GALILEAN ELECTRODYNAMICS

Experience, Reason, and Simplicity Above Authority
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EDITORIAL POLICY

Galilean Electrodynamics aims to publish high-quality scientific papers that discuss challenges to accepted orthodoxy in physics, especially in the realm of relativity theory, both special and general. In particular, the journal seeks papers arguing that Einstein's theories are unnecessarily complicated, have been confirmed only in a narrow sector of physics, lead to logical contradictions, and are unable to derive results that must be postulated, though they are derivable by classical methods.

The journal also publishes papers in areas of potential application for better relativistic underpinnings, from quantum mechanics to cosmology. We are interested, for example, in challenges to the accepted Copenhagen interpretation for the predictions of quantum mechanics, and to the accepted Big-Bang theory for the origin of the Universe.

On occasion, the journal will publish papers on other less relativity-related topics. But all papers are expected to be in the realms of physics, engineering or mathematics. Non-mathematical, philosophical papers will generally not be accepted unless they are fairly short or have something new and outstandingly interesting to say.

The journal seeks to publish any and all new and rational physical theories consistent with experimental fact. Where there is more than one new theory that meets the criteria of consistency with experiment, faultless logic and greater simplicity than orthodoxy offers, none will be favored over the others, except where Ockham's razor yields an overwhelming verdict.

Though the main purpose of the journal is to publish papers contesting orthodoxy in physics, it will also publish papers responding in defense of orthodoxy. We invite such responses because our ultimate purpose here is to find the truth. We ask only that such responses offer something more substantive than simple citation of doctrine.

The journal most values papers that cite experimental evidence, develop rational analyses, and achieve clear and simple presentation. Papers reporting experimental results are preferred over purely theoretical papers of equally high standard. No paper seen to contradict experiment will be accepted. But papers challenging the current interpretation for observed facts will be taken very seriously.

Short papers are preferred over long papers of comparable quality. Shortness often correlates with clarity; papers easily understandable to keen college seniors and graduate students are given emphatic preference over esoteric analyses accessible to only a limited number of specialists. For many reasons, short papers may pass review and be published much faster than long ones.

The journal also publishes correspondence, news notes, and book reviews challenging physics orthodoxy. Readers are encouraged to submit interesting and vivid items in any of these categories.

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From the Editor: A letter from our files

A Basis for Quantum Mechanics

The assumption that all charge interactions occur in the charge fields, where there is propagation at the speed c, is sufficient to derive electromagnetic theory. [1] The Lorentz transform describes the paths the results of the interactions take to a target [2,3]. This success suggests that electrons are not point particles, but are instead distributed fields.

In free space the fields take the familiar spherically symmetric form. When near other matter, the fields are altered by the local fields of other particles, and take other forms. For example, in orbit around a nucleus they appear as rings, forming standing waves, so they appear stationary and don't radiate. When approaching a conductor, they smear out over the conductor and behave like waves. Electrons always seem to have the same mass, so the information about the electron must be mainly in its far fields, not in the details of how they converge to their centers.

Feynman introduced quantum mechanics by using the analogy between the diffraction of light and electrons at a two-hole aperture with a backstop and counter. Light diffraction is easy to explain in terms of its wave nature. Electron diffraction is more difficult to explain if electrons are particles. This note provides an explanation for their wave behavior.

Modern physicists seem to forget that elementary physics teaches that, unless shields terminate the charge fields, they extend to infinity. If one considers that the backstop includes many charges whose fields fill the space between the aperture plate and backstop and extend through both aperture openings, the uncertainty of the terminal point becomes more understandable. On their way to the backstop, the incoming electrons choose between the available fields to determine the path to take.

Quantum mechanics teaches that the choice is made as if electrons form waves with a wavelength $\lambda = h / mv$ where h *is* Planck's constant, m is the mass of electrons and v is their velocity. Suppose the fields of stationary electrons have a speed c, equal to the speed of light with respect to the charge center, and that they have a periodic structure with a wavelength L. If an electron approaches another charge with speed v, the elements that make up the two charge fields will have a speed difference v, so it would take a time L / v for the set associated with the stationary electron to pass the wavelength of the moving electron. Since the field of the stationary charges has a speed c, in the time L / v it will have moved a distance Lc / v, which is the effective wavelength of moving electrons. Equating these expressions for the wavelength, $h / mv = Lc / v$ yields $L = h / mc = 2.43 \times 10^{-12}$ m. This suggests that electrons have a structure with a wavelength of about 300 times their presumed 'radius'.

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Ether and the Derivation of Planck's Constant

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Quantum Mechanics offer science solutions for the discrete energy levels of electrons circling around the nucleus in atoms. The mathematical solutions of QM do not provide a physical explanation why the allowed quantum energy levels of atoms are fixed. In this article we show how the QM-solutions can be explained: QM- and classical physics merge.

1. Introduction

The experiments of Rutherford (1871-1937) lead to the first atomic model, which was named after him. The Rutherford-model, based on the diffraction of α-beams, could not explain the stability and the discrete energy levels of atoms. In order to be able to describe the existence of stable atoms and discrete energy levels, Bohr (1885-1962) introduced his thesis. Bohr, and Heisenberg, Dirac, and Schrödinger in their work, lead to the complete mathematical solution of the atomic model.

The QM-solutions however are, to a certain degree, unsatisfactory because these solutions do not describe the physical processes that lead to, for example, the allowed discrete energy levels of atoms. Knowledge of the physical processes responsible for QM would complement its already undisputable mathematical position.

The principal quantum number n for atoms coincides with fixed energy levels of the atom. The quantization of the energy of the atom can be interpreted as originating from distance quantization. Analyzing this possibility, we encounter strong direct circumstantial evidence pointing to the existence of the ***Quantum Distance***.

2. The Mechanical Free Rotator

The atom is a so-called 'free rotator'. The electrons rotate around the nucleus at discrete energy levels, indefinitely, without losing energy or collapsing.

We consider first the mechanical free rotator. Two masses, M_p and M_e, circle around each other. The masses are mechanically connected through a rigid, mass-less rod of length R (Fig. 1). When both masses M_p and M_e are rotating, and when there is no interaction with any other system, the masses M_p and M_e will rotate stably for infinite time.

Because both masses are connected with the rigid rod, the dynamics can be described by classical kinematics. The rotating point of the system (fig. 1) is determined by the relative masses, according to the following equations:

$$R = R_e + R_p \quad , \quad R_p = (M_e / M_p)R_e$$

Because both masses are rigidly connected to each other, the following equations for velocity, angular velocity, and central force must be valid:

$$V_p = (M_e / M_p)V_e \quad , \quad \omega = V_e / R_e = V_p / R_p \quad ,$$

$$M_e V_e^2 / R_e = M_p V_p^2 / R_p = F_c \quad .$$

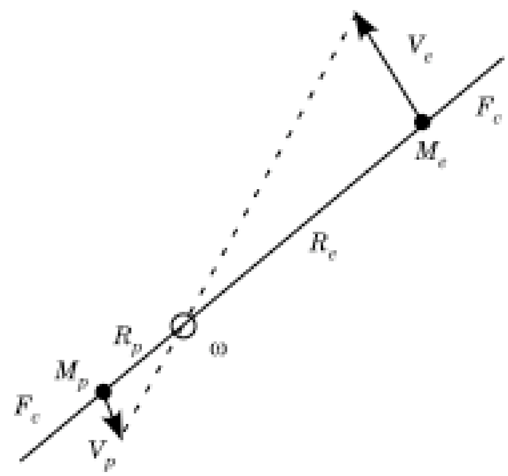

Figure 1. The mechanical free rotator. F_c is centrifugal force putting tension on the rod.

3. The EM-Rotator

When both masses are not connected through a rigid mass-less rod, and are charged masses, like the electron (M_e) and proton (M_p) in the Hydrogen atom, the above properties of the mechanical free rotator must also be valid in stable situations.

To obtain a free EM-rotator with stable orbits, the function of the mass-less rod must be taken over by forces working on electrons and nucleus in the atom. All forces must be neutralized/equalized during the rotation of the electron around the proton at any time.

In a stable situation, the following mechanical conditions for proton (M_p) and electron (M_e) in the Hydrogen atom must be valid:

$$R = R_p + R_e \quad , \quad R_p = (M_e / M_p)R_e \quad ,$$

$$V_p = (M_e / M_p)V_e \quad , \quad \omega = V_e / R_e = V_p / R_p \quad ,$$

$$M_e V_e^2 / R_e = M_p V_p^2 / R_p = F_c \quad ,$$

where now the centrifugal force F_c, working equally on proton and electron, has to be compensated a force internal to the system: the electrostatic force F_e.

We consider the EM-free rotator where the centrifugal force (F_c) is compensated at ***all times*** by the electrostatic force (F_e). This assumption implies that the electron is in a steady orbit around the proton. The additional mechanical requirements for the steady EM-rotator are:

$$F_e = e^2 / 4\pi\varepsilon_0 R^2 \equiv F_c = MeVe^2 / R_e$$

and

$$F_e = e^2 / 4\pi\varepsilon_0 R^2 \equiv F_c = M_p V_p^2 / R_p$$

The equilibrium relationship for the free and stable EM-rotator is:

$$R_e = e^2 \Big/ \left[4\pi\varepsilon_0 (1 + M_e / M_p)^2 M_e V_e^2 \right] \quad (1)$$

where R_e is the distance of the electron to the rotation point of the system (Fig. 1), M_e the mass of the electron, M_p the mass of the proton, V_e the rotation speed of the electron, e the elementary charge of the electron and ε_0 the dielectric constant in vacuum.

This equation describes the radius R_e of the orbiting electron as a function of the rotation speed V_e in the situation where the system is stable ($dE / dt = 0$) and the orbiting speed is constant ($dV_e / dt = 0$). Analyzing this equation we observe that for any speed of the electron V_e, there is a possible solution R_e.

The situation sketched in Fig. 1 is also the situation where the electron and proton are both in a steady orbit around O. The electrostatic force F_e now compensates the centrifugal force F_c.

As there is for any speed of the electron V_e also an orbit distance R_e where all forces are in equilibrium, there are infinite solutions and so there are no theoretical solutions based on this model that resemble the reality of fixed energy levels.

The proton and electron have, besides mass, also a charge. The moving electron and proton would each present an electric current. The magnetic fields induced by electron and nucleus would induce a magnetic force F_m between proton and electron equal to:

$$F_m = \mu_0 e^2 Ve^2 \Big/ \left[4\pi R_e^{\,2} (1 + M_e / M_p)^2 \right] \times M_e / M_p$$

This magnetic force F_m, when relevant, would be negligible compared to the electrostatic force F_e. The nuclear forces are negligible at the molecular distance.

A moving charge presents dynamic energy in the form of magnetic energy. The Rutherford-model was considered not stable because the circling electrons around the nucleus would loose energy by emitting radiation; so a stable EM-rotator like the Rutherford-model was considered impossible. A moving charge can emit radiation and loose energy, but it is not true that a moving charge in all circumstances has to loose energy. We refer to the article "The Equivalence of magnetic and Kinetic Energy" where it is proven that both energy forms are identical. A moving mass can circle indefinitely without loosing energy, and so can a charge.

4. The Energy Level of the Hydrogen EM-free Rotator Atom

Although it has in the past been impossible to obtain a mathematical solution for a EM-free rotator that resembles the Hydrogen atom with it's clear energy levels, we continue the search.

