INTRODUCTION

IS MAGNETISM ULTIMATELY ELECTROSTATIC?

Recent evidence for charge polarization inside electrons and atomic nuclei provides a deeper understanding of magnetism, gravity and light.

We show that such polarization occurs in current carrying wires due to the non zero electric field sustained in such wires by an ac generator and rectifier or a common battery as an electron source and sink. We also show that the dipoles are transverse to the current direction and that they increase in proportion to the separation of the wires to produce exactly the so called magnetic repulsion or attraction between constant ie direct, current carrying wires.

To do this, the dipole per unit length must be rnAev/c where r is the separation, n is the density of electrons, e, and A is the cross section area of the wire, v is the velocity of the electrons in the wire in the direction of current along the length of the wire, and c is $\sqrt{3}$ times the speed of light. Then the force, 10^{-7}ii*dsds*/r^2 between two parallel current segments ds and ds* can be written as the force between two such colinear electrostatic dipoles, namely,

F= $9(10^9$ (rnAev/c)(rnAev*/c)dsds*/r^4.

Since r is typically a few centimeters and v is typically a tenth of a millimeter/per second in this context, rv/c is about 10^{-15} , about the diameter of an atomic nucleus. The meaning of the two r's, in the numerator, is that as the wires are drawn further apart the transverse force from the first wire is reduced allowing the transverse dipole created by the longitudinal field in the second wire to become larger-and vice versa-in proportion to, r. That is, parallel wires carrying currents in the same(opposite) direction "magnetically" attract(repel) each other due to colinear electrostatic dipoles in their nuclei. Parallel(antiparallel)dipoles repel(attract) each other.

We show that this relation generalizes to all relative orientations. Why does such charge polarization with its magnetic effects not occur in dielectric wires subject to an electric field? Because the loosely bound electrons around atomic nuclei in these dieletrics redistribute themselves, to cancel the effects of the outside electric field on the central nuclei. The dielectric as a whole becomes polarized opposite to the applied field.

But If the applied field is constantly changing, then the nuclei of dielectrics have a chance to respond to the applied field before the surrounding electrons can completely cancel the changing applied field. The result of each change in force can be shown to be charge polarization transverse to the force or force change.

This in fact happens all the time as the Earth spins. As the Earth spins on its axis and orbits the sun, etc, the motion of the Earth's atoms implies constantly changing forces. These mechanical forces are ultimately electrical on mostly dielectric atoms eg silica, and so produce a small amount of charge polarization in these atomic nuclei each time the forces change direction. (That mechanical forces are ultimately electrical, is seen from the example of two colliding billiard balls and the electrical nature of the constituent atoms.)

IS GRAVITY ULTIMATELY ELECTROSTATIC?

Thus the gravitational force of the Earth on terrestrial objects may be attributable to charge polarization inside their atomic nuclei transverse to the direction of the Earth's spin, ie along the Earth's radii and lines of longitude. The inverse square gravitational force is equivalent to an inverse fourth power electrostatic dipole-dipole force if the dipoles in any pairwise interaction are proportional to the distance between the dipoles. Thus adjacent objects along a radius attract and objects on adjacent longitudes repel but the total force on any object is the sum total of all such pairwise forces. We show that this is equal to the gravitational force.

We show also that the gravitational force between any two terrestrial objects, a small steel ball suspended near a larger steel ball as measured by Cavendish, can be written as the horizontal projection of their attraction to the Earth's center. We show that it is possible to generalize this cause of the gravitational force of all planets, their satellites, the sun and other stars to charge polarization inside their nuclei attributable to their angular momentum. Gravity would not exist in a motionless universe. These and other aspects of this electrostatic dipole theory of gravity are spelled out in the last section of the book.

LIGHT SPEED, A NON ETHEREAL MECHANISM

The current theory of light entails some strange assumptions: eg massless, probabilistic particles, time dilation, space contraction and curvature etc. There might be a way to circumvent these assumptions with one less strange assumption. That is, an implication of charge polarization inside electrons and atomic nuclei is that the so called speed of light or rather the delay in the response of a radiation receiver to radiation from a radiation emitter could be due to changes in charge polarization inside the electrons and atomic nuclei of the receiver resulting from rapidly changing instantaneous electrostatic forces from the emitter. The cumulative effect then of instantaneous forces would produce an observable response in the receiver after r/c seconds if the light or radar or radio source forces per unit charge, $E_s(t)$,are not too weak relative to the source receiver distance,r*>=r..

