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Classical Electron Mass and Fields II

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This paper continues the development of a model of the electron (HYDRA), which includes rotational or magnetic terms. The atomic electron state is discussed and a comparison is made with a simple harmonic oscillator. Experimental data is reviewed that supports the possibility of a new lepton.

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BACKGROUND

Static gravitation and electric field equations, including the basic electron mass formula, were derived in our first paper[1] on this subject. It did not address the dynamic (magnetic) fields and energies. The full development of the electric circuit model (HYDRA) includes these energies. The original paper only presented a development of the electron mass formula with frequencies derived from the electric and gravitation self-energies, including a hypothetical cross power normalization. An appendix included a derivation of this cross power expression. The entire development given in the first paper can be presented without recourse to relativistic principles and the results are valid at the hundred parts per million level. By including both the experimentally obtained value of the magnetic moment anomaly and relativistic principles, an exact equation may be developed for the electron magnetic moment from the first paper as follows,

$$\mu_e/\mu_B = \{(1+k)/(1-k)\}^{1/2} \equiv (1+k)/(1-k^2)^{1/2}$$

$$\equiv k/(1-k^2)^{1/2} + [\{k/(1-k^2)^{1/2}\}^2 + 1]^{1/2} \qquad (1)$$

where,

$$k = (2\alpha\mu_B/eC^2)^2(1\text{Hz}/\sqrt{2}t_p) \qquad (2)$$

$$t_p \equiv (hG/2\pi C^5)^{1/2} \qquad (3)$$

and

$$k = 1.158979797 \cdot 10^{-3} \tag{4}$$

$$t_p = 5.390530364 \cdot 10^{-44} \text{ sec} \tag{5}$$

$$G = 6.672521721 \cdot 10^{-11} \text{ m}^3/\text{kg} \cdot \text{sec}^2, \tag{6}$$

using the values from Taylor and Cohen[2], except for the calculated values for G and t_p. The fundamental Hertz frequency unit is determined from

$$(2k \cdot f_{uHz})/(1-k^2)^{1/2} = (\alpha/\pi) \cdot 1\text{Hz}/\{1-(\alpha/2\pi)^2\}^{1/2} \tag{7}$$

and charge velocity is given by,

$$V_c = kC. \tag{8}$$

This expression of the mass formula sets the electron model with a radius equal to the classical electron radius and has allowed the charge velocity to reduce slightly from the classical value of $\alpha C/2\pi$. This, then, gives an exact match to the experimentally determined value of the anomalous magnetic moment. The formulation is exact and should be used to relate the other fundamental constants. For the further development of the HYDRA formulation, only approximate values of the constants will be used, for simplification and the fact that the magnetic field or neutrino energy is not known to a high degree of precision.

Throughout the development of this work, we strove to minimize the number of assumptions and keep the model and mathematics as basic as possible. Physically, the electron is represented as a spherical shell of charge with an equivalent (effective) radius equal to the classical electron radius. It oscillates or pulsates in the radial as well as azimuthal directions. Charge and mass are treated identically and are only distinguishable by frequency. Frequency variation (longitudinal or transverse) of the fields is not addressed. Frequency variation is applied to current or charge flow only. Radial oscillation is identified as zero order rotational motion produced by a radial charge velocity of $\alpha C/2\pi$ and results in a frequency of C/λ_C. Tangential velocity is set at αC so that angular frequency is given by

$$\omega_e = \alpha C/r_e = 2\pi C/\lambda_C. \tag{9}$$

Energy characterized by the fields is assumed to be trapped in the free space material that comprises the current path of the electrical circuits. Each field energy is associated with a resonate circuit and each of these circuits is interconnected through power cross flow terms. Each current frequency is derived from the associated field self-energy by the following definition,

$$f = E_{se}/h. \tag{10}$$

The zero order (static or radial) section of the HYDRA model is depicted in Figure 1. This is the base or front section of an infinite chain of cross-linked pairs.

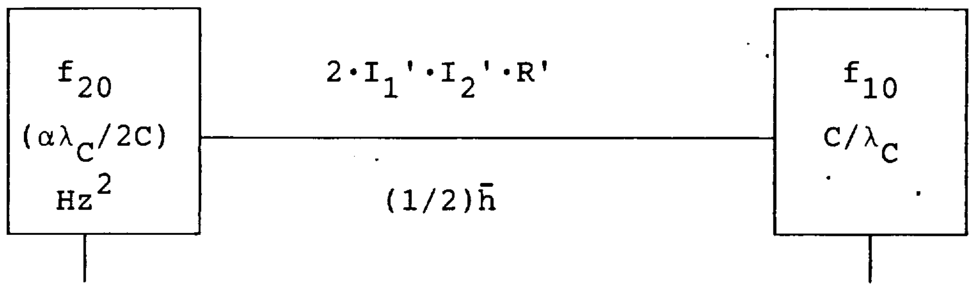

Figure 1. Zero Order Rung

The significance of this simple diagram is that the gravitation and electric energies are cross connected through spin action and that this diagram represents a multiply resonate system. It demonstrates that gravitational energy is not only significant at the nuclear level, but the failing to include it in wave mechanics has resulted in an inability to calculate numerical values for particle masses. An extension of these concepts into quantum theory should prove most interesting. The transfer of energy from one system to another is quantified by power and the transfer of action from one system to another is characterized by energy. By deriving a fundamental base frequency or time, unit power and energy can be developed from action quanta. This, then, summarizes the work presented in our first paper.

