The Electron Radius and the Cosmic Microwave Background Radiation

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This paper presents a summary of calculations in a revamped system of electrodynamics, which the author calls Ether Electrodynamics. The results relate to a newly introduced fundamental principle, a rigorously deduced formalism for the electric field of a spinning and precessing electron, the rejection of the magnetic field, the true formal cause of line radiation, a formalism describing how electron spin is quantized, the extension of spin quantization to quantization of precession, the inevitable identity of quantized precession frequency with the Cosmic Microwave Background (CMB) frequency, the subsequent calculation of the electron radius and the relation to the mass of the proton. Ether Electrodynamics promises to rigorously restructure numerous fields of scientific endeavor.

1 Introduction

Due to the mostly ad hoc nature of the electrodynamics practiced today (i.e. Special Relativity, Maxwellian Electrodynamics, Quantum Electrodynamics) a revamp is seen to be necessary. For instance, in the case of the electric field of a moving charged particle one can search the literature and find a number of formalisms meant to describe the nature of the electric field of a moving electron [1–4]. These all disagree, and further their nature is ad hoc. Thus, it is suggested that an approach be taken which adheres to theoretical rigor, strips out ad hoc introductions and applies reductionism. In this spirit we return to the foundational philosophy of Physical Theory (PT) (i.e. Newton's absolute space-time) and the Galilean Velocity Transformation (GVT), which is immediately deducible from PT, and thenceforth proceed to the introduction of an important new principle– the "Drag Forward.".

2 The ether as dogma

If empty space is filled with an elastic medium, that medium will produce waves when it is disturbed, which travel at a specific propagation velocity with respect to the medium. In 1886-89, Heinrich Hertz [22] verified the existence of these waves, which were predicted by James Clerk Maxwell. Crucially, if there were no ether medium in space, it would not be possible to disturb it to produce waves. Therefore, space contains an ether, and the ether is dogma.

3 The "Drag Forward"

Another principle, in addition to the GVT, is necessary to understand electrodynamics. A charged particle emits an electric field into the ether, which can be described by Faraday field lines. It can be deduced that these field lines must be dragged forward in the direction of motion of the charged particle. This is illustrated in Fig. 1, where the hollow tube has a cannon at one end and a physicist at the other. The cannon is aimed perpendicularly to the bottom of the tube. If a uniform horizontal velocity v is given to the tube and then the cannon is fired, will the sponge ball it fires hit the physicist or not? The answer is, of course, yes. As we know, there will be imparted to the ball a horizontal momentum due to the horizontal motion of the tube. The vector velocity of the ball will have, as its horizontal projection, the velocity v of the tube, i.e. the vector velocity of the ball will be dragged forward from the direction it was aimed in. Therefore. the trajectories of the ball and the physicist will cross.

According to observations, the same is true for a beam of light. For instance, the Laser Interferometer Gravitational-Wave Observatory [5] has, as one of its parts, a 4 kilometer long vacuum tube with a laser at one end and a mirror at the other. An engineer ostensibly had to align the direction of the laser so as to get a reflection off the mirror. He then locked down the laser direction such that it always remained the same. Since the interferometer tube is fixed to the surface of the Earth and the Earth is rotating on its axis and revolving around the Sun, while the Sun is revolving around the center of The Milky Way, etc., the velocity of the tube, while instantaneously practically constant, will vary in magnitude and direction with respect to the ether throughout the day. Assuming the light does not have the same transverse momentum imparted to it as the sponge ball, a rough estimate shows that the laser light would miss the mirror by over a meter at times. Therefore, since we can assume the light does not miss the mirror in LIGO, it must have the drag forward property. In fact, since all radiation can be traced to electric field emissions from charged particles, it can be shown that the radially symmetric field lines of a charged particle which is stationary in the ether should all be dragged forward when the particle is moving in the ether.

So, since field lines propagate at velocity c in the ether while a particle is moving with velocity v with respect to the ether, the field lines would be dragged forward axially by velocity v as shown in Fig. 2. This is corroborated by an effect that occurs when bunches of electrons orbit around a synchrotron machine. When the orbital velocity is much less than c, the radiation pattern is omnidirectional. As v ap-

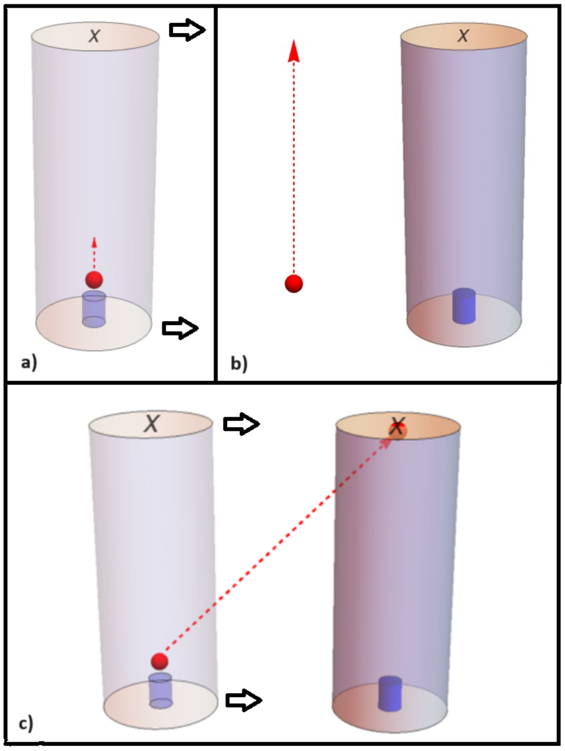

Fig. 1: **The "drag forward"**
a) The ball has just left the cannon. The tube is moving to the right.
b) The trajectory of the ball is not dragged forward, thus it does not hit the physicist represented by the X.
c) In the regime of the drag forward, the horizontal velocity of the ball is the same as the horizontal velocity of the tube. Therefore, the trajectory of the ball is dragged forward and hits the physicist.

