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A HEURISTIC ELECTROMAGNETIC APPROACH TO GRAVITY

by

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INTRODUCTION

That much of man's epistemological effort is expended in the direction which enables him to perform crucial experiments is an expression of his belief in the generalizable or purposeful nature of phenomenon, or more expressively, the belief in the existence of necessity. From this belief stems the formalisms, together with their axioms (Laws) and their rules of logic. These he offers as the language and organizing principles of the phenomenon which he purports the formalisms to explain. Successful generalization of these formalisms to other systems of facts often entails modification of either the axioms or rules of logic or both; e.g., the changes in quantum mechanics as introduced by Schrodinger. If this generalization is not possible, he soon abandons the one formalism for a more applicable one. It is of interest that he not only expects his formalism to interpolate correctly for him, but is also pleased only if it predicts and yields relationships previously unsuspected but nevertheless valid. Since the formalisms are mere languages containing no information with which they are not endowed and which are, at best, only approximations to reality, it is indeed fortuitous that they offer any useful guidance. It is, nevertheless, just this guidance that man seeks and values so highly.

Consequently, even the abandoned formalism is valuable if it is still applicable in this way; indeed, disuse does not change its value. Within the author's knowledge, the gravitation mechanicians, presently considering the more general algorisms such as the tensor formalism, view quantum mechanics and its precursor, classical mechanics, as effete. This, in the sense above, is perhaps not true.

COMPONENTS

In a manner both indifferent to the rigors of classical mechanics and quantum mechanics and tolerant in the regions of their contradiction, consider the gravitational attraction of two atomic unit masses at a separation of r. The gravitational force between them is given as

$$f = \frac{G\,m\,m}{r^2},$$

where f is construed as the atomic unit mass gravitational attraction, G, the gravitation constant, and m, the atomic unit mass in grams. This is equivalent to the force between two equal weights of N unit masses, the force being divided by N^2. (Considering that a unit mass attracts equally each unit mass of the other weight.) For the purpose of calculations, assume first that the gravitational energy is quantized and second that the elementary particle of this quantization is the atomic unit mass. Now, perhaps it is reasonable to suggest that at a separation-distance of a centimeter, adjacent energy level differences correspond to an increment of r that is near the limit of resolution, i.e., 1μm. Then the energy difference is

$$E_{v+1} - E_v = \Delta E = f\,dr = \frac{G\,m\,m}{r^2}\,dr$$

$$= \frac{6.67 \times 10^{-8}\ \text{dyne cm}^2}{1\ \text{cm}^2\ \text{gm}^2}\left(1.6 \times 10^{-24}\ \text{gm}\right)^2 10^{-4}\ \text{cm}$$

$$\Delta E \cong 1.7 \times 10^{-58}\ \text{erg}.$$

The frequency and wave length corresponding to this energy are

$$\nu = \frac{\Delta E}{h} = \frac{1.7 \times 10^{-58}\ \text{erg}}{6.55 \times 10^{-27}\ \text{erg sec}} = 2.6 \times 10^{-33}\ \text{sec}^{-1}$$

$$\lambda = \frac{c}{\nu} = \frac{3.0 \times 10^{10}\ \text{cm/sec}}{2.6 \times 10^{-33}\ \text{sec}^{-1}} = 1.2 \times 10^{43}\ \text{cm}.$$

Were it a physical verity that a wave length was associated with gravitation forces, it is suggested that the value calculated above is only to be regarded as the extreme maximum, for indeed, it would be difficult to justify the value of dr for a unit mass as one μm. (1μm).

The elucidation of the source of energy is indeed a formidable task, nevertheless, there is the remarkable suggestion that it is of a transitory and composite nature. This suggestion arises from Heisenburg's Uncertainty principle. The period of time, Δt, that an atom can retain an energy, Δe, in excess of the energy of the nearest quantum level is related to that energy, Δe, by the inequality:

$$\Delta E \, \Delta t \geq \frac{h}{2\pi}$$

If this energy is of the order 10^{-59} ergs. it is retained for 6.2×10^{33} sec. The emission of this energy can be imagined to be steady as in the classical radiation theory and characterized by a wave length. If the total time of emission is of the same order of magnitude as the period of the radiated wave, then an approximate wave length is obtained.

