# *Electron, Universe, and the Large Numbers Between*

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## Abstract

We show how to calculate mass and charge of the single free electron and present a simplified model of the particle having finite size and shape from internal dynamics. The full internal structure reveals Reimann's differential geometry. The model readily accounts for the electron's duality nature as well as other particle characteristics (i.e., spin, mass, charge, and magnetic moment). The model goes further by identifying a new Large Integer Number ($10^{22}$) liken to but more basic than Dirac's "Large Number". We show how this new Large Number might be explained by theory rather than by numerology or mere coincidence. The electron model and the new Large Number predict an ultra-low quantum of mass (the mass-quant) radiated/absorbed by the electron's internal and external dynamics. Furthermore, the model reveals an elegant symmetry between the micro and the macro universe and gives also a solution for quantum gravity due to many body electrons. At least there is an important application in techniques due to energy management and energy storage in the hydrogen atom's electron.

***In short:*** *1) The local scalar and vector functions concerning the single free electron are time dependent. 2) The electron shows an internal time dependent structure. 3) The electron decays.. 4) Charge is related to restmass and space changes.*

The reader may find a useful list of fundamental constants, formulas and other values related to this paper at:
http://www.fh-niederrhein.de/~physik07/internet_symmetry/k_fundam_constants.pdf.

## 1. Introduction

Point Mechanics deals with point masses whose special dimension is negligibly in comparison with the distances involved in the problem under consideration. Kepler's laws describe the earth as a point "cycling" the sun. We know, of course, the earth is not a point.

Theoretical physicists, however, find this notion very convenient for describing the approximate motion of planets in classical mechanics. This concept seems to be an extraordinary good approximation in thermodynamics when dealing with molecules and atoms, being good point-like mass as well. Now it seems obvious in the classical field to view the electron as a real point particle. But, from Quantum Mechanics the electron is (*sometimes*) not a point mass.

The motion of a point in mechanics is described by a position vector **r** as a function of time where **r**($t$) consists of three components (x, y and z) of a rectangular coordinate system (pre-relativistic physics). With Newton's definition of force and his law "action=-reaction" which states, "*The sum of the momentum of two mutually interacting point masses remains constant*", we have a principle which remains valid even with relativity.
Now, if we consider a single free electron with a (usually non realistic) restriction of a "center of mass at rest" then the convenient concept of mutual interaction between two or more particles now also applied to only one particle seems to fail. But this is not the case when we allow *internal* dynamics (i.e., action with back action) to exist which are responsible for the electron's characteristic values such as restmass, spin, charge, and magnetic moment.

Quantum Mechanics tells us that a particle is no longer in a definite place at a definite point in time. QM adopts the Heisenberg's Uncertainty Principle (*which we will not use as a real principle in our theory – our theory is dominated by the Second Law: "Energy Tribute"* ), so that one has only a certain definite probability for the occurrence of a particle or other event. In QM it is only meaningful to use quantities that can be measured such as the restmass, spin, charge and magnetic moment. According to our present understanding, **reality** is described by a complex wave function $\psi(\mathbf{r},t)$ which is linked to the probability of finding a particle at the position **r** at time $t$. Physically measurable quantities such as the momentum of the particle are values calculable form $\psi$. An electron can be described by a plane wave $\psi$ (3dim.), or a delta function, or something in between these two extremes. In the one, the electron behaves like a wave and in the other, like a point particle. But the electron is never a real point particle, not even in a classical theory, when the position vector is **r**($t$), or in an extended QM($\psi$)+GR($\lambda$) view when the operator {x} is applied to the Wave function $\{x\}\psi(x(t),t)$. [2] (Here $t$ from the GR view is the Eigen-time instead of $\lambda$ the space curvature parameter.) This topic will be further addressed in this paper. The (*non trivial*) position operator due to internal action (in short) will be:

$$\{x\} = \int \partial t \tag{1.1}$$

Einstein's two famous wordings "***Der Herrgott würfelt nicht***" (*God does not throw dies*) and "***Eine Theorie, die Ladung und Masse a priori setzt ist unvollständig***" (*A theory setting charge and mass of an electron a priori is incomplete*) both would allow a theory which predicts (local) parameters within formula for calculating mass and charge of the single electron. Today such a theory is not available in physics. Local parameters have been explicitly forbidden by Bell's theorem due to the statistically based physical theory in Quantum Mechanics.

Dirac's electron theory (1935) deals with both mass and charge as being fundamental constants. In a 1963 Scientific American article [1] he wrote, "*One of the following three fundamental values of physics, h, c, or e, can not be fundamental*". Dirac speculated the Planck constant ($h$) is not, but velocity of light ($c$) and elementary charge ($e$) are. From our point of view, an extended principle theory (including Einstein's General Theory of Relativity, Maxwell's Electro Dynamic, and Thermodynamics) that deals only with a minimum set of basic fundamental constants, $h$, $c$ and $G$, and that is able to predict the mass and charge of a single free electron should be welcomed in all mainstream physics.

Of course Quantum Gravity Operators and General Theory of Relativity Parameters can only match when theory meets experiments.

Recently, Boris Unrau [2] presented a new theoretical attempt of combining GR results with a new definition of the Mass-Operator adopted from the Dirac Equation or Klein Gordon Equation respectively while comparing with Einstein's results. He extends the degree of freedom of the common wave function by allowing $\Psi$ to be a function of the space curvature parameter lambda itself ($\Psi(x^\mu(\lambda),\lambda)$). By differentiation of the invariant scalar wave function he receives a tensor of higher rank,

$$\frac{d\Psi(x^\mu(\lambda),\lambda)}{d\lambda} = \frac{\partial\Psi}{\partial x^\mu}\frac{dx^\mu}{d\lambda} + \frac{\partial\Psi}{\partial\lambda}. \tag{1.2}$$

In Quantum Mechanics the four-impulse operator (combining momentum and energy) has been defined in the following way:

$$p^{\mu} = \frac{\partial}{\partial x^{\mu}}. \tag{1.3}$$

Unrau defines something new here, the mass-operator:

$$m = \frac{\partial}{\partial \lambda}. \tag{1.4}$$

And with $\varphi=\varphi(x_\mu)*\exp(-im\lambda)$ he receives ($h = c = 1$) the Klein Gordon Equation:

$$\frac{\partial^2 \varphi}{\partial x^{\mu} \partial x_{\mu}} - \frac{\partial^2 \varphi}{\partial \lambda^2} = \frac{\partial^2 \varphi}{\partial x^{\mu} \partial x_{\mu}} + m^2 \cdot \varphi = 0. \tag{1.5}$$

Unrau tries to find a pattern for the 12 fundamental particles from an Eigenwert-Spectrum. But, in his approach and in common QM as well, the rest mass of the electron remains an input parameter.

Not so in our theory. We calculate mass and charge of the single free electron from a quantum thermodynamically based theory while introducing the operator *dt* (in short eigentime change operator) for a pre-relativistic and $d\lambda$ for a relativistic discussion. Our two fundamental input parameters are the Planck mass and Planck charge calculated from fundamental constants. (It is a great challenge for any Grand Unified Theory to calculate the fundamental constants *h*, *c* and *G* which are input parameters for the Planck mass formula!) It is important to say here that the Planck mass is virtual by theoretical definition, but the electron restmass is experimentally real. We should also keep in mind Einstein's wording: "*Rest mass and charge need to be derived by theory*".

In our theory, the internal dynamics (or internal action) of a single electron (mass center at rest) are shown to operate under the principle of the Carnot cycle. We will elaborate in a separate paper, and only briefly here, that the principle theory of Quantum ThermoDynamic (QTD) combined with the principle theory of Relativity (GR) and with the aid of Maxwell's Electro Dynamic (ED), and while introducing quantum mechanical operators (QED), allows us to calculate the restmass and the elementary charge. The additional or common Hypothesis (Principle) to combine them successfully is: "***Only the laws of nature will not change in space or time***." (i.e., Laws do not depend on the GR-space curvature's parameter, λ.)

