The Speed of Light: Cumulative Instantaneous Forces at a Distance

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Light itself need not be produced by instantaneous transitions between energy levels and then propagated as a wave or photon or a probabilistic photon with a velocity equal to the speed of light. Instead, light or radiation in general, may be regarded as the effect of oscillations of charged particles in a source that produce at a distance in-phase oscillations of charged particles in the primary receiver, first inside atomic nuclei, then after a delay, oscillations of electrons, e.g., of free electrons or of bound electrons where the widening of orbits of bound atomic electrons leads to their ejection into the conduction band or beyond. The proposed mechanism to produce such light transmission is similar to Maxwell's changing electric fields causing magnetic fields and changing magnetic fields causing electric fields. In Maxwell's theory, these effects propagate as a spherical wave in vacuous space. In the proposed theory these changes occur inside atomic nuclei due to cumulative instantaneous forces at a distance.

1. Introduction

We have discussed elsewhere [1] the magnetism associated with electric dipoles inside lattice nuclei and free electrons of current carrying wires and in the atomic nuclei of photoreceptors as well as the magnetism associated with the spin or electric dipoles inside atomic electrons in specific molecular configurations of ferromagnetic atoms. Here we show that the magnetic fields of planets and stars are attributable to electric dipoles inside atomic nuclei of these spinning astronomical bodies and that the gravitational fields of planets and stars are essentially the same as their magnetic fields but measured differently.

2. Electric Dipoles inside Conductors

Let's discuss electric dipoles inside the lattice nuclei and free electrons of current carrying wires. For example, the attraction of parallel copper wires, $r = 2$ cm apart, with a radius $r_c = 1$ mm of cross section area $A = \pi r_c^{\,2} = \pi\left(10^{-3}\right)^2 = 3.14\times10^{-6}$ m^2, with currents each of $I = 1$ Amp. The currents in Amperes can be written

$$I = NAev_e\,, \tag{1}$$

where $N = 8.47\times10^{28}$ electrons/m^3, $e = 1.6\times10^{-19}$ C, whose drift velocity v_e caused by the field, E driving the current is

$$v_e = \frac{eE\tau}{m_e}\left[\text{m/s}\right], \tag{2}$$

where $\tau = 2\times10^{-14}$ seconds for copper from Drude's model [2]. With electron mass $m_e = 9.11\times10^{-31}$ kg, substituting v_e from Eq. (2) into Eq. (1) and solving for E we obtain,

$$E = \frac{m_e I}{NAe^2\tau} = \frac{\left(9.11\times10^{-31}\right)(1)}{\left(8.47\times10^{28}\right)\left(3.14\times10^{-6}\right)\left(1.6\times10^{-19}\right)\left(2\times10^{-14}\right)} \tag{3}$$
$$= 6.6\times10^{-19}\ \text{V/m}\,.$$

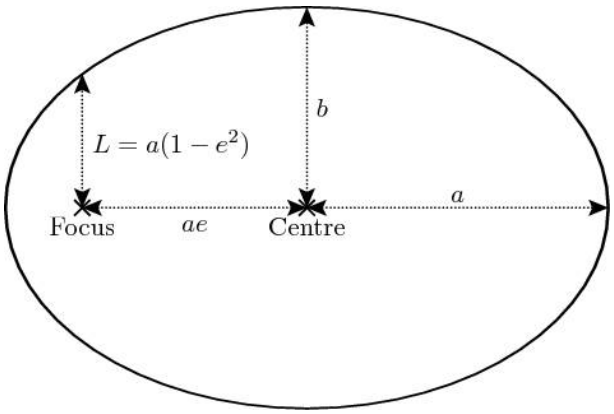

Fig. 1. Displacement of positive and negative centers of charge

Thus when the current of 1 Amp, $v_e = I/NeA = 2.35\times10^{-5}$ m/s, and the field E driving the current is 6.6×10^{-19} V/m. We claim this sustained E field produces, in addition to the drift velocity and current of the electrons, an elliptization transverse to the current of orbital charge inside free electrons and lattice nuclei. This produces a displacement of positive and negative centers of charge inside the nuclei. Note that the free electrons and lattice nuclei are in otherwise field-free regions and so susceptible to the applied E field.

The ellipse focus is the positive center of charge at a distance $R = a(1-\varepsilon)$ from the point on ellipse nearest to the focus on the ellipse, the periapsis. The ellipse center is the center of negative charge of the orbiting negative mass m_0 inside the nucleus at a distance $R\varepsilon/(1-\varepsilon)$ from the positive center of charge, where $R \approx 10^{-15}$ meters.