When the electron circles around the proton at a smaller distance ($R_2 < R_1$) the electrostatic energy (W_e) of the system is decreased according to:

$$\Delta W_e = -e^2 / 4\pi\varepsilon_0 R_2 + e^2 / 4\pi\varepsilon_0 R_1 \quad (2)$$

The kinetic energy of the Hydrogen atom, when considering the atom is an EM-rotator, would increase because the electron is now circling around with higher speed.

$$W_k = 1/2 M_e V_e^2 + 1/2 M_p V_p^2 = \tfrac{1}{2} \times \left[M_e V_e^2 (1 + M_e / M_p) \right] \quad (3)$$

Considering Eq. (1):

$$R_e = e^2 \Big/ \left[4\pi\varepsilon_0 (1 + M_e / M_p)^2 MeVe^2 \right]$$

we can express the dynamic/kinetic energy of the system W_k (3) with:

$$W_k = 1/2 M_e V_e^2 + 1/2 M_p V_p^2 = e^2 \Big/ 8\pi\varepsilon_0 (1 + M_e / M_p) R_e \quad (4)$$

Eq. (2) shows the difference in electrostatic energy levels between the orbit radius R_2 and R_1. The electrostatic energy level of the atom, when $R_1 = \infty$ and $R_2 = R_e$, is:

$$W_e = -e^2 \Big/ \left[4\pi\varepsilon_0 R_e (1 + M_e / M_p) \right] \quad (2a)$$

We observe that the kinetic energy of the system W_k (4) is ***at all times*** half of the released potential energy W_e of the electrostatic field (2a). Eqs. (2a) and (4) give

so

$$W = W_e + W_k = -e^2 \Big/ \left[8\pi\varepsilon_0 R_e (1 + Me / Mp) \right] \quad (5)$$

When the atom emits a photon in our EM-rotator, due to the descent of the electron to a lower orbit, the energy of the photon is half the decreased potential energy. Because of the energy conservation law the energy of the emitted photon must be:

$$hv = e^2 \Big/ \left[8\pi\varepsilon_0 (1 + M_e / M_p)^2 R_{e_1} \right] - e^2 \Big/ \left[8\pi\varepsilon_0 (1 + M_e / M_p)^2 R_{e_2} \right]$$

$$hv = e^2 \Big/ \left[8\pi\varepsilon_0 (1 + M_e / M_p)^2 \times (R_{e_2} - R_{e_1}) / R_{e_2} R_{e_1} \right]$$

These are the photons emitted by the EM-rotator when the orbiting distance R_e determines the energy level.

The energy level of the Hydrogen atom, according to the Bohr-atomic model (W_B), is:

$$W_B = (-e^4 M_e / 8\varepsilon_0{}^2 h^2) \times 1 / n^2 \tag{6}$$

where n is the principal quantum number.

The Bohr-atomic model describes the observed energy levels of the atom very well for $n = 1, 2, 3$ ... In Eq. (6) the only variable is n. The energy level of the EM-rotator (5) is completely determined by the distance of the electron to the nucleus.

In classical EM-physics the energy level of the atom is completely determined by the distance between nucleus and electron (5). The QM-solution (6) shows a quantified formula where the orbiting distance is no longer presented. Bohr's Correspondence Principle tells us that both worlds (QM and EM) have to obey the same physic laws. However the quantum rules are of no significance in the macro-world.

At the quantum level physics have to obey the quantum-physics laws and the macrophysics laws. The Correspondence Principle of Bohr tells us that at the quantum level there are no additional rules, only that in the macro-world the quantum rules are no longer significant. The same principle tells us that the macrophysics laws also have to be valid at the quantum level.

Although the Eqs. (5) and (6) are different, Bohr's Correspondence Principle tells us they could be the same; (5) describing the rules of the macro-world and (6) the rules of the micro-world where the laws of both worlds are relevant.

Neglecting the M_e / M_p factor in Eq. (5) we get:

$$W = -e^2 / 8\pi\varepsilon_0 R_n \, (^{***}) \tag{5a}$$

where R_n is the orbiting distance of the electron. [Asterisks mark formulas where the theoretical and experimental values deviate factor 1.003458. The deviation factor appears to be systematic. The deviation implies a difficult mathematical problem that by far exceeds my capabilities.]

When Eqs. (5a) and (6) are equally valid we can express the orbiting distance R_e with the principal quantum number n. The energy of Eq. (6) must be equal to Eq. (5a) and therefore:

$$(e^4 M_e / 8\varepsilon_0{}^2 h^2) \times 1 / n^2 = e^2 / 8\pi\varepsilon_0 R_n \tag{5c}$$

where
$$R_n = n^2 h^2 \varepsilon_0 / e^2 \pi M_e \tag{7}$$

For the ground level of the Bohr-Hydrogen atom ($n = 1$) the calculated distance, of course, coincides with the Bohr radius of the Hydrogen atom $R_B = 5.29177 \times 10^{-11}$ meter; the orbiting distance of the electron being in ground state.

Similar calculations with the Rydberg constant ($R_\infty = 1 / R_r = e^4 M_e / 8\varepsilon_0{}^2 h^3 c$) and Eq. (5c) gives:

$$n_\infty{}^2 = 8\pi h c \varepsilon_0 / e^2 = 1722.045 \tag{8}$$

The Rydberg principal quantum number is calculated at $n_\infty = 41.4975$.

The above calculations of the Bohr-radius of the Hydrogen atom ($n = 1$) and the Rydberg quantum number n_∞ are completely consistent with QM-calculations. Assuming that equation (5a) is identical to (6) doesn't imply any discrepancy.

Summarizing we deduced that the EM-free rotator for the Hydrogen atom has infinite solutions. With the assumption that the hydrogen atom is an EM-rotator there is at any distance or speed a possible equilibrium. The discrete energy levels of the electrons in the atom, the quantisation of energy, can completely be explained by a quantum restriction that the electron can only have stable orbits around the nucleus at the discrete distances; $R_{\text{Bohr}} \times n^2$.

5. The Quantization of Distance

Bohr's Correspondence Principle suggests that Eqs. (5a) and (6) are the same, and they appear to be so. Because the energy levels of atoms are discrete, quantized, one can presume that the distance is quantized in some way because the specific energy quantization of the atom must coincide with certain discrete leaps in orbiting distance. Despite the energy quantization with n by QM, classical EM-physics still determines that the increasing quantum level n **has to** coincide with corresponding increase of orbit distances according to the conservation law of energy.

The equations for the energy level of the atom according to Bohr's model (6) and the EM equation (5a) can be seen as identical. We can express the quantum energy levels of the Hydrogen atom adequately with:

$$W_n = (-e^2 / 8\pi\varepsilon_0 R_{\text{Bohr}}) \times 1 / n^2 \tag{9}$$

where the radius R_{Bohr} is the radius of the Hydrogen atom according to Bohr ($n = 1$) and n the principal quantum number.

The distance $R_n = R_{\text{Bohr}} \times n^2$ of the electron to the nucleus is the macro-world factor that determines the energy level of the atom and also determines the energy level of Bohr's atomic model. The quantum number n indicates that for the quantum distances $R_{\text{Bohr}} \times n^2$, for $n = 1, 2, 3 \ldots$ the stable ionization energy levels are observed.

Because Eq. (6) is identical to Eq. (5a) when $R_n = R_{\text{Bohr}} \times n^2$ we derive equation:

$$R_n = n^2 h^2 \varepsilon_0 / e^2 \pi M_e \tag{10}$$

R_n is the orbit distance of the electron in the Bohr-Hydrogen atom. The classical Compton-radius R_c of the electron is calculated according to the equation:

$$M_e = \mu_0 e^2 / 4\pi R_c$$

Exactly the same radius for the electron is derived in the Chapter "The Electron" in **From Paradox to Paradigm** [10] where the rest mass/energy of the electron is calculated:

$$M_e c^2 = e^2 / 8\pi\varepsilon_0 R_c + \mu_0 c^2 e^2 / 8\pi R_c$$

where the first part of the equation is the electrostatic energy and the second part the dynamic spin-energy of the electron.

Substitution of M_e in (10) and considering $c^2 = 1/\mu_0\varepsilon_0$ we find:

$$R_n / R_c = 4\varepsilon_0{}^2 h^2 n^2 c^2 / e^4 \tag{10a}$$

for $n = 1$ the radius of orbit is the Bohr-radius of the Hydrogen atom. We calculate the ratio:

$$R_{\text{Bohr}} / R_c = 10.867397 \times 12^3$$

The distance ratio between the last energy trap in the atom, the Rydberg distance, and the first, the Bohr-distance, is expressed with ratio (the quantum number n_∞):

$$(R_\infty)^{-1} / R_{\text{Bohr}} = (n_\infty)^2 = 8\pi hc\varepsilon_0 / e^2 = 1722.045 = 12^3 / 1.003458 \approx 12^3 = (N_\infty)^3 \quad (11) \ ***$$

With Eq. (8) we calculated that the Rydberg principal quantum number is $n_\infty = 41.4975$. The principal quantum number can also be expressed generally with the ratio: $n^2 = R_n / R_{\text{Bohr}}$

The difference between (11) and (8) is that the quantum number N is calculated differently. We will show that the ***Rydberg distance is*** $R_\infty{}^{-1} = 12^3 R_{\text{Bohr}} = N_\infty^3 R_{Bohr}$ and that there are therefore $N_\infty = 12$ ionization levels, and that $R_n / R_{\text{Bohr}} = n^2 = N^3$

6. The Planck-Radius

The energy quantification of the atoms at molecular distance are possibly the result of the quantization of distance.

In the "*The photon and the constant of Planck*" in [10], the Planck-radius is calculated at:

$$R_{\text{Planck}} = e^4 / 32\pi^2 M_e \varepsilon_0{}^2 hc^3 = 1.636393 \times 10^{-18} \text{meter} \tag{12}$$

The classical radius or Compton–radius of the electron is:

$$R_c = \mu_0 e^2 / 4\pi M_e = 2.81794 \times 10^{-15} \text{meter} \tag{13}$$

We observe that the ratio between the Compton-radius and the Planck-distance is:

$$R_c / R_{\text{Planck}} = 8\pi hc\varepsilon_0 / e^2 = 1722.0436 = 12^3 / 1.003458$$

which is exactly the same factor as between the Rydberg radius and the Bohr radius (11). ***

We will show that this equality is not just a coincidence, but the result of the existence of the quantum distance (QD). The Planck-distance, the Compton radius, the Bohr-radius and the Rydberg constant are directly and integer related by the quantum number 12^3.

The derivation of the Planck-distance is based on the assumption that space is not absolutely empty, but that space is filled with so called point-volumes with a radius of the Planck-distance. Although a not empty space is formally not consistent with the assumption of science that space is absolutely empty, science already admits inherently that space is not empty by the general acceptation of the field theory. The field theory assumes that in 'empty' space, vacuum, there can be fields such as electrostatic fields, magnetic fields, and gravity fields.

How can there exist fields in vacuum when this vacuum is assumed to be absolutely empty?

Philosophically this is not considered possible. Science already implicitly accepts that vacuum is not absolute empty, only science doesn't yet admit it officially or formally!

There are more very strong indications that vacuum is not just empty space. The phenomenon of stellar aberration for example indicates strongly that there is 'ether'. [4] So when we assume space is not empty, but filled with so-called point-volumes, this is scientifically not unacceptable. The remarkable thing that happens is that when we fill space with point-volumes, a completely QM-consistent explanation for the 12 atomic ionization levels is found and at the same time calculations of the correct distance/energy level of the nucleus at the ionization levels are obtained. Although mainstream science rejects ether, the scientific explanations are too compelling to ignore.

When we imagine that space is filled up with bulb shaped point-volumes with radius $QD = R_{\text{Planck}}$ then space cannot be homogeneous everywhere (Fig. 2).

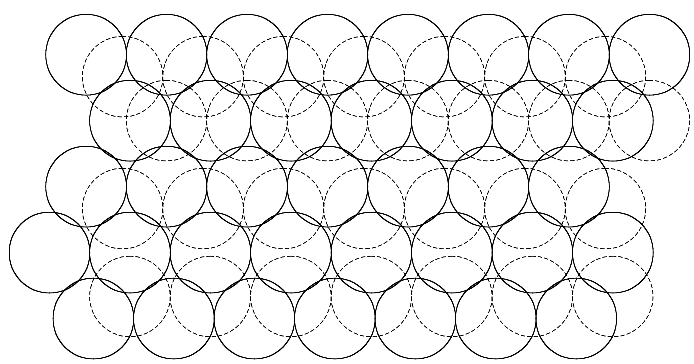

Figure 2. An impression of space filed with point-volumes.