First order motion in the electron is represented by the magnetic field energy. The HYDRA model requires a pair of energies to develop a necessary cross-power flow equation for mass resonance. This, then, requires a gravitational equivalent of the magnetic field energy. Therefore, we are postulating that this gravitational-magnetic equivalent field exists, but, as indicated by previous investigations[3], the measurable effects of such a field would be most difficult to detect. However, let us first calculate the circuit energies associated with the electron. Capacitance and inductance for the electron are defined by

$$l = 2\pi r_e \mu_o \qquad (11)$$

$$c = 2\pi r_e \varepsilon_o \qquad (12)$$

and capacitive energy is given by,[4]

$$E_c = (1/2)q^2/c = E_{ese} = E_{10} = m_e C^2 \qquad (13)$$

which is the self-energy of the electric field or the zero order energy. The first order (magnetic) energy is given by

$$E_l = (1/2)\cdot l\cdot I^2 = E_{11} \qquad (14)$$

and

$$I = ef = e(\alpha C/2\pi r_e) = e(C/\lambda_C) \qquad (15)$$

where the inductive energy is then

$$E_l = \alpha^2 E_{ese} = \alpha^2 m_e C^2 = E_{11}. \qquad (16)$$

This would appear to set the first order electrical frequency at

$$f_{11} = E_{11}/h = \alpha^2 (C/\lambda_C). \qquad (17)$$

However, further development of the HYDRA model will demonstrate that there are two cross links connected to the magnetic term, each containing half the magnetic energy, and that the energy forms up as

$$E_{11} = E_l = 2 \cdot h \cdot f_{11} \qquad (18)$$

or,

$$f_{11} = (1/2)\alpha^2 (C/\lambda_C). \qquad (19)$$

Now, let us look at the total energy of the electron from a relativistic viewpoint[5]. Total particle energy should be

$$E_t = m_e C^2/(1-\alpha^2)^{1/2} \qquad (20)$$

or,

$$E_t = \{h(C/\lambda_C)\}/(1-\alpha^2)^{1/2} \qquad (21)$$

and,

$$E_t = h(C/\lambda_C) + h(1/2)\alpha^2 (C/\lambda_C) + \cdots \qquad (22)$$

which sets the frequencies of the energy terms and matches our frequency development, so far. It should be noted that the zero order term does not shift with tangential velocity and may be considered velocity frame invariant. The zero order term should be associated with rest mass or gravitational mass. As will be developed, the higher order energy terms will be associated with inertial mass. Within the rest frame of the electron, these two masses will be shown to be equal. The gravitational and electrical field energies appear to be velocity frame independent, however, inertial mass is obviously not.

The fundamental unit for the rotational velocity is given by

$$f_u = \{(1+\alpha)/(1-\alpha)\}^{1/2}\ \mathrm{Hz} - \{(1-\alpha)/(1+\alpha)\}^{1/2}\ \mathrm{Hz} \qquad (23)$$

or

$$f_u = 2\alpha\{1 + (1/2)\alpha^2 + \cdots\}\ \mathrm{Hz}. \qquad (24)$$

Note that the zero order rotational unit is simply the radial fundamental unit (αHz/π), as developed in the first paper, but multiplied by 2π. However, the first order rotational fundamental unit is α^3 Hz instead of 2α Hz. Therefore, the second leg of the HYDRA forms up as shown in Figure 2. The next rung of paired terms will form with its own specific fundamental frequency unit as will each of the higher order terms in the model.

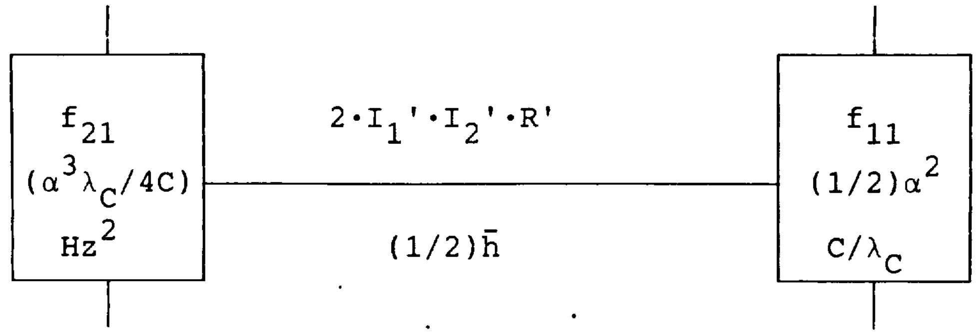

Figure 2. First Order Rung

These frequencies are simply $\alpha^2/2$ times the zero order frequencies. This cross-power term also equates to spin action, or

$$A_{x1} = 2\cdot(ef_{21}/\alpha^3 Hz)(ef_{11}/\alpha^3 Hz)\{(\mu_o/\varepsilon_o)^{1/2}/2\pi\}$$

$$= (1/2)\bar{h}. \tag{25}$$

Then, by expressing the first order energies in terms of the zero order energies, the electron mass formulae is rederived as follows,

$$2\cdot f_{11}\cdot f_{21} = (\alpha^5/4)(1Hz)^2 \tag{26}$$

and since

$$f_{11} = (\alpha^2/2)\cdot f_{10} \tag{27}$$

and

$$f_{21} = (\alpha^2/2)\cdot f_{20} \tag{28}$$

or,

$$2\cdot f_{10}\cdot f_{20} = \alpha(1\ \text{Hz})^2 \qquad (29)$$

which is simply expressing the first order cross power equation in terms of zero order frequencies. This equation is identical to the original cross frequency relationship and produces the same mass equation as derived in the first paper, or

$$m_e = (e/2C)\{h(1\ \text{Hz})^2/(\pi\varepsilon_o^2 GC)\}^{1/4}. \qquad (30)$$

This derivation then sets the first order (inertial) mass identically equal to the zero order (gravitation) mass. Note that first order spin unit energy is much less than the zero order unit spin energy, although the spin action is the same. The f_{21} system represents the gravitational equivalent of a magnetic system. The second order rotational system may be developed in the same manner as the first and as shown in Figure 3.