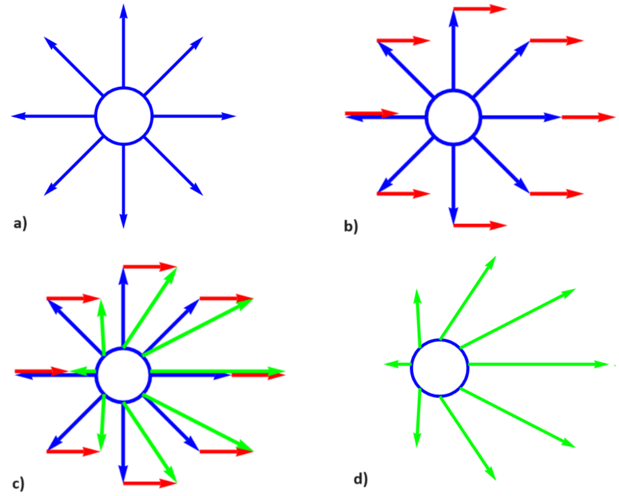

Fig. 2: **Field lines.**
a) The blue circle represents the electron. The blue field lines are radially symmetric for an electron at rest without spin or precession.
b) The electron moves at velocity v along the positive x-axis. The red axial vectors drag the blue vectors forward.
c) The sums of the blue and red vectors give the green vectors. The green vectors are the field lines after the drag forward.
d) The only vectors shown now are the dragged forward vectors.

proaches c, the radiation pattern is dragged into a forward-facing cone. This effect has been misnamed special relativistic beaming. It is, in fact, the dragging forward of field lines due to the fact that momentum is incorporated directly into the electric field. It is to be noted that the dragged forward field lines discussed above are the observations of a Stationary ether observer (SEO). If an SEO increases his velocity so as to eventually match the moving particle, the ether field lines will undergo a GVT to become radially symmetric when the observer has matched velocities with the particle. Thus, Maxwell's Laws are invariant with respect to the frame.

4 Spin drag

What is true for the drag forward in translation is also true in rotation. A spinning particle will have its field lines dragged from a radial position to a more tangential orientation as seen by an SEO. The angle with respect to a vector tangent to the electron surface being given by $\arctan \frac{c}{v}$. Since the velocity of spin goes as $v_{eq} \sin\phi$, where v_{eq} is the spin velocity at the equator and ϕ is the polar angle, the amount of dragging toward the poles is less than at the equator. The field line at the pole is radial. A spinning particle is, under the drag forward, a spin dipole.

5 Rejection of the magnetic field

In this work the magnetic field has been rejected as a physical field. A reductionist approach favors the electric field with the drag forward principle, which is capable of explaining all magnetic effects. For example, a radially symmetric electric field is created by a radially symmetric charge distribution on the surface of a spherical electron. It is not possible to apply a central force field to such a distribution in order to produce a torque on an electron and thus impart spin to it (but q.v. §Spin Quantization for the actual physics of electron spin). Quantum mechanics dismisses, in ad hoc fashion, electron spin as non-mechanical because it cannot treat it physically. On the other hand, the precession of the spin axis is said to be caused by a magnetic field which is considered a non-central force field. However, it is not possible to deduce such a field rigorously from observations and therefore is not considered physical. In this model (EED), all effects can be described by electric fields that adhere to the physical principles of the GVT and the drag forward. These electric fields have both radial and tangential components.

The current-loop model of magnetism states:

$$\mu = IA = \left(\frac{e}{2\pi r}v\right) A = \frac{e}{2\pi r} v \pi r^2 = \frac{evr}{2}, \tag{1}$$

where μ is the magnetic moment, I is the loop current, A is the loop area, e is the electronic charge, r is the radius, and v is the velocity. What this implies is that the moment of a wire loop μ is proportional (in fact equal) to the current in the loop and proportional to the area of the loop. As applied to a spinning particle, whose charge is e (an electron), if we consider the entire electron charge to be distributed around the equator of the electron, consider the radius of the electron to be r, and consider the equatorial spin velocity to be v, then the last equality in (1) gives the moment.

Multiplying the last equality in Eq. (1) by $\frac{m_e}{m_e}$ we get:

$$\frac{m_e}{m_e}\frac{evr}{2} = \frac{e}{2m_e}(m_e vr) = \frac{eL}{2m_e}, \tag{2}$$

where L is the spin angular momentum and m_e is the electron mass. Substituting the moment into the Larmor precession frequency formula [6]([7], p. 175),

$$\omega_p = \frac{\tau}{L\sin\theta} = \frac{\vec{\mu}\times\vec{B}}{L\sin\theta} = \frac{|\mu|\,|B|\sin\theta}{L\sin\theta} = \frac{|\mu|\,|B|}{L}, \tag{3}$$

we obtain,

$$\omega_p = \frac{eB}{2m_e}, \tag{4}$$

where ω_p is the angular precession frequency. But the measured frequency of an electron in a magnetic field of strength B differed from the prediction of (4) and was believed to be twice this value, to good accuracy, so the formula was multiplied by an empirical correction factor g, which was set to 2 [8]. Two was also seen to be the g factor of a spinning electron in the work of M. Abraham [9], A. Landé [10], and P.A.M. Dirac [11] (or [12], p. 270–278, 286).

So we have,

$$\omega_p = g\frac{eB}{2m_e}, \tag{5}$$

where g was initially believed to be exactly 2. Now, if we integrate result (1) annularly over the electron sphere we get,

$$\mu = 2\cdot\int_0^{\frac{\pi}{2}} 2\pi r\, r\sin\phi\left(\frac{\rho\, v\sin\phi\, r\sin\phi}{2}\right)d\phi, \tag{6}$$

and since the charge density over the sphere $\rho = \frac{e}{4\pi r^2}$, we obtain,

$$\frac{e\,v\,r}{2}\int_0^{\frac{\pi}{2}}\sin^3\phi\, d\phi = \frac{e\,v\,r}{3}. \tag{7}$$

Using,

$$\frac{\hbar}{2} = \frac{2}{3}m_e\,v\,r, \tag{8}$$

where $\frac{\hbar}{2}$ is the measured spin angular momentum of the electron and the right side of (8) is the theoretical annular surface integral of the spin angular momentum of an electron, where m_e is the electron mass, solving (8) for v and substituting for v in (7) we obtain,

$$\frac{eh}{8\pi m_e}, \tag{9}$$

or the Bohr magneton. Dividing the measured magnetic moment of the electron, $-9.2847647043(28)\,J/T$ [13] by (9) we can, of course, get an accurate value for g if the constants e and h are accurate. Thus, $g = 2.0023193$.

What is shown above is that the Larmor precession formula (3) is ad hoc and requires harmonization to produce the correct result. The reason is that the magnetic field is not a physical field, i.e. it cannot be deduced rigorously from observations. Therefore, for these reasons and several others, the magnetic field is rejected from physics and is relegated to the status of a conventional field.

6 Line Radiation

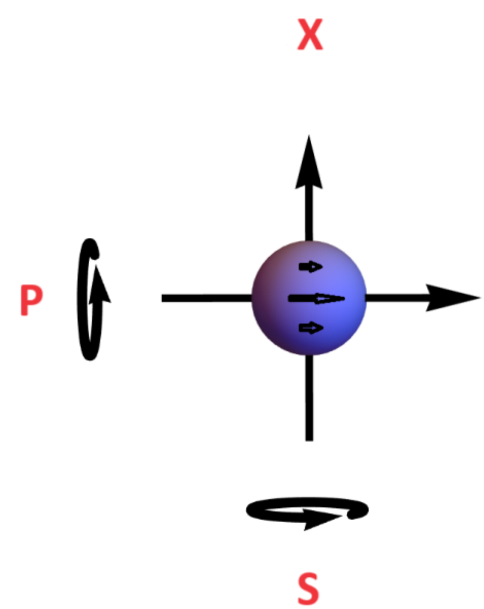

Fig. 3: **.** Looking down from the red X, the velocity of the surface of the (blue) electron depicted by arrows (longer at the equator, less at the mid-latitudes, zero at the poles) is caused by spin around the spin axis S. Since the particle is also precessing around axis P, the various surface spin velocities will pass under the observer and appear to be sinusoidally modulated.

Examining physical phenomena where line radiation is emitted, the examples of nuclear magnetic resonance radiation, gyromagnetic radiation, and atomic line radiation are known. In the first two a spinning charged particle's spin axis precesses around magnetic field lines. This is associated with the observation of line radiation. Referring to Fig. 3 it can be seen that if a particle is spinning and precessing, with the precession axis perpendicular to the spin axis, an outside observer looking down on the particle will see a sinusoidally modulated surface velocity for the particle. Thus, a relationship between spin, accompanied by precession, of a charged particle and the production of sinusoidal (line) radiation is deduced. Remember, due to the rejection of the magnetic field we no longer need to consider electromagnetic waves but will now speak of purely electric waves and fields.

In a simple classical Faraday field line model of the electric field, the field is typically modeled with radially symmetric field lines, naturally giving the electric field as proportional to the areal density of field lines (i.e. inverse-square law). The dragged-forward model of the electric field of an electron without spin and without precession also has, trivially, radially symmetric field lines and therefore an inverse-square field. But with a spinning particle the field lines are as described in §Spin Drag. Please consult Fig. 4 as an aid to understanding the subsections below.

6.1 No Spin, No Precession

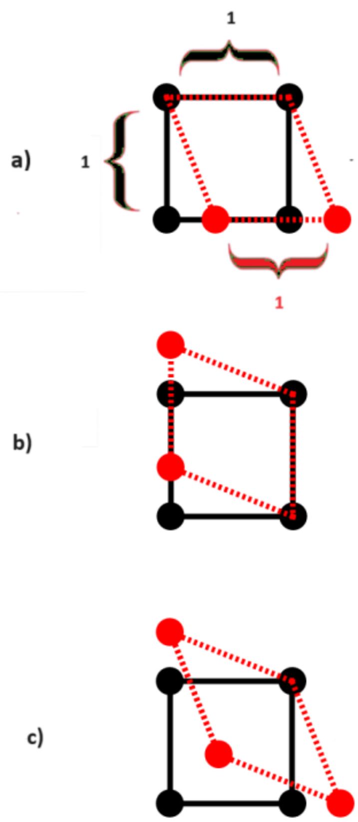

Fig. 4: **Figures of projection.**
(These figures of projection are for projections of radius r, not $2r$.)
a) The black dots and lines represent a 1×1 surface square of a particle with no spin or precession. When spin is introduced, only the two lower red dots are on the equator and are therefore dragged forward relative to the two upper dots, which are at a higher latitude. The figure outlined with dotted red lines is a rhombus with a base of 1 and a height of 1, as shown by the braces.
b) This is similar to figure a, but it is for precession only (no spin). Note that the red dragged figure is also a 1 by 1 rhombus.
c) This shows the figure when there is both precession and spin. The figure is a general quadrilateral, not a rhombus. The area is not 1.

Draw an infinitesimal square with one unit of length and one of width on the surface of a sphere with a radius of r, so that the bottom of the square is on the spin equator with the top one unit above. Assign $\frac{1}{4}$ of a field line to each corner of the square. Let the electric field strength E at the location of this square be the number of field lines divided by the area. Therefore, $E = 1$ on the surface of the sphere at the position of this square. Note that the field lines on the corners of the infinitesimal square have radial divergence. The field law follows an inverse-square relationship, as the two field lines on the equator (separated by one unit of length) diverge to twice this separation (two units) at a radius of $2r$. The same is true for two radial field lines that diverge in the direction perpendicular to the equator, i.e., lying on the same meridian. E will be $\frac{1}{4}$ when the original square is projected onto the sphere of radius $2r$.

6.2 Spin, No Precession

Using the same infinitesimal square as in the previous subsection, we now consider a spinning particle. Since the field lines on the equator (at polar angle $\phi = \frac{\pi}{2}$) are dragged forward due to spin they will be projected forward from their previous positions when they intersect the sphere with twice the radius. The two field lines on the top of the square at polar angle $\phi = \frac{\pi}{2} - \Delta\phi$ will also be projected forward, but to a lesser extent due to their lower velocity. The projected figure at radius $2r$ is clearly a rhombus, with a base length of one unit and a height of one unit. The area of such a rhombus is 1 square unit [14]. Therefore the electric field strength, E, at radius $2r$ is $\frac{1}{4}$, the same as above, and the field law is inverse-square.