7. The Orientation of Point-Volumes Surrounding a Charge

When there is a charge in space the shown non-orientation in Fig. 2 of the point-volumes will be influenced. Vacuum is able to contain fields (field-theory) like the electrostatic field presented in vacuum by the dielectric constant ε_0. The charge in vacuum will initiate dielectric displacement in the point-volumes. The electric field will influence the orientation of the point-volumes.

In Fig. 3 we demonstrate that the energy of the charge influences the point-volumes.

The point-volumes are responsible for transport of the electric field according to the laws of physics. Dielectric displacement is achieved in the point-volumes and distributed over space. One can imagine that at the QD level space is not homogeneous and quantification is inevitable.

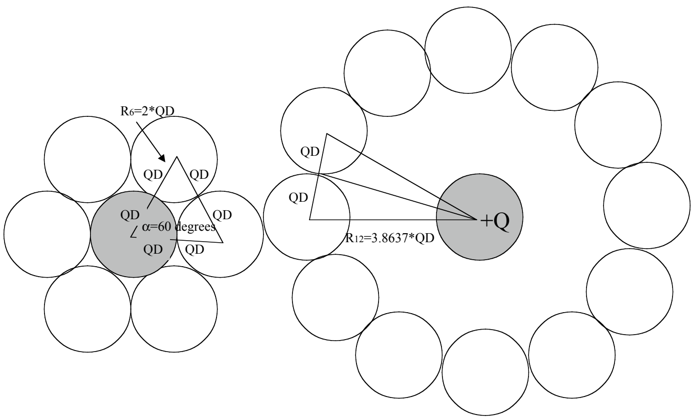

Figure 3. The orientation of point-volumes around a charge

The orientation of the point-volumes around the charge will minimize the energy level according to physics laws. The non-orientation of Fig. 2 has disappeared.

The reader can see that the space around charge $+Q$ can no longer be filled homogeneously with point-volumes. The orientation of the 6 point-volumes around the charge sketched in Fig. 3 is still comparable with field free point-volumes in Fig. 2, but the circle of 12 point-volumes around $+Q$ cannot be found in the field/energy free vacuum of Fig. 2.

The tension of the electric field draws the point-volumes towards $+Q$ and at the same time orientates the point-volumes or 'ether' as far as possible into a bulb shape orientation.

7. The Quantum Distance and the Second Quantum Dimension (Compton-Radius)

The Planck-radius is the smallest known distance so we assume that the quantum distance is: $QD = R_{\text{Planck}}$

$$R_{\text{Planck}} = e^4 / 32\pi^2 M_e \varepsilon_0{}^2 hc^3 = 1.636393 \times 10^{-18} \,\text{meter} \qquad (12)$$

We have seen that the ratio between the classical radius of the electron, the Compton radius (R_c), and QD is the same as the ratio between the Rydberg-distance R_r and the Bohr-distance. Is this a coincidence or not?

We assume the ratio has the integer value of:

$$(R_\infty)^{-1} / R_{\text{Bohr}} = Rc / QD = (N_\infty)^3 = 8\pi hc\varepsilon_0 / e^2 = 12^3$$

In Fig. 3 the quantum numbers 6 and 12 already give some symmetry. First we will concentrate on the quantum number 12^3 and show that with this number we can create "homogeneous" space.

In Fig. 4 schematically the Compton-radius is the radius of the drawn circle.

$$R_c = 12^3 \times QD$$

$$\tan(\alpha) = 2 * QD / Rc = 2QD / 12^3 QD = 1/864$$

$$\alpha = 360 \times 60 / 864 = 25'$$

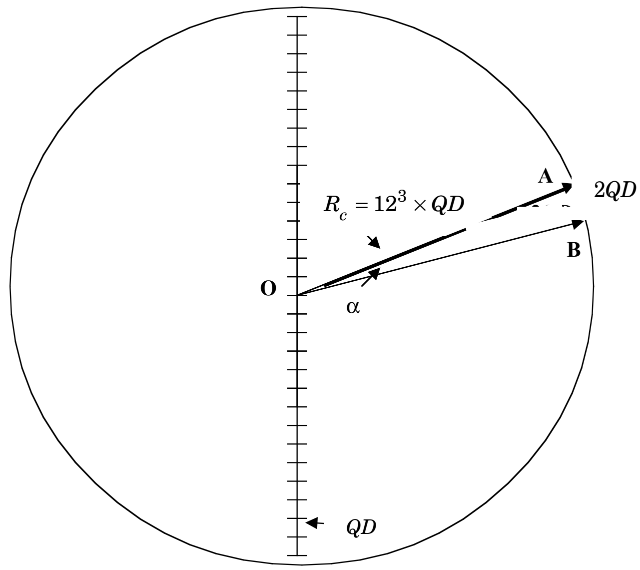

Figure 4. The quantum distance transformation.

Calculation gives 25 minutes for the angle α (= Fine Structure Constant = $2\pi/864$***) in Fig. 4. In 360 degrees there are ***exactly*** 864 angles of 25 minutes. The perimeter of the 'circle' in Fig. 4, the sum of all 864 straight lines $AB = 2 \times QD$, is:

$$864 \times 2 \times QD = 12^3 \times QD = Rc \,.$$

The perimeter of the created circle is R_c (864 angles α of 25′ = 360 degrees) while the perimeter of a circle in the macro-world is $2\pi R_c$!

This result is remarkable. How can R_c be $2\pi R_c$ at the same time?

When we want to compare the quantum perimeter with the macro-world perimeter the correction factor is 2π.

The straight line AB, the basis of triangle OAB, is $2 \times QD$. The surface of one triangle OAB is:

$$O_{OAB} = R_c \times QD = 12^3 QD^2 \quad .$$

The total surface of one side with 864 triangles is: $O_c = 12^6 QD^2 / 2$.

The surface of both sides of the created 'circle' has 12^3 triangles with a total surface $O_c = 12^6 QD^2 = R_C{}^2$.

The 'macro-world' surface of two circles with radius R_c is $O_c = 2\pi R_c^2$, so with the surface there is also a 'translation' factor of 2π for the transformation from the QD to R_c level.

At the Compton-level R_c, $12^3/2$ point-volumes create a 'perfect' circle for observers in O (Fig. 4). The observer in O can observe no more than two, right angled "perfect" circles, at the same time at distance R_c. Because there is no restriction for the angle of observation of the two 'perfect' circles, one should be able to observe the circles in 'any' direction, but not at the same time (the point-volumes create at R_c the two-dimensional quantum space).

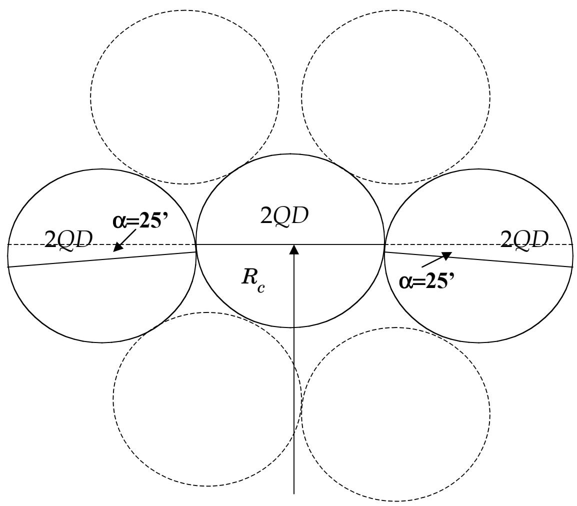

Figure 5. Illustration of the imperfect Quantum Space at the Compton-distance.

The quantum bulbs at R_c (Fig. 5) touch each other in such a way that they can form with $12^3/2$ QD-bulbs a 'perfect' circle around O; all QD-bulbs of circle R_c are 'in touch'. One can observe that the QD-bulbs up and down R_c (Fig. 5) do not have closed perimeters because 'curved' three-dimensional space around a charge cannot be filled continuously with bulbs. Inhomogeneity is unavoidable.

8. The Transformation to the Third Quantum Dimension (Bohr-distance)

We demonstrated that with $12^3/2$ point-volumes we can create a perfect 'circle' with 864 triangles OAB. Point O (Fig. 4) is the center of the created Compton quantum circle (R_c). Between O and R_c the quantum space is imperfect. The 'bulbs' with radius QD cannot fill up spherical space homogeneously. The 'perfect' geometry is created at R_c. For the observer in O it is not possible to observe perfect circles all around (no perfect bulb possible when space is filled with point-volumes). The orientation of the two possible circles R_c is not fixed.

With the 'perfect' two-dimensional circle R_c we are able to create a perfect bulb shell tunnel with diameter R_c at the distance $12^3 \times R_c$; the Bohr-distance.

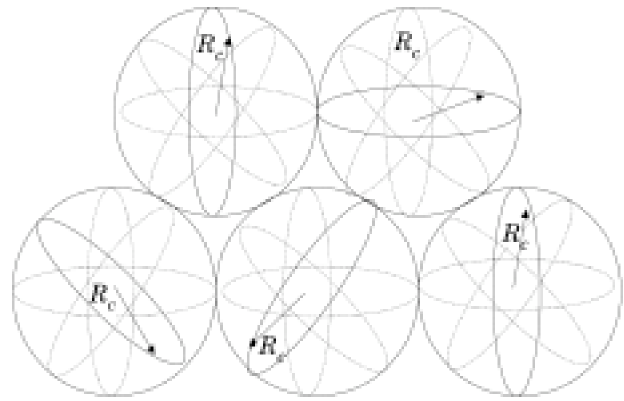

Figure 6. Compton circles creating the third quantum dimension.

With $12^3/2$ circles R_c (two circles each) we are able, in conjunction with the creation of the Compton-circle, to create two 'perfect' bulb shell tunnels with radius R_c at the Bohr-distance; the beginning of the third quantum dimension. The ratio between the distances R_B and R_c should be 12^3.

We have observed that the ratio between the Bohr-radius and the Compton-radius is:

$$R_{\text{Bohr}} / R_C = 4\varepsilon_0 h^2 / \mu_0 e^4 = 10.8674 \times 12^3 \quad (14)$$

The Bohr/Compton distance ratio appears to be 10.8674 times larger than the ratio R_c / QD or the Rydberg/Bohr ratio.

The volume of a bulb with radius R_B is in the macro-world is $V_B = \frac{4}{3}\pi R_B^3$ (where $R_{\text{Bohr}} = R_B$). The surface of the created Compton-circle is πR_c^2 including the correction from 1-QD to the 2-QD level. The 'volume' of the circle (R_c) at the 2-QD level with 'thickness' QD is $V_C = \pi \times R_c^2 \times QD$ and for $QD = R_c / 12^3$ we get: $V_C = \pi \times {R_C}^3 / 12^3$; the volume of the Compton circle-plate.

When we calculate the ratio V_{Bohr} / V_C we observe that the ratio $V_{\text{Bohr}} / V_C = \frac{4}{3} R_B^3 / R_C^3 = 8.8297 \times 10^{12}$

$$R_B^3 / R_C^3 = 10.8674^3 \times 12^9 \quad , \quad R_B / R_C = 10.8674 \times 12^3$$

So when we compare the volume of the Bohr-bulb and the Compton-plate the ratio R_B / R_c =10.8674 ×12^3 is confirmed.

We must however not forget that the situation at 2-QD is not the same as the 1-QD level or the 3-QD level. We have seen that a mathematical correction from 1-QD to 2-QD with the factor 2π was necessary. We now compare the third dimension of the

Bohr-bulb with second dimension of the Compton plate. A mathematical correction is necessary.

The factor 10.8674 is the correction factor from the 2-QD to the 3-QD. From the first to the second QD the correction factor is 2π. This transformation explains the origin of the mathematical natural constant π. Is it a coincidence that the other mathematical natural constant e can be found in 10.8674, because $4 \times e = 10.8731$ and the difference is therefore only 0.05%? **

(** When we correct for neglecting the factor $(1 + M_e / M_p)$=1.0005446, when Eq. 5a was derived from 5, the deviation factor with 4*e is less than 2.10^-5)

So both mathematical natural constants may well originate from the dimension transfer from the point-volume to three-dimensional space.