First conclusion from the common principle:

The restmass ($m(\lambda)=c^2/E$) does conform with the First Law (Energy Conservation) if we allow an exchange energy to exist between the electron and the *subquantique milieu* (from DeBroglie) [3] of the universe. In our approach this exchange energy is present due to the II Law and not by hypothesis. We can apply $m(\lambda)$ immediately to the Eq. (1.5) and so extend the Klein-Gordon Equation that way. (However, this is not the topic of our current paper)

## 2. Simplified Electron Model

The new results presented in this paper concerning the single free electron can be combined with standard results from mainstream physics in a set of equations matching our theory with CODATA values to within 8 digits **based on our calculation of restmass (m) and charge (e)** of the free electron (see Section 3.3). What follows is a description of our new electron model.

We start with a definition of circular action and compare it with the well known experimental and theoretical mass spin of the electron from Quantum Mechanics.

We thus find an action radius ($r_G$) from the Spin (circular mass action or mass spin):

$$1/2\hbar = m\cdot c\cdot r_G \quad (2.1)$$

From Hamilton's total Action,

$$h = m\cdot c^2\cdot t_G \quad (2.2)$$

we get the periodic action time ($t_G$) due to internal dynamics. The action time ($t_G$) is the same for circular action (1/2h-bar) and linear action (1/2h-bar) because internal mass actions simply need to be completed at the same time (from discussion with Mike Wales) [4].

The Gravitational Electromagnetic Mass Tensor ($T_{GE}$) from Einstein's General Theory of Relativity for a single free electron can be calculated,

$$T_{GE} = m/(r_G\cdot t_G{}^2) = 7.05x10^{22}\,Jm^{-3} \quad (2.3)$$

where α is the fine structure constant, h is Planck constant, and κ=8π*G/c^2.

$$m\cdot c^2 = 16\pi^2\cdot T_{GE}\cdot r_G{}^3 = 8.178x10^{-14}\,J \quad (2.4)$$

$$m\cdot c^2 = (G/2\alpha)\cdot m^2/R_G \quad (2.5)$$

$$N^2/24 = r_G/R_G \quad (2.6)$$

$$a = h\cdot(c/2)\cdot\kappa\cdot T_{GE}/(m\cdot c^2) \quad (2.7)$$

$$a = G\cdot(m/r_G{}^2) = 1.631x10^{-15}\,m\cdot s^{-2} \quad (2.8)$$

Eq. (2.7) and (2.8) prove that inertial acceleration from **GR**($\kappa$)+**QM**($h$) and gravitational acceleration from Newton's gravity formula (***C****lassical* ***M****echanics* (G)) are the same. Eq. (2.4) indicates a torus shape of the restmass ($m$). (Notice also: $m*c^2*\alpha^3=2\pi^2*r_e{}^3*T_{GE}$ , where $r_e$ here is the classical electron radius.) So the results form our theory ($R_G$, $r_G$, and $t_G$) together with common results from Quantum Mechanics and the Theory of Relativity (which contains Newton's Classical Mechanics as an approximation, i.e., Newton's gravity formula) lead to the description of a simplified model of a single free electron. We will complete this discussion later when we actually show how to calculate restmass and charge.

Our electron model (mass center at rest) as shown in figure 1 is not at all a point particle but a spinning and oscillating 3-dimensional energy-volume due to internal action defining its rest energy. The outer spinning charge is a *skin* surface (radius=$1/2g_s*r_G$ and $g_s$ is the electron's g-factor) slightly removed from the outward stretched mass shell surface (radius=$r_G$). Its Electro Dynamics leads to the magnetic moment (circular charge action or charge spin).

$$\mu_Z = e\cdot c\cdot 1/2g_s\cdot r_G = -9.285x10^{-24}\,Am^2 \quad (2.9)$$

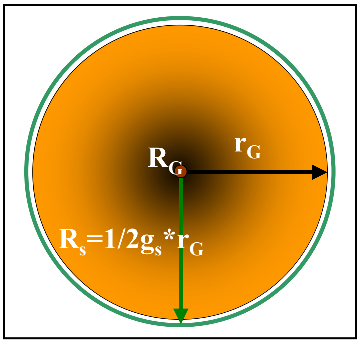

Figure1: The electron Model

Charge is not mass. So charge is another topic (GR+ED or GR+QED) which we will discuss separately in a later section. There is no reason to define the free electron either being a point mass or a matter wave. In our theory the electron appears to be nearly a point mass due to nucleus (radius $R_G$ see also 2.5) oscillation acting together with the outward shell (radius $r_G$). The outward shell also spins significantly and both oscillation and spin stand for matter wave (wavelength $2\pi*r_G$ see 2.1). (Do not mix (non electromagnetic) internal mass-oscillation here with external or common Brownian motion which governs electromagnetic radiation thermodynamically!) So two aspects *unified* by internal action that way obviously reconciles the (classical) Quantum Thermodynamics with the (classical) Quantum Mechanics which led to our (simplified picture) model - of course restricted to a single **free** electron. See figure 1.

Notice further results from this electron model:

- Internal mass rotational velocity of a single free electron: $V_r = c/2$ (2.10)
- Internal mass vibration velocity of a single free electron: $V_o = c/\pi$ (2.11)
- Velocity of light: $c = 4\pi*(r_G/t_G)$ (2.12)
- Classical electron radius: $r_e = (2\alpha)*r_G$ (2.13)
- Bohr Radius: $r_B = (2/\alpha)*r_G$ (2.14)
- Hydrogen electron's Bohr Orbit velocity: $v_B = c*\alpha = (c/2)*(2\alpha)$ (2.15)

The last result, Eq. (2.15), relates the interaction of the electron's mass and charge with the proton's mass and charge. So, it seems this electron model applies to the bound as well as the free electron.

The term ($2\alpha$) appears as a coupling constant between the electron and proton of the hydrogen atom's action.

# 3. Equation of Motion

## 3.1 Pre-relativistic physics

We will quote several original passages from Einstein's Book, "*Grundzüge der Relativitätstheorie*", (1969) [5]. Starting on page 20 of his book, we find the equation of motion of a mass point with the constant restmass (m) which in pre-relativistic physics is an invariant tensor of zero Rank.

$$m\frac{d^2x_\nu}{dt^2} = F_\nu \tag{3.1}$$

Here ($dx_\nu$) is a vector. The term ($dt$) is an invariant as is $1/dt$. So ($d^2x_\nu/dt^2$) is a vector too. And $F_\nu$ is a tensor of Rank one, or in other words, a vector. So, the Force ($F_\nu$) has a vector character as does the difference,

$$m\frac{d^2x_\nu}{dt^2} - F_\nu = 0 \tag{3.2}$$

This equation of motion is true for every other coordinate system of our reference space. Any motion of the point mass can be assigned to the coordinates ($x_\nu$) from our frame of reference and to the time ($t$) from a unit clock placed in the origin of our system. This gives us an objective meaning of the "Gleichzeitigkeit" (at the same time) of an action at the distance. This time ($t$) is also independent from the position of our coordinate system. Time ($t$) is an invariant due to Galileian coordinate systems as are the mass ($m$) and $s^2$ (unfortunately, this concept does not conform with Maxwell-Lorentz Electrodynamics. The electromagnetic field equations are not covariant within Galileian transformations) so that we have:

$$s^2 = \sum(\Delta x_\nu)^2 \tag{3.3}$$

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> *"Wir geben damit der Aussage der Gleichzeitigkeit distanter Ereignisse (hypothetisch) eine objektive Bedeutung. Die so festgelegte Zeit ist jedenfalls unabhängig von der Lage des Koordinatensystems im Bezugssysteme, also eine Invariante bezüglich der Transformationen:*

$$\Delta x'_{\nu} = \sum b_{\nu\alpha} \cdot \Delta x_{\alpha} \tag{3.4}$$

*Die vorrelativistische Physik postuliert, daß die ihre Gesetze ausdrückenden Gleichungssysteme mit Bezug auf die (obignen) Transformationen kovariant seinen. Es wird damit die Isotropie und Homogenität des Raumes zum Ausdruck gebracht."*

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"*Aber diese Bestrebungen, die Translationsrelativität auf die Galileitransformationen zu gründen, scheiterte and den elektromagnetischen Vorgängen. Die Maxwell-Lorentzschen elektromagnetischen Feldgleichungen sind bezüglich Galileitransformationen nicht kovariant."*

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"*Man kann zur Vervollständigung der Zeitdefinition das Prinzip der Konstanz der Vakuumlichtgeschwindigkeit benutzen."*

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*"Es folgt aus dieser Defintion keineswegs der in der vorrelativistischen Physik vorausgesetzte absolute Charakter der Zeit (d. h. Unabhängikeit der Zeitwerte von der Wahl des zugrunde gelegten Inertialsystems)."*

In short: K is a Cartesian coordinate system and (r) the difference between two points. So we can define the distance (r) by the velocity of light and the time interval Δt:

$$\mathrm{r} = c \cdot \Delta \mathrm{t} \tag{3.5}$$

or due to the coordinates while the formula above is squared and re-written:

$$\sum (\Delta x_{\nu})^2 - c^2 \cdot \Delta t^2 = 0 \tag{3.6}$$

Now the Lorentz transformations assure that if c=const is true for K it is also true for K', a coordinate system which might travel with relative velocity respectively to K.

## 3.2 Relativistic Physics

The equation of motion if the restmass is not a point and not a constant is:

$$\frac{d}{dt}(m\frac{dx_{\nu}}{dt}) = F_{\nu} = \partial_{\nu} P^{\mu} \tag{3.7}$$

We make use of the following (pre-relativistic) identity at first:

$$\frac{d\vec{P}}{dt} = \frac{\partial}{\partial t}\vec{P}_{xyz}\frac{\partial t}{\partial t} + \frac{\partial}{\partial x}\vec{P}_{yzt}\frac{\partial x}{\partial t} + \frac{\partial}{\partial t}\vec{P}_{xzt}\frac{\partial y}{\partial t} + \frac{\partial}{\partial t}\vec{P}_{xyt}\frac{\partial z}{\partial t} = \partial_{\nu} P^{\mu} \tag{3.8}$$

The impulse vector ***P*** =m*v can be written as a product of a scalar function *P* multiplied by unit vector ***u***. We use the force to be conservative and additionally assume the center of mass is at rest and in the origin of our frame of reference.

$$\vec{P} = P(r(t), m(t)) \cdot \vec{u}(t) \tag{3.9}$$

So we only have to deal with the partial differentiation in time. The dot will be used for that now.

$$\frac{d}{dt}\vec{P} = \dot{m} \cdot \dot{r} \cdot \vec{u} + m \cdot \ddot{r} \cdot \vec{u} + .. = \vec{f}_C + \vec{f}_G + .. \tag{3.10}$$

We assume that this equation describes the internal action of the single electron's matter at rest. From the QM point of view (in our case) the dot is an Operator for mass and charge as well, if applied to *m*(*t*), *r*(*t*) and to ***u****(t)*. (We will see this later in detail.) These functions deal with the scalar wave function $f(t)$. The unit vector $\boldsymbol{u}(t)$ allows rotation with time while $r(t)$ is responsible for oscillation at the "same" time.

**Here** $m(t)$ **is new aspect concerning elementary particles like the electron which Einstein did not discuss in his book**. It seems obvious to apply the II Law from Thermodynamics to $m(t)$ which works internally similar to a Carnot cycle. So we can combine TD with Einstein's GR. The charge will be dealt with by combining Einstein's GR and Maxwell's ED. At a minimum, we have TD+GR+ED with Einstein's GR-Theory centrally as a first and classical step.

We show that the first two parts (altogether five) of Eq. (3.10) gives charge and mass of the electron, even from the pre-relativistic physics discussion, as an approximation of course, due to the fine structure constant. The consequence of this approximation reveals the fine structure constant. We also want to point out that the calculation of mass and charge requires a Principle Theories, i.e., General Relativity plus Thermodynamics. The aim will be to calculate the fine structure constant of the single free electron from a pre-relativistic point of view (CM+ED+TD) first. Then from a general discussion we will combine GR+QED+QTD while using Einstein's GR-differential Operators applied to QED-wave-functions and extended by common Thermo_Dynamical knowledge.

### 3.2.1 Special Relativity [$x_4=i*l=i*(t*\mathbf{c})$]

$$s^2 = \sum(\Delta x_\nu)^2 =(\Delta x_1)^2 + (\Delta x_2)^2 + (\Delta x_3)^2 - (\Delta l)^2 \tag{3.11}$$

The invariant here (see 3.12) is not $dl^2$, but $d\lambda^2$, which usually represents the moving of the point by external Forces ($F_\mu$). Proper coordinate transformations satisfying the above mentioned invariant relation are the **Lorentz-transfromations** and not the Galileian transformations which we know from the pre-relativistic physics. So we have to write,

$$-ds^2 = -[(dx_1)^2 + (dx_2)^2 + (dx_3)^2] - (dx_4)^2 = (dl)^2 \cdot (1-q^2) = d\lambda^2 \tag{3.12}$$

Here $d\lambda=c*d\tau$ and $\tau$ is the *Eigenzeit im Ruhesystem* of the (internal electron's) clock and it is $dl=c*dt$ while $t$ is the time of the (external laboratory) clock in the arbitrarily chosen Galileian frame of reference. This leads us to the 4-dimensional vector of motion, usually discussed while assuming a point mass (with the definition of the velocity ratio: $q=\mathrm{v}_{ext}/c$). Let us assume the external force ($F_\mu=0$) vanishes but not the internal one, $f_\nu$ , which is responsible for internal dynamics.

$$\frac{d}{d\lambda}(m(\lambda,q)\frac{dx_\nu}{d\lambda}) = \frac{1}{c^2}\partial_\nu P^\mu = \frac{1}{c^2} f_\nu \tag{3.13}$$

From our point of view this shows action of a **non point** and **non invariant** and *non constant* rest mass if we assume $m(\lambda, q_{int}, \Delta Q_{int})$ as a function of lambda, internal velocity, and heat transfer ΔQ which will be defined by *internal* forces ($f_\mu$) describing this action. Here the reality appearing as internal action can be assigned to a couple of four (internal) coordinates ($x_1$, $x_2$, $x_3$, $x_4$) (notice: we assume the center of mass is at rest $q_{ext}=0$!)

$$\frac{d}{dl}[c^2 \cdot m(\lambda, q_{\text{int}}, \Delta Q_{\text{int}})\frac{dx_\mu}{dl}] = f_\mu \tag{3.14}$$

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"*Zwischen zwei Ereignissen gibt es keine absolute vom Bezugssystem unabhängige räumliche und keine absolute zeitliche Beziehung, wohl aber eine absolute von der Wahl des Bezugsraumes unabhängige zeit-räumliche Beziehung. Der Umstand, daß es keine objektive sinnvolle Zerspaltung des vierdimensionalen Kontinuums in ein dreidimensional räumliches und ein eindimensional zeitliches Kontinuum gibt, bringt es mit sich, daß die Naturgesetze erst dann ihre logisch befriedigende Form annehmen, wenn man sie als Gesetze im vierdimensionalen Raum-Zeit-Kontinuum ausdrückt.*"

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"*Wenn wir ferner die drückende Frage nach dem objektiven Grund der Bevorzugung gewisser Koordinatensysteme (Inertialsysteme) radikal aus der Welt schaffen wollen, so werden wir beliebig bewegte Koordinatensysteme zulassen müssen. Sobald wir damit ernst machen, kommen wir mit derjenigen physikalischen Interpretation von Raum und Zeit in Konflikt, die uns in der speziellen Relativitätstheorie zum Ziel geführt hat... Die Gesetze der Lagerung starrer Körper wie überhaupt die Naturgesetze kennen wir in bezug auf K' (rotiert) nicht unmittelbar, da K' kein Inertialsystem ist. Wohl aber kennen wir sie in bezug auf das Inertialsystem K , können sie also in bezug auf K beurteilen."*

A rotating disk, due to the Lorentz-contradiction, shows a shorter circumference while the radius is not affected. Further, a clock in the center runs faster than at the edge of the disk which runs slower due to rotation. So we have different times from different clocks relative to the reference clock from the coordinate system K (which is considered to be free from acceleration and thus identified as a Galileian system), while K' is the rotating system. **But we must find the same physical result relative to K' as with K, otherwise our laws must unnaturally depend on time**.

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*"Hieraus folgt, das die Lagerungsgesetze der starren Körper in bezug auf K' nicht übereinstimmen mit den Lagerungsgesetzen der euklidischen Geometrie. Ordnen wir ferner auf der Peripherie und im Zentrum des Kreises je eine von zwei gleich beschaffenen Uhren an (mit K' rotierend), so geht – von K' aus beurteilt – die Uhr an der Peripherie langsamer als die Uhr im Zentrum. Das selbe muß auch - von K aus beurteilt - stattfinden, wenn wir die Zeit von K' nicht auf ganz unnatürliche Weise definieren wollen (nämlich so, daß die in bezug auf K' geltenden Gesetze explizit von der Zeit abhängen)."*

*"Es läßt sich also Raum und Zeit nicht in der Weise in bezug auf K' definieren, wie wir es in der speziellen Relativitätstheorie in bezug auf die Inertialsysteme getan haben. Nach dem Äquivalenzprinzip (Träge und schwere Masse sind nicht zu unterscheiden) ist aber K' auch als ruhendes System aufzufassen, in bezug auf welches eine Gravitationsfeld herrscht (Zentrifugalfeld, Feld der Corioliskräfte). Wir kommen also zu dem Resultat, das Gravitationsfeld beeinflußt, bzw. bestimmt die metrischen Gesetze des raumzeitlichen Kontinuums. Wenn die Geometrie die Lagerungsgesetze des* ***idealen festen*** *Körpers ausdrücken soll, so ist sie im Falle der Anwesenheit von Gravitationsfeldern nicht euklidisch."*

*"Analog führen wir in der allgemeinen Relativitätstheorie beliebige Koordinaten (x1,x2,x3,x4) ein, welche die Raumzeitpunkte derart eindeutig numerieren, daß raumzeitlich benachbarten Ereignissen benachbarte Werte der Koordinaten zugeordnet werden; sonst soll diese Koordinatenwahl beliebig sein. Wir werden dem Relativitätsprinzip in weitestem Sinne dadurch gerecht, daß wir die Gesetze in solche Form geben, daß sie bezüglich jedes derartigen Koordinatensystems gelten, d. h., daß die sie ausdrückenden Gleichungen bezüglich beliebiger Transformationen kovariant sind."*

*"Es wird also die unmittelbar mit den Einheitsmaßstäben und –uhren meßbare Größe (3.15) oder auch das negative dieser Größe eine für zwei benachbarte Ereignisse (Punkte des vierdimensionalen Kontinuums) eindeutig bestimmte Invariante sein, wenn nur überall mit Einheitsmaßstäben (bzw. Uhren) operiert wird, die sich als einander gleich herausstellen, wenn man sie zusammenbringt und aneinander anlegt (bzw. ihren Ablauf vergleicht).* ***Hier ist die physikalische Voraussetzung wesentlich, daß die relative Länge zweier Maßstäbe bzw. die relative Ganggeschwindigkeit zweier Uhren im Prinzip unabhängig ist von ihrer Vorgeschichte****. Diese Voraussetzung ist aber in der Erfahrung sehr sicher begründet; wäre sie nicht zutreffend, so könnte es keine scharfen Spektrallinien geben, da die einzelnen Atome des selben Elementes sicherlich nicht die gleiche Vorgeschichte haben, und da es bei Annahme relativer Variabilität der Einzelgebilde je nach der Vorgeschichte auch ungereimt wäre, anzunehmen, daß die Masse bzw. Eigenfrequenzen der einzelnen Atome desselben Elementes jemals einander gleich gewesen wären."*

**So Einstein explicitly excluded any time-history of measurements**. He argued that mass and Eigen-frequencies of atoms of the same element could/should not be the same if this were true. This agreed with experiments of his day which did not show any such time dependent effect!

But, is this true today? Future experiments may tell us! Do experiments really tell us the fine structure constant is time dependent? Or is the gravitational constant *G* time dependent as Dirac speculated theoretically? Our full theory at least gives an answer from the point of a single free electron. (paper in preparation)

Unlike Einstein's opinion, we believe that once the (quasi) **internal Carnot cycle** is assumed for the *elementary* mass, the restmass can not be constant in time due to the second law (unless the thermo-dynamic decay mass emission process is immediately accompanied by a regenerative mass-energy absorption. This symmetry does not exist in nature because gravity is only attractive!). So, now GR+QTD is prepared to calculate mass and charge of the single free electron. The experiments should find the change of mass state conditions on a sub-microscopic and on a large astronomical time scale (energy scale) as well! This, of course, will be the central test to verify this theory!

### 3.2.2 General Relativity

$$-ds^2 = (dX_1)^2 + (dX_2)^2 + (dX_3)^2 - (dX_4)^2 = -g_{\mu\nu}\frac{dx_\mu}{d\lambda}\frac{dx_\nu}{d\lambda}d\lambda^2 \tag{3.15}$$

Here λ is a space curvature parameter. The unit distance measurement $-ds^2$ (with unit meter and unit clock) of two neighborhood actions and also the positive $ds^2$ are uniquely determined and both are invariant.

In the next equation expressed by arbitrary coordinates ($x_\mu$),

$$ds^2 = g_{\mu\nu}\cdot dx_\mu \cdot dx_\nu \tag{3.16}$$

The functions ($g_{\mu\nu}$) determine the metric of the space-time continuum as well as the gravitational field. We will show later how this metric contributes to the fine structure constant.

The free electron rest mass applied to external forces along with its own internal forces will move under inertial and gravitational forces. The full equation reads:

$$\frac{d}{ds}[m\cdot\frac{dx_\mu}{ds}] + m\cdot\Gamma^\mu{}_{ab}\cdot\frac{dx_a}{ds}\cdot\frac{dx_b}{ds} = \frac{1}{c^2}(F_\mu + f_\mu) \tag{3.17}$$

If the gravitational field component $\Gamma^\mu$ vanishes and the external force (F=0) can be excluded then for the single free electron (center at rest) we obtain the equation of motion, or in our words, "**an *equation of internal action for a free electron at rest***":

$$\frac{1}{g_{\mu\mu}}\cdot\frac{d}{dl}[c^2\cdot m(l,q_{\text{int}},\Delta Q)\frac{dx_\mu}{dl}] = f_\mu \tag{3.18}$$

(we use $\Delta Q=\Delta Q_{\text{int}}>0$ here) Internal forces (altogether five parts) due to internal action yields mass and charge of the free electron from the first two parts ($f_G$) and ($f_C$) as assumed already in (3.10) (pre-relativistic physics). In the limit of small $q_{\text{int}} = V_{\text{interanl}}/c$ (which at least will not be true for the real electron's internal action) we get for a single free electron at rest from a general relativity discussion the same result as from the pre-relativistic discussion. Let us set $g_{44}$= 1 for that. (But $g_{44}$ is only close to one as we will find out later from the derivation of the fine structure formula from a GR-assumption.)

$$\dot{m}\cdot\dot{r}\cdot\vec{u} + m\cdot\ddot{r}\cdot\vec{u} + .. = \vec{f}_C + \vec{f}_G + .. \tag{3.19}$$

Eq. (3.19) is similar to the pre-relativistic one and, like $q_{int}$ and $g_{44}$ chosen above, will be a pre-relativistic approximation in the GR-Theory. So it is obvious that this equation leads to an incomplete but very helpful result! We will see later that the fine structure constant is incomplete from the pre-relativistic derivation. But GR+QED+QTD and its unification can give the correct fine structure constant values as compared with the CODATA numbers from experiment.

- From Maxwell's Electro Dynamic we get the Coulomb force formula:

$$\vec{f}_C = \frac{\mu\cdot(c^2\cdot e)\cdot e}{(4\pi\cdot r^2)}\cdot\vec{u} \tag{3.20}$$

- From Einstein's General Theory of Relativity we get Newton's force formula,

$$\vec{f}_G = -\frac{\frac{\kappa}{2}\cdot(c^2\cdot m)\cdot \mathrm{m}}{(4\pi\cdot r^2)}\cdot\vec{u} \tag{3.21}$$

Eq. (3.20) and (3.21) combined with (3.19) yields two differential equations:

$$\ddot{r} = -\frac{\kappa}{2}\cdot(\mathrm{m}\cdot c^2)/(4\pi\cdot r^2) \tag{3.22}$$

$$\dot{\mathrm{m}}\cdot\dot{r} = \mu\cdot(e^2\cdot c^2)/(4\pi\cdot r^2) \tag{3.23}$$

- From the II Law of Thermodynamics (small energy loss per cycle) applied we get a proper solution for $r(t)$ while we assume for the mass: m=m(r($t$), $t$). So if we know $r(t)$ it is easy to calculate the rest mass form (3.22) and if we know the mass we can calculate the charge ($e$) from (3.23).

Notice that the calculation of restmass form (3.22) is due to a distinct mass (field) surface requiring a certain $r$(t) which leads to ($r_G$ and $R_G$). But the surface concerning the charge from (3.23) might not show the same shape. For that we have to solve Einstein's field equations generally. So $m$(t) is the same function in both equations while $r$(t) is not. This we will have to respect while choosing a proper unique solution. Otherwise it is not possible to calculate mass and charge from (3.22) and (3.23). Figure 2 shows a simulation of a periodic function $f(t)$ which at least gives (as a generating function) restmass and charge for a free electron even from a classical, pre-relativistic discussion while assuming the restmass is continuously generated and viewed as a quasi **internal** Carnot cycle (scalar field oscillation) with finite life time $\tau_\varepsilon$. So, let us define

$$a(t) = (t - t_0)/\tau_\varepsilon \tag{3.24}$$

Of course physically, the pre-relativistic result must be incomplete a priori but also must show the correct way to go generally. (Notice: the time point ($t_o$) is due to the electron and may not be the same time as the universe starting point at the big bang).

The following wave function $f(t)$, as a special solution, satisfies the two differential equations (3.22) and (3.23):

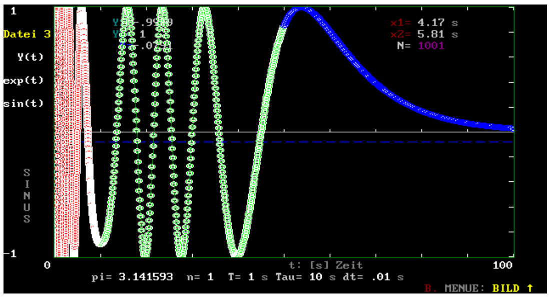
$$f(t) = f_0\cdot\cos\{e^{-a(t)}\cdot\omega_N\cdot(t - to) + \delta_0\} \tag{3.25}$$

Notice the <u>internal</u> decay process of a quasi internal Carnot cycle taken into account by $a(t)=\Delta Q_{int}/Eo$ is close to ln(3=space dimension) and determines the internal exponential decay process (see figure 2) in our pre-relativistic approximation. Further $\Delta Q_{int}$ is a constant per action cycle! But in detail, $a(t)$ leads us to the **zero order formula of the fine structure *constant*** (from (3.22) and (3.23)),

$$\alpha_0 = \frac{3}{4}\cdot[(1 - a(t))]^2 = 1/137.112 \text{ (See Eq. 3.28)}$$

We are suggesting that Coulomb and Newton forces respectively come from the same physics in micro and macro space and so "micro" and "macro" formulae are similar. But when applied to only one electron there must be a re-interpretation due to internal action. The lifespan parameter ($\tau_\varepsilon$) is not available from experimental results apparently, but the action time and the integer number N can be calculated from the experimental restmass. At least we want to mention that we can not present a complete theory calculating all these parameters ($\alpha$, N, and $\tau_\varepsilon$), especially N, uniquely from a closed theory. But we can present a broad application of our new large integer number (N) in micro and macro physics while taking the alpha value form CODATA (see Section 5).

*r(t)* = **periodic function** ($t$,τ,T,N)




$t$: Newton`s absolute time (GR-Eigenzeit)
τ: lifespan (II Law parameter)
T: periodic (action) time (I. Law parameter)
N: integer number (degree of freedom)

Figure 2: Single free electron wave function, $r(t)$

### 3.3 Results from Differential Equations (3.22) and (3.23).

- Electron rest mass:

$$m = \sqrt{\frac{1}{4\pi} \cdot \frac{h \cdot c}{G} \cdot 2\alpha \cdot \frac{24}{\mathrm{N}^2}} \tag{3.26}$$

- Electron charge:

$$e = \sqrt{2\alpha \cdot h \cdot c \cdot \varepsilon_0} \tag{3.27}$$

- Fine structure constant:

$$\alpha_0 = \frac{3}{4} \cdot [(1 - a(t))]^2 = 1/137.112 \tag{3.28}$$

$$\alpha_1 = \frac{3}{4} \cdot [(1 - \beta_0 \cdot \mathrm{In}(3))]^2 = 1/137.031 \tag{3.29}$$

$$\alpha = \frac{3}{4} \cdot [X_{44}(1 - \beta_1 \cdot \ln(3))]^2 = 1/137.035998 \tag{3.30}$$

Here $\beta = 1/(1 - V_i / c^2)^{1/2}$. If $Vi=\alpha_0$*c=$Vo$ would be the internal velocity of the free electron (compare with the 1. orbit velocity from the hydrogen atom's electron $v_B=\alpha$*c when using the Bohr model) we find $\alpha_1$=1/137.03115. Now with $Vi=\alpha_1$*c=$V_1$ then alpha is 1/137.03106 and if $1/X_{44} = \sqrt{g_{44}} = 1.00001796$ we get α=1/137.035998 (see 3.30) So with $g_{44}$, significantly not one, alpha approximates the GR-hydrogen atom's fine structure.

**We assume that the 3-dimensional space is a GR restriction and the only convenient one applied to nature**. The energy loss ΔQ=$a(\lambda)$*Eo is constant per action-cycle. So ln(3)=$a(\lambda)$=$\Delta\lambda/\tau$ restricts physics to the GR's 4-dimensional non Euclidian space. In the pre-relativistic approach the hypothesis has been ln3=$a(t)$=$(t-t_o)/\tau_\varepsilon$. But as we can see only GR can lead us to a complete fine structure constant result within the GR-invariant ln(3)=$a(\lambda)$=$(1-q^2)^{1/2}$*$a(t)$. Notice that for q=v/c we have to ask what kind of velocity we are dealing with. We can avoid this theoretical discussion at this point by using the

CODATA α-value for further calculations instead of our pre-relativistic result $\alpha_0$ that can be derived with the aid of $f(t)$ applied to (3.22) and (3.23) (see figure 2 as a simulation).

> "*There is a most profound and beautiful question associated with the observed coupling constant, e the amplitude for a real electron to emit or absorb a real photon. It is a simple number that has been experimentally determined to be close to α=-0.08542455. (My physicist friends won't recognize this number, because they like to remember it as the inverse of its square: about 137.03597 with about an uncertainty of about 2 in the last decimal place. It has been a mystery ever since it was discovered more than fifty years ago, and all good theoretical physicists put this number up on their wall and worry about it.) Immediately you would like to know where this number for a coupling comes from: is it related to pi or perhaps to the base of natural logarithms? Nobody knows. It's one of the greatest damn mysteries of physics: a magic number that comes to us with no understanding by man. You might say the 'hand of God' wrote that number, and 'we don't know how He pushed his pencil.' We know what kind of a dance to do experimentally to measure this number very accurately, but we don't know what kind of dance to do on the computer to make this number come out, without putting it in secretly!*" R.P. Feynman [6]

Every interested reader familiar with basic math in differentiation should now be able to derive the formula for the fine structure constant of zero order Eq. (3.28). Take the function (3.25) and apply it to Eq. (3.22) and (3.23).

# 4. Predictions from simplified electron model

## 4.1 New Large Integer Number's estimation (N=1x10²²)

From Eq. (3.26) and (3.16) applied to Eq. (3.20) and (3.21) we have the force ratio of a single free electron's **internal action:**

$$\frac{f_G}{f_C} = \frac{24}{\mathrm{N}^2} \tag{4.1}$$

From a textbook we know the two electron's external interaction is (*using codata1986 values*):

$$\frac{F_G}{F_C} = \left(\frac{m}{e}\right)^2 \cdot G \cdot 4\pi \cdot \varepsilon_0 = 2.399996 \cdot 10^{-43} \tag{4.2}$$

**So N=1e22 will be assumed for further calculations**! We suggest here that Coulomb and Newton forces come from the same physics in micro and macro space. So N is due to micro and macro physics. The importance of this large number N is discussed in Section 5.

## 4.2 The Mass-quant ($m_Q$): quantum of mass emitted/absorbed by the electron

Assuming an internal Carnot cycle we have to combine the first law (energy conservation),

$$0 = \oint dU = \oint \delta Q + \oint \delta W \tag{4.3}$$

with the second law (Heat $\Delta Q_{ext} = \Delta Q$ not zero).

$$\Delta Q = \oint \delta Q \neq 0 \tag{4.4}$$

And while using W=Work (W=W(r($t$),$t$)),

$$0 = \Delta Q + \oint \frac{\partial W}{\partial\left(\frac{\partial r}{\partial t}\right)} d\left(\frac{\partial r}{\partial t}\right) + \oint \frac{\partial W}{\partial r} dr \tag{4.5}$$

Or, re-written using Momentum-Vector **P** and Force-Vector **F** (while **F** is the time-derivative of the momentum **P**). Due to the discussion in Section 3.2 we can write:

$$0 = \Delta Q + \int_0^T [\vec{P}\frac{\partial^2 \vec{r}}{\partial t^2} - \frac{\partial \vec{P}}{\partial t}\frac{\partial \vec{r}}{\partial t}] \cdot \partial t \tag{4.6}$$

In a more general discussion we have to replace (*t, r(t) and f(t)* by λ , $x^{\mu}(\lambda)$ *and f(λ)*) and use the energy impulse tensor combined with the Lagrange formalism and to use operators for Eigenwert calculations. (See B. Unrau [2]). In the following, {x} is the position operator (see Introduction Section). For internal action we now replace the common momentum operator and the energy operator by a ***(new) mass operator and (new) charge operator (see 3.22 and 3.23) applied to a single free electron's wave function*** *f(t)* which at least will be defined as a complex function φ(t), solving these two differential equations. The fundamental equation will be the combination of the first and second law for further discussions while writing Eq. (4.6) in the following way: (*We would like to mention that the common wave functions that are derived from the Schrödinger Equation are also solutions of the following differential equation (4.7) and vice versa. However, it is not the topic of this paper!*)

$$0 = \Delta Q + \int_0^{T_a} (\vec{P} \bullet \ddot{\vec{x}} - \dot{\vec{P}} \bullet \dot{\vec{x}}) \cdot \partial t \tag{4.7}$$

Here $cT_a$ is the internal action distance with ($T_a$) being the internal action time and x={x}Ψ($t$)∗(1,1,1)=-i*c*intgral[φ($t$)]***u**($t$) and **P**=m($r(t),t,q_{int},\Delta Q_{int}$)*$v_{int}(t)$.

Eq. (4.7) allows energy with a non-zero (rest) mass to be absorbed (ΔQ>0) or emitted (ΔQ<0) from the single free electron's restmass under investigation (we now use $\Delta Q_{ext} = \Delta Q = -\Delta Q_{int}$):

$$\Delta m = (m / \mathrm{N}) \cdot \Delta N \tag{4.8}$$

Eq. (4.8) directly derived from Eq. (3.26) (in short, m~1/N) represents a quantum of mass Δm depending on Δ$N$. This mass-quant can be absorbed or emitted from the electron's restmass. The certain **mass-quant ($m_Q$)** is expected to have an approximate mass equivalence of about $2.93 \times 10^{-15}$eV and an ultra-low frequency (ULF) internal rotational frequency of about $\omega_Q = (m_Q \cdot c^2)/\hbar = 4.452$ Hz (see also Eq. 4.15). The radiated power associated with this mass-quant is,

$$\mathrm{P}_{mQ} = m_Q \cdot c^2 \cdot \omega_Q \approx 2x10^{-33} J \cdot \sec^{-1} \ (watts). \tag{4.9}$$

This small $2 \times 10^{-33}$ watts of power may seem insignificant, and it truly is at the macro-scale. In fact, the amplitude (h) (not to be confused with Planck constant $h$) for this small amount of radiation is a mere $10^{-43}$ (no dimensional units). The best gravity wave detector built today has a sensitivity of amplitude (h) = >$10^{-23}$ (sensitivity varies with frequency). But, at the micro-scale, we believe this radiation can have an important effect upon particle interactions as we shall show.

## 4.3 The electron and gravity – three different approaches - same result

A spinning charged torus electron model, such as ours, can interact readily in the surrounding thermodynamic, electromagnetic and gravitational environment. We take three different approaches using our electron model to arrive at one central relationship (gravitational) between the electron ($m_e$), the proton ($m_p$), the mass-quant ($m_Q$), Hubble mass ($m_H$), and the hydrogen atom.

### 4.3.1 Mass-quant explains quantum gravity?

"*Periodic internal (non adiabatic, non isochoric) action forces emission of a **mass-quant** couple outward*" is a conclusion from our *Principle* combined with the II Law of Thermodynamics within the General Theory of Relativity applied to a single particle's quasi internal Carnot cycle.

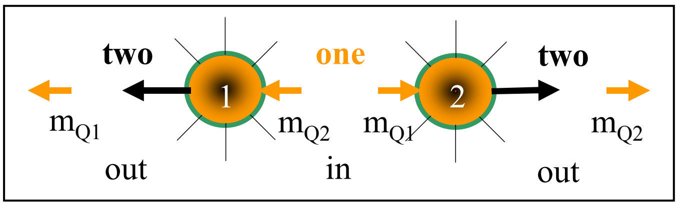



Figure 3: **Mass-quant** absorption and *stimulated* emission process

While absorbing one **mass-quant** each electron emits by (*stimulated*) emission two **mass-quants** in *forward* direction. Responsible for the backward momentum! That way the picture shows ***Quantum Gravity between two electrons based on internal and external Dynamics*** (symmetry does not exist here because gravity is only attractive explained by Einstein's GR field tensor!). It also shows how to overcome the many-body problem in a physical and statistical way. Of course this is only a simplified model not completed and tested only inspired by the existence of mass quants (energy tribute) predicted by our theory.
It is possible that the electron emits and absorbs mass-quants regeneratively 100%, but not at 100%, as we conclude from II Law. Of course, this is true without violating the I Law if we view the electron and the universe as a unit and together being a closed system. So the internal action requires an energy tribute be given back to the sub-quantique milieu. We suspect gravity has a part to play in why the mass quant exchange is not 100% regeneratively. In short: Gravity basically is due to inertial acceleration or in other words *is due to a certain internal thermo-dynamic friction or due to stimulated emission of mass quants into forward direction*. Gravity is the back action. **So quantum gravity of two or more electrons is a caused by the II Law (energy tribute)!**

The Poynting Vector in our Theory reads:

$$\vec{S} = \frac{c^2}{\mu_0} \cdot (\vec{E} \times \vec{B}) = \frac{c^2}{(\kappa/2)} \cdot \vec{c} \cdot \frac{1}{T_a^2} \ , \tag{4.10}$$

and defines a fundamental coupling constant $K_0$ in units $[(kg \cdot m/s) \cdot (1/C)]$ where $T_a$ is the action time in [seconds].

$$K_0 = \left( \frac{c^2 \cdot \mu_0}{(\kappa/2)} \right)^{1/2} = 3.4793x10^{18} kg \cdot m/(C \cdot s) \tag{4.11}$$

Eq. (4.11) shows action between Einstein's Gravitational Dynamics and Maxwell's Electro Dynamics; Momentum on the one hand and Current pulse on the other. By defining K= **(Momentum / current pulse)** for the single electron to be the following:

$$K_e = \sqrt{\alpha} \cdot \frac{K_0}{g_s} = 1.48437x10^{17} kg \cdot m/(C \cdot s) \tag{4.12}$$

$$B_e = \frac{1}{2} \cdot (m \cdot c)/(e \cdot \frac{g_s}{2} \cdot r_G) = 4.4089x10^9 kg/(C \cdot s) = \frac{1}{2} \cdot E/\mu_Z \tag{4.13}$$

Here we interpret $B_e$ to be the internal magnetic flux density of the electron's charge action (with action time $T_a$). Then the relationship of B/K = (**momentum / energy pulse**) applied to the electron is:

$$B_e / K_e = 2 \cdot (m_Q \cdot c) / \hbar = 2.97x10^{-8} m^{-1} \ . \qquad (4.14)$$

This is equivalent to the momentum of the mass-quant over fundamental circular action, which gives:

$$\omega_Q = \frac{1}{2} \cdot c \cdot \frac{B_e}{K_e} = 4.4522\text{Hz} , \qquad (4.15)$$

the circular frequency of the mass-quant. The associated energy mass is:

$$(\hbar \cdot \omega_Q) / c^2 = \text{Mass-quant } (m_Q) \approx 5.224x10^{-51} kg. \qquad (4.16)$$

So, our calculation for the mass quant now comes from a theoretical point of view, where before in Eq. (4.8) and (4.9) we only predicted and speculated the existence of mass quants.

### 4.3.2 The electron as a gravity wave emitter

A point-like electron model might not react in the presence of a gravity wave. A spherical particle may react to a gravity wave but probably incapable of generating its own gravitational radiation.

Our spinning and oscillating electron model, on the other hand, by nature of its torus shape [7] and spin, is expected to radiate and absorb gravity radiation power.

J. P. Ostriker (1979) [8] presented an equation for finding the gravitational radiation power of a spinning macro-scale object. Simplified, the equation states,

$$P = \varepsilon \cdot mass^2 \cdot \ell^4 \cdot \omega_o{}^6 / \left(c^5 / G\right) = J \cdot sec^{-1} \text{ or } (watts) , \qquad (4.17)$$

where $\varepsilon$ is a dimensionless constant related to the object's shape, $\ell$ is length, and $\omega_O$ is rotational velocity. Applying this to the spinning oscillating electron model we find the gravitational radiation power to be,

$$P_e = \left(1/\alpha\right)^2 \cdot G m_e{}^2 \cdot r_c{}^4 \cdot \omega_e{}^6 / c^5 \approx 2x10^{-33} watts , \qquad (4.18)$$

where $r_C$ is electron Compton radius and $\omega_e$ is electron rotational frequency. Eq. (4.18) simplified further gives,

$$P_e = \frac{1}{3} \cdot \left(8\pi G m_e / \sigma_e\right) \cdot \left(m_e c\right) \approx 2x10^{-33} watts , \qquad (4.19)$$

where $[\sigma_e = (8\pi/3) \cdot r_e{}^2 = 6.6522683x10^{-29} m^2]$ is Thomson electron cross section and $r_e$ is the classical electron radius. Here, $\left(8\pi G m_e / \sigma_e = 2.296x10^{-11} m \cdot s^{-2}\right)$ is the acceleration due to electron's self-gravitation and $(m_e \cdot c = 2.7309x10^{-22} kg \cdot m \cdot s^{-1})$ is the electron momentum.

It is important to note that the specific electron radiation power from Eq. (4.18) and (4.19) is precisely equivalent to the predicted mass-quant ($m_Q$) from "Quantum-Thermo-Dynamics", Eq. (4.9), which showed,

$$P_{\text{mass-quant}} = m_Q \cdot c^2 \cdot \omega_Q \approx 2x10^{-33} watts .$$

Later, we will be discussing the apparent symmetry that exists between the very small electron and the very large universe. As a part of symmetry, we have calculated a minimum field mass for the universe called the "Hubble mass" ($m_H$). A more in depth discussion about the Hubble mass is found in Section (5.4), but for now we want to mention that the gravitational radiation for the electron and mass-quant is the same for the Hubble mass when Hubble mass is linked to the single electron's (internal mass torus) rotational velocity, $\omega_e$:

$$\mathrm{P}_{\text{Hubble mass}} = m_H \cdot c^2 \cdot \omega_e \approx 2x10^{-33}\, watts\,. \tag{4 .20}$$

### 4.3.3 The hydrogen atom and gravity radiation

If we consider the hydrogen atom as a complex spinning/oscillating system dominated by proton mass, then we suggest it can generate gravity radiation in a similar fashion to that of the electron. Accounting for both proton and electron rotational interactions, an equation for the hydrogen atom's gravity radiation power might read:

$$\mathrm{P}_{\text{hydrogen}} = \left(\frac{G \cdot m_p^{\;2} \cdot \alpha}{\pi \cdot c}\right) \cdot \left(\frac{\omega_B \cdot \omega_p}{g_p}\right) \approx 2x10^{-33} \text{ watts}\,, \tag{4.21}$$

where $\omega_B$ is Bohr rotational velocity (c/Bohr radius), $\omega_p$ is the proton rotational frequency, and $g_p$ is the proton *g*-factor.

Comparing Eq. (4.9) and (4.18) through (4.21) we see an important pattern:

$$\mathbf{P_{electron} = P_{proton} = P_{mass\text{-}quant} = P_{Hubble\ mass} = P_{hydrogen} = 2x10^{-33}\ watts}. \tag{4.22}$$

The hydrogen atom as presented appears to be a fine tuned system with *electromagnetic* and *gravitational* forces in perfect harmony. For example:

- The *gravitational* radiation associated with the bound electron is,

$$\mathrm{P}_{\mathrm{e}} = G \cdot m_e^{\;2} \cdot \left(\frac{\omega_e}{\alpha}\right)^2 \cdot \frac{g_s}{2c} \approx 2x10^{-33} \text{watts}\,, \tag{4.23}$$

  where $\omega_e$ is the electron rotational frequency and $g_s$ is the electron g-factor (-2.0023193043737).

- The *gravitational* radiation for the bound proton is,

$$\mathrm{P}_{\mathrm{p}} = G \cdot m_p^{\;2} \cdot \omega_p \cdot 2 \cdot Ry / \left(\mu_p / \mu_N\right) \approx 2x10^{-33} \text{watts}\,, \tag{4.24}$$

where *Ry* is Rydberg constant (10973731.569 m$^{-1}$) and $\mu_p / \mu_N$ is the proton magnetic moment to Nuclear magneton ratio (2.792847337).

Combining Eq. (4.23) and (4.24) we now have the hydrogen atom's *electromagnetic* properties:

$$\frac{m_e}{m_p} = \frac{2\alpha}{\omega_e} \cdot \left(\frac{\omega_p \cdot Ry \cdot c}{g_s} \cdot \frac{\mu_N}{\mu_p}\right)^{1/2} \tag{4.25}$$

**From *gravitational* radiation equations we obtain the *electromagnetic* properties!**

So, it would appear that the structure of the hydrogen atom is very much determined by the gravitational as well as the electromagnetic forces of individual particles making up the atom.

### 4.3.4 Results from three approaches

From these three different approaches: Mass-quants and quantum gravity (Section 4.3.1), the electron as a gravity radiation emitter (Section 4.3.2), and the Hydrogen atom and gravity radiation (Section 4.3.3), we have arrived at the same result. So, we have reason to believe that the electron does emit and/or absorb gravitational radiation, with a specific radiation power (P) of approximately 2x10$^{-33}$

watts. This, in fact, is the equivalent energy for the predicted mass-quant based upon our electron model,

$$\frac{(\hbar\cdot \mathrm{P})^{1/2}}{\mathrm{c}^2} = \text{mass-quant}(m_Q) \approx 5.224x10^{-51}kg \tag{4.26}$$

# 5. The electron, Large Number coincidence and cosmic symmetry

The occurrence of large dimensionless numbers has been reported by several researchers. Many in the main stream of physics have accepted these numbers with intrigue but considered them as mere coincidence and of little real importance in explaining physical processes. We do not present a complete theory of large numbers, but we do show several cases suggesting a physical basis for their occurrence.

## 5.1 Background on large numbers

Weyl (1919) [9,10] was one of the first to notice the large number ratio, $4x10^{42}$, between the electron's electrostatic and gravitational fields. He speculated that this large dimensionless number might represent the ratio between the radius of the electron and the radius of the universe. We concur.

Eddington (1931, 1936) [11,12] gave significance to certain dimensionless numbers appearing in physics (i.e., inverse fine structure constant, $hc/e^2 \approx 137$ and the mass ratio of the proton and electron, $m_p/m_e \approx 1836$ ). He also recognized the following "large number" coincidences:

1) The relation between the Coulomb and gravitational forces in the hydrogen atom,

$$N_1 = e^2/(4\pi\cdot\varepsilon_0\cdot G\cdot m_p\cdot m_e) \approx 10^{40} \tag{5.1}$$

2) The number of nucleons in the universe, $N_2 = 10^{80}$, so that $N_1 = N_2{}^2$.

Dirac (1938) [13], like Weyl and Eddington before him, considered the large number relationship between electrostatic and gravitational forces of two electrons:

$$N_{Dirac} = e^2/(4\pi\cdot\varepsilon_0\cdot Gm_e{}^2) = 4.1666691x10^{42} \tag{5.2}$$

He proposed that cosmological quantities can be related to particle quantities by way of these large dimensionless numbers. He suggested large number coincidences can be explained if fundamental constants, in particular, *G*, varied as the universe aged. Though interesting, his ideas lost favor when new evidence was found in support of the constancy of *G* over time [14,15].

Jordan (1947) [16,17] made the same assumption about changing *G* over time when he discovered that the ratio of one solar mass $M_\otimes$ to the mass of the electron ($m_e$) is connected to the large number, $10^{60}$.

Weinberg (1972) [18] related the pion mass to fundamental constants and Hubble constant:

$$m_\pi \approx \left(\frac{h^2\cdot \mathrm{H}_0}{2\pi\cdot G\cdot c}\right)^{1/3} \tag{5.3}$$

Still others [19,20] have suggested an anthropic argument to show that the large number coincidence is a natural result of intelligent observers being present to discover these occurrences. This logic may have merit, but does not make a definitive statement about the physical laws that produce these large numbers.

We identified a large integer number $\mathrm{N} = 1x10^{22}$ (1985) [21], while developing our electron model. This number N may represent a more fundamental large number than all previous large numbers.

In fact,

$$N^2 / 24 = 4.1666x10^{42} \quad (5.4)$$

is Dirac's number. As mentioned in (Section (4.1), the large number N is derived from internal action of a single electron, whereas Dirac's is from external interaction of two electrons. The fact that my large number and Dirac's number are the same suggests that perhaps Coulomb and Newton forces come from the same physics in micro and macro space.

As we shall show, the **large number N**, the **number 24**, and the **fine structure constant (α)** all seem to recur when applying our electron model to the physical world. These three numbers reveal an elegant symmetry between the small and large scale universe – because the small can tell us something about the large. (Notice: only the magnitude of the number **N** remains to be explained by a completed electron theory; whereas, alpha and 24 have been derived already.)

## 5.2 More large number occurrences

The following are examples of large number occurrences using the recurring Large Number **N=1x10²²**, the number **24** and the fine structure constant **α** from our electron theory:

- Cosmic Tension / electron internal force ($r_e$=2α*$r_G$= 2.8179x10$^{-15}$ m):

$$\left(c^4 / G\right) / \left(m_e \cdot c^2 / r_e\right) = 4.166x10^{42} = N^2 / 24 \quad (5.5)$$

- Observable universe mass from cosmic parameters [22] / electron mass:

$$M_u / m_e \approx 1.9x10^{83} = (N^2 / 24)^2 \cdot \frac{2}{\pi} \cdot \left(\frac{\alpha}{24}\right)^{1/2} \quad (5.6)$$

- Observable universe radius from cosmic parameters [22] / electron radius:

$$R_u / r_e \approx 4.6x10^{40} \approx \frac{N^2}{24} \cdot \frac{2}{\pi} \cdot \left(\frac{\alpha}{24}\right)^{1/2} \quad (5.7)$$

- Electron internal rotational frequency and Hubble constant [22], $\omega_e$ / $H_o$ :

$$7.76x10^{20} \sec^{-1} / 2.3x10^{-18} \sec^{-1} \approx N^2 \cdot \frac{2}{\pi} \cdot (\alpha / 24)^{3/2} \quad (5.8)$$

- Planck mass / electron mass: *(explained by our theory)*

$$m_{planck} / m_e = N/(24 \cdot \alpha)^{1/2} \quad (5.9)$$

- Typical galaxy mass / solar mass ratio: $10^{11} / 1 \approx N^{1/2}$ (5.10)

## 5.3 Where do these numbers come from?

The question, "Where do these numbers come from?" might be answered by new discoveries of modern cosmology and development of quantum theories.

We do not favor any particular theory of cosmology. However, in order to show the occurrence of the large number N we do want to consider the latest inflation theories [23], which at present represent our best explanation for the birth and expansion of the early universe.

The theories suggest that the primordial cosmic dynamics were driven by quantum vacuum energy released during the Grand Unified Theory (GUT) phase transition ($t$ = 10$^{-35}$ seconds). A universe timeline is presented in Appendix A. These quantum effects may account for the large numbers and for the observed symmetry that exists between the small and large scale cosmos.

Our electron model reveals the large number $\mathbf{N=10^{22}}$. But, why does this same **N** appear when the very small is compared with the very large? Perhaps these numbers relate to our early universe development and subsequent expansion. For example, look at the change from the Planck era to today and one can see the occurrence of these numbers:

- Planck time / beginning of GUT phase transition ratio:

$$t_{planck} / t_{GUT} \approx \alpha \cdot 1x10^{11} = \alpha \cdot \mathrm{N}^{1/2} \tag{5.11}$$

- Planck time / Hubble constant ratio [24]:

$$1/(t_{planck} \cdot \mathrm{H}_0) \approx 8.06x10^{60} = \frac{\mathrm{N}^3}{24^2} \cdot \frac{2\alpha}{\pi} \tag{5.12}$$

- Today's visible universe mass / Planck mass ratio:

$$M_u / m_{planck} \approx 8.06x10^{60} = \frac{\mathrm{N}^3}{24^2} \cdot \frac{2\alpha}{\pi} \tag{5.13}$$

- Today's visible universe radius / Planck radius ratio:

$$R_u / \ell_{planck} \approx 8.06x10^{60} = \frac{\mathrm{N}^3}{24^2} \cdot \frac{2\alpha}{\pi} \tag{5.14}$$

- Planck Temperature / CMB Temperature ratio:

$$(T_{planck} / T_{CMB})^2 \approx 2.7x10^{63} = \frac{\mathrm{N}^3}{24^2} \cdot \frac{\pi}{2} \tag{5.15}$$

## 5.4 Cosmic symmetry

In an attempt to find an answer for the occurrences of the three numbers from Sections (5.1) through (5.3) we have also discovered an elegant symmetry that exists between the micro and macro scale universe. To find this symmetry, we applied two well established equations, Planck's [ $\hbar/(m \cdot c \cdot r)$ ] and Mach's [ $Gