 340 eV), the trajectory or amplitude paths of these photons are large compared to their "Light wavelengths". The result is that the globular wave envelope of ionizing photons becomes smeared along their displacement path. Conversely, blackbody photons hardly display the extent of their ballistic existence, since their displacement paths represent only a fraction of their globular wavelengths.

Of course, for the relay of ionizing photons to occur beyond the path λ_0 – just as was determined for blackbody photons – their energy must be absorbed by a massbound charge found in their "finite paths of displacement" before the path λ_0 is exhausted and the photon energy dissipates; and in this, once again, the aetherometric relations between photon emission, absorption and re-emission on one hand, and kinetic energy of the emitter on the other, come into the foreground: only in conditions of close packing and effective resonance of oscillatory states can massbound charges be made to absorb photon energy and release it without long wavelength decay, because in those conditions the kinetic state of the massbound charges is conserved while being transmitted by repeated (relayed) electromagnetic absorption and re-emission, with no intervention of ambipolar fields.

It is clear, then, from the preceding aetherometric analysis, that photons with large values of

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the amplitude wavelength (ie ionizing photons) can propagate – that is, smear their globular envelope into a fiber laid along their amplitude path. It is most likely that this property is extensible to all ionizing photons, and thus what in effect explains the cosmic spectra of "ballistic" gamma-rays.

8.2. The fine structure of photon energy and the power of its flux

In that same communication [5], we introduced the aetherometric functions for power or energy flux (triplicity of waves: triplicity of spacelines *and* triplicity of timelines), which treats the amplitude wavelength λ_0 functions – whether inertial or massfree – always as the wavelength of a third wave, the component wave of the energy flux, or the wave that permits investigation of the fine structure of power functions. Indeed, the physical understanding of the roles of amplitude wavelength and the power of the photon flux is one indissociable process. If the amplitude wavelength describes a displacement path for massfree photons, what then is the frequency that couples to this amplitude wavelength - or, equivalently, what is the third timeline that describes the time-flow of the photon energy? In essence, a better delineation of the physical nature and fine structure of the photon cannot progress unless we better understand what is the power of its energy flux and how long after emission this energy flow lasts before extinction or dissipation of the photon.

Solution of this problem is intimately connected to the grasp of the physical function of what above we denoted as "the voltage W_{vFOT} of the photon". We stated that this is the voltage which the photon energy can generate when absorbed by a massbound charge - an electron, for instance - and that it must be differentiated from the voltage of the kinetic energy of the emitter of that photon. Now, while it is true that the voltage wave W_{vFOT} plays no (direct) role in the fine structure of photon energy, it plays a most critical role in the description of the fine structure of photon energy flux. As we have shown already [5], the power function of the photon is given by the square of lightspeed times the voltage wave of the photon

$$P_{microFOT} = c^2 \, W_{vFOT} = c^2 \, (h\upsilon/p_e) \qquad (22)$$

It follows that, after all, it is *nearly* a simple matter to figure out how long it takes for photon energy to flow (by returning to the "vacuum state") and its extinction to occur. One might think, at first, that this finite duration is given by the timeline of the quantum wave, which is the reciprocal of the quantum frequency, υ^{-1}, and necessarily coupled to the quantum wavelength. If the photon were electrical, and the third wave were "natively" electrical in its fine structure, this idea might be justified – given that, by the above expression, the voltage wave of the photon appears to be a function of the Duane-Hunt wavelength expressed aetherometrically [10] as

$$\lambda_x = h/p_e = \int = h/q \qquad (23)$$

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with the result that the timeline of the third wave would necessarily appear to be the reciprocal of the quantum frequency, υ^{-1}:

$$W_{vFOT} = h\upsilon/p_e = \lambda_x \upsilon \quad (24)$$

However, this conclusion is deeply incorrect, since the above equation is only the *electrical equivalent* of the (voltage) potential of a photon, an equivalent that comes into play only when the photon is quantically absorbed by a massbound charge, so that, after all, there are no quantum electric terms per se in the fine structure of the energy or of the energy flux of a photon, because photon energy varies proportionately to the amplitude wavelength λ_0, rather than being fixed by the Duane-Hunt wavelength λ_x.

Once this erroneous conclusion dissipates, it becomes simple to determine the frequency of that third wave, and thus the value of the timeline of flux of the energy of any photon. The result is rather surprising - even if not surprising from an aetherometric viewpoint [5, 23]:

$$W_{vFOT}/\lambda_0 = h\upsilon/(p_e \lambda_0) = \lambda_x \upsilon/\lambda_0 = \mathcal{E}_k \quad (25)$$

In other words, the frequency of the third photon wave *is a constant* placed by nature exactly at the value ($6.433*10^{15}$ sec^{-1}) of the magnetic frequency $\mathcal{E}_k$ characteristic of the electron mass-energy and of the quantum frequency υ_k characteristic of the Hartree (kinetic) energy of hydrogen. Elsewhere, we have shown how this frequency magnitude relates to the synchronization of quantum events to the universal ambipolar Aether lattice [5, 24]. That is why there is also *only one photon which has a single frequency magnitude for all three of its waves* (and that is so even though its amplitude wavelength does *not* coincide with its quantum wavelength): the Hartree photon (see column 4 of **Table 1**).

This also means that all photons, qua *energy events* with a flux in time, have a single duration - their flux lasting, in all cases, only

$$\tau_k = \upsilon_k^{-1} = \mathcal{E}_k^{-1} = \lambda_0/W_{vFOT} = 1.55*10^{-16} \text{ sec} \quad (26)$$

All photons have the same unique duration, and are just as simply grounded in the universal Time-manifold of the Aether lattice (or synchronized to universal Time) as we found electrons to be [5]. We had already suspected such a shared linkage when we were able to express the faradic (capacitative) and inductive (magnetic) frequencies of any induction coil as a function of the Tesla frequency $\mathcal{E}_k$ [23].

Accordingly, the amplitude wavelength of photon energy is the real wavelength of the third wave, so that this wave can be suspended in its fine-structure components simply as:

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$$W_{vFOT} = \lambda_0 \, \mathcal{E}_k \quad (27)$$

Only upon absorption of its energy flux by a massbound charge, does the photon flux wave itself become converted into a quantum-electric voltage wave:

$$W_{vFOT} = \lambda_0 \, \mathcal{E}_k \Rightarrow (h\upsilon/c^2)(c^2/p_e) = \lambda_x \, \upsilon \quad (28)$$

It follows that unit photon energy everywhere flows with a power proportional to the product of its amplitude wavelength (path of displacement of the wave globule) and the cosmic Tesla frequency $\mathcal{E}_k$. Then we can, at last, suspend the 6-dimensional power continuum of a photon in its fine-structure components:

$$P_{microFOT} = c^2 \, W_{vFOT} = c^2 \, (\lambda_0 \, \mathcal{E}_k) = (\lambda_{quantum} \, \upsilon)^2 \, (\lambda_0 \, \mathcal{E}_k) \quad (29)$$

Only for one photon energy already encountered above (see column 3, **Table 1**), when $\lambda_0 = \lambda_{quantum}$ and the photon energy is 340 eV, as described by

$h \{[(\alpha^{-1} \, 10^{-1}) \, (\eta \, 10^{-1})]^{0.5} \, \mathcal{E}_k\}$

can we formally write the magnitude of this power function indistinctly as:

$$P_{microFOT} = c^2 \, W_{vFOT} = c^2 \, (\lambda_0 \, \mathcal{E}_k) = \lambda_{quantum}^3 \, \upsilon^2 \, \mathcal{E}_k = \lambda_0^3 \, \upsilon^2 \, \mathcal{E}_k = 0.35 \text{ watts} \quad (30)$$