After the dimension correction we have also the ratio $R_B / R_c = 12^3$.

The total mathematical correction from the point-volume (first dimension) to our third dimension is: $2^3 \times e \times \pi = 68.318$.

9. The 12 Ionization Levels of the Atom

At the end of Section 5, we stated that we would show that the Rydberg distance is exactly $12^3 \times R_B$ and that there are 12 ionization levels.

Calculating the principal quantum number n for the Rydberg distance we found in accordance with QM that $n_\infty = 41.4975$. This means that according to QM there are over 40 ionization levels from the Bohr distance to the Rydberg distance. The principal quantum number is calculated with the help of Eq. (7):

$$R_n = n^2 h^2 \varepsilon_0 / e^2 \pi M e$$

Substitution of the Compton radius [Eq. (13)] gives

$$R_n / R_c = 4{\varepsilon_0}^2 h^2 n^2 c^2 / e^4 \tag{7a}$$

It is relevant to observe that with Eq. (7a, and therefore also with Eq. (7), we are calculating the ratio between R_n and R_c; we are comparing third QD R_n with second QD R_c.

With Eq. (6) $W_B = (-e^4 M e / 8\pi {\varepsilon_0}^2 h^2) \times 1 / n^2$ we are with M_e (and therefore R_c) in the second QD. Eq. (6) therefore has to be translated to the third QD. The energy value of (6) is independent of the quantum dimension and therefore correct, but the calculated principal quantum number is not. We can achieve the correct transformation of Eq. (6) from 2-QD to 3-QD with (5c):

$$W_B = (-e^4 M e / 8{\varepsilon_0}^2 h^2) \times 1 / n^2 = -e^2 / 8\pi\varepsilon_0 R_n$$

For $n = 1$ we calculate the Bohr distance. We define $R_n = R_{\text{Bohr}} \times N^3$ instead of $R_n = R_{\text{Bohr}} \times n^2$ in Eq. (9):

$$W_B = (-e^4 M e / 8{\varepsilon_0}^2 h^2) \times 1 / n^2 = (-e^2 / 8\pi\varepsilon_0 R_{\text{Bohr}}) \times 1 / N^3$$

The two equations are still identical for $n^2 = N^3$.

Actually nothing has changed. The only difference is that N^3 indicates that N is determined by the third quantum dimension and not by the second QD. All that changes is that N is not integer for all integer values of n. This is of no importance because the quantization of distance has not changed. The ratio R_n / R_B is still integer related according to $n^2 = N^3$. The dimension correction only changed the number of ionization levels in the range from the Bohr radius to the Rydberg distance from 41.5 to 12; the actual observed number of ionization levels.

At the Bohr distance point-volumes in space around a charge $+Q$ creates two 'perfect' bulb shell tunnels with radius R_c (beginning of the third quantum dimension). Outside the tunnels at the Bohr radius space is not yet 'perfectly' three-dimensional for the electron.

For distances from $+Q$ further than the Rydberg constant (N>12) there is no ionization level anymore because the fourth quantum dimension has started where space is everywhere 'perfectly' three-dimensional for the electron.

10. Planck's Constant

The above analyses give the unique possibility to eliminate Planck's constant h as an independent natural constant.

The formula for the Planck distance is:

$$R_{\text{Planck}} = e^4 / 32\pi^2 M e \varepsilon_0^2 h c^3 \tag{12}$$

The classical radius or Compton–radius of the electron is:

$$R_c = \mu_0 e^2 / 4\pi M_e \tag{13}$$

We showed that the ratio between the Planck radius and the classical radius of the electron is 12^3.

$$R_c / R_{\text{Planck}} = 12^3 = 8\pi\varepsilon_0 h c / e^2$$
$$h = Rc / R_{\text{Planck}} \times e^2 / 8\pi\varepsilon_0 c = 12^3 e^2 / 8\pi\varepsilon_0 c \tag{14}$$

The theoretical value for Planck's (14) constant is h = 6.648982×10^{-34} [Js] while the empirical measured value is h = 6.626069×10^{-34} [Js].

The theoretical derived constant of Planck is a factor 1.003458 times the empirical value. The discrepancy is just 0.35%. Scientists claim that this formula for Planck's constant is merely a numerical approximation, not exact and therefore the formula is false!

11. The Deviation Between the Theoretical and the Empirical Values of h

Theoretical Physics endorsed the drag coefficient of Fresnel when the empirical 'confirmation' by Fizeau showed a deviation of 10%! Is the derived formula for Planck's constant false when the deviation is just 0.35%? Statistically, it is impossible to obtain by coincidence a formula for Planck's constant with just a deviation of 0.35%. Scientists should acknowledge that, and let the scientific debate determine whether the theory behind the derivation is acceptable or not. It is the task of the scientific community (not just editors and referees) to determine that.

Although this paper reveals more than enough arguments and evidence to justify publication without explaining the cited deviation of 0.35% I will indicate how the deviation can be explained.

The empirical value of h is obtained with the formula that describes the relation between the energy and the frequency of the photon; $E = h\nu$. The derivation of theoretical formula for the Planck distance (12) is based on this equation. Other formulas refer to particles with mass.

The photon propagates through space and does not distort tension-free ether. Masses, however, distort the surrounding ether. A nucleus, a charged mass, affects the stress free cubical orientated ether and shapes the surrounding space into a stresed spherical orientation. The stress free cubical orientated space contains more point-volumes or ether per volume than spherical-orientated ether surrounding the nucleus of an atom. The packing density of point-volumes in the spherical orientated space/ether around a nucleus therefore differs from the cubical tension-free ether packing density. (Figs, 2, 3 & 5).

When a nucleus polarizes the surrounding ether/space (electric field), the point-volumes are forced to orient into a spherical shape. The point-volumes surrounding a charged nucleus occupy more space. The experimentally determined constant of Planck and the formula for the Planck distance refer to physics of tension-free cubical-oriented ether. While deriving Planck's constant the difference between stress and stress-free ether is not mathematically addressed. The packing difference possibly explains the systematic deviation factor of 1.003458.

12. The Quantization of Physics by Means of the Quantum Distance

The above calculations and explanations are confusing. The link between QM and classical physics was buried deeply. We will tell the story again in words so all doubts may disappear.

Ref [4] proves without doubt that ether is scientifically much more likely than an absolutely empty space. The widely accepted field theories implicitly assume a vacuum that is ***not*** absolutely empty. So the assumption that vacuum is space filled with point-volumes is not scientifically impossible. The point-volumes supply the physical means to transfer the electromagnetic fields in vacuum according to natural constants ε_0 and μ_0.

When space is filled with point-volumes and there is no electric field; vacuum is 'stress-free'. A charge placed in vacuum polarizes the point-volumes and draws them to the charge Q. Space, vacuum, is not 'stress-free' anymore. The point-volumes obligatory orientate around $+Q$ into a bulb configuration because of the electrostatic force. The dimension of the point-volume determines the sequence of the distances at which perfect symmetric figures can be created.

At R_c two 'perfect' circles are created that defines the dimensions of the electron. The electron can orbit around the nucleus "resistant free" in the third Quantum Dimension at the Bohr radius in two tunnels and in the tunnels at the other 11 ionization levels until the Rydberg istance. Between the ionization levels the electron has to be deformed according to the imperfect dimensions of space in between. The deformation of the electron needs force/energy and therefore creates the energy traps at the ionization levels.

When an electron circles around a proton at distances greater than the Rydberg distance the electron and proton are moving in each others fourth quantum dimension. The quantum effects have become irrelevant when the radius of the orbiting electron R_e between proton and electron exceeds the Rydberg distance.

The electron must be deformed when it travels between the ionization levels. When the electron reaches a tunnel at an ionization level it will oscillate in the tunnel when it tries to penetrate the imperfect space around the tunnel; the electron will oscillate. When the electron emits a photon while captured, the overflow of kinetic energy is released; the energy of the electron is reduced to the quantified energy needed to perfectly circle the nucleus at that distance. The deformation of the electron requires force/energy and therefore creates the observed energy traps. The imperfection of space increases more and more when the electron approaches the Bohr distance; the first distance where 2 perfect bulb shell tunnels for the electron to orbit the nucleus are created.

The resonances of the perfect Bohr circle at the ionization levels $n = 2, 3, \ldots$ are 'safe heavens' for the electron in the imperfect space. When the electron is caught in the energy trap of one of the ionization levels, the overflowing kinetic energy is emitted.

Under normal conditions it is impossible for the electron to close in on the nucleus under the Bohr distance. The deformation of the electron is so severe that the required force to deform the electron is not available. The electron cannot close in on the nucleus under 'normal' conditions.

Discussion

We described the Hydrogen atom as an EM free rotator and found complete consistent formulas with QM. Scientists state that Bohr's atom model is invalid for atoms when the charge of the nucleus exceeds the charge of the positron ($Z > 1$) and that therefore the presented EM free rotator for atoms when $Z > 1$ must be invalid to.

The reason why Bohr's atomic model is not adequate to describe atoms when $Z > 1$ is that the formula for the (macroscopic) Coulomb force between two charges ($F = Q_1 Q_2 / 4\pi\varepsilon_0 r^2$) is only valid in describing the electrostatic force between charges in our macro-world. The Coulomb force is an in our macro-world experimental derived formula. The QM rules at subatomic levels are not relevant anymore in our macro world and for that reason the Coulomb-force formula is not valid at QM levels. At the subatomic (ionization) levels there is interference of the electrostatic fields of the positive charges in the nucleus. This interference disappears in the macro-world. The Coulomb force for the EM free rotator and Bohr's model should be:

$$F = Z^2 e^2 / 4\pi\varepsilon_0 R^2 \quad \text{or} \quad F = \frac{2^3 \pi \exp(1)}{12^3 / 2} \times \frac{Z^2 e^2}{\varepsilon_0 (n^2 R_B)^2} \quad (***)$$

Interference occurs at subatomic levels because the electrostatic fields of the protons in the nucleus seek a way out. Not all point-volumes around the nucleus are in touch (inhomogeneous space) so the resistance for electrostatic fields differs around the nucleus. The different fields of the protons in the nucleus follow the same low resistance 'route' in space (=interference).

The electrostatic field around a nucleus is not homogeneous. Interference of electrostatic fields at the subatomic level is expected, while in our three-dimensional world, space/vacuum is homogenous.

In general QM describes mathematically the physics at the molecular level and the sub-atomic level very well. This is so even when one realizes that the use of mathematical correction factors by QM is not uncommon. Despite the significance of the mathematical solutions QM offers, there is a serious flaw: the physics behind the QM math are not understood.

The perspective of science concerning vacuum is an absolutely empty space, although in Theoretical Physics the field theory is widely accepted, and contradicts at least philosophically the assumed absolutely empty space.

I request the reader to answer the following question: What is the chance that by coincidence the Rydberg distance is 12^3 times the Bohr radius, and that the Bohr radius is 12^3 times the Compton radius, and that the Compton radius is 12^3 times the Planck radius, and that at the same time the 12 atomic ionization levels of the atom are identified, Planck's constant eliminated as an independent natural constant, the origin of the mathematical constant e and π is located, and the mysterious aspects of molecular QM are answered?

Is it impossible that science erroneously concluded that vacuum is absolute empty space?

Complete mathematical and physical understanding of QM in the case of Bohr's atomic model can be achieved when we consider space filled with point-volumes with radius QD. The matrix of point-volumes filling up space around the nucleus is imperfect for electrons (R_c) at distances smaller than the Rydberg constant. The resonance of 12^3 QD in the 'matrix of space' from the Planck-distance to the Rydberg distance can be simulated mathematically. This simulation will show the 12-ionization levels of the electron orbiting around the nucleus. Many, many other quantum resonance distances between the QD and the Rydberg distance will be identified.

The reader should realize that the above shown relations between $R_r / R_B = R_B / R_c = R_c / QD = 12^3$ is the consequence of the three-dimensional properties of the electron. The electron circles around the nucleus, and the dimension of the electron determines the distances where space is 'perfect' for the electron. Should the electron have other dimensions than R_c the observed distances R_r and R_B would change accordingly.

The quantization of distance in the presented EM free rotator is completely consistent with the quantization of energy in QM. The solution is even much simpler because in QM every atom has its own energy quantizations while with the EM free rotator and the geometrical energy traps at the ionization levels; **the distance quantization for every atom is the same**.

The radii of nuclei are according to QM approximately 10^{-12} meter. The QM volume of nuclei contain therefore approximately 10^{18} point volumes. Theoretically any QED particle/process can be realized with the presence of 10^{18} point volumes. Dragged ether is consistent with any QM/QED (sub) nuclear process or particle discovered or calculated by Theoretical Physics. But despite the consistency of dragged ether with QM, scientists argue that dragged ether is violating QM/QED, and that the dragged ether theory must therefore be false!

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A Proposed Picture of our Universe

Present theories are based on the premise that we are in a universe of tiny particles we call 'electrons,' 'protons', 'photons' and the various other entities envisioned by modern physicists. It appears, however, that at least in the case of charged particles, the interactions between charges are much easier to understand if they are considered to take place in their fields where they involve a propagation at the velocity of light.

The importance of the fields is easily seen: imagine a very large pair of oppositely charged parallel conducting plates. Neglecting the fringing field, if one plane is pulled away from the other, the work done goes into the field newly between the plates; there is no change in the vicinity of the plates where the charges are. Since the fields dominate charge behavior, it is useful to think of the charges as fields, not as particles surrounded by fields.

concluded on p. 40

Sub-Quantum Physics 11: The N-Wave Photon, Particles, Transversality, & Polarization*

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Previous articles argue that the photon is a weak shock N-wave in the kinetic-fluid equivalent of Weinberg's hugely-dense space medium. Here we see photons *acting* transversely in all processes of photonic excitation or de-excitation, thus explaining the photon property of transversality. Simple inertial properties of an electron in the kinetic-fluid medium are invoked to show how the transverse action of an arriving N-wave photon causes oscillations in electron position in an antenna. Polarization can be attributed to N-wave photons if the wave cross-sections are blade-shaped rather than circular. This explanation is consistent with Malus' law and polarizations observed in molecular scattering of sunlight. The N-wave photon concept is seen as supplementary to, and not in lieu of, other theories of the makeup of the physical vacuum.

Key words: quantum, photon, physical vacuum, space medium*

1. Introduction

This is one article in the second phase of a research program that sees the Schrödinger wave function as an envelope of motion of a quantum particle under random bombardment from an underlying physical vacuum or space medium. Previous articles argue that the photon is a weak shock N-wave in the kinetic-fluid equivalent of Weinberg's hugely-dense space medium.

The Spin-Zero Photon Hypothesis

The N-wave photon is plausible if the photon has a spin angular momentum of zero. The first phase of research showed that the H-atom's 2P state consists of electron motions in essentially degenerate classical ellipses distributed symmetrically about a directional axis [1]. The 2P excited state was seen as a pair of axi-symmetric forward and backward lobes contending with each other in dynamic equilibrium, one a wave containing the electron, and the other a 'reaction wave' in the space medium that reflects the electron away from the nucleus each time it approaches in an essentially degenerate elliptical orbit. The notion of a reaction wave emerged from study of the first excited state of the oscillator [2]. Degenerate elliptical orbits obviously have no angular momentum, so the 2P state does not have orbital angular momentum, and no angular momentum can be carried away by the photon emitted when the 2P state decays to the 1S ground state. The Y_{10} spherical harmonic factor in the 2P wave function hence denotes 'orbital directionality' rather than 'orbital angular momentum'. This finding is termed the 'spin-zero photon hypothesis' [3]. Under this hypothesis, the photon is seen as merely a simple disturbance in the medium.

The Hugely-Dense Space Medium

The second phase of the research program argues that the photon is a weak shock N-wave in the space medium seen as hugely dense, like the Steven Weinberg [4] physical vacuum (space medium) with a mass-energy density equivalent to $3\times10^{112}\ \text{ergs}/\text{cm}^3$. Through the formula $E = mc^2$, this energy density equals a mass density of $33\times10^{90}\ \text{grams}/\text{cm}^3$. Appendix A describes the 'Maxwellian decompositions' of Schrödinger position probability densities discovered in the first research phase. The decompositions show that Schrödinger densities are super-positions of position probability densities of motions in appropriate classical (Newtonian) orbits [5]. This allows a perspective shift from Weinberg's traditional relativistic 'field picture' of the dense physical vacuum to that of 'mass picture' where the mass is a rest mass of a Newtonian medium in which the speed of sound is what we recognize as the speed of light.

Weak Shock N-Waves

Riemann and others established the physics of shock waves in the last half of the 1800's. Books by Courant [6] and by Hirschfelder [7] were used in the present research program.

Seeing the physical vacuum as a Newtonian compressible medium permits modeling the photon as a weak shock N-wave [8]. N-waves are familiar as the phenomena of 'sonic boom' that attends supersonic flight. In the compressible-medium approximation, the shock fronts have zero thickness.

An N-wave contains three sections: a leading shock front called the head shock, a trailing front called the tail shock, and a rarefaction wave of a given length connecting the two shocks. In the head shock, the pressure abruptly rises to a certain level above the pressure of the medium. In the rarefaction wave, the pressure gradually declines in two stages. In the first rarefaction stage, the pressure drops from head shock pressure to the pressure of the medium, and in the second rarefaction stage, the pressure drops from medium pressure to a lower pressure that is at the inlet of the tail shock. In the tail shock, the pressure abruptly rises back to atmospheric pressure. The 'wavelength' X of the N-wave is the distance between the front of the head shock and the back of the tail shock, seen at one instant of time. Under the compressible-medium approximation, the head and tail shocks are of zero thickness, and the wavelength corresponds to the length of the full rarefaction wave. Figure 1 gives time traces that show the structure of an N-wave.

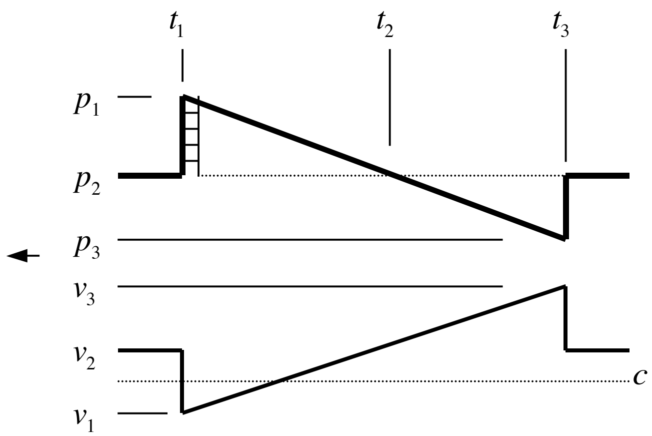

Figure 1. N-wave Pressure and velocity profiles over time.

An N-Wave Photon in a Compressible Medium

The momentum flux time integral (or 'impulse') I of the N-wave is the time integral of the overpressure, and the result is a quantity to the first power of the head and tail shock strengths. The energy flux time integral Q of the N-wave is a factor times the time integral of the square of the overpressure, and the result is a quantity to the second power of the shock strengths.

In dealing with the impulse, the first N-wave article [8] focuses on the quotient of the strength of the tail shock divided by the strength of the head shock. When this tail/head quotient lies in a certain range slightly less than 1.0, the negative impulse of the second rarefaction stage almost cancels the positive impulse of the first rarefaction stage, but does not quite do so. The net impulse is then a positive amount that is to the second order in the head shock strength. With an appropriate choice of the tail/head quotient, the ratio Q / I of the energy flux integral to net impulse is exactly the speed of sound c. In this case the N-wave has the exact inertial properties of a photon.

To complete the modeling of a photon as an N-wave, it is necessary to ascribe a particular cross sectional area D^2 to the photon, where D is the 'width' of the photon, and the same width will apply for all photon energies, that is, $E = QD^2$. When this is done, one can immediately solve for the shock strength δ that corresponds to a photon of given energy E and wavelength X through the identity:

$$EX = hc = \frac{1}{3} p_0 D^2 X^2 \delta^2 \equiv \frac{1}{3} p_0 B^2 \text{ where } B = DX\delta \equiv \text{constant} \quad (1)$$

where $p_0 = 3 \times 10^{-112}$ dynes / cm^2 and $B = 1.4 \times 10^{-64}$ cm^2.

Setting Choices of X and D

In the expression for B one must now choose appropriate reference values of the variables D and X that will permit a calculating a reference value of the shock strength. We choose as the reference wavelength $X_0 = 1.24 \times 10^{-18}$ cm, corresponding to a photon energy E_0 = 100 TeV, roughly the most energetic photon observed so far. We choose as the reference cross-section width $D_0 = 2 \times 10^{-14}$ cm, with an eye to covering the reach of the strong nuclear force. From the constancy of B, the resulting value of the reference shock strength is $d_0 = 8.1 \times 10^{-33}$.

Then, when one uses $X\delta = X_0\delta_0$, from the constancy of B and D_0, Eq. (1) yields the fact that for any energy E the energy is proportional to the shock strength:

$$E = (EX) / X = \left(\frac{1}{3} p_0 D_0 X_0 \delta_0 D_0 \right) X\delta \Big/ X = \left(\frac{1}{3} p_0 D_0{}^2 X_0 \delta_0 \right) \delta \quad . (2)$$

The N-Wave Photon in a Kinetic Medium

A second paper in the series [9] extends the theory to a kinetic medium consisting of tiny identical super-dense non-attracting hard sphere particles (which we can call 'ponderons'). The paper shows that transport properties then smear out the abrupt shock fronts of the N-wave and convert it into a single-cycle sinusoidal N-wave consisting of a positive half-wave followed by a negative half-wave of slightly smaller amplitude (see Fig. 2), such that again the energy divided by the momentum is just c, as required of a photon.

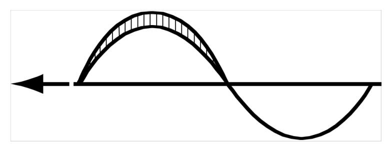

Figure 2 Pressure pulse of the single-cycle sinusoidal N-wave, showing pressure excess.

The physical process causing the smearing out is the proportionality between the thermal conductivity and the mean free path l of the particles making up the medium. The mean free path is in turn proportional to an occupancy volume ratio f times the diameter σ_p of a ponderon. When the free volume to ponderon volume ratio f is 30, the ponderon diameter relates to the reference wavelength and reference shock strength by the formula $\sigma_p = X_0\delta_0 / 20$.

Table 1

hc	erg-cm	199×10^{-18}
ρ_0	g / cm^3	33×10^{90}
p_0	dyne / cm^2	3×10^{112}
D_0	cm	2×10^{-14}
X_0	cm	1.24×10^{-18}
δ_0		8.1×10^{-33}
l	cm	1.8×10^{-51}
σ_p	cm	5×10^{-52}
$V_p = (\pi / 6)\sigma_p^3$	cm^3	69×10^{-156}
$\rho_p = 30 \times 33 \times 10^{90}$	g / cm^3	10^{93}
m_p	g	68×10^{-63}
$e_p = m_p c^2$	erg	61×10^{-42}
e_p	eV	38×10^{-30}

Table 1 lists the resulting properties we have selected for the photons and the ponderons. The subscript p denotes a ponderon property.

N-Wave Photon Compatible With Special Relativity

The third paper in the series enumerates proofs that the N-wave photon is compatible with special relativity [10]. **1)** The photon has the correct relativistic linear relation between the momentum and the energy. **2)** Since Lorentz transformations are transitive, it is always possible to make a two-step Lorentz transformation between two arbitrary initial and final reference frames: first from the initial to the absolute frame at rest in the medium, and second from the absolute frame to the final frame; hence the existence of an absolute frame is compatible. **3)** Seen from the absolute frame, a 'light-pulse clock' in a moving frame will slow down because the light pulse's transverse path out and back will be longer than if the clock were at rest. **4)** Seen from the absolute frame, a classical Doppler shift will be suffered by a photon overtaking a moving object, since it will deliver its momentum and energy to the object over a longer period than to an object at rest; an observer in the rest frame then notes that an observer on the moving object will see the arriving photon's energy change slightly offset because of the slower clocks on the moving object; the overall Doppler effect seen by the moving observer will be precisely that predicted by special relativity. **5)** Under conditions when separated clocks are synchronized by Einstein's light-signal protocol, even if an observer happened to be at rest in the absolute frame, he would not be able to know it.

The N-wave photon hypothesis thus passes the plausibility hurdles of displaying photon inertial properties and satisfying special relativity. Now it will be shown how the hypothesis can explain transversality and polarization phenomena.

2. Photons Act Transversely

In the kinetic medium picture described here, the N-wave photon itself does not have any transverse property. But it is postulated that photons *act* transversely in all processes of photonic excitation or de-excitation It is shown below how such action can produce transverse effects.

Transverse Action Explains Transverse Waves

In the customary electromagnetic field picture of light, the fields are assumed to be transverse to the propagation direction. But the assumption of transverse actions is just as reasonable as the traditional field postulate of a transverse wave.

The issue relates to what happens in a photonic excitation or de-excitation. In the view mentioned earlier here, the hydrogen-atom 2P excited state consists of a pair of axisymmetric forward and backward lobes, one a wave containing the electron, and the other a 'reaction wave' in the space medium that reflects the electron away from the nucleus each time it approaches in an essentially degenerate elliptical orbit. A logical model for the de-excitation process is the collapse of the two lobes into 'pancakes' and the ejection of an N-wave photon away from the axis in some direction in the plane between them. This ejection would thus be transverse to the axis of the previously existing two lobes.

Inertial Properties of Particles

Simple inertial properties of an electron in the kinetic-fluid medium can be modeled with an eye to explaining transverse action of photons. The simplest model of an electron is a sphere. (Appendix B models a ring-shaped electron). For a spherical model of the electron, one can assign it the same density as the surrounding medium (it is an 'ice cube' in the medium). The resulting inertial properties of an electron (denoted by subscript e) are as follows:

Table 2.

Mass M_e	g	9.11×10^{-28}
Density ρ_e	$\mathrm{g / cm^3}$	33×10^{90}
Volume $\Omega_e = M_e / \rho_e$	$\mathrm{cm^3}$	27.6×10^{-120}
Diameter $D_e = (6\Omega_e / \pi)^{1/3}$	cm	3.75×10^{-40}

It should be mentioned that the viscosity of the kinetic medium is 8×10^{50} g/cm-sec (poise). Such a viscosity will bind the electron very tightly to the motion of the immediately surrounding medium.

Electric charge is a property that is assumed to be acting.

Transverse Action Explains a Radio Antenna

Consider an antenna with free electrons on its outer skin. The electrons are assumed to space themselves evenly in such a way that the voltage is uniform along the antenna. Suppose an N-wave photon arrives at a point of an antenna that is not the exact center. The N-wave produces temporary unbalance of pressure on the particles. It pushes particles away during the N-wave positive-pressure pulse, and draws them near during the negative-pressure pulse. When the period of the N-wave matches the antenna's period of oscillation, the photon is absorbed.

It should be clear that this picture requires a transverse direction of arrival of the photon. If the photon arrived almost parallel to the antenna, it would excite electron motion in the circumferential direction, and not along the length of the antenna.

Polarization From Blade-Shaped N-Wave Cross-Sections

Polarization can be attributed to N-wave photons if the wave cross-sections are blade-shaped rather than circular. As will be soon shown, this explanation is consistent with Malus' law and with polarizations observed in molecular scattering of sunlight.

Rather than having a shape that is circular, a photon's cross-section is postulated to have a shape that is roughly rectangular, broad in one transverse direction (its measure is the 'breadth') and thin in the perpendicular transverse direction (its measure is the 'thickness'). The photon cross-sectional area is the product of the breadth and the thickness. We conjecture that the ratio of breadth to thickness, the 'aspect ratio', is the same for all photons, just as is the cross-sectional area. Numerical values consistent with the kinetic medium tabulated earlier are a breadth of 10^{-13} cm (the reach of the strong force [11]), a thickness of 4×10^{-15} cm, a cross-sectional area of $(2\times10^{-14}\ \mathrm{cm})^2$, and an aspect ratio of 25.

Next it is postulated that one of the two transverse directions constitutes a property that can be called 'orientation', which is essentially the same as the macroscopic field-picture expression 'the direction of the electric vector'. When the orientation is directed along an antenna, a radio frequency photon can be absorbed. Photons with orientations that are perpendicular to the antenna will not be absorbed. Absorptions of photons with orientations at angles in between are presumed to depend on details of electron relative positions at the point of photon arrival at the antenna surface, but absorptions are more likely if the orientation is closer to the direction of the antenna.

An assumption coherent with macroscopic polarization data is that the photon-absorption probability is proportional to $\cos^2\theta$, the square of the cosine of the angle θ between the photon orientation and the direction of the antenna.

The $\cos^2\theta$ assumption easily explains the behavior of a polaroid ('dichroic') medium [12]. In such a medium, one direction (the 'absorption direction') acts like the direction of an absorbing antenna. When illuminated by light consisting of photons uniformly distributed as to their orientation (natural light), the polaroid medium absorbs a photon with probability $\cos^2\theta$, where θ is the angle between the absorption direction and the photon orientation. In contrast, the medium does not absorb (and hence transmits) a photon with probability $1-\cos^2\theta$. The transmitted photons from natural light are then distributed with probability $\cos^2\psi$ where ψ is the angle between the photon orientation and the 'transmission direction' (the direction perpendicular to the polaroid absorption direction). This explains Malus' law for the observed $\cos^2\psi$ drop-off of transmitted intensity with angle ψ from the transmission direction [13]. Also, it explains how a polaroid material absorbs 50 percent of natural light and transmits 50 percent [14].

We can now explain observed polarization of light scattered from air molecules in the sky. Un-polarized sunlight moves in the z direction and is incident on an air molecule at some point in the sky. Because photons act in a transverse way, an incident photon will set the charges in the molecule into motion so that they act as antenna vibrating in some direction (say the x direction) in the transverse $x-y$ plane. In this process the photon will be absorbed and re-emitted in the y direction down to an observer on the ground. Light arriving at the ground is linearly polarized in the x direction (parallel to the direction of the antenna's length and perpendicular to the direction of arrival) [15].

3. N-Wave Photon Supplements Other Theory

The N-wave photon concept should be seen as supplementary to, and not in lieu of, other theories of the makeup of the physical vacuum.

Quantum field theory and string theory are both in fact theories of the physical vacuum. These theories aim principally to account for elementary particles and the forces between them, in terms of symmetry rules and processes that go on in the physical vacuum. Both these theories were constructed so as to be consistent with the combination of quantum wave mechanics plus special relativity.

The N-wave photon has been shown in this and previous papers to be not only equally consistent with both wave mechanics and special relativity, but also to explain them at a deeper level. The N-wave photon concept shows how wave mechanics and special relativity emerge from a 'Newtonian substrate' model of the vacuum. Thus the N-wave photon concept explains Planck's constant of action in terms of the size of the model's smallest particle of matter (the ponderon), and explains how an absolute rest frame can at the same time support special relativity. However, the N-wave photon theory here does not conflict in any way nor negate in any way the findings of field or string theories. It is supplementary to them.

Because the conceptual Newtonian substrate is made up of a multiplicity of tiny particles, such a substrate exhibits the characteristic of 'granularity'. The 'field' methodologies of wave mechanics, quantum field theory, and string theory are precisely such as to ignore any granularity in the medium at levels smaller than the dimensions of the smallest wave. In this sense these theories represent what engineers call 'black box' approaches to the examination of physical phenomena. In all previous progress in science and technology, black-box theories provided frameworks for (and demand for) searches for physical explanations at deeper levels. Such a demand certainly motivated the author's search that led to the concept of the N-wave photon to explain the puzzles of the wave-particle duality implied by the quantum uncertainty principle and the apparent absence of any fixed absolute frame implied by special relativity.

The human mind is only able to fix its attention on one aspect of the world at any instant of time, and so it should not surprise us that we can distinguish a multiplicity of facets about any physical thing in the world that falls under our consideration. Consequently, it is eminently reasonable to enlarge the current perspective of physics to include an additional way to view nature at the deepest levels, as long as the new way passes all the hurdles of coherence with previous well-established facts.

It is appropriate finally then to enumerate the ways in which the N-wave photon is coherent with established facts about the nature and behavior of photons. Starting with properties already addressed in this series of papers, first, the N-wave photon exhibits the known inverse relationship between photon energy and wavelength. Second, it exhibits the photon's linear relation between momentum and energy. Third it exhibits the correct photon Doppler shift between frames as seen in special relativity. Fourth, transversality can be attributed to the N-wave photon by positing that photons act transversely. Fifth, polarization phenomena can be explained by the hypothesis that the photon cross section is not circular, and that one of the breadth and thickness directions is an 'orientation' that determines absorption or transmission.

Next, consider sixth and seventh properties not so far mentioned in this paper. The sixth property is that velocities of N-wave photons of all energies will be measured to be essentially the speed of light c. Any overage will always be below the threshold of observability. This is because for weak shock waves such as in the N-wave photon, the shock strength δ (the fractional pressure overage) is equal to the fractional velocity overage. As cited in earlier articles, it is currently thought impossible to detect fractional velocity overages as small as 10^{-20}. Also, up to now no photons with energies much exceeding 100 TeV (10^{-14} eV) have been detected. In this article, a 100 TeV photon is assigned a fractional velocity overage of 8.1×10^{-33}. On this scale, even a hypothetical 'Planck photon' of energy 1.22×10^{23} eV would have a probably imperceptible fractional velocity overage of 10^{-18}. The seventh property is that N-wave photons can superpose on each other, because they involve weak shock waves, which have this property. Superposition is a well-recognized property of photons.

The above-discussed Newtonian substrate model of the vacuum offers fundamental physics a degree of continuity with classical physics that it has not enjoyed for the most part of a century. Compellingly attractive should be the prospect of announcing that one need no longer fear the intellectually shocking apparent paradoxes of special relativity and the quantum uncertainty. We make them intelligible simply by recognizing that mc^2 can also be written $\frac{1}{2}\cdot m\cdot v_{\mathrm{rms}}^2$, where v_{rms} is the root mean square velocity of the new unit of granularity, the ponderon [16].

Appendix A: The Maxwellian Decomposition

Figure 3 shows the Maxwellian decomposition for the simple harmonic oscillator ground state. To prove the identity we convert the integral into a definite integral by changing the variable of integration from z to $w=z^2-x^2$, noting that $dw=2zdz$, substituting $z^2=w+x^2$ in the exponential, bringing a resulting $\exp(-x^2)$ factor outside of the integral sign, and recognizing the remaining definite integral as $\Gamma(1/2)$.

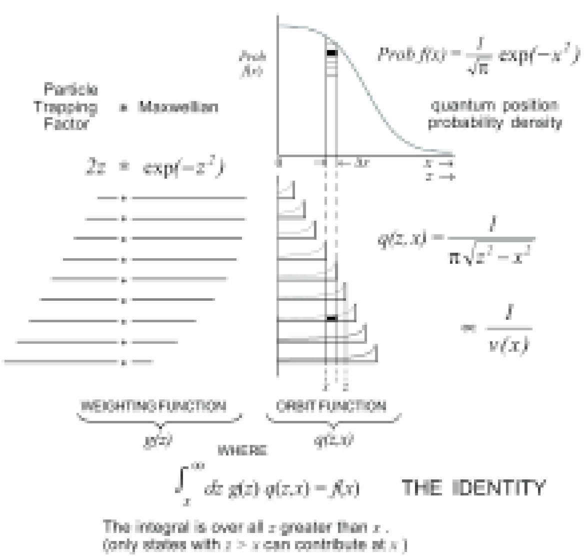

Figure 3. The Maxwellian decomposition.

Appendix B: Dimensions of a Ring Electron

Using the same mass density as for the 'spherical' electron, we can find the dimensions of a particle that consists of a ring of electron mass M_e rotating at the speed of light c and has spin angular momentum of $h/2$. The radius R_e is $h/(2cM_e)=$ $(1.05\times10^{-27}\ \text{g-cm}^2/\text{sec})/[(2\cdot3\times10^{10}\ \text{cm/sec})(9.1\times10^{-28}\,\text{g})]$, or $2\times10^{-11}\,\text{cm}$. The ring volume is Ω_r. The thickness of the ring

$$T_r=[(4\Omega_e/\pi)\cdot(2\pi R_r)]^{1/2}=$$

$$[(4\cdot28\cdot10^{-120}\,\text{cm}^3)/(2\pi^2\cdot20\times10^{-12}\,\text{cm})]^{1/2}=0.53\times10^{-54}\,\text{cm}\quad.$$

Acknowledgement

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The Magnetic and Faraday Fields as Planck Vacuum Responses

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The electric and magnetic fields of an elementary charge are universally associated with the charge as that charge moves through the void of the classical vacuum. The present paper, however, makes the four-fold argument that: **1)** the Planck vacuum (PV), as opposed to the classical vacuum, is polarizable; **2)** the only field associated with the charge is a bare, or unscreened, Coulomb field; **3)** the magnetic and Faraday fields are PV responses to charge movement; and **4)** the Maxwell equations owe their existence to PV polarizability. The Lorentz transformation can be deduced from the results. **Keywords:** bare charge, Faraday field, fine structure constant, Lorentz transformation, magnetic field, Planck vacuum, vacuum polarization.

1. Introduction

The relativistic electric and magnetic fields of an elementary charge traveling at a uniform relative velocity $\beta=v/c<1$ can be expressed as [1]

$$\mathbf{E} = \frac{\mathbf{E}_c / \gamma^2}{(1-\beta^2 \sin^2 \theta)^{3/2}} \quad \text{where} \quad E_c = 3\mathbf{r} / r^2 \tag{1}$$

and

$$\mathbf{B} = \vec{\beta} \times \mathbf{E} \tag{2}$$

where e is the observed electronic charge; $\mathbf{E}_c$ is the Coulomb field of the charge; θ is the angle between the charge velocity and the field point; $\gamma^2 = 1/(1-\beta^2)$; and $\mathbf{r}$ is the radius vector from the charge to the field point. The total electric field in (1) can be expressed as $\mathbf{E} = \mathbf{E}_{cr} + \vec{\psi}$, where $\mathbf{E}_{cr}$ is curl-less and reduces to the Coulomb field of the charge in the non-relativistic limit; and where $\vec{\psi}$ is the Faraday field. In classical electrodynamics, these fields are associated with the charge as it travels through the classical vacuum of an assumed, empty space.

The present paper makes the following arguments: 1) that the PV is a polarizable medium with an effective dielectric constant $\varepsilon = 1/\sqrt{\alpha}$, where α is the fine structure constant [2]; 2) that the only field properly associated with the particle is the bare, or unscreened, Coulomb field e_* / r^2, where e_* is the bare (true) electronic charge [2]; 3) that the magnetic and Faraday fields $\mathbf{B}$ and $\vec{\psi}$ are vacuum responses to the movement of free, bare charge; and finally, 4) that the Maxwell equations owe their existence to the polarizability of the PV.

The charged elementary particles are characterized by the triad (e_*, m, r_c) in the PV theory of the vacuum state [2], where the parameters m and r_c are the particle mass and Compton radius which are related to the bare charge e_* by the Compton relation $r_c mc^2 = e_*^2$. The bare Coulomb field of the particle is $e_*\mathbf{r} / r^3$ which, as the PV is polarizable, is observed in the laboratory as the Coulomb field $\mathbf{E}_c = e\mathbf{r} / r^3$.

The vacuum polarization remains radially symmetric about the bare charge when the charge is in uniform motion. This effect causes the polarization vector at each point within the vacuum to rotate in order to maintain that radial symmetry, producing a variable magnetic field element in the process. This changing field element in turn induces a Faraday field element which induces another magnetic field element and so on *ad infinitum*, the collection of field elements leading to the relativistic $\mathbf{E}$ and $\mathbf{B}$ fields of the first paragraph. The derivation of these total fields is due to Pemper [3] and is presented in brief form in Section 3 after calculating the first magnetic field element in Section 2. The PV and the Pemper theories are complimentary, and lead to a complete picture of how the fields of the moving charge emerge from the vacuum.

Section 4 derives the magnetic permittivity for the PV, and the Summary and Comments Section 5 closes the paper.

2. Elemental Magnetic Field}

The Coulomb field of a charged particle as observed in the laboratory is [2]

$$\mathbf{E}_c = e\mathbf{r} / r^3 = \sqrt{\alpha}\; e_*\mathbf{r} / r^3 \tag{3}$$

where the polarization of the PV, manifested by the square root of the fine structure constant, changes the bare Coulomb field of the particle $e_*\mathbf{r} / r^3$ into the observed Coulomb field $e\,\mathbf{r} / r^3$. The effective dielectric constant of the vacuum is thus $\varepsilon = 1/\sqrt{\alpha} = e_* / e \approx 12$.

The electric susceptibility [1] of the vacuum is $\chi_e = (\varepsilon - 1)/4\pi = (e_* - e)/4\pi e$, giving a dipole moment per-unit-volume equal to

$$\mathbf{P} = \chi_e \mathbf{E}_c = (e_* - e)\mathbf{r} / 4\pi r^3 \quad . \tag{4}$$

The 'graininess' of the PV is of the order of the Planck-particle (PP) Compton radius $r_* = L^*$ [2], where L^* is the Planck length [4]; so the vacuum appears to be smooth for all classical and quantum mechanical calculations and (4) is, effectively, a continuous function of position.

The magnetic field is explained in terms of a rotation of the vacuum polarization (4) in Fig. 1, where the bare charge e_* is propagating in the z direction with a uniform speed υ. The field point is located at (r,θ) which is $(b,0)$ in the coordinate frame of the Figure. The polarization $\mathbf{P}$ is the result of the creation of numerous differential dipoles of moment $\mathbf{p}$ by the bare Coulomb field $e_*\mathbf{r}/r^3$, the average $<\mathbf{p}>$ pointing in the field direction. The polarization is $\mathbf{P} = N, <\mathbf{p}>$ [1] in a differential volume around the field point, where N is the number of dipoles per-unit-volume. It is clear from the figure that the polarization $\mathbf{P}$ and the corresponding dipole moments $<\mathbf{p}>$ rotate around the field point with the instantaneous velocity $r\omega$ due to the movement of the bare charge e_*. The angular rotation rate from the Figure is $= \upsilon\sin\theta/r$ with a period equal to $T = 2\pi/\omega = 2\pi r/\upsilon\sin\theta$.

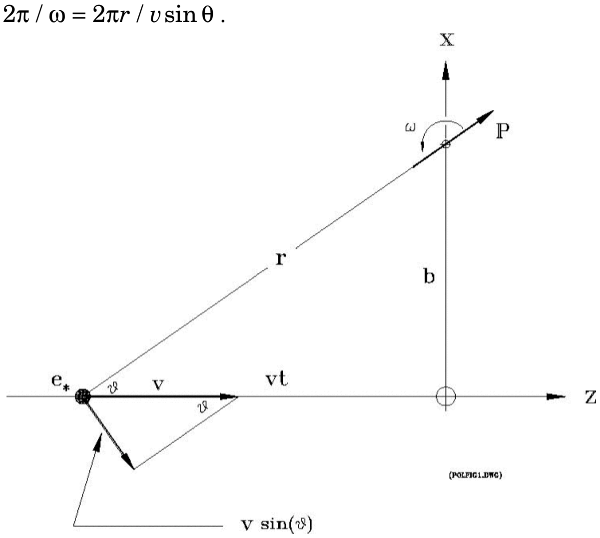

Figure 1. The effect of a bare charge e_* moving at a uniform velocity $\mathbf{v}$ through the laboratory reference frame (the field point is at $(b,0)$) is to produce a rotating polarization vector $\mathbf{P}$ whose instantaneous, angular rotation rate is $\omega = \upsilon\sin\theta/r$. As $\mathbf{P} \propto (e_* - e)$, the existence of the polarization vector depends on the fact that the fine structure constant $\alpha = e^2/e_*^2 \neq 1$, which is a manifestation of the polarizability of the PV. The particle and laboratory frames coincide at $t = 0$ ($t < 0$ in the Figure).

If a is the effective length of the dipole, then the effective charge is $e_d = |<\mathbf{p}>|/a$. The current corresponding to the rotating dipoles is thus $i = Ne_d/T$ and leads to a magnetic field at the center of the instantaneous current loop at (r,θ) of [1]

$$\mathbf{B}(\mathbf{r},\theta) = \frac{2\pi i}{ca}\vec{\varphi} = \frac{2\pi i}{ca}\frac{Ne_d}{T}\vec{\varphi} = \frac{\beta\sin\theta}{a^2 r}N|<\mathbf{p}>|\vec{\varphi} \tag{5}$$

where c is the speed of light and $\vec{\varphi}$ is a unit vector in the azimuthal direction about the z-axis. This calculation shows the induced magnetic field at (r,θ) to be proportional to the relative velocity $\beta\sin\theta$ resulting from the lever-arm velocity $\upsilon\sin\theta$ in the Figure.

The polarization is proportional to the Coulomb field (3) and, from (5), to the relative lever-arm velocity $\upsilon\sin\theta$. Thus the elemental magnetic field $\mathbf{B}_1$ of the moving charge is proportional to the product of the two (field and velocity),

$$\mathbf{B}_1 = 1 \bullet \left(\sqrt{\alpha}\,\frac{e_*}{r^2}\vec{\varphi}\right) \bullet \beta\sin\theta = \vec{\beta}\times\mathbf{E}_c \tag{6}$$

where the proportionality constant is taken to be 1, consistent with the experimental evidence. The subscript on the magnetic field anticipates the derivation of the first-step Faraday field in the next Section.

3. Total E and B Fields

The Pemper derivation [3] of the total electromagnetic fields employs the Galilean (rather than the Lorentz) transformation to derive (1) and (2). The derivation involves an iterative feedback process taking place at each point in the vacuum that instantaneously builds up the total fields step by step from the initial magnetic field element $\mathbf{B}_1$ derived in the previous Section. The Pemper derivation in brief form is presented below, as [3] cannot be found in most college libraries.

The build up begins with a uniformly moving charge and its Coulomb field (3) generating the first-step magnetic field in (6); with the first-step contribution to the total electric field coming from Faraday's law

$$\nabla\times\mathbf{E}_1 = -\frac{1}{c}\partial\mathbf{B}_1/\partial t \tag{7}$$

which reduces to

$$\frac{1}{r}\partial\mathbf{E}_1/\partial\theta = -\frac{1}{c}\partial\mathbf{B}_1/\partial t \tag{8}$$

The charge in Figure 1 travels in the z-direction with speed υ from which the first-step magnetic field of (6) can be expressed as

$$\mathbf{B}_1 = \frac{eb\beta}{r^3}\vec{\varphi} = \frac{eb\beta}{(b^2+\upsilon^2t^2)^{3/2}}\vec{\varphi} \tag{9}$$

using the Galilean transformation. Taking the time derivative of (9), substituting $b/r = \sin\theta$, and integrating over θ in (8) from zero to θ leads to the first-step electric field

$$\mathbf{E}_1 = \left(\tfrac{3}{2}\beta^2\sin^2\theta - \lambda_1\right)\mathbf{E}_c \tag{10}$$

where λ_1 is an integration constant.

The second step in the build up begins with

$$\mathbf{B}_2 = \vec{\beta}\times\mathbf{E}_1 \quad \text{where} \quad B_2 = \tfrac{3}{2}eb^3\beta^3/r^5 - \lambda_1\, eb\beta/r^3 \tag{11}$$

is the magnitude of $\mathbf{B}_2$ in terms of the parameters of Fig. 1. Repeating the calculation leading from (6) to (10) yields the second-step electric field

$$\mathbf{E}_2 = \left[\tfrac{3\bullet 5}{2\bullet 4}\beta^4 \sin^4\theta - \lambda_1\left(\tfrac{3}{2}\beta \sin^2\theta\right) - \lambda_2\right]\mathbf{E}_c \qquad (12)$$

where λ_2 is the second-step integration constant. Recycling the process *ad infinitum* leads to the total field magnitude in the radial direction given by:

$$E = E_c + E_1 + E_2 + E_3 + ... \qquad (13)$$

or

$$= E_c + \left[\tfrac{3}{2}\beta^2 \sin^2\theta - \lambda_1\right]E_c$$
$$+\left[\tfrac{3\bullet 5}{2\bullet 4}\beta^4 \sin^4\theta - \lambda_1 \tfrac{3}{2}\beta^2 \sin^2\theta - \lambda_2\right]E_c + \qquad (14)$$
$$\left[\tfrac{3\bullet 5\bullet 7}{2\bullet 4\bullet 6}\beta^6 \sin^6\theta - \lambda_1 \tfrac{3\bullet 5}{2\bullet 4}\beta^4 \sin^4\theta - \lambda_2 \tfrac{3}{2}\beta^2 \sin^2\theta - \lambda_3\right]E_c + ..$$

or

$$E = \left[1 + \tfrac{3}{2}\beta^2 \sin^2\theta + \tfrac{3\bullet 5}{2\bullet 4}\beta^4 \sin^4\theta + \tfrac{3\bullet 5\bullet 7}{2\bullet 4\bullet 6}\beta^6 \sin^6\theta + ...\right]E_c$$
$$-\lambda_1\left[1 + \tfrac{3}{2}\beta^2 \sin^2\theta + \tfrac{3\bullet 5}{2\bullet 4}\beta^4 \sin^4\theta + \tfrac{3\bullet 5\bullet 7}{2\bullet 4\bullet 6}\beta^6 \sin^6\theta + ...\right]E_c \qquad (15)$$
$$-\lambda_2\left[1 + \tfrac{3}{2}\beta^2 \sin^2\theta + \tfrac{3\bullet 5}{2\bullet 4}\beta^4 \sin^4\theta + \tfrac{3\bullet 5\bullet 7}{2\bullet 4\bullet 6}\beta^6 \sin^6\theta + ...\right]E_c$$

or

$$E = (1-\lambda)E_c \Big/ (1-\beta^2 \sin^2\theta)^{3/2} \qquad (15)$$

The expression in the first bracket of (14) is recognized as the first-step electric field (10), the next two brackets containing the second- and third-step fields respectively. Equation (15) consists of a rearrangement of the terms in (14), where the constants from λ_1 to λ_3 have been isolated. The infinite sums in the brackets of (15) are all the same, and reduce to $1/(1-\beta^2\sin^2\theta)^{3/2}$. The terms in (15) are collected and reduce Eq. (15) to Eq. (16), where the constant λ is given by the sum of the separate constants:

$$\lambda \equiv \sum_{i=1}^{\infty} \lambda_i \quad , \qquad (17)$$

Finally, the constant λ can be evaluated from the conservation of electric flux, which follows from Gauss' law for the true electronic charge e_*:

$$\int \mathbf{D}\bullet d\mathbf{S} = 4\pi e_* \rightarrow \int \mathbf{E}\bullet d\mathbf{S} = 4\pi e \qquad (18)$$

where $d\mathbf{S}$ is taken over any closed Gaussian surface surrounding the bare charge, and where $\mathbf{D} = \varepsilon\mathbf{E} = (e_*/e)\mathbf{E}$ was used to bridge the arrow. Inserting (16) into the second equation of (18) and integrating yields

$$\lambda = \beta^2 \qquad (19)$$

which leads from (16) to the relativistic field Eq. (1) from which the final magnetic field (2) follows from $\vec{\beta} \times \mathbf{E}$.

The conservation of electric flux expressed by the second equation of (18) was assumed as a postulate in [3]. The first equation shows that the postulate follows from Gauss' law and the conservation of bare charge.

Vacuum Permeability

The electric permittivity ε (dielectric constant) and magnetic permittivity μ (permeability) are both equal to unity in the classical vacuum where the observed electronic charge is e. In the polarizable PV where the true electronic charge is e_*, however, the effective electric permittivity is $\varepsilon = e_*/e = 1\big/\sqrt{\alpha} \approx 12$ where α is the fine structure constant. The purpose of this section is to find the corresponding effective magnetic permittivity.

The plane-wave equation for the cartesian components $u(\mathbf{r},t)$ of the electromagnetic fields in an unbounded, uniform and isotropic dielectric medium is [1]

$$\nabla^2 u(\mathbf{r},t) - \frac{\mu\varepsilon}{c^2}\frac{\partial^2}{\partial t^2}u(\mathbf{r},t) = 0 \qquad (20)$$

where c is the speed of light. The plane-wave solution $u(\mathbf{r},t)$ to this equation travels with speed $v = c\big/\sqrt{\mu\varepsilon}$. In the classical vacuum $\mu = 1$ and $\varepsilon = 1$; so $\mu\varepsilon = 1$, and the wave propagates at the speed of light ($v = c$).

The field components must also propagate at the speed of light in the PV model, where the effective electric permittivity is $\varepsilon = e_*/e$. Thus $\mu\varepsilon = 1$ leads to

$$\mu = \frac{1}{\varepsilon} = \frac{e}{e_*} = \sqrt{\alpha} \approx 0.085 \qquad (21)$$

and the fact that the PV is diamagnetic ($\mu < 1$) [1].

5. Summary and Comments

The PV [2] and Pemper [3] vacuum models are complementary and together provide a complete picture of the origin of the relativistic field equations (1) and (2), suggesting that the Maxwell equations arise from the polarizability of the vacuum and the Pemper feedback cycle. Furthermore, as (1) and (2) are Lorentz covariant [1] and were derived using the Galilean transformation, these results can be used to deduce the Lorentz transformation from a Galilean foundation. In effect, the Lorentz transformation is an ingenious artifact for avoiding the complicated polarization/feedback dynamics of the PV when performing relativistic calculations.

Using the retarded electromagnetic potentials [5], the relativistic electric field in (1) can be expressed in the form $\mathbf{E} = \mathbf{E}_{cr} + \bar{\psi}$, where (in the $y = 0$ plane)

$$\mathbf{E}_{cr} = \frac{(1-\beta^2)\hat{\mathbf{x}} + (z - vt)\hat{\mathbf{z}}}{[x^2(1-\beta^2) + (z-vt)^2]^{3/2}} = \frac{\sqrt{\alpha}(\hat{\mathbf{r}} - \beta^2 \sin\theta\hat{\mathbf{x}})}{(1-\beta^2\sin^2\theta)^{3/2}}\left(\frac{e_*}{r^2}\right) \qquad (22)$$

and

$$\vec{\psi} = -\frac{e\beta^2(z - vt)\hat{\mathbf{z}}}{[x^2(1-\beta^2)+(z-vt)^2]^{3/2}} = \frac{\sqrt{\alpha}\ \beta^2 \cos\theta\ \hat{\mathbf{z}}}{(1-\beta^2\sin^2\theta)^{3/2}}\left(\frac{e_*}{r^2}\right) \quad (23)$$

and where $\mathbf{E}_{cr}$ is the curl-less ($\nabla\times\mathbf{E}_{cr}=0$) component of $\mathbf{E}$, and $\vec{\psi}$ is again the Faraday field. The magnetic field is given by $\mathbf{B}=\vec{\beta}\times\mathbf{E}_{cr}$ because the cross-product of $\vec{\beta}$ and $\vec{\psi}$ vanishes because $\vec{\beta}$ and $\vec{\psi}$ are parallel.

The bare Coulomb field $e_*\mathbf{r}/r^3$ of the charge e_* is distorted into (22) by the vacuum polarization and the Pemper feedback cycle (Sections 2 and 3), both of which are also responsible for the additional fields $\mathbf{B}$ and $\vec{\psi}$. Without the vacuum polarizability, the magnetic field $\mathbf{B}$ could not exist, there would be no Faraday field $\vec{\psi}$, and there would be no Maxwell equations.

Although the effective electric and magnetic permittivities $\varepsilon = 1/\mu = e_*/e$ defined in Sections 2 and 4 are not directly observable, they are just as real as the fine structure constant $\alpha = e^2/e_*^2$. They differ from the standard definitions ($\varepsilon = 1/\mu = 1$) because they view the vacuum from the perspective of the bare charge e_* rather than the screened, or observed electronic charge e. The standard permittivities are related to the PV [2,6] through the relations

$$\varepsilon = 1/\mu = e_*^2/r_*m_*c^2 = e_*^2/r_cmc^2 = 1 \quad (24)$$

where r_* and m_* are the Compton radius and mass of the PP (e_*, m_*, r_*), and r_c and m are the Compton radius and the mass of the observed elementary particles (e_*, m, r_c); and where $r_*m_* = r_cm = e_*^2/c^2 = \hbar/c$ are the corresponding Compton relations [2] and $\hbar$ is Planck's constant.

References

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[3] T.G. Barnes, **Physics of the Future: A Classical Unification of Physics** (Institute for Creation Research, California, 1983).

[4] C.W. Misner, K.S. Throne, and J.A. Wheeler, **Gravitation** (W.H. Freeman and Co., San Francisco, 1973).

[5] Equations (14.6) and Figure 14.2 in Chapter 14 of [1] were used to perform the calculations.

[6] W.C. Daywitt, "A Model for Davies' Universal Superforce", Galilean Electrodynamics **17**, 83-87 (2006). In this reference, the PP and the PV are referred to, respectively, as the 'super-particle' and 'super-particle vacuum'.

Correspondence

A Proposed Picture of our Universe (Cont. from p. 31)

If the fields are pictured as a gas made up of a myriad of subatomic particles that have, somehow, been stabilized to yield an inverse square relationship, that would explain the utility of the Monte-Carlo method of solving electrostatic potential problems, and if, in addition, they are assumed to have an intrinsic random propagation at an effective speed equal to the speed of light, that would explain the applicability in quantum electrodynamics of 'photons' to their study. As shown by the author, the concept also provides a basis for showing that the Lorentz transform can be represented as an orthogonal conical transformation and for deriving the properties of the magnetic field. The x term in the Lorentz time transform, missing from the Minkowski diagram, appears naturally in the conical transformation.

If the mass of a charge is made up of these particles, it would suggest that all mass involves the speed of light, thereby providing a reason for that speed appearing in the mass/energy relationship, and validating the idea that photons have mass; general relativity would not be needed.

From the author's point of view, the various particles formed when the principal particles break up are merely temporary groupings of the field that form during certain events.

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The Copenhagen Saga (a poem dedicated to Christine)

So it happened here on earth
A rare gift came from Santa
Copenhagen was its place of birth
It was said to govern all quanta

Its given name *Nonclassical*
It meant a truly new deal
And now no more classical
Pursued by all with great zeal

Bonds with the past: a recipe
without a precise connection
A productive but sheer reverie,
knowingly short of perfection

Uncertainty now became absolute
Man humbly accepted limitations
Einstein had not given it a foot
in fear of too many frustrations

The dilemma appeared plain
The gift was way out of bound
or old Albert had been insane
Truth: nonclassical is not sound

Digesting the mere essential
deserves fair and ample thought
Physics fooled by a gift's potential
produced an unintended fraud

The gift was about collectiveness
Ψ statistics was classical and real,
ensembles with true randomness,
Bohm's variables part of the deal

So gift recipients' blinded claims
had gone too far obscuring the sight
Retracing steps and reassessing aims
Nonclassical still is a veritable plight

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