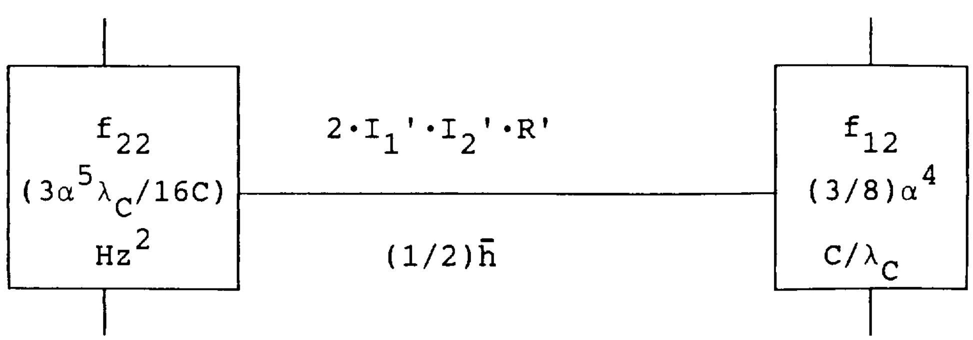

Figure 3. Second Order Rung

The fundamental unit for the second order pair is $(3/4)\alpha^5$ Hz and the second order cross term forms up as before, since these second order frequencies are simply $(3\alpha^4/8)$ factors of the zero order frequencies.

$$A_{x2} = 2\cdot\{ef_{22}/(3\alpha^5 Hz/4)\}\{ef_{12}/(3\alpha^5 Hz/4)\}$$

$$\cdot\{(\mu_o/\varepsilon_o)^{1/2}/2\pi)\}$$

$$= (1/2)\bar{h}. \qquad (31)$$

Again, this produces,

$$2\cdot f_{22}\cdot f_{12} = (9\alpha^9/64)(1\ Hz)^2 \qquad (32)$$

and will result, when expressed in zero order frequencies, in the development of the same mass equation derived for the zero order energies. Thus, the second order inertial mass is identical to the zero order gravitation mass. Note that the first and second order inertial masses do not sum to double the inertial mass, but that each order mass is formed independently for each gravitation and electrical pair. Also note that the second order energies must be doubled, as was done with the first order, because of the two cross links (one up the ladder to the next higher term and the other to the next lower term). Higher order terms may be developed in the same manner as the second order and the corresponding energies (magnetic, spin, and gravitation) will be greatly reduced, thus allowing total particle energy to converge to a finite value even though the model permits an infinite number of terms. The interconnection between the electrical terms forms up as shown in Figure 4.

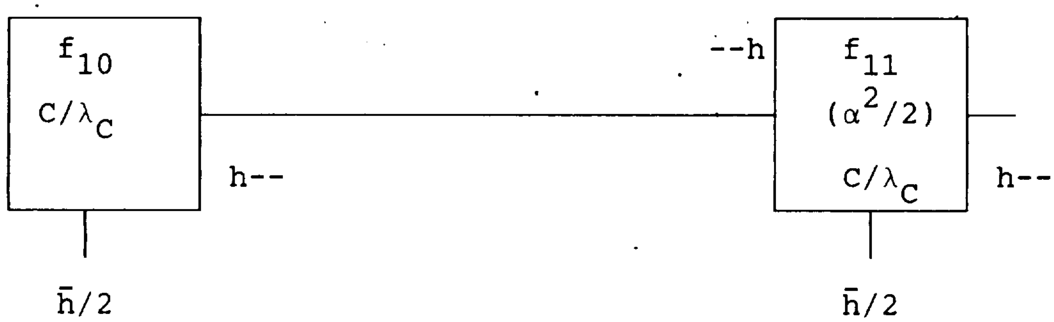

Figure 4. Electrical Cross Link (f_{10} - f_{11})

The cross power for the electrical terms bridges across two electrical frequencies. Therefore, the cross power associated with each term must be calculated separately, using their respective unit frequency. The cross power is given by,

$$P_x = I_{10} \cdot I_{11} \cdot R = e^2(\alpha^2/2)(C/\lambda_C)^2(\mu_o/\varepsilon_o)^{1/2}. \qquad (33)$$

This is a cross unit frequency power link and must use the free space value of resistance, as well as a separate power calculation for the two directions of power flow and h instead of $\bar{h}$ for each direction of action. The timing or frequency for this cross term has two values or

$$f_{u10} = \alpha^3(C/\lambda_C) \quad (34)$$

$$f_{u11} = 2\alpha(C/\lambda_C). \quad (35)$$

Thus the two cross energies associated with the two action units in the cross link are,

$$E_{01} = P_x/f_{u10} = e^2(1/2\alpha)(C/\lambda_C)(\mu_o/\varepsilon_o)^{1/2} = h(C/\lambda_C) \quad (36)$$

$$E_{11}/2 = P_x/f_{u11} = e^2(\alpha/4)(C/\lambda_C)(\mu_o/\varepsilon_o)^{1/2}$$

$$= h(\alpha^2/2)(C/\lambda_C). \quad (37)$$

This demonstrates that the total energy contained in this cross link is equal to the total mass energy plus one-half of the magnetic energy. The other half of the magnetic energy lies in the link to the next higher (second) electrical or, more specifically, magnetic term. Note that the spin action cross rungs are established with the same unit frequency but the cross links between higher order terms have two separate frequency units and, therefore, form up differently. The cross links between the gravitation zero and higher order terms form up in an identical manner and the energy associated with their respective fields is contained in the free space of their cross links. Figure 5 depicts the zero to first order gravitation link.

Figure 5. Gravitation Cross Link (f_{20} - f_{21})

As in the electrical case, the cross power for the gravitation terms bridges across two unit frequencies. Thus, the cross power for each term must be calculated separately, using their respective unit frequency. As before,

$$P_x = I_{20} \cdot I_{21} \cdot R = e^2(\alpha^4/8)(\lambda_C/C)^2(Hz^4)(\mu_o/\varepsilon_o)^{1/2} \qquad (38)$$

and

$$f_{u20} = \alpha^3(\alpha\lambda_C/2C)(1\ Hz)^2 \qquad (39)$$

$$f_{u21} = 2\alpha(\alpha\lambda_C/2C)(1\ Hz)^2. \qquad (40)$$

Then the gravitational link energies associated with each action (h) unit are as follows

$$E_{20} = P_x/f_{u20} = (e^2/4)(\lambda_C/C)(Hz^2)(\mu_o/\varepsilon_o)^{1/2} \qquad (41)$$

$$E_{20} = h(\alpha\lambda_C/2C)Hz^2 \quad (42)$$

and

$$E_{21}/2 = P_x/f_{u21} = e^2(\alpha^2/8)(\lambda_C/C)(Hz^2)(\mu_o/\varepsilon_o)^{1/2} \quad (43)$$

$$E_{21}/2 = h(\alpha^3\lambda_C/4C)Hz^2 = (1/2)\alpha^2 h(\alpha\lambda_C/2C)Hz^2 \quad (44)$$

Again, the total energy contained in the zero to first order gravitation term link is equal to the field self-energies associated with the gravitation field and one-half the magnetic-gravitation field. One could continue with each subsequent link indefinitely, but we will finish with the electrical link between the magnetic field term (f_{11}) and the next higher term (f_{12}), as shown in Figure 6.