This polarization of charge accounts for the identity between Ampere's formula for the force between parallel current wire segments and the force between collinear electric dipoles, associated with these segments.

That is, if we assign transverse electric dipoles, erv/c and, erv'/c to each lattice nucleus, and there are $NAds$ and $NAds'$ of

these dipoles in parallel wire segments opposite each other, the force between these collinear electric dipoles is, from Fig. 2c, below, the right hand side of the following equation,

$$dF = \frac{k_e}{c^2}\frac{ii'dsds'}{r^2} = k_e\frac{NeArv}{c}\frac{NeArv'}{c}\frac{dsds'}{r^4}, \qquad (4)$$

where the Coulomb constant $k_e = 8.99\times10^9\ \text{N-m}^2/\text{C}^2$, and $k_e/c^2 = \mu_0/4\pi = 10^{-7}\ \text{H/m}$ is the magnetic constant in SI units.

Note that in addition to transverse collinear dipoles in the wire elements there are longitudinal parallel dipoles that repel each other means that the net attraction, from fig (2c), is three times the representation of the electric dipole -dipole force in the above equation. We can maintain the equality if we require the unit dipoles are, $erv/\sqrt{3}c$ and $erv'/\sqrt{3}c$.

The transverse collinear force between a dipole in one wire on a dipole in the other inhibits the length of the dipole in the other wire that would otherwise be determined only by the sustained field E in the other wire and the inhibiting effects of surrounding local fields. That is, the inner shell of atomic electrons also prevents the dipole inside the lattice nuclei from becoming too large.

Fig. 2 shows the forces and torques between dipoles and implicitly the forces between current carrying segments perpendicular to the dipoles where the dipoles are defined as above.

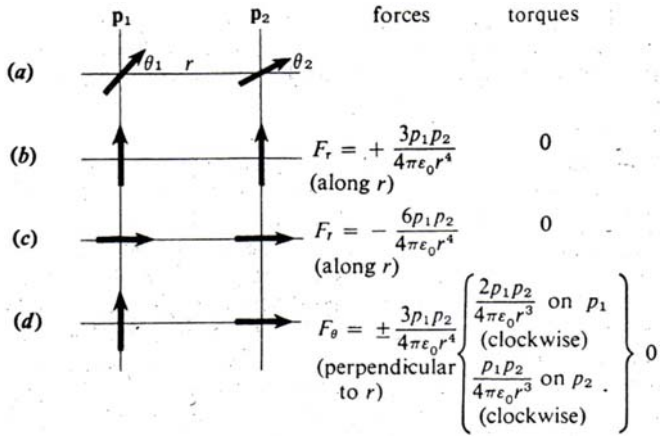

Fig. 2. Forces between electric dipoles

The dipoles per unit length and cross section area in this example are

$$R\frac{\varepsilon}{1-\varepsilon} = r\frac{v_e}{c} = (.02)\frac{2.35\times10^{-5}}{3\times10^8} = 1.57\times10^{-15}\ \text{m} \qquad (5)$$

In a cross section layer $A = 10^{-6}\,\text{m}^2$ by $10^{-10}\,\text{m}$ meters long of copper wire, there are $8.47\times10^{28-6-10}$ of these.

We have shown in **Faster Than Light** [3], p. 25, that if the radius of the electron or nucleus is $R = 1.724\times10^{-15}\,\text{m}$, the elasticity of charge inside the nucleus or electron is the speed of light squared. In this example then, $\varepsilon/(1-\varepsilon) = .90$. By trial and error, $.9/.1 = 9$, $.8/.2 = 4$ and $.476/.524 = .908$. So for $E = 6.6\times10^{-19}\,\text{V/m}$ and $v_e = I/NeA = 2.35\times10^{-5}\,\text{m/s}$, $\varepsilon = .476$.

The effect of E_x on the orbital charge, $-2e$ inside the electron or $-e$ inside the nucleus, during the 10^{-14} second time between thermal collisions, is to produce an ellipse of eccentricity, ε with major axis perpendicular to the X-axis. The increase in orbital velocity required for eccentricity, $\varepsilon' = \varepsilon/2 = .238$ is,

$$\frac{2eE\tau}{m_0} = v_1 - v_0 = \sqrt{1+\varepsilon}\,v_0 - v_0 = \left(1+\frac{\varepsilon}{2}-\frac{\varepsilon^2}{8}+\ldots\right)v_0 - v_0 \approx \frac{\varepsilon}{2}v_0\,. \qquad (6)$$

$$\frac{2eE\tau}{m_0} = \frac{2\left(1.6\times10^{-19}\right)\left(6.6\times10^{-3}\right)\left(2\times10^{-14}\right)}{m_0}\left[\text{m/s}\right] \approx \varepsilon' v_0\,. \qquad (7)$$

The initial orbital velocity v_0 of a particle with charge, $-2e$ circling a core particle of charge, $+e$, is

$$v_0 = \sqrt{\frac{2k_e e^2}{m_0 R}} = \sqrt{\frac{2\left(9\times10^9\right)\left(1.6\times10^{-19}\right)^2}{m_0\left(1.72\times10^{-15}\right)}} = \frac{5.17\times10^{-7}}{\sqrt{m_0}}\ \left[\text{m/s}\right]. \qquad (8)$$

Thus, the mass of an orbiting charged particle inside a nucleus or inside an electron that, with this applied E field, $6.6\times10^{-3}\,\text{V/m}$, that will give the required ellipse eccentricity $\varepsilon' = .238$, and electric dipole to produce the observed magnetic attraction, this mass is m_0. From Eq. (7) and (8),

$$\sqrt{m_0} = \frac{2eE\tau}{\varepsilon'\left(v_0\sqrt{m_0}\right)} = \frac{2\left(1.6\times10^{-19}\right)\left(6.6\times10^{-3}\right)\left(2\times10^{-14}\right)}{(.238)\left(5.17\times10^{-7}\right)} \qquad (9)$$

$$= 3.44\times10^{-28}\ \text{kg}^{1/2}$$

$$m_0 = 1.18\times10^{-55}\ \text{kg} \qquad (10)$$

$$v_0 = \frac{v_0\sqrt{m_0}}{\sqrt{m_0}} = \frac{5.17\times10^{-7}}{3.44\times10^{-28}} = 1.49\times10^{21}\ \text{m/s} \qquad (11)$$

$$f_0 = \frac{v_0}{2\pi R} = \frac{1.49\times10^{21}}{2\pi\left(1.72\times10^{-15}\right)} = 1.37\times10^{35}\,\text{Hz} \qquad (12)$$

These formulas show how the electric field driving a current causes charge polarization transverse to the current inside lattice nuclei and free electrons that can account for the magnetic force between parallel current carrying wires. The transverse field of one wire on the other inhibits the transverse polarization in the other wire so that the inverse fourth power force is reduced to the familiar inverse square magnetic force.

The orbiting charged particle inside the free electrons and inside lattice nuclei must be 100 billion billion times smaller than the electron in mass and volume and moving at superluminal velocity, v_0~$10^{21}\,\text{m/s}$ to create the electric dipoles implied by the field E and currents $neAv$, and $neAv'$.

The recent Cern experiments showing neutrinos traveling faster than light then only as fast as light suggest that the mass of the neutrino does not increase to infinity at the speed of light that Einstein and Lorentz claimed based on Walter Kaufmann's 1901 experiments with beta electrons.

The Cern experiments thus support the idea that the decreasing rate of increased deflection of Kaufmann's beta electrons by a magnetic field as their velocity increased is not due to an increase in mass but to a decrease in the rate of increased charge polarization inside the electrons. The conversion of energy into

mass is the conversion of the energy of the electron's motion into the energy of the orbiting particle inside the electron.

So an electron may not go faster than the speed of light before coming apart but the orbiting charged particle inside the electron responsible for the apparent mass increase must go much faster than the speed of light to account for this phenomenon.

It is important to note before going further that the speed of light as measured/observed in terms of the time between the sending and receiving of light or radio signals has to do with the time it takes for a relatively weak oscillation of charge at the receiver to become detectable. This delay time at the receiver can be calibrated to the source receiver distance so that the distance divided by delay time is equal to the square root of the ratio of the electric to the magnetic, constant. In the GPS system, the microwave emitter/receiver calibration is made very precise and, in the reflected light beam apparati, and distances chosen by Fizeau, Foucault and Michelson, less precise. The lenses used by Bradley to measure stellar aberration, produced a speed of light between the lenses that was extrapolated to the unknown distance to the star being observed at times of year, six months apart. By choosing a different objective lens for a given distance to the eyepiece, the speed between the lenses, and by extrapolation to the star, could be made closer to the speed of light. We discuss this in more detail in **Faster Than Light** [3].

Our proposed view of the electron and nucleus also makes possible a less abstract explanation of pair production and annihilation than the current QM explanation. Pair production always occurs in close proximity to a heavy nucleus, e.g. the lead nucleus, and in the presence of high energy gamma radiation. Thus, a neutral composite particle with a 10^{-55} kg mass of charge $-2e$, orbiting in a figure eight around two core, 10^{-30} kg, masses of charge $+e$, subject to a resonant frequency of gamma radiation, becomes briefly an electron ($+e-2e=-e$) and a positron ($+e$). This is pair production. The electron and positron are detected as photographed streaks in a magnetic field in a cloud chamber or as digitally recorded paths in a spark and drift particle detector. Their oppositely curved paths start from the same point. A widening, then a contracting, orbital movement of a 10^{-55} kg mass of charge, $-2e$, accompany pair production and annihilation. These are the MeV gamma oscillations produced by a nearby radioactive source for example, that cause the widening orbital movements inside the neutral particle preceding pair production. This is soon followed by slightly smaller, MeV oscillations of contracting orbital movement preceding capture and pair annihilation. The annihilation radiation is detectable by a crystal scintillation counter.

Recently, there has been a renewal of interest at Harvard, Yale and Cambridge in finding charge polarization, an electric dipole moment, EDM, inside electrons, but without awareness of Victor Weiskopf's 1965 attempts at MIT. All of these attempts suffer from the same failure to realize that the magnetic field of moving electrons is attributable to electric dipoles inside the electrons. This is divulged here and in my 1980 papers, and subsequent papers all over the internet for the last 30 years. So far these ideas have been dismissed as too radical.

The same failure implied the more expensive failure of the Tokamak. By increasing the magnetic field to contain fusion reactions, the electric field, specifically the electric dipole field, was increased. The increased electric dipole point charge interaction with moving ions was in the opposite direction and thus reduced the increased magnetic interaction from what it would otherwise have been. Thus, it took more and more energy to produce containment. The remaining net energy produced by fusion minus this increased containment energy became, impractically, smaller and smaller.

Einstein showed that the Lorentz factor for mass increase also applied to time and implied apparent time dilation. Relative time dilation could explain the 1887 Michelson Morely result. That is, a source of light was directed eastward in the direction of the Earth's spin at speed, V, to a half transparent slanted mirror where half of the beam passed to a full mirror and half of the beam was reflected at right angles to a second full mirror. The back reflections of the beams on the slanted half mirror were observed through a telescope at right angles to the longitudinal beam and did not show a pattern of alternating dark and light bands.

But if light was moving at a constant speed, c, along each of these paths it would have taken slightly longer for the light to move back and forth along the longitudinal path in the direction the Earth was moving than along the transverse path. And dark and light bands would have been observed but were not. Einstein's explanation was that time only appeared to move more slowly, or distances only appeared to be less, along the longitudinal round trip relative to distance or the passage of time along the transverse round trip- and vice versa. The null result implied that one could not tell if time moved more slowly along the longitudinal scale or time moved more rapidly along the transverse scale. Only relative, not absolute measurements of space and time were possible. A simpler explanation is that light does not move. Light does not move, either as a wave or as the moving particles called photons. Instead, light is the effect of cumulative instantaneous forces at a distance.

The Cern result, showing that mass does not increase to infinity at the speed of light, suggests that an alternative to the relativistic time dilation explanation of the Michelson Morely experiment is possible. Light speed measurements imply that light can be regarded as the cumulative effect of instantaneous forces at a distance. Weak microwave sources (50Watts) in the GPS system have longer delays than strong visible light sources from stars with more than 100 or 1000 times the energy of the 1026 Watt Sun.

The GPS delays are calibrated from Newtonian calculations of the distance between the satellites about 12000 miles from stationary receivers on Earth to be exactly equal to the assumed speed of light. The assumed speed of light is the square root of the ratio of the magnetic constant to the electric constant.

A small scale test can be carried out to show light is indeed the cumulative effect of instantaneous forces at a distance: A ten nanosecond light pulse from a laser is blocked at a photocell 30 feet away at the expected time of arrival and substantial light is still received as indicated by a voltage pulse above the noise level. When light is blocked from the photocell during the emission

of the light pulse but not at the expected time of arrival, negligible light is received [3].

The Cern results, showing that mass does not increase to infinity at the speed of light, suggests that superluminal charged particles could exist inside atomic nuclei. Such orbital charges inside atomic nuclei can explain the apparent discrete atomic orbits and quantized wave energies associated with discrete radiation frequencies from heated gases. That is, the outer atomic orbits must be in synch with the inner ones and with the orbital systems inside the atomic nuclei. No non classical mechanics is needed; only classical forces applied equally to subluminal and superluminal charged particles. Exchange interactions, quarks, the electroweak force and the strong force, that are used to explain nuclear cohesion and the particle emissions from high energy collisions involving electrons, protons, neutrons, helium ions etc., can be explained now in a simpler, less abstract way; in terms not of energy exchanges between virtual particles over very small time scales but in terms of electrical forces between actual charged particles, some a 100 billion, billion times smaller in mass and volume than the electron, moving between larger charged particles inside the nucleus and over similarly, very small time scales.