Something like $(1-\exp -ct/r)[(E_{s,max}) (2\pi rf/c)^2(\sin 2\pi ft)QD/r^{*3}] = E_R(t)$ as derived below. Notice that the term in brackets is the same field predicted by Maxwell r/c seconds after time zero but we allow that there is some value r less than the source to receiver distance r* at which time, r/c < r*/c, the field at the receiver rises above noise to its maximal value.

How do we arrive at this formulation? An electrostatic dipole field is produced by oscillating dipoles; for example, an oscillation of free electrons in a vertical emitting radio antenna meters in height or many billions of excited atomic electrons ten angstroms in height on and around a vertical heated tungsten filament of a light bulb. Note that these oscillations occur only when the bound electrons are thermally excited to wider orbits and fall back to their ordinary bound orbit. Some fraction of these atomic dipoles, but still billions, will have mostly vertical projections, which total we consider first.

The receiver is for example a small vertical rod, a home radio antenna or a semiconductor photodiode, or the cone or rod cells on the retina of a human eye, etc..

When otherwise directed components of the field from a light source are considered, the effect of this one polarization will be lessened as we know in comparing the effects of the polarized coherent light of lasers to unpolarized light etc.. That is, a large number of the small randomly directed and random phase atomic dipoles in the source act as one on each possible atomic dipole in the photoreceptor. An outer orbital electron is made to move in larger and larger longitudinal orbits until it is excited away from the nucleus and into the conductive part of the cell where the reception of a photon is registered, that is, measured, for example, by applying a constant voltage on this conductive part and noting the voltage change as the electron or electrons are driven through a resistor.

Initially in the receiver there is a sequence over time,t, of Coulomb forces, $F(t)=9(10^9)Ne^2D\sin 2\pi ft/r^3 = K\sin 2\pi ft/r^3$, K=NeD, perpendicular to a line from the source, on free or outer molecular electrons and on the orbital charge inside the lattice nuclei. As a first approximation, the resulting displacement of the electron from its equilibrium position is proportional to this force and inversely proportional to the mass: $x(t)=K\sin 2\pi ft/mr^3$; its velocity $v(t)=x'(t) = (Ke)(2\pi f\cos 2\pi ft/mr^3)$.

As in the case of a constant voltage, there is here a transverse distortion of the orbits of negatively charged particles around a more positive core inside the lattice nuclei of this current carrying conductor which produces transverse dipoles,$(kr/c)(Ke)(2\pi f\cos 2\pi ft/mr^3)$ perpendicular to both the line to the source and to the longitudinal,vertical displacements of the electrons.

We have written the dipole krv/c where k<1 since the oscillating charge in the source and receiver are not in phase as they are in the case discussed above of a pair of parallel direct current carrying wires. Note the orbital frequencies of charge inside the nuclei are billions of times larger than those of orbital electrons in atoms - as derived specifically later. The transverse distortion is analogous to the movement of a space satellite when boosted into a higher orbit by a tangential force resulting first in an elliptical orbit transverse to the tangential boosting force.

As the longitudinal force and movement of charge varies sinusoidally, this produces a current of varying transverse dipoles inside the atomic nuclei. This transverse current creates dipoles transverse to itself, i.e., longitudinally, $(Kekr/c)(krx"(t)/cmr^3) = - Ke(2\pi fkr/c)^2 \sin 2\pi ft/mr^3$.

So in a nucleus with orbital charge moving initially along all possible circles on an imaginary sphere, there is as a result of these forces a preference for elliptical excitations on two of three mutually orthogonal axes. The longitudinal dipoles produce a field in the opposite direction of the initial longitudinal field that is $(2\pi fkr/c)^2$ times the original field and thus equal exactly to the delayed radiation field derived from Maxwell's equations. This is all quite analogous to Maxwell's changing electric field creating a magnetic field and the changing magnetic field creating an electric field. But instead of changes happening through ethereal vortices or wheels and ball bearings or some mathematical equivalent, i.e., the curl of a vector field, in the space between source and receiver, it happens in orbital movements of actual, charged, particles inside atomic nuclei in the receiver and source:

$E_R(t)=(1-\exp -ct/r)(E_s)(2\pi fkr/c)^2(\sin 2\pi ft)/r^{*3}$ then is the indicated equation we derive more rigorously later for the field at the receiver at a distance, r*, from the source analogous here to a forced mechanical harmonic oscillator eg a child being pushed back and forth on a swing. We allow that the field at the receiver may rise above noise before r*/c seconds, namely at r/c seconds where the transverse dipoles in the receiver, krv/c, may exceed 1 angstrom at a much smaller value than r* if v(t) rises to a sufficiently large average or rms value after t =r/c seconds less than r*/c seconds.

Such an explanation of light transmission requires that the cumulative increase of the received radiation above a threshold of observation depends on constant exposure of the receiver to the source. That is, radiation we observe from stars cannot have originated years or centuries ago as implied by the extrapolation of terrestrial light speed measurements to such distances; indeed it could not have originated more than 12 hours or 12 times 3600 =43,200 seconds earlier at most

when a heavenly object rises and then falls below the horizon of any observer tracking its trajectory across the sky.

.

LIGHT SPEED MEASUREMENTS

We show that radar speed and light speed measurements are consistent with this mechanism and the implication that radiation is received in many instances in less than the r*/c time delay assumed for sources at a distance r* from a receiver.

Let us consider first, Roemer's so called measurement of the speed of light in 1676. Roemer's measurement of the speed of light required that light be a wave front or a group of moving particles. That is, Roemer's measurement required that reflected sunlight, reflected from the surfaces of Jupiter's moons, traveled as a wave front or particle for about 40 minutes using Bradley's value (or 55 minutes using Roemer's value) until it reached the Earth. By which time an observer on the Earth would have orbited and spun with the Earth a substantial distance, sometimes under clouds, to a location with an unclouded view of the night sky. Roemer's measurement did not entail constant exposure of the light receiver to the light. But nothing of course could block the reception of light at the expected time of arrival.

Until Bradley's paper on stellar aberration in 1728, the most knowledgeable astronomers at the time like Cassini, thought that the changes Roemer observed were due to the changes in viewing position and not light speed. Unlike

Roemer's measurement, Fizeau's measurement of light speed entailed constant exposure of the light receiver to the distant mirror when light from the distant mirror was supposedly traveling about five miles to successive gaps of a spinning cogwheel or toothed wheel. That is, a strong sodium vapor light source reflected off of a nearby, slanted, partially transparent mirror, the source mirror, and was focused by a lens to pass through a fixed region of successive gaps in a spinning toothed wheel to a distant mirror 8.67km away through the 1849 Parisian night sky and then reflected back and focused through the same or another gap if not blocked by a tooth, going straight through the slanted glass to the observers eye. The wheel with 720 teeth when revolving at 25 rev/s gave the maximum light intensity. If the wheel made one complete revolution in a second, the time between successive gaps at the locus of the focused light would be 1/720 of a second. So 1/25 times 1/720=1/18000 second is the time it takes for light to leave through one gap and reach the distant mirror and then to return just in time to pass through the next gap etc.. This meant a speed of

(17.34)km./$5.55(10^{-4})$s.=$3.124(10^{7})$m/s,.

But it is also true that the during the supposed travel time or rather one quarter of it, light from the source mirror is exposed to the distant mirror and then for half of it a tooth is interposed between the source and distant mirrors and then for another quarter the observer's eye behind the source is exposed to the distant mirror. Thus it is possible that instantaneous forces at a distance initiated at these unobstructed times, and, delays taking place in the distant mirror and the receiver's eyes, could account for the observed delay made measurable by the spinning toothed wheel.

It is interesting to note that Bradley's 1723-28 light speed observations also could be explained more directly not in terms of the light delay from the observed star but in terms of the light delay from the refractive glass, the objective lens at the far end of his 12.5 foot telescope, where the star's light is then re-emitted to the eyepiece in front of the eye (forming a reverse image there) and then being reversed again by the refracting eyepiece into the eye.

That is, a bright northerly star, eg, the head in the Dragon constellation, at a specific time, spun briefly into the narrow view of the telescope raised from a north south line of longitude to point directly overhead ie the zenith(51degrees lat. at London) and capable of being moved by a micrometer mechanism in seconds of a degree but not to exceed eight minutes of a degree of altitude up or down or to the side being east or west or north or south.

The Earth, orbits at 29km/s in its orbital plane directly below this somewhat polar star. In March, the motion was such that if you drew a line from this star to the object glass of the telescope and then down to the eyepiece at the time of day the star passed into and out of view in a east to west direction you would see that the star appeared more south than at other times of year.

That is, at this time, the star appeared 41 seconds of arc more southerly than in September as determined by moving the micrometer until the star was exactly at the center point of the cross-hairs of the eyepiece at the time of day when it crossed the line of longitude ie the Greenwich or zero meridian.

It was as if the earth and eye were moving exactly opposite to the way they were moving in September and in a more directly north direction so that by the time the light reached the eye, the eye had moved more northerly and the image of the star appeared to come from a more southerly direction.

This meant that the time it took the light impinging on the objective glass to register on the eye 12.5 feet away was the time it took the Earth and so the observer's eye, to move in the Earth's orbital plane a small southerly distance from the base of a vertical perpendicular dropped from the objective glass edge at the instant the starlight impinged on the objective glass.(Of course all this time the spin of the earth makes the star image to move in an east to west direction also but we are ignoring this and just looking at the orbital movement that appears to

be northerly at this time of year.) The distance along the vertical perpendicular is ct where c is the unknown speed of light and the horizontal(north-south) distance is vt where v is the orbital speed of the earth. The time, t , is the same in both cases.

We know that at one day in March, this distance is 41 arc seconds more south than at the opposite time of year in September and thus 20.5 arc seconds more south than when 3 months earlier or later where ,there is no such change. Consider then the right triangle formed by the vertical side of length ct, the hypotenuse being the 25.5 foot telescope and the horizontal side, vt. The quotient, vt/ct , is the tangent of 20.5 arc seconds =.0000099 and so c is 29 times this or $2.929292(10^8)$ meters/second. The implied delay time in this interpretation is about 25.5 nanoseconds.

Bradley's calculation here allows the possibility that light delay could be in the space between the star and the eye or, as one in Bradley's circle,T Melvill, in 1753 suggested, wholly inside the eye. (p483 of Bradley, Miscellaneous Works and Correspondence edited by Stephen Rigaud) or in the space between the objective lens of the telescope and the eye as proposed here.

If we choose the latter interpretation we see that Cassini's explanation of Romer's observations was correct. That is, light from the sun or from the reflection of sunlight on Jupiter and its moon's could be observed in fractions of a second after it is emitted.

The Earth's orbital speed, 29km/sec was known then from the known 365 day period and Cassini's 1672 observation of Mars' position from two widely separated points on Earth(Paris and French Guyana) at the same time which gave the Earth sun distance or orbital radius as $1.4(10^8)$km. ($1.46(10^8)$ is the more accurate present estimate). Since 39370inches =1km, 29km/sec is $1.141730(10^6)$ inches per second.

. Thus in the case of the Bradley and Fizeau measurements, the delays in the perception of light are nanoseconds or milliseconds and not 40 or 55 minutes in the case of Roemer's measurement and the receiving eye was exposed to the refracted image at the time of secondary emission from the glass lens.

In any case, Maxwell's theory of light transmission and delay in 1861 based on Kirchoff's theory of transmission in an aerial coaxial cable(1857), both a few years after Fizeau's measurement in 1849, showed that Fizeau's light speed measurement agreed roughly, not only with the Bradley, Roemer values but also with the ratio of the magnetic force constant, $\mu 0 = 4\Pi(10^{-7})$ to the electric force constant, $1/4\Pi\epsilon 0 = 9(10^9)$. That is, the force between parallel wires a meter apart carrying currents of 1 Amp or 1 Coul/s is 10^{-7} Newtons and the force between two

charged spheres each carrying one Coulomb of charge is $9(10^9)$Newtons. And that light speed was a fundamental constant relating magnetism to electricity, $c^2 = 1/(\epsilon_0\mu_0$, Kirchoff's value was $c=3.1(10^8)$m/s.

This led many to conclude that the differences in the other measurements were due to experimental errors and that more care in making these measurements- Albert Michelson spent his entire life doing this- would yield exactly the ratio of the electric force to the magnetic force. Another possibility is that the speed of light could vary with power of the received radiation.

But an even more important implication of the theoretical value is that some unknown mechanism involving the interplay between magnetic and electric forces might explain the radiation of light. Modern experiments showing charge polarization inside atomic nuclei hint at the nature of this mechanism, perhaps, as summarized above and examined in more detail later.

It is necessary to point out here that radar communications with distant space probes, radar reflections off the moon or distant planets, etc., do not confirm the light speed interpretation of Roemer's observations of Jupiter's moons, as they would seem to at first glance. Anomalous gravitational measurements suggested by one of the Pioneer space probe's communications as well as an unaccounted for change in trajectory after the probes encounter with Jupiter as it moved to the edge of the solar system; also the unexplained disappearance of many space probes after successful launching could be due to false assumptions of the speed of light leading to miscommunication with the probes. For example the assumption that radiation could be received at the expected time from a space probe by one of the three antennas on earth that was not facing the probe at the time of reception. This assumption contradicts the evidence of other light speed measurements eg Bradley,Fizeau,Foucault, Michelson etc..

Radar communications with the gps system involving transmission delays of about .0066 seconds until the signals rise above noise or to a calibrated level are consistent with the proposed mechanism as well as the standard theory. (The power is small enough and so the value of v(t) in the expression krv(t)/c is small enough for r/c seconds where $r=2.02(10^3)$km approximately) The same may be true for communication with the 8kW transmitter on the Pioneer 2 space probe near Pluto at a distance of $4.34(10^{12})$ meters or, dividing by $3(10^8)$ m/s, 14,400 seconds or 4 hours away. But it may also be, as allowed by the proposed mechanism, that the speed of light delay was less. I am told by NASA that the duration of repetition of ones and zeros in a series comprising a code or an instruction or a set of instructions, sent to and from the space probe exceeded the speed of light delay in general so that if transmission delay was less it would not have been detected.

Note that the speed of light used in Doppler shift measurements of the red(blue) shift of stars receding(advancing) at some rate of speed,v, could apply to the rate of delay of the star light in successive receding positions after it scattered from a refraction grating and before it was observed and recorded in the spectrometer. This is completely analogous to Bradley's measurement of light speed where only the ratio of v/c is used. Similarly for radar signals from a space probe reflected by a dish onto the waveguide slit at the focus of a parabolic dish.

One of the objections to this proposed mechanism is that instantaneous forces are impossible and that and orbital system inside atomic nuclei involving orbiting particles moving at speeds greater than the speed of light are impossible. This contention is based on the aparent increase of mass of high speed beta electrons whose speeds approached the speed of light. Beta electrons (electrons emitted by nuclei of radioactive atoms) of various speeds near the speed of light were observed. Their increasing responsiveness to a magnetic field as their velocity increased was seen, unexpectedly, to slack off when the velocity increased beyond a specific amount. The rate of increase of the response, as the velocity increased, unexpectedly decreased. Instead of being attributed to changes in magnetic responsiveness, these changes were attributed to increasing inertia or mass. The force producing the velocity seemed to show a conversion of energy into inertial mass which instead was the absorption of a greater amount of energy needed to produce a smaller increase of charge polarization inside the electron..

Walter Kaufmann, the one person in 1901-1906 who had most familiarity with this sort of experiment objected that the data seemed to require different values for the inertial mass in different directions. But his objections were ignored in favor of the simpler explanation offered by Special Relativity whose success in explaining the Michelson Morely experiment was in its favor.

We will discuss Kaufmann's theory in more detail later and show that a similar explanation is that there is a change in magnetic responsiveness as the speed of a charged particle increases to the speed of light.

Thus we have sketched a mechanism, and evidence for it, that explains observed delays in light and radio/radar transmission in terms of real (non zero mass and volume) particles inside atomic nuclei, The proposed mechanism allows various speeds of transmission that are often greater than the speed of light. eg light from Jupiter and its moons, the sun and visible stars arrives almost instantaneously, while much weaker radiation such as light from planets and stars refracted from a telescope objective lens or radar signals from gps satellites arrive with the r/c delays consistent with the standard theory as well as with the proposed mechanism.

GRAVITY, MAGNETISM AND LIGHT