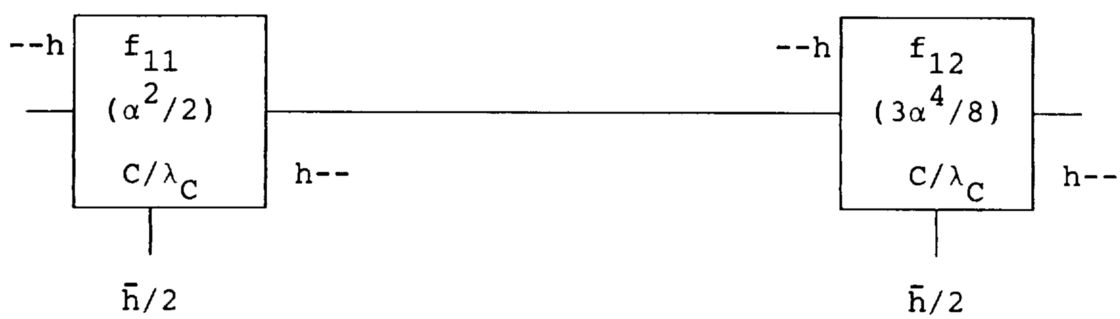

Figure 6. Electrical Cross Link (f_{11} - f_{12})

Cross power is calculated as before,

$$P_x = I_{11}\cdot I_{12}\cdot R = e^2(3\alpha^6/16)(C/\lambda_C)^2(\mu_o/\varepsilon_o)^{1/2} \quad (45)$$

and the timing or frequency units form up as,

$$f_{u11} = (3\alpha^5/4)(C/\lambda_C) \quad (46)$$

$$f_{u12} = \alpha^3(C/\lambda_C) \quad (47)$$

where the two cross energies in this cross link are

$$E_{11}/2 = P_x/f_{u11} = e^2(\alpha/4)(C/\lambda_C)(\mu_o/\varepsilon_o)^{1/2} \quad (48)$$

$$E_{11}/2 = h(\alpha^2/2)(C/\lambda_C) \quad (49)$$

$$E_{12}/2 = P_x/f_{u12} = e^2(3\alpha^3/16)(C/\lambda_C)(\mu_o/\varepsilon_o)^{1/2} \quad (50)$$

$$E_{12}/2 = h(3\alpha^4/8)(C/\lambda_C) \quad (51)$$

and that these link energies match as expected such that the remaining half of the total magnetic energy (E_{11}) is indeed contained in this (f_{11} - f_{12}) cross link. Figure 7 depicts the complete HYDRA model.

This then establishes the HYDRA model as a kind of Jacob's ladder with an infinite number of rungs. Total particle energy is contained within these cross links. Note that total mass energy is contained within the first electrical link, but that this energy is not the total particle energy. Total particle energy would appear to be given by

$$E_t = E_{electric} + E_{magnetic} + E_{spin} + E_{grav} + \cdots . \quad (52)$$