Light itself need not be mysteriously produced by instantaneous transitions between energy levels and then propagated as a wave or photon or a probabilistic photon with a velocity equal to the speed of light. Instead, light or radiation in general, may be regarded as the effect of oscillations of charged particles in a source that produce, instantaneously at a distance, in phase oscillations of charged particles in the primary receiver, first inside atomic nuclei, then after a delay, oscillations of electrons, e.g. of free electrons or of bound electrons where the widening of orbits of bound atomic electrons leads to their ejection.

The required mechanism to produce such light transmission is similar to Maxwell's changing electric fields causing magnetic fields and changing magnetic fields causing electric fields. In Maxwell's theory these effects propagate as a spherical wave in vacuous space. In the modified Maxwell theory these changes occur inside atomic nuclei due to cumulative instantaneous forces at a distance.

One of the implications of this new theory of electromagnetic radiation is that the magnetic fields of planets and stars are electric dipole fields and equivalent to their gravitational fields but measured with magnetic materials. (the km/s. velocity of spacecraft magnetometers is not properly taken into account in measuring planetary magnetic fields.) The sources of these fields are electric dipoles inside atomic nuclei and electrons.

Changing electric dipoles inside atomic nuclei are associated with radio and light radiation. Repeated oscillations of charge at a specific frequency in a light or radio source produce increasing amplitudes of charge oscillations inside atomic nuclei in the parallel, say longitudinal, receiver before the amplitude of electron oscillations in the receiver is detectable. Accompanying the longitudinal oscillations are transverse oscillations that account for radiation pressure. The mechanism, similar to Maxwell's field mechanism, but inside atomic nuclei, is described in the next two sections.

This, and not a moving wave or particle, would then account for the observed delays. For example, weak radio carrier oscillations, a billion per second, with phase shift modulations, from a spacecraft, 8 watt transmitter, near Pluto, means five hours before the carrier and its modulations are detectable- so long as the same receiver antenna is constantly turned to face the direction of the spacecraft. Some of the reported measurement anomalies and communications problems may be traced to difficulties in sustaining continuously open transmission and calibrating decreasing signal strength with increasing distance.

But for distances more than 10 hours away and apparent communication with spacecraft at these distances, the delay could be, not r/c, but kr/c, $k<1$.

That is, the r/c delay may apply for a specified number of repetitions of oscillating fields of a given strength, but that for greater strengths or for a larger number and frequency of repetitions of even lesser strengths, the delay can be less. For example, Bradley's light speed measurement of the time it takes light from a distant star to be reradiated from a telescope's objective lens to the eye as the Earth moves at 29 km per second, under the observed star, in the opposite direction it moved six months earlier.

Thus the star appeared to be a few fractions of a degree displaced from its six month earlier position. But this was attributable to delay of a few nanoseconds between the objective lens and eye as the Earth and placement of the star moved. To extrapolate this delay or rate of speed from an 8 foot and 12 foot telescope to a star, 10^{20} meters away, is a bit of a stretch.

But that is what Bradley did. His justification for doing so was that his speed of light estimate was then within 15% of Roemer's estimate, based on a completely different method, about fifty years earlier. The absolute magnitude of the star, gamma Draconis, we now know, is +4.8 while that of the Sun is -1.93. The difference of -6.73 implies the star is as bright as 700 Suns. The Sun at 3.9×10^{26} Watts is equivalent to 10^{24} 100-watt light bulbs.

The other extreme is the delay of the weak radio signal from spacecraft near, Pluto which could well be 5 hours while the delay of much greater power, light sources like stars, could well be nanoseconds or less.

3. Conclusion

We discuss in more detail in Faster Than Light, the interpretation problems with these and other light speed measurements and the proposed alternative mechanism to explain the delays.

Faster than light movements of particles inside electrons and inside atomic nuclei give us a clearer and deeper understanding of light emission and absorption; also of quantum energy transitions in blackbody radiation and atomic and nuclear spectra; also of magnetism and gravity as attributable to electric dipoles inside atomic electrons, and inside atomic nuclei.

References

[1] R. N. Sansbury, "Light Speed Measurements", *Proc of the NPA* **8**: 507-517 (2011).

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[3] R. N. Sansbury, **Faster Than Light** (Cedar, 2012).

[4] T. W. Ng, Ed., **Optical Testing Digest** (1997-1998).