To illustrate all the aspects of the fundamentals of the aetherometric theory of the photon, and of the solutions to the functional and conceptual problems posed by the structure, formation (emission) and topogeometry of photons, we have tested these fine structure elements with six different photons (see columns 1 to 6 of **Table 1**), the first three being ionizing x-ray or gamma-ray photons, and the last three being blackbody photons. Of the latter, the first (column 4, **Table 1**) is the Hartree photon [22], an example of an HFOT photon, while the last two are both LFOT photons. A direct comparison of the first and second lines across all columns of **Table 1** shows that indeed the amplitude wavelength λ_0 increases with increasing photon energy. Likewise, a comparison of lines 2 and 4 shows that the photon amplitude wavelength increases parallel to the quantum frequency of the photon. A direct comparison of lines 2 and 3 shows that as the amplitude wavelength λ_0 increases, the "light wavelength" $\lambda_{quantum}$ decreases, so that the two vary inversely. The last line in **Table 1** demonstrates how the frequency of the third photon wave *is the constant* $\mathcal{E}_k$.

In conclusion, there are two fundamental aspects of photon energy flux – one relating to a

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proportion and the other to a constant; the former relates how the electromagnetic power of a photon varies in proportion to energy, quantum frequency and amplitude wavelength, while the latter pertains to the differential W_{vFOT}/λ_0 that always yields a constant, ε_k, no matter what the photon energy is.

8.3. The Time- and Space-manifolds of photon energy flux: photon duration, emission of blackbody photon strings and low-end energy limits to blackbody photon production

When expressed electrically – ie by its electrical equivalent – the power multiplicity of the photon superficially appears to have an homogenous Time-manifold where all timelines are identical and reducible to being reciprocals of the quantum frequency of the photon:

$$P_{microFOT} = c^2 W_{vFOT} = \lambda_x \lambda_{quantum}^2 \upsilon^3 = c^3 (W_{vFOT}/c) \qquad (31)$$

but in fact, the Time-manifold of the photon is not homogenous because its third wave, or flux wave, does *not* have an electric and quantum structure. Rather, it couples the photon amplitude wavelength λ_0 – what de Broglie once thought would be the mass of the photon – to the universal frequency constant ε_k [9], so that the native state of the photon energy flux (the power of the flux of each photon unit of energy) is instead only given by:

$$P_{microFOT} = c^2 W_{vFOT} = \lambda_0 \lambda_{quantum}^2 \upsilon^2 \varepsilon_k \qquad (32)$$

This flux is only numerically equivalent to ($\lambda_x \lambda_{quantum}^2 \upsilon^3$), and only physically converted into this exact quantum form when the photon is absorbed by a massbound charge. Thus, effectively, the Time-manifold of a photon qua energy unit is not homogenous at all, but always composed of heterogenous timelines:

$$\tau_{maniFOT} = (\upsilon^2 \varepsilon_k)^{-1} = \upsilon^{-2} \tau_k \qquad (33)$$

This Time-manifold is universal for all photons, and has the singularity already mentioned, that alone for the Hartree photon do the time measures or timelines become quantitatively homogeneous, so that this photon's Time-manifold can be written as:

$$\tau_{maniFOTHartree} = (\upsilon_k^2 \varepsilon_k)^{-1} = \tau_k^3 \qquad (34)$$

Conversely, as stated already, only the 340 eV x-ray photon has an homogenous space mani-

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fold, so that the displacement path of the center of its globule given by the the amplitude wavelength λ_0 is of the same size as the quantum wavelength. Since the power of its flux can be described as

$$P_{microFOT340eV} = \lambda_{quantum}^3\, \upsilon^2\, \varepsilon_k = \lambda_0^3\, \upsilon^2\, \varepsilon_k$$

its Space-manifold takes on the indistinct form

$$S_{maniFOT340eV} = \lambda_{quantum}^3 = \lambda_0^3 \qquad (35)$$

Thus in the vast world of photons there are only two (fine-)structurally singular photons, one whose flux has an homogenous Time-manifold, and another whose flux has an homogenous Space-manifold.

The duration of a photon, or of its energy flux proper, is a function of another ratio, a ratio of frequencies, υ/ε_k, or inversely, of times: all photons with light wavelength <47nm, or energy greater than Hartree – ie all ionizing photons – have υ/ε_k ratios greater than 1, and thus will complete υ/ε_k cycles of their light waves before their extinction at the end of the path λ_0. This is yet another fact, and one commensurate with the ratio of wavelengths, that underlines the, albeit limited, propagative or "ballistic" aspect of ionizing photons. Conversely all blackbody photons have fractional υ/ε_k ratios and, consequently, their unit flux will extinguish before a full cycle of their light waves is accomplished, or their globular envelope completely closes, or finishes forming. The reader will wonder how that is possible. The only answer is that, for the light-wave cycle of such blackbody photons to be completed (or always to be emitted as complete) and the globular wave-envelope to be entirely sphericized, a number of photons given by the reciprocal ratio, ε_k/υ, must be emitted in synchronized succession (diachronism) as part of the same emission, as if melded in a well orchestrated sequence. Only such a process can complete a single globular but multi-photon wave envelope, for a total duration now given as the reciprocal of the quantum frequency itself

$$t_{bb\ FOT} = (\varepsilon_k/\upsilon)\, \tau_k = \upsilon^{-1} \qquad (36)$$

Thus, the time that it takes to form a blackbody photon is longer than the universal time beat τ_k, and we are forced to conclude that what one tends to call *single* blackbody photons *in situ* are actually *diachronic packet composites of many photons*, whose number is given by the ratio between the universal Tesla frequency ε_k and the quantum frequency of the blackbody photon:

(ε_k/υ) = number of blackbody photons needed to complete the flux that forms a single globular envelope

This leads us to the last astonishing conclusion of our aetherometric analysis: that the total flux of energy per formed blackbody globular envelope is different from, and greater than, the total flux of

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energy per blackbody photon involved in forming that envelope:

$$(\mathcal{E}_k/\upsilon)\ P_{microFOT} = (\mathcal{E}_k/\upsilon)\ c^2\ W_{vFOT} = \lambda_0\ \lambda_{quantum}{}^2\ \upsilon\ \mathcal{E}_k{}^2 \qquad (37)$$

With this finding, the physical distinction between ionizing and blackbody photons becomes sharpest, as the former always last longer than the cycling time of their constituent waves and therefore always form one or more globular envelopes that they smear along a displacement path, whereas blackbody photons can only generate a globular envelope by the synchronized emission of more than one photon, as if there was, in effect, a minimum duration for the overall emission of blackbody photons given by the reciprocal of the quantum frequency, $t_{bb\ FOT} = (\mathcal{E}_k/\upsilon)\ \tau_k = \upsilon^{-1}$. Accordingly, the manifestation of blackbody globular wave-envelopes is composite for blackbody photons with energy less than Hartree, whereas in ionizing photons a globular envelope is always complete irrespective of its smearing and repetition, or the extent to which it is repeated, in the path of its displacement.

However, this solution to the flux of electromagnetic energy also cannot be correct or complete. Accepting it at face value, either all the quantum times or durations of blackbody photons would have to be integer multiples of τ_k (a physical impossibility, given the known spectrum of blackbody photons), or, for non-integer values of $\mathcal{E}_k/\upsilon$, the emitted photon strings (sequential packets or bundles) would have to contain photon energy fragments. Since quantum time provides the minimum interval necessary to form a globule or wave envelope, and the fundamental notion is that photon strings are emitted so as to form (at least) a single and complete globule, such fragments could not possibly be envelope fragments - otherwise observed Light would not have the wavelength or frequency that it is supposed and known to have. But to avoid this, we would appear to fall instead into having to suppose the existence of photon fragments - of fragments of photon energy units, another impossibility and illogicality. Suppose that a given photon has a quantum time of 25.3 x τ_k: this would suggest that, when it came to energy flux, a third of a photon would flow along with the photon string. The only solution is to conclude that only complete photons are emitted, and that the total number of photons (or photon energy units) emitted in the diachronic string is always the "ceiling" of the ratio υ^{-1}/τ_k - i.e. the smallest integer not exceeded by this ratio. In the previous example, the total number of photons would be 26, and the total flux time of the emission equal to $26^*\tau_k$. The reason why this would not skew the known wavelength or frequency of Light is that while incomplete wave envelopes are not permitted, partially re-covered or re-traced envelopes are permitted as they retain their dimensions - which are the wavelength and frequency dimensions of Light (we could summarize this as: complete envelopes with a surplus photon unit are allowed, but neither incomplete envelopes nor energy fragments are allowed). Moreover, this "ceiling rule" tallies perfectly with the aetherometric proposal that these blackbody photon strings are emitted from electrons (for exam-