So: ie. $\Delta t \simeq \tau \equiv \frac{1}{\nu} = \frac{\lambda}{c}$

$$c \Delta t \simeq \lambda = 6.2 \times 10^{33} \cdot 3. \times 10^{10} = 1.8 \times 10^{44} \text{ cm}$$

Thus again, a maximum wave length* is calculated that compares well with the previous one. Perhaps it is not considered remarkable when one remembers that two mechanics are used and that an adroit choice would enable one to make a large number of unreal correlations. Nevertheless, continuance in this vein is fruitful.

The locus of a charged particle in a perpendicular electric and magnetic field is a cycloid with a principal direction of motion orthogonal to both the electric and magnetic vector. Moreover, both positive and negative particles move in the same direction. If either the direction of the electric or magnetic vector is reversed, the principle motion of the charged particles

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* Footnote It might be conceptually easier to consider, instead of a wave length, ~~the~~ characteristic length of a pulse.

is also reversed. (See Appendix - Part I) In an electromagnetic wave, the direction of propagation, the electric vector, and the magnetic vector are mutually orthogonal. If these directions can be superimposed respectively upon e_1, e_2, and e_3 of right-handed cartesian-coordinates, let the electromagnetic wave be described as a dextro-wave or dextro-pulse and the other case described as a levo-wave or pulse. During normal propagation, the levo-wave retains its identity. Upon reflection, however, due to the reversal in the direction of the ~~electro~~ vector, it is transformed into the dextro-wave. The charged particle in the field of levo-wave moves in the direction of the source, even when the wave is oscillatory, and in the presence of the dextro-wave in the direction of propagation. The average force on the particle is proportional to the product of the charge and the field strength. (See Appendix - Part II) However, the average force on a rigid dipole is zero. (See Appendix - Part III) From the preceding imbroglio, an interesting synthesis can be effected.

SYNTHESIS

It may be of heuristic value to consider this proposition: that gravitational force is primarily due to the interaction of charged particles (more specifically, of non-rigid dipoles or polypoles) with weak levo pulses of very long characteristic length. Let us speculate further and draw when possible upon known phenomena.

1. A comparison of the electrostatic and gravitational forces between alleged unit charges (i.e., electrons) and atomic unit masses respectively, indicate that the electrostatic force is approximately 10^{25} times that of gravity. Certainly, if the gravitational force were approximately equal to or greater than the electrostatic force, the proposition would be untenable.

2. This proposition suggests that as in electrostatics, the intensity of the electric field, and <u>therefore</u> the gravitational force, is subject to Coulomb's Law of Inverse Squares. (The satisfaction of Coulomb's Law is indeed demanded by experiment. Thus, the emitted pulses or waves are of a spherical nature.)

3. The extreme character of these wave lengths permits ordinary objects, even systems of heavenly bodies, to be considered as coherent sources of the pulses or waves. Quite analogous to non-monochromatic light, it might be anticipated that at great distances interference effects might be noticed. This would correspond to a small repulsion term in the gravitational force significant only at great distances. Consequently, the proposition offers forth an explanation of the small maximums (observed but not unconfirmed) in the distribution of galaxies in the Coma Cluster. Other astronomical observations might thus be similarly reduced.

4. Van der Waal's forces originate in the transient dipoles of moving electrons around a positively charged nucleus. Where, as a rigid system of

charges would receive no net force in a perpendicular electric and magnetic field, a loosely bound system would. Thus, both Van der Waal's forces and gravity are related to the kinematic and uncertain character of charged particles which constitute matter. If the foregoing statement is true and neutrons are not composed of equal numbers of opposite charges, then it is apperceived that the gravitational constant may be a weakly varying function of atomic weight, since the proportion of neutrons in the nucleus increases generally with atomic weight. This astounding suggestion is neither contradicted by astronomical data (where the accuracy is low) or by the Cavendish experiment where only very heavy metals are used. (E.g., gold or platinum.)

5. The expanding universe would represent a decrease in perturbing potentials originating at large distances from the system now considered. (A quantum mechanical system), corresponding to the decrease in potential would be a decrease in the energy levels. Thus the increment of energy might be emitted as the postulated levo-waves, resulting in gravitational attraction. If this were so, it would be a very interesting example of Le Chalelier's Law, since the propagation of levo-waves would tend to contract the universe by gravitational attraction.

6. In considering the source of the waves it is of course not mandatory that all waves produced are levo, but only that the energy corresponding to these waves is greater than that corresponding to the dextro-wave. If normal transitions as in Roman spectrum, nuclear, or spin transitions could sp result in absorptions of incorrect amounts of energy, then the reemission of the incorrect excess could be the source of gravitational waves. However, the excess of levo-pulses might be a general phenomenon existing even in the visible spectrum. ~~but~~ A plausible reason is not offered.

7. If another speculation is not begrudged, and if it may take the form that the interaction of a photon with a gravitational field (as in the halo

effects concomitant with certain galaxies) can be considered as the electromagnetic interaction of a photon with an excess of levo-waves, and if levo-waves were also in excess in visible light, then it is plausible to suggest that enantiomorphs would not rotate plane polarized light in exactly equal amounts in opposite directions. It must be remembered that the polarized light would contain different intensities of levo and dextro waves. Moreover, if this suggested phenomenon could be distinguished from experimental errors, (optical rotation is strongly temperature dependent) then it is subject to a simple check by the reflection of the plane polarized light previous to transmission through the optically active substance and observation of an excess rotation in the opposite direction.

Now if it has been the author's pleasure in evincing the reader that classical mechanics and quantum mechanics have a spectulation-facient value in regard to the gravitational phenomenon, then permit him to recall that the treatment is intended as strictly heuristic and as such may contain many implicite contradictions. ~~However,~~ Although an attempt has been made to reduce the proposition to experimentally testable statements, some of these experiments are at present beyond the power of man to control. Exemplia gratia; obviously he could not presently diffract or reflect these suggested pulses as such and observe variations in gravitational intensity as in Lloyd's Mirror experiment. It might be suggested that a local reversal of the magnetic vector or electric vector to form the dextro wave could give a useful anti-gravitational field, yet the frequency of the postulated wave is such that no detectable current would be generated and this would then necessitate an outside source of power to reverse the field. Conceivably, gravitational force could be a function of temperature diminishing rapidly at very low values, if transition excess energy were involved. There might be considerable time delay, however, while emission is taking place before the force change could be measured, provided that general gravitational radiation wasn't sufficient to re-excite the system. (I.e., an atom)

Nevertheless, let it be remembered that not all the experiments proposed are beyond the scope or practical consideration, (for example, the gravitation constant's dependence upon atomic weight) and that many interesting if fortuitous agreements with the facts are observed. The author means to imply that the value of the proposition remains more with the directed stimulation toward investigation than as the answer to the gravity question.

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SUMMARY

Some functions of man's scientific formalisms are succinctly discussed with emphasis placed upon their speculatory utility. Classical and quantum mechanics are drawn upon in an attempt to obtain a proposition of gravity. The formalisms suggested a proposition involving electromagnetic waves of extreme characteristic length. A distinction is made between dextro- and levo-waves. It is indicated that the proposition offered is compatible with known phenomena and suggests feasible viewpoints for some other difficult problems. Experiments are also discussed.

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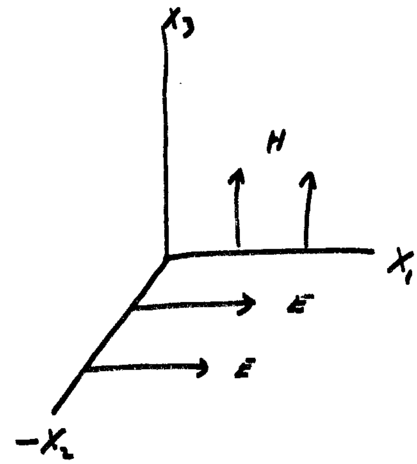
APPENDIX

I. Positive charged particle in a perpendicular electric and magnetic field.



$$m\ddot{x}_i = q E_i + \frac{q}{c}\epsilon_{ikm} H_m$$

$$E = (E, 0, 0) \qquad H = (0, 0, H) \qquad q = e$$

$$\ddot{X}_1 = \frac{e}{m}E + \frac{e}{mc}\dot{X}_2 H$$

$$\ddot{X}_2 = \qquad - \frac{e}{mc}\dot{x}_2 H$$

$$\ddot{X}_1 + i\ddot{X}_2 = \ddot{z} = \frac{eE}{m} + \frac{e}{mc}\dot{x}_2 H - i\frac{e}{mc}\dot{X}_1 H$$

$$\ddot{z} = \frac{eE}{m} + \frac{eH}{imc}\dot{z} \qquad \text{Let } w = \frac{eH}{mc}$$

$$\ddot{z} + i w \dot{z} - \frac{eE}{m} = 0$$

at $t = 0$ $z = 0$, $\dot{z} = 0$

$$\dot{z} = -\frac{ieE}{wm}\left[1 - e^{-iwt}\right]$$

integrating a second time

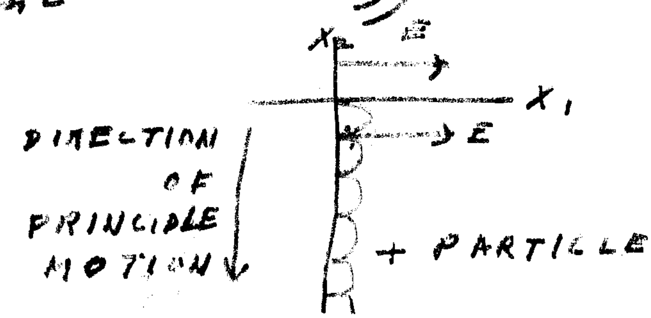
$$z = -\frac{eE}{w^2 m}\left[iwt - 1 + e^{-iwt}\right]$$

then

$$\left.\begin{aligned} x_1 &= \frac{eE}{w^2 m}\left[1 - \cos wt\right] \\ x_2 &= -\frac{eE}{w^2 m}\left[wt - \sin wt\right] \end{aligned}\right\} + \text{CHARGED PARTICLE}$$

SIMILARLY

$$\left.\begin{aligned} x_1 &= -\frac{eE}{m w^2}\left[1 - \cos wt\right] \\ x_2 &= -\frac{eE}{w^2 m}\left[wt - \sin wt\right] \end{aligned}\right\} - \text{CHARGED PARTICLE}$$



II. Average force on a charged particle in a perpendicular electric and magnetic field.

$$F_2 = m\ddot{x}_2 = -\frac{q}{c}\dot{x}_1 H$$

$$= -\frac{q}{c} H \frac{qE}{\omega m}\sin\omega t \qquad \omega = \frac{qH}{mc}$$

$$= -qE\sin\omega t$$

$$\overline{F}_2 = -\frac{qE}{2\pi}\int_0^{2\pi}\sin\omega t \, d\omega t = \frac{qE}{2\pi}[-1-1]$$

$$\overline{F}_2 = -\frac{qE}{\pi} = m\overline{\ddot{x}_2}$$

III. Dipole in a perpendicular electric and magnetic field.

THE LAGRANGIAN IS $L = T - q\phi + \frac{q}{c}A\cdot v$

WHERE ϕ = SCALAR POTENTIAL $= -X_1 E$

AND A = MAGNETIC VECTOR POTENTIAL $= [0, HX_1, 0]$

$$q = e \qquad \mu = \frac{Mm}{m+M}, \quad I = Ma^2 + ml^2$$

$$L = \frac{1}{2}\frac{Mm}{m+M}\dot{x}_2^2 + \frac{1}{2}[Ma^2 + ml^2](\dot{\theta})^2 - Eea\cos\theta + eEl\cos\theta$$

$$L = \frac{1}{2}\mu\dot{X}_2^2 + \frac{1}{2}I(\dot{\theta})^2 + eE\cos\theta(a+l) + \frac{eH}{c}\cos\theta[(a+l)\dot{X}_2 + (a^2-l^2)\dot{\theta}]$$

$$\frac{\partial L}{\partial \dot{X}_2} = \mu\dot{X}_2 + \frac{eH}{c}\cos\theta(a+l)$$

$$\frac{\partial L}{\partial X_2} = 0 \quad \text{then}$$

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{X}_2}\right) = \frac{d}{dt}(\mu\dot{X}_2) = \mu\ddot{X}_2 = 0$$ THUS THE FORCE ON THE CENTER OF GRAVITY OF THE RIGID DIPOLE IS ZERO.

THE SECOND EQUATION OF MOTION IS

$$0 = I\frac{d^2\theta}{dt^2} + \frac{eH}{c}(a^2-l^2)\sin\theta\frac{d\theta}{dt} + eE(a+l)\sin\theta$$