6.3 Spin and Precession

Again, using the infinitesimal square method, we will now examine what occurs when the sphere is both spinning and precessing around an axis perpendicular to the spin axis. In Fig. 4 the displacements of the field lines in projection are depicted when the sphere is both spinning and precessing. It is evident that the projection is clearly not a rhombus, but rather a general quadrilateral with an area given by:

$$\frac{\vec{D}_1 \times \vec{D}_2}{2} = x_1 y_2 - x_2 y_1, \tag{10}$$

where $\vec{D}_1$ and $\vec{D}_2$ are the vector diagonals of the quadrilateral and x_1, x_2, y_1, y_2 are the coordinates of the two vectors referred to the origin.

Since the points x_1, x_2, y_1, y_2 are determined by the difference in velocities of spin (resp. precession) at two different polar (resp. azimuthal) angles, the differences in coordinates, $x_1 - x_2$ and $y_1 - y_2$ are necessarily sinusoidal functions of ϕ and θ. For instance, in general the velocity of spin at any latitude ϕ is $v_{s0} \sin\phi$, giving a spin velocity of v_{s0} for a point on the equator and $v_{s0} \sin\left(\frac{\pi}{2} - \Delta\phi\right)$ for a point at latitude (polar angle) $\phi = \frac{\pi}{2} - \Delta\phi$, where v_{s0} is an arbitrary equatorial spin velocity. For a general angle ϕ, we have that the derivative of spin velocity wrt ϕ is,

$$\frac{dv_s}{d\phi} = \lim_{\Delta\phi \to 0} \frac{v_{s0} \sin\phi - v_{s0} \sin(\phi - \Delta\phi)}{\Delta\phi} = v_{s0} \cos\phi. \quad (11)$$

So for some infinitesimal difference in polar angle the difference in spin velocity is $v_{s0} \cos\phi \, d\phi$. The same is true of the precession velocity v_p and azimuthal angle θ, so that we obtain $v_{p0} \cos\theta \, d\theta$. (N.B.: the precession axis intersection with the sphere has coordinates $\phi, \theta = \frac{\pi}{2}, \frac{\pi}{2}$ and $\frac{\pi}{2}, \frac{3\pi}{2}$.) After some rather tedious mathematics one can state the electric field of a spinning precessing electron as:

$$E(r, \phi, \theta) = E_0(r) \left(1 + \frac{v_{p0} v_{s0} \cos\theta \cos\phi}{c^2} \right), \quad (12)$$

where $E(r, \phi, \theta)$ is the electric field strength at some point exterior to the surface of the electron, $E_0(r)$ is the electric field strength of an electron without spin or precession, r is the radius from the center of the electron, v_{p0} is the arbitrary precession velocity on the great circle containing the spin poles, v_{s0} is the arbitrary spin velocity on the equator and c is the speed of light.

For purposes of clarity, (12) will be rewritten as follows:

$$E(r, \phi, \theta) = E_0(r) \left(1 + \frac{v_p v_s \cos\theta \cos\phi}{c^2} \right), \quad (13)$$

where v_p and v_s now represent the arbitrary precession and spin velocities, respectively. This equation represents line radiation and demonstrates that sinusoidal electric radiation is generated only when a charged particle both spins and precesses.

7 Spin Quantization

In accordance with the Stern-Gerlach experiment, the measured spin angular momentum of the electron is always $\frac{\hbar}{2}$. This means, as stated in (8), that the spin velocity is quantized. Therefore, it is not possible to apply a torque to the electron to make it spin faster or slower. It can be inferred that the mechanical spin should be in equilibrium between a torque that tries to increase the electron spin and one that tries to decrease it. Once this equilibrium is achieved, the spin cannot be altered.

7.1 The Back Reaction Torque

Due to the drag forward, the emitted electric field will cause a back reaction torque in the opposite direction to the dragged forward field lines,

$$P_B = \frac{\mathcal{ED} \cdot Vol}{dt} = \frac{\mathcal{ED} \, dA \, c \, dt}{dt} \quad (14)$$

where P_B is the power emitted from some infinitesimal surface area dA on the electron, $\mathcal{ED}$ is the energy density of the emitted electric field at dA, Vol is the volume of the prism with base dA and height $c\,dt$ and c is the speed of light and dt is an infinitesimal time. Since $\vec{F} = \frac{\vec{P}_B}{c}$, where $\vec{F}$ is the back reaction force vector in the direction opposite to the dragged forward field line and $\vec{P}_B$ is the back reaction power vector due to the emitted field,

$$\tau_B = 2 \int_0^{\frac{\pi}{2}} \int_0^{2\pi} \vec{r}_a(\phi, \theta) \times \vec{F}(\phi, \theta) \; d\theta \, d\phi, \quad (15)$$

where τ_B is the back reaction torque, $\vec{r}_a(\phi, \theta)$ is the perpendicular radius vector from the spin axis to the coordinate (ϕ, θ) on the surface of the electron and, similarly, $\vec{F}(\phi, \theta)$ is the back reaction force vector. Expanding (15) into an annular integral,

$$\tau_B = 2 \int_0^{\frac{\pi}{2}} \left[\frac{\epsilon_0 E_E^2}{2} \right] \left(2\pi r_a^3 \frac{v_s \sin^3\phi}{\sqrt{c^2 + v_s^2 \sin^2\phi}} \right) d\phi, \quad (16)$$

where the energy density term appears in square brackets, $\vec{r}_a(\phi, \theta)$ has been replaced by $r_e \sin\phi$, the perpendicular distance from the spin axis of point (ϕ, θ), and E_E is the emitted electric field. Expanding (16),

$$\tau_B = 2 \int_0^{\frac{\pi}{2}} \left[\frac{\epsilon_0 e^2}{2(4\pi\epsilon_0)^2 r_e^4} \right] \left(2\pi r_e^3 \frac{v_s \sin^3\phi}{\sqrt{c^2 + v_s^2 \sin^2\phi}} \right) d\phi, \quad (17)$$

which reduces to,

$$\tau_B = \left(\frac{1}{2} \right) \frac{e^2}{4\pi\epsilon_0 r_e} \int_0^{\frac{\pi}{2}} \frac{v_s \sin^3\phi}{\sqrt{c^2 + v_s^2 \sin^2\phi}} d\phi. \quad (18)$$

7.2 The Ether Induction Torque

Place a free electron in the ether and the ether will be polarized, i.e. the ether acquires an induced electric field. If one takes a hollow copper sphere and places an electron in the center, the copper sphere will become polarized, with positive charges appearing on the inside of the sphere and negative charges on the outside. The field lines sent in toward the central electron will be radially symmetric and attractive (positive polarity), and will have a field strength at the surface of the electron given by,

$$E_P = k \frac{e}{4\pi\epsilon_0 r_e^2}, \quad (19)$$

where $0 < k \leq 1$, e is the elementary electron charge, ϵ_0 is the permittivity of free space, and r_e is the radius of the electron.

Given the example of a ball-point pen, can it be balanced perfectly on its tip? No, if the balance is off even infinitesimally, the equilibrium collapses– it is unstable. Similarly, an electron in the ether must have at least an infinitesimal spin. Accordingly, due to the GVT, the incoming radial field lines will be transformed so that they have a tangential component wrt to the electron. A torque tending to spin the electron faster in the direction it is already spinning will occur, due to the attractive nature of the incoming field lines on the surface charge of the electron. This effect will be multiplied by the fact that if the electron has any spin, the field lines it emits will be dragged forward and therefore the ether will be polarized along the dragged forward field lines, not along radially symmetric field lines. Since the electron is spinning wrt to the incoming non-radial polarization field lines, the GVT will give an angle for the incoming ether field lines twice what it was for the radially symmetric case, in the asymptotic limit of zero spin. It should also be seen that there is an asymptote at infinite spin velocity in which the ether is polarized along lines tangential to the electron surface. In this case, the perfectly tangential incoming lines do not change angle under the GVT transformation and therefore the multiplication factor is unity. This behavior is summed up in a geometric factor GF,

$$GF = \frac{2v_s \sin\phi}{\sqrt{4v_s^2 \sin^2\phi^2 + c^2}}. \tag{20}$$

(Note: It is the ratio of GF for τ_I to the corresponding factor for τ_B (i.e $\dfrac{v_s \sin\phi}{\sqrt{c^2 + v_s^2 \sin^2\phi}}$ which gives the low velocity asymptote of 2 and the high velocity asymptote of 1.)

The ether induction torque due to spin is calculated ad follows:

$$\tau_I = 2\int_0^{\frac{\pi}{2}} \int_0^{2\pi} \vec{r}_a(\phi,\theta) \times \left(\rho\, \vec{E}_P(\phi,\theta)\right)\, d\theta\, d\phi, \tag{21}$$

where $\vec{r}_a(\phi,\theta)$ is the perpendicular radius vector from the spin axis to the coordinate (ϕ,θ) on the surface of the electron, ρ is the surface charge density of the electron and $\vec{E}_P(\phi,\theta) = k\vec{E}_E$ is the incoming vector polarization electric field of the ether at surface point (ϕ,θ). Expanding the torque over the surface in an annular integration, we have:

$$\tau_I = \left(\frac{e}{4\pi r_e^2}\right)\left(\frac{ke}{4\pi\epsilon_0 r_e^2}\right) r_a \int_0^{\frac{\pi}{2}} 4\pi r_e^2 GF\, \sin\phi\, d\phi, \tag{22}$$

or,

$$\tau_I = \left(\frac{ke^2}{4\pi\epsilon_0 r_e}\right)\int_0^{\frac{\pi}{2}} \frac{2v_s \sin^3\phi}{\sqrt{c^2 + 4v_s^2 \sin^2\phi}} d\phi, \tag{23}$$

where GF has been expanded and $r_a = r_e \sin\phi$.

7.3 Net torque

Choosing $k = \frac{1}{2}$ gives a condition where the net torque,

$$\tau_{net} = \tau_I - \tau_B =$$

$$\frac{e^2}{8\pi\epsilon_0 r_e}\int_0^{\frac{\pi}{2}} \left(\frac{2v_s \sin^3\phi}{\sqrt{c^2 + 4v_s^2 \sin^2\phi}} - \frac{v_s \sin^3\phi}{\sqrt{c^2 + v_s^2 \sin^2\phi}}\right) d\phi, \tag{24}$$

where,

$$\lim_{v_s \to +\infty} \frac{2v_s \sin^3\phi}{\sqrt{c^2 + 4v_s^2 \sin^2\phi}} = \lim_{v_s \to +\infty} \frac{v_s \sin^3\phi}{\sqrt{c^2 + v_s^2 \sin^2\phi}} = \sin^2\phi, \tag{25}$$

and

$$\int_0^{\frac{\pi}{2}} \sin^2\phi = \frac{\pi}{4}. \tag{26}$$

The above considerations lead to the conclusion that equilibrium between τ_I and τ_B is only obtained as $v_s \to \infty$, whereas the physical observation is that spin angular momentum, and therefore spin velocity, are quantized at a finite value. This value can be determined from the spin angular momentum,

$$L_s = \frac{\hbar}{2} = \frac{2}{3} m_e v_s r_e \tag{27}$$

if the electron radius r_e is known.

7.4 The supplemental back reaction

In order for equilibrium to be established at a finite value of v_s, it seems necessary that there be some additional back reaction. Study of (13) reveals that this can be provided if the electron also processes. This precession is completely natural due to the same type of instability as the spin. Note that the precession (poloidal motion) will be at right angles to the spin (azimuthal motion). Referring to (13), if $v_p \neq 0$, at equilibrium, there will be a modulation of the electric field in both the θ and ϕ directions since we know $v_s \neq 0$.

If one integrates the nominal electric field E_0 over the surface of an electron one obtains the result,

$$\int_0^{\pi} \int_0^{2\pi} r_e^2 \sin\phi\, E_0\, d\theta\, d\phi = 4\pi r_e^2 E_0^2. \tag{28}$$

If one does the same for the precession-modulated field, the right side of (13), one obtains again $4\pi r_e^2 E_0$, since crests and troughs cancel,

$$\int_0^{\pi} \int_0^{2\pi} r_e^2 \sin\phi\, E_0 \left(1 + \frac{v_p v_s \cos\theta \cos\phi}{c^2}\right) d\theta\, d\phi = 4\pi r_e^2 E_0^2. \tag{29}$$

Next, if one integrates the *square* of the nominal electric field E_0^2 over the surface, one obtains $4\pi r_e^2 E_0^2$. However, the integration of the *square* of the precession-modulated field gives,

$$\int_0^{\pi} \int_0^{2\pi} r_e^2 \sin\phi\, E_0^2 \left(1 + \frac{v_p v_s \cos\theta \cos\phi}{c^2}\right)^2 d\theta\, d\phi = \frac{2\pi r_e^2 E_0^2 \left(6c^4 + v_p^2 v_s^2\right)}{3c^4}. \tag{30}$$

The supplemental back reaction (SBR) can be obtained by dividing the right side of (30) by $4\pi r_e^2 E_0^2$,

$$\frac{2\pi r_e^2 E_0^2 \left(6c^4 + v_p^2 v_s^2\right)}{3c^4} \Bigg/ 4\pi r_e^2 E_0^2 = 1 + \frac{v_p^2 v_s^2}{6c^4}, \tag{31}$$

and multiplying the last term on the right side of (31) by the back reaction torque. The supplemental back reaction factor SBRF is $\frac{v_p^2 v_s^2}{6c^4}$. The SBR itself is $SBRF \times \tau_B$. This allows us to update the back reaction torque to,

$$\tau_B^* = \frac{e^2}{8\pi\epsilon_0 r_e}\left(1 + \frac{v_p^2 v_s^2}{6c^4}\right)\int_0^{\frac{\pi}{2}} \frac{v_s \sin^3\phi}{\sqrt{c^2 + v_s^2 \sin^2\phi}} d\phi, \tag{32}$$

and the net torque to,

$$\tau_{net}^* = \frac{e^2}{8\pi\epsilon_0 r_e}\int_0^{\frac{\pi}{2}} \frac{2v_s \sin^3\phi}{\sqrt{c^2 + 4v_s^2 \sin^2\phi}} d\phi - \frac{e^2}{8\pi\epsilon_0 r_e}\int_0^{\frac{\pi}{2}}\left(1 + \frac{v_p^2 v_s^2}{6c^4}\right) \frac{v_s \sin^3\phi}{\sqrt{c^2 + v_s^2 \sin^2\phi}} d\phi. \tag{33}$$

Note, there is no change to the induction torque since it is a function of E to the first power and therefore there is no non-negligible change to induction due to added precession.

7.5 Solving the torque integrals

The torque integrals were solved for $v_s \geq c$ by mathematical manipulation and an appeal to a table of integrals [15]:

$$\tau_I = \int_0^{\frac{\pi}{2}} \frac{2v_s \sin^3\phi}{\sqrt{c^2 + 4v_s^2 \sin^2\phi}} d\phi = \frac{c}{4v_s} + \frac{1}{2}\left(\frac{c^2}{4v_s^2} + 1\right)\arcsin\sqrt{\frac{4v_s^2}{4v_s^2 + c^2}} - \frac{c^2}{8v_s^2}\left(\frac{\pi}{2} - \arcsin\frac{\frac{c^2}{4v_s^2} - 1}{\frac{c^2}{4v_s^2} + 1}\right) \tag{34}$$

and

$$\tau_B = \int_0^{\frac{\pi}{2}} \frac{v_s \sin^3\phi}{\sqrt{c^2 + v_s^2 \sin^2\phi}} d\phi = \frac{c}{2v_s} + \frac{1}{2}\left(\frac{c^2}{v_s^2} + 1\right)\arcsin\sqrt{\frac{v_s^2}{v_s^2 + c^2}} - \frac{c^2}{2v_s^2}\left(\frac{\pi}{2} - \arcsin\frac{\frac{c^2}{v_s^2} - 1}{\frac{c^2}{v_s^2} + 1}\right). \tag{35}$$

7.6 Solving quantization for the radius

It can be seen that (33) is a variable equation in v_s, v_p and r_e. Rearranging (8) bearing in mind v is spin velocity and substituting for v_s in (34) and (35) and subsequently into (33) a variable equation in r_e and v_p is obtained which cannot be immediately solved for r_e.

7.6.1 Estimates for r_e

Some estimates for r_e exist among which are a QED theoretical estimate by Dehmelt of 10^{-22} m [16] and two estimates from work at DESY, one at $\sim 4.3 \times 10^{-19}$ m [17], the other at $8.5 \times 10^{-19} m$ [18]. Although the estimates from DESY are based on measuring the radius of the constituents of the proton, i.e. quarks under Quantum Chromodynamics (QCD), in EED the elementary particles are the electron and positron. For reasons not treated in this paper particles and antiparticles do not annihilate.

In EED the composition of the proton consists of an electron sandwiched between two positrons with all particle spin axes aligned and the electron spin anti-parallel to the two positron spins. Since mass is known to change with changes in the electrostatic energy of a system, e.g. mass defect, binding energy and H. Poincaré's identification of $\frac{E}{c^2}$ as the mass of an electromagnetic field [21], the proton mass can be considered to be due to electric potential energy. A rough calculation of the electron radius can be formulated from the potential energy of one positron in the potential field of the other. Neglecting the effect of the central electron, as the first positron is pushed closer to the second a point should be reached when enough potential energy has been stored to equal $m_p c^2$, where m_p is the proton mass. Clearly,

$$\frac{PE}{m_e c^2} = \frac{e^2}{4\pi\epsilon_0 r_{sep} m_e c^2} = \frac{m_p}{m_e} = 1836.153, \tag{36}$$

where PE is potential energy, m_e is the electron mass, e is the elementary charge, r_{sep} is the separation of the centers of the two positrons and $\frac{m_p}{m_e}$ is the proton/electron mass ratio [19]. To find r_{sep}, switch it with $\frac{m_p}{m_e}$ in (36) and calculate. Since the positron centers are 4 electron radii apart divide r_{sep} by 4 to get the final result $3.836746 \times 10^{-19} m$ for r_e, which is close to the lower DESY measurement.