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ple) by a specific physical process whereby each photon is released from the kinetic energy associated with only one of the flux rings of the electron mass-energy torus [22], the entire photon string being released sequentially from the kinetic energy associated with immediately contiguous rings. This, then, provides a physical reason as to why the number of emitted blackbody photons in a string must be an integer. It also underlines the fact that the maximum number of blackbody photons that can be released from any kinetic state of the electron is 19,206, which is the number of the flux rings composing the electron torus; when and if all these rings generate photons, the electron will have lost the entirety of its kinetic energy.

In turn, this raises another question - of whether there is a low-end limit to photon energy - or, equivalently, a maximum wavelength. Current physics - rather astrophysics than particle physics or electromagnetism - holds that the only limit to blackbody photon wavelength is the size of the universe itself. However, if the aetherometric theory of sequential blackbody photon emission from adjoining flux rings of the electron torus is valid, then there is a low-end limit to the photon energy that can be shed from a single electron – when all rings have shed their associated kinetic energy – and this will vary with the configuration of the electron torus and the number of rings [10]: in the electroinertial configuration, this low-end limit is 1.385 eV with a frequency of 334 GHz, and in the photoinertial configuration, 11.77 μeV with a frequency of 2.845 GHz. Still lower photon energies are possible from electrons in stacks - a single stack, with both electrons sharing the same kinetic energy, will halve those frequencies to 167 GHz and 1.42GHz, respectively. Still lower photon energies and frequencies are possible in emissions from protons. We have not yet presented the aetherometric theory of proton fine-structure and mass variation, but it suffices to say here that the "average proton" has ca. 64.7 billion flux rings in the extranucleonic configuration, and η times more rings in the intranucleonic configuration, putting its low-end frequency limits at 9.937 kHz and 844 Hz, respectively. Heavier than average protons have slightly lower limits. Water molecules have a nucleus with 16 nucleonic masses, putting the lower frequency limit for blackbody emission from its nucleus at 844 Hz/16 = 52.76 Hz – that is, in the range of, but well below, the 76 Hz band used by the U.S. Navy for underwater ELP communication [25]. It is interesting to note that, according to the aetherometric scale of temperature and the aetherometric analysis of the Boltzmann constant [26-27], the "intrinsic temperature" of a 52.75 Hz photon is $2.5 \cdot 10^{-9}$ Kelvin, or 2.5 billionths of a degree Kelvin above absolute zero. For as long as the nucleons *of an atom or molecule* solidarily share kinetic energy, lower and lower energy or frequency endpoint emissions of blackbody photons are possible with increasing number of nucleons per nucleus, ie increasing atomic weight. For example, the nucleus of ^{238}U may release photons with a frequency as low as 3.5 Hz (and wavelength of 84,986 km). Thus, it seems there is no absolute low energy endpoint limit to blackbody photons, only a variety of low-energy limits that are each specific to the size of the mass that coherently shares a kinetic state which it can shed in the form of photons.

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In closing, we examined in detail the fine structure of photon energy and its flux, and arrived at a radically different topogeometric and dynamic view of the functions of blackbody and ionizing photons than that which is to this day dominant in particle physics and electromagnetic theory. All photons appear to be *massless* productions that dissipate kinetic energy or mass-energy back to the "vacuum state", with ascertainable time intervals between emission and extinction. All photons also have a globular wave envelope defined by the fine structure of their energy; but whereas blackbody photons with energy less than Hartree's are formed in sequential strings that *fasciculate* and together complete a shared globular wave envelope, all ionizing photons with energy greater than Hartree's smear their globular wave envelope or envelopes into a continuous *fiber* that may span substantial distances.

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