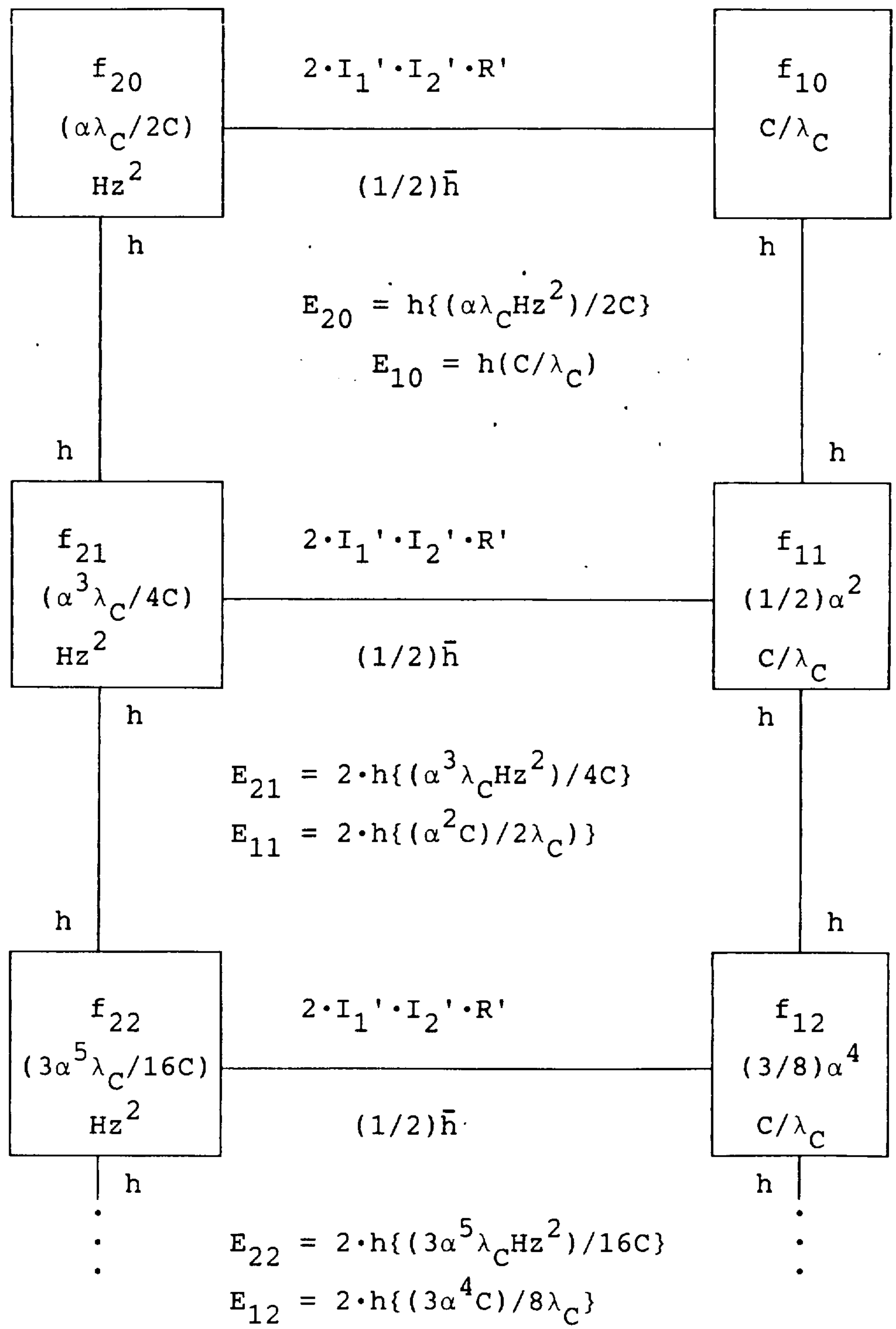

Figure 7. HYDRA Model

The magnetic and higher order term energy is not a part of the mass energy, nor is the spin energy. Experimental proof of this statement would be most difficult as the magnitude of these energies is quite small. When this particle is broken up, the electrical and gravitation zero order terms break off to form the photon which is associated with radial motion, while the magnetic terms form the neutrino and may be associated with angular motion. The electron essentially is radially and rotationally trapped in its reference plane by the cross links formed between the zero (radial) and higher order (rotational) terms. Neutrino energy should be approximately equal to magnetic energy or, by this development, α^2 times the mass energy.

ATOMIC ELECTRON

The HYDRA model was developed for the nuclear electron but should be applicable to the electron in its atomic state. Since the model is a tightly coupled resonate system, the atomic state should be obtained by interchanging components of the model. If the first order magnetic terms are interchanged with the zero order radial terms, the atomic state is produced. The nuclear electron was characterized by the total mass energy being represented by electric field self-energy. Thus it might be described as the "electrical" electron while the atomic state is characterized by the total mass energy being represented by magnetic field energy. Thus the atomic electron may likewise be characterized as the "magnetic" electron. But first we should set the atomic radius (r_{ae}) of the electron by requiring that its electric field self-energy must match the first order energy value or

$$E_{ese} = \alpha^2 m_e C^2 = e^2/4\pi\varepsilon_o r_{ae} \tag{53}$$

and

$$r_{ae} = e^2/4\pi\varepsilon_o \alpha^2 m_e C^2 = r_e/\alpha^2 \equiv a_o . \tag{54}$$

where a_o is the Bohr radius and E_{ese} or E_{11} equals the Hartree energy. Now if the frequency of the angular charge motion is the Compton frequency (C/λ_C), then

$$I_{aem} = ef_{aem} = eC/\lambda_C \tag{55}$$

and

$$E_{aem} = (1/2) l_{aem} I^2_{ae} \tag{56}$$

or

$$E_{aem} = (1/2)(2\pi r_{ae}\mu_o)(eC/\lambda_C)^2 = m_e C^2 . \tag{57}$$

The electric energy frequency is given by the first order electric term as,

$$f_{aee} = f_{11} = (\alpha^2/2)(C/\lambda_C) \equiv Ry \tag{58}$$

where Ry is the Rydberg constant expressed as frequency, in Hertz. Thus we have, rather simply, derived the basic constants associated with the atomic electron using the

HYDRA model. Having the fundamental oscillation (Rydberg) frequency of the atomic electron's electric circuit, all of the spectral line series' may be calculated for the Hydrogen atom. The only physical inconsistency encountered is when charge velocity is calculated from charge frequency or

$$\omega_C = V_C/(r_{ae}) = 2\pi(C/\lambda_C) \tag{59}$$

and

$$V_C = C/\alpha \tag{60}$$

which, rather embarrassingly, exceeds the speed of light. However, this would explain why the atomic electron is not found as a stable isolated particle, or state of the electron. It must surround a nucleus to exist. The nucleus seems to provide a necessary platform, or reference system, that overcomes this difficulty. If the nucleus were a positron, it would provide a spin platform that has an angular frequency of $\alpha C/r_e$. This angular frequency platform, when extended to the Bohr radius, produces a tangential velocity of C/α. Which implies that, if the charge in the atomic electron is stationary (zero angular velocity relative to the lab frame), it has a tangential velocity of C/α relative to the nucleus' rotating charge system. Thus the atomic electron, in the lab system, could have zero velocity but exhibit an exceedingly high velocity relative to the rotational charge system of the nucleus, but not in the lab frame. Thus, in the lab system, no charge is exceeding the speed of light. In fact, the atomic electron should have a charge velocity less than C, and if we take the tangential charge velocity in the lab frame as

$$V_C(\text{lab}) = \alpha C. \tag{61}$$

Charge frequency is then

$$f_{ae}(\text{lab}) = \alpha C/(2\pi r_{ae}) = \alpha^2(C/\lambda_C) \tag{62}$$

where the atomic electron's magnetic moment in the lab frame is given by

$$\mu_{ae}(\text{lab}) = I \cdot A = e\{(\alpha/2\pi)C/r_{ae}\}\{\pi r_{ae}^2\} = \mu_B. \tag{63}$$

Total magnetic energy, in the lab frame, is given by

$$E_{mag}\ (\text{lab}) = (1/2)\mathrm{l}I^2 = \alpha^2 m_e C^2 \tag{64}$$

which is the magnetic energy of the nuclear electron state. Therefore, in the lab reference frame, the electric and magnetic energies are identical. This condition places the atomic electron in the position of being able to absorb and emit photons, quite readily, within the lab frame. This was not true for the nuclear electron. Atomic excitation energies are in the eV range, while nuclear levels are MeV.

Note that the atomic electron spins down from the Rydberg frequency to gain energy relative to the nucleus' charge spin platform and that it would have zero velocity (in the lab frame) when it has jumped one Rydberg frequency unit. The resonances that form spectral lines are subharmonics of the Rydberg frequency. In this electrical model, current is proportional to frequency, thus power and energy are proportional to frequency squared.