7.7 Solving for the radius continued

With some difficulty it is possible to estimate v_p from the above estimate of radius and therefore find the frequency of precession $f_p = \frac{v_p}{2\pi r_e}$ using the equation found in §7.6. This frequency is so close to the Cosmic Microwave Background frequency that it is safe to assume the measured CMB frequency is the actual frequency of precession, since there are no other cosmic radiations in that range. From

$$\omega_p = 2\pi f_p = \frac{\tau}{L_s}, \tag{37}$$

we obtain,

$$\tau = \frac{\hbar}{2}\omega_p = \frac{hf_p}{2} = \frac{hf_{cmb}}{2} = 9.3427589115\times10^{-23} mks, \tag{38}$$

where $f_{cmb} = 2.82 \times 10^{11} Hz$ is the CMB spectral radiance peak wrt wavelength [20].

Making the substitutions mentioned in the first paragraph of this subsection and also substituting $(2\pi r_e)(2.82\times10^{11})$ for v_p gives a variable equation in the single variable r_e. This can easily be plotted with a computer algebra program such as Mathematica (by Wolfram Research). It will be readily seen that there is no solution, i.e. no x-axis crossing of the data. This seems to indicate that no equilibrium in torques exists and therefore no quantization of spin, but this is a naïve appraisal. Checking the abscissa of the plot when the ordinate is $9.3427589115 \times 10^{-23}$ gives a result of $1.1533 \times 10^{-19} m$ for the radius of the electron. So, when the net torque, i.e. $\tau_I - \left(1 + \frac{v_p^2 v_s^2}{6c^4}\right)\tau_B$ is $9.3427589115 \times 10^{-23} mks$ the precession frequency will be f_{cmb} by (38), since when the spin is quantized no torque can change the spin. The electron must nevertheless react to this torque and therefore it precesses. The quantized spin velocity v_s can be obtained from (8) and the value obtained for r_e above. It is 7.52846×10^{14} or about $2 \times 10^6\, c$.

7.8 Refinement of the proton mass model of radius

In the proton mass model of §7.6.1, the distance between positrons was assumed to be 4 electron radii center-to-center. In this refinement a charge-weighted distance is calculated, first based on two iterative approaches.

7.8.1 First approach

The two positrons were partitioned equally n times in their ϕ and θ coordinates each. The area partitions thus produced were weighted by the amount of charge they contained, assuming a symmetrical charge distribution. Since charge is therefore proportional to the area of the partition the weighting was $r^2 \sin\phi$. The radius was set to unity. Any area of charge on positron 1 produces a potential field which gives any area of charge on positron 2 potential energy. The separation of the positron centers is 4 (positron radii). The distance calculation used was $\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 + z_2)^2}$ for all partitions from an area on positron 1 to an area on positron 2, weighted and then summed.

The normalized result for $n = 90$ was 4.16708. The normalized result for $n = 180$ was 4.16677.

7.8.2 Second approach

Starting with the z coordinate (axial) direction the z-axis distance is,

$$4 + \cos\phi_1 + \cos\phi_2. \tag{39}$$

Squaring gives,

$$z^2 = 16 + 4\cos\phi_1 + 4\cos\phi_2 + \cos^2\phi_1 + \cos^2\phi_2 + 2\cos\phi_1\cos\phi_2, \tag{40}$$

and after weighting,

$$z^2 = 16 + 4\sin\phi_1\cos\phi_1 + 4\sin\phi_2\cos\phi_2 + \sin\phi_1\cos^2\phi_1 + \sin\phi_2\cos^2\phi_2 + 2\sin\phi_1\sin\phi_2\cos\phi_1\cos\phi_2. \tag{41}$$

The only non-zero terms, 1, 4 and 5, have average values 16, 0.212207 and 0.212207 respectively. The weighted square of the distance between positron 1 and positron 2 in the x–y plane is given as,

$$\begin{aligned} x^2 + y^2 &= \sin^3\phi_1\cos^2\theta_1 + \sin^3\phi_2\cos^2\theta_2 \\ &- 2\sin^2\phi_1\cos\theta_1\sin^2\phi_2\cos\theta_2 + \sin^3\phi_1\sin^2\theta_1 \\ &+ \sin^3\phi_2\sin^2\theta_2 - 2\sin^2\phi_1\sin\theta_1\sin^2\phi_2\sin\theta_2, \end{aligned} \tag{42}$$

where the only non-zero terms (1, 2, 4 and 5) all have average value 0.212207. Therefore the total average weighted distance is obtained as

$$\sqrt{16 + (6)(0.212207)} = 4.15611 \tag{43}$$

electron radii.

8 The proton mass

From

$$m_p = \frac{e^2}{4\pi\epsilon_0\,(4.15611)\,(1.1533\times10^{-19})\,m_e c^2} = 5878.988, \tag{44}$$

where the number of electron radii is from (43) and the electron radius from §7.7 are used. The proton mass thus calculated is too high by a factor of $5878.988/1836.153 = 3.20180$ or approximately π. It may be worth speculating that the CMB frequency measurement is not very accurate and that the actual electron radius is such that the mass is too high by a factor of exactly π. The factor of π might then be explained by the restoring force of the ether which gives rise to the following calculation.

Assume an ether dipole has volume $\mathcal{V}_{dipole} = 2r_{elc}^3$ where $r_{elc} = 1.40897 \times 10^{-15}$, the ether lattice constant, is the distance between particles in the ether (it is also half the classical electron radius). The ether consists of an alternating 3D lattice of positrons and electrons and, as such, is a medium with tension and thus an elastic restoring force, which is capable of propagating transverse waves– the type discovered by H. Hertz in 1886–1889 [22]. Let the energy density of a homogeneous solenoidal ether electric field E_{sol} be $\mathcal{ED} = \frac{\epsilon_0 E_{sol}^2}{2}$, then the total energy in the volume of the dipole is $\mathcal{E}_{dipole} = \mathcal{ED} \times \mathcal{V}_{dipole} = \frac{e^2}{16\pi^2 \epsilon_0 r_{elc} n^2}$. Assume an inverse square law restoring force for the ether, i.e. the elastic force which tends to return a displaced ether particle to its original position $\mathcal{F}_{rest} = \frac{e^2}{4\pi\epsilon_0 r_{elc}^2 n^2}$, where $0 < n < 1$ is the fraction of an ether lattice constant, r_{elc}, through which the particle is moved. The work done by moving a particle against the restoring force of the ether would be

$$\mathcal{W}_{rest} = \int \mathcal{F}_{rest}\, dr = \frac{e^2}{4\pi\epsilon_0 r_{elc} n^2}. \tag{45}$$

Thus the energy stored in the ether polarization field is $\frac{4}{\pi}$ of what is calculated for $\mathcal{E}_{dipole}$ above. It only remains to explain the factor of 4. (The nature of the material in this section is somewhat speculative and in need of further corroboration. This would require further study of the restoring force of the ether.)

9 Spin stability

Taking the derivative of the ether induction torque τ_I wrt spin velocity v_s will give, examining (34), $\sim -10^{-28}$, a negative number. (Note, the derivatives of the arcsin terms are approximately zero.) This means that an attempt to increase (decrease) the spin velocity by, let's say, $1\, m\, s^{-1}$ will meet with a large negative (positive) torque which opposes any change in v_s.

10 Concerning the g factor

If the quantized precession torque of $9.34275891 \times 10^{-23} mks$ (see (38)) is divided by the torque imposed by an external magnetic field (in EED an electric field with non-zero curl) of sufficient strength to cause the precession of an electron at ν_{cmb} we obtain $g/2$. For instance the torque of an external field is the annular integral of $\vec{r_a} \times (q\vec{v_s} \times \vec{B_{ext}})$,

$$\begin{aligned} &4\pi r_e^3 \frac{e}{4\pi r_e^2} v_s B_{ext} \int_0^{\frac{\pi}{2}} \sin^3\phi\, d\phi = \\ &(1.1533 \times 10^{-19})(1.602177 \times 10^{-19})(7.52846 \times 10^{14}) \times \\ &B_{ext}\left(\frac{2}{3}\right) = 9.27401 \times 10^{-24} B_{ext}\, mks, \end{aligned} \tag{46}$$

where B_{ext} is the strength of the external torque field causing precession at the CMB frequency. B_{ext} can be calculated from (5) thus,

$$B_{ext} = 2\frac{\omega_{cmb} m_e}{ge} = 10.06246\, T, \tag{47}$$

giving

$$9.27401 \times 10^{-24} B_{ext}\, mks = 9.33197 \times 10^{-23}\, mks \tag{48}$$

which, upon taking the ratio of the two torques (38) and (48), gives

$$\frac{9.342759 \times 10^{-23}}{9.33197 \times 10^{-23}} = 1.0011596 = \frac{g}{2}. \tag{49}$$

This supports the idea that the precession generated by an external field is conditioned by the quantized precession and is not as expected from a naïve application of an external magnetic field. Thus we have confirmation that the magnetic field is not a physical field and that the CMB radiation is line radiation produced by the quantized precessional motion of electrons.

11 Conclusions drawn from EED

In general EED combines Newtonian mechanics with observations of electric fields, the ether, and elementary particles. The electric field follows the inverse square law and can be modified by two principles–the Galilean Velocity Transformation and the drag forward. This promotes an optics of Faraday field lines which makes field and force calculations amenable. Thus, EED is an electric worldview where all forces i.e. gravity, strong force, weak force, are fundamentally due to the electric force.

Various facts, which were not presented here, allow the deduction that particles and anti-particles do not annihilate, that the elementary particles are the electron and positron, and that the only fundamental force field is the electric field. Thus a matter universe is overthrown and in its place a matter-antimatter universe with equal parts of each arises. The compositions of various particles can be ascertained or beckon to be. For instance the electron neutrino would be an electron-positron pair. Its mass would be extremely low (estimated at $\sim 10^{-46}\, kg$). It would have a dipole moment (both electric and spin), experience forces from gravity and inhomogeneous electric fields and thus would be accelerated toward the central mass of galaxies. There, after achieving considerable energy, two electron neutrinos could combine to form neutrons or anti-neutrons (which contain the same particles as two neutrinos). The inhomogeneous field would expel the neutrons outwards where they would decay to hydrogen and the anti-neutrons would be forced to accumulate in the central mass. This sorting mechanism assures that what we encounter are atoms with protons in the nucleus with orbiting electrons and not atoms with nuclear anti-protons with positrons orbiting. Thus matter would be created at the center of galaxies and this might explain some observational anomalies. [23]

That finally a respectable explanation for line radiation has been obtained is cause for rejoicing. The line radiation equation (13) also suggests that the mass of the electron increases with precession frequency. At about $3 \times 10^{21} Hz$ accordingly, the mass of the electron would double. This might be of use in explaining some of the physics of supernovae, etc.

Since the electric field of a charged particle is emitted continuously and flows away from the particle continuously, line radiation at the CMB frequency would be continuously produced by free electrons somewhat like the zero-point energy was supposed to be. Perhaps it could be collected and converted to useful energy by rectennas. The power available would be $\sim 10^{-5}\, Wm^{-2}$. [20]

Besides advances leading to particle mass and composition there also seems to be the possibility of improving applications such as spectroscopy, microscopy, protein folding, molecular interaction and structure, cosmology, gravity formalism and moving away from mean field theories. Certainly, the formalisms that are in common use such as Special and General Relativity, Quantum Mechanics and Quantum Field Theory [24], The Standard Model, and ΛCDM appeal to mass media journalists but do not adhere to the standards of rigor that would be acceptable in physics. They have more of the character of stumbling blocks on the road to the truth.

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