SIMPLE HARMONIC MOTION

The fundamental frequency generated by intrinsic spin can be represented as a simple harmonic oscillator, whereby a force constant may be calculated for the system as follows,

$$(\alpha/\pi)\mathrm{Hz} = (1/2\pi)\{(2\alpha\bar{h}^2 f_1 \bar{h}^2 f_2)/[(1/2)\bar{h}^2]^2\}^{1/2}. \qquad (65)$$

This is simply a formulation of the basic electron mass in terms of the field frequencies. It is interesting to note how the field energies and spin action combine to produce this elementary form of a mechanical oscillator. The force constant[6] for the above system is given by

$$K_f = m_e(2\alpha)^2(1\mathrm{Hz})^2 = 1.94\cdot 10^{-34}\ \mathrm{n/m} \qquad (66)$$

and radial acceleration is given by

$$a_r = -(k_f/m_e)r_e = -(2\alpha)^2(1hz)^2 r_e = -6.0 \cdot 10^{-19} \text{ m/sec}^2 \quad (67)$$

which may be compared with the radial acceleration produced by the circulating mass or

$$a_r = \omega^2 r_e = (2\alpha Hz)^2 r_e = 6.0 \cdot 10^{-19} \text{ m/sec}^2. \quad (68)$$

If the hypothesis is correct, that the energy is trapped in free space between the electric and magnetic systems (or in the cross flow), then free space should exhibit a force constant which would then produce a natural oscillation system. Equation (66) appears to be that constant and would likewise explain the origin of intrinsic spin, or vice versa, since Equation (66) was derived with spin action.

SS PARTICLE DATA

Lepton and quark mass estimates were given in Appendix B of the first paper. A new lepton (SS particle) was predicted to have the form,

$$m_{ss}c^2 \simeq 9 \cdot [\{\alpha Hz/(2\alpha)^2\}\{\alpha f_p/(2\alpha)^2\}]^{1/2} \simeq 42{,}250 \ m_e c^2 \quad (69)$$

from the symmetry of the three known lepton masses. A paper[7] that describes experimental results from the Deutsches Elektronen-Synchrotron (DESY) operation in 1983-84 describes the possible observation of this particle. This work involved electron-positron annihilation with center of mass energy between 43.2 GeV and 45.2 GeV. While the experimenters were focusing on quark production, they were open to the possibility of new particle production. This paper describes an event with a total collision energy of 43.450 GeV that produced two muons and two hadronic jets. Their analyses ruled out new or heavy lepton production. However, pair production of SS particles appears to fit the experimental data quite well. The estimated total beam energy to produce a pair of SS particles is given by

$$E_{cm} = 2 \cdot m_{ss} c^2 = 2 \cdot (42{,}250)(0.511) \text{ MeV} = 43.180 \text{ GeV} \quad (70)$$

which fits the experimental data at the 0.6 percent level. Lepton pair production should be a high probability event and the puzzling aspect of this observed event was that the expected number of events from known processes was about 10^{-3} or one in a thousand. The experimenters did not feel that they had been lucky enough to hit such a long shot, so they logged the data as "an unusual event." One observed event does not prove a theory, but corroboration should be easily obtainable since an energy level of 43.45 GeV is attainable by several existing facilities, assuming that the

DESY beam energy calibration is accurate. Nevertheless, Figure 8 through Figure 10 depict possible decay schemes for the ss particle. The authors would appreciate any information on experimental data in this energy range.

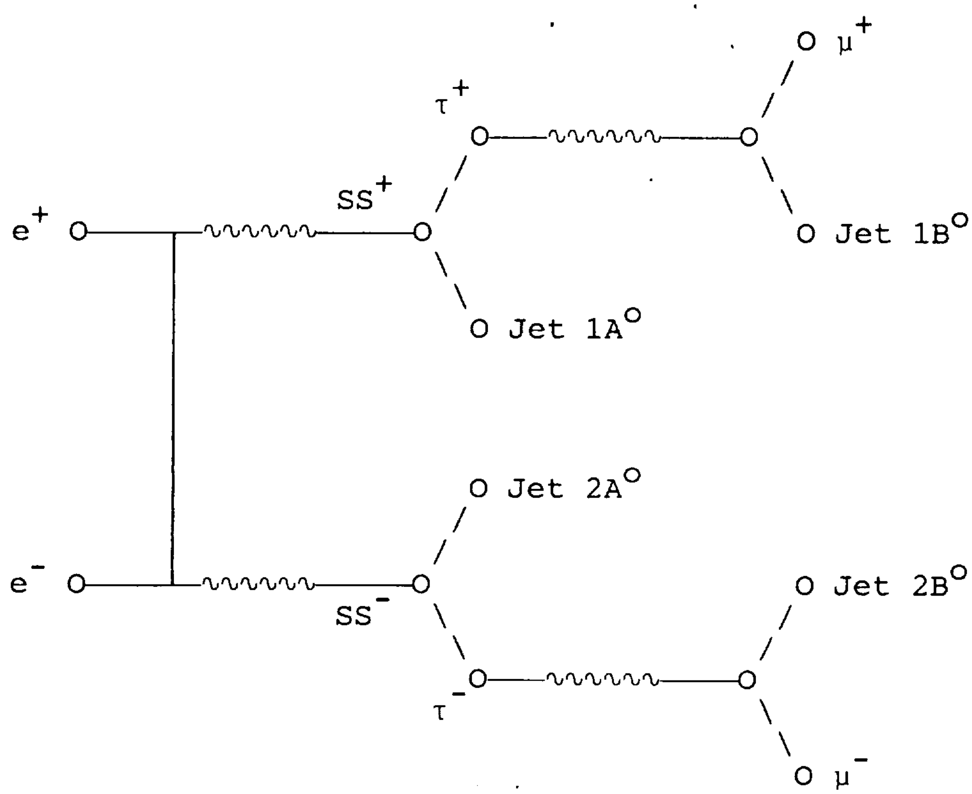

Figure 8. Sequential Decay - 4 Jet Mode

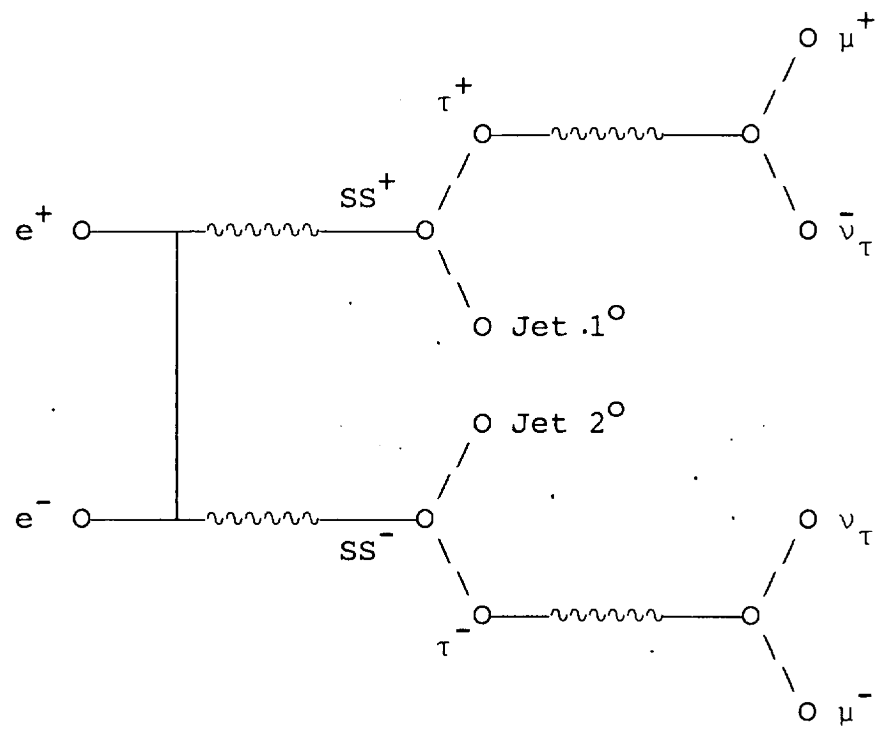

Figure 9. Sequential Decay - 2 Jet Mode

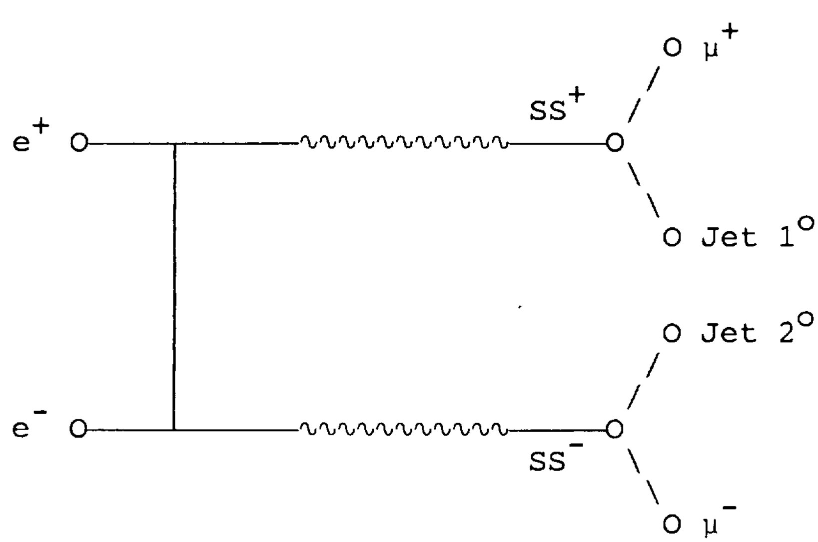

Figure 10. Direct Decay

The nuclear electron was shown to have an electric field frequency of f_C, C/λ_C. The physically produced resonate frequency should be f_e, C/r_e, and would be an expected natural frequency found within the electron system. The gravitational field frequency was shown to be given by f_g, $(\alpha\lambda_C/2C)f_{uHz}^2$, and should have an equivalent f_{ge} frequency. In addition, the Planck frequency (f_p) or inverse of Planck time should be present in the electron system. If we define the Planck frequency as

$$f_p \equiv 1/\{hG/\pi C^5\}^{1/2} = 1/\sqrt{2}t_p \tag{71}$$

this produces

$$f_C \cdot f_e = f_p \cdot f_{uHz}. \tag{72}$$

If the gravitational equivalent (f_{pg}) of the Planck frequency exists, it should have the following form

$$f_{pg} \cdot f_p = f_{uHz}^2 \tag{73}$$

or

$$f_{pg} = (1/f_p) \cdot f_{uHz}^2. \tag{74}$$

Following the electrical field Planck frequency derivation, the gravitational frequency (f_{ge}) equivalent to the electrical parameter f_e should be

$$f_{ge} = (f_{pg}/f_g)\cdot f_{uHz}^2. \tag{75}$$

Keeping in mind that the fundamental one Hertz unit frequency derived earlier is used explicitly in this formulation and may be expressed as,

$$f_{uHz} = f_C f_e/f_p = \sqrt{2}t_p f_C f_e = 1.002096683 \text{ Hz}. \tag{76}$$

These four frequencies form the basis for the zero order electron frequency structure and are related by

$$f_e f_C f_g f_{ge} = f_p f_{pg}\cdot f_{uHz}^2 = f_{uHz}^4. \tag{77}$$

Now one can construct the zero order frequency structure from the cross frequency diagram as shown in Figure 11.

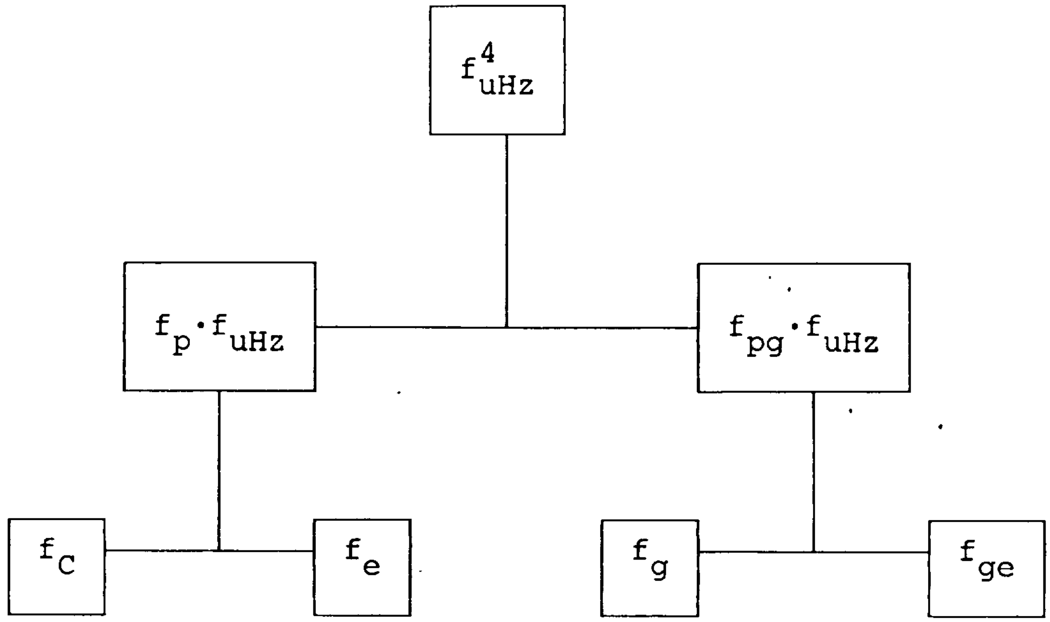

Figure 11. Zero Order Electron Frequency Structure

Figure 11 shows that the frequency structure achieves closure at the fourth order of the fundamental Hertz unit. Note that the two Planck units close at the second order of the fundamental Hertz unit, Equation (73). While there are thousands of different ways to construct this structure with the electron frequencies, which demonstrates the abundance of available multiple frequency resonances, this is the only one that does not cross gravitation and electric parameters at the base level, nor includes Planck frequencies at the base level. Perhaps closure at the fourth order of the fundamental Hertz frequency is indicative of the fact that the electron is a four dimensional or space-time particle.

ZERO ORDER NUMERICAL VALUES

Numerical values may be calculated for the electron frequency structure using values from Reference 4 and the calculated results are at the 0.1 part per million level of precision, unless otherwise indicated. The four base frequencies are therefore,

$$f_C = C/\lambda_C = 1.23558979 \cdot 10^{20} \text{ Hz} \tag{78}$$

$$f_e = (2\pi/\alpha)(C/\lambda_C) = 1.063870629 \cdot 10^{23} \text{ Hz} \tag{79}$$

$$f_g = (\alpha/2)(\lambda_C/C)f_{uHz}^2 = 2.965379674 \cdot 10^{-23} \text{ Hz} \tag{80}$$

$$f_{ge} = (1/\pi)(\lambda_C/C)f_{uHz}^2 = 2.58699188 \cdot 10^{-21} \text{ Hz.} \tag{81}$$

These four base frequencies normalize to the fourth order unit Hertz frequency as

$$f_C \cdot f_e \cdot f_g \cdot f_{ge} = 1.008413145 \text{ Hz}^4 = f_{uHz}^4. \tag{82}$$

The two Planck frequencies are given by

$$f_p = f_C f_e / f_{uHz} = 1.311757348 \cdot 10^{43} \text{ Hz} \tag{83}$$

$$f_{pg} = f_g f_{ge} / f_{uHz} = 7.65536227 \cdot 10^{-44} \text{ Hz} \tag{84}$$

which normalize to

$$f_p f_{pg} = 1.004197771\ \text{Hz}^2 = f_{uHz}^2. \qquad (85)$$

Planck time may be calculated by

$$t_p = f_{uHz}/\sqrt{2f_C f_e} \doteq 5.390530362\cdot 10^{-44}\ \text{sec} \qquad (86)$$

and the Newtonian gravitation constant is given by

$$G = (t_p^2 2\pi C^5)/h = 6.672521724\cdot 10^{-11}\ \text{m}^3/\text{kg}\cdot\text{sec}^2. \qquad (87)$$

Unit Hertz frequency value has been previously calculated by

$$f_{\Delta Hz} = (\alpha/\pi)\text{Hz}/\{(1-(\alpha/2\pi)^2\}^{1/2} = 2.322821195\cdot 10^{-3}\ \text{Hz} \qquad (88)$$

and

$$f_{\Delta u} = 2kf_{uHz}/(1-k^2)^{1/2} = 2.317961151\cdot 10^{-3}\ f_{uHz} \qquad (89)$$

or, since the two displacements are equal

$$f_{uHz} = f_{\Delta Hz}/f_{\Delta u} = 1.002096689\ \text{Hz}. \qquad (90)$$

and, since

$$\mu_e/\mu_B = \{(1+k)/(1-k)\}^{1/2} \qquad (91)$$

$$k = \{(\mu_e/\mu_B)^2-1\}/\{(\mu_e/\mu_B)^2+1\} \quad (92)$$

$$k = (2a_e+a_e^2)/(2+2a_e+a_e^2) \quad (93)$$

$$a_e = 1.159652193\cdot10^{-3} \quad [0.0086 \text{ ppm}] \quad (94)$$

$$k = 1.158979797\cdot10^{-3}. \quad (95)$$

This, then, closes the zero order electron frequency structure as depicted in Figure 11 and developed in the first paper.

SUMMARY

This paper summarized our first paper, which contained the zero order HYDRA equations, and presented the full HYDRA model development. It fully differentiates between inertial and gravitational mass as well as introduces the concept of a magnetic-gravitational field with associated energy. A comparison with the simple harmonic oscillator was made and the concept of the atomic (magnetic) electron was discussed. A possible observation of the predicted ss particle was reviewed with the mass values in agreement at the 0.6 percent level of precision. The zero order electron frequency structure was shown to contain four base or

fundamental frequencies that may be paired or crossed to form the Plank frequencies, in a symmetrical manner. While these two papers have focused on the numerical results of our work, the next paper will discuss a physical interpretation of this work along with speculations concerning future work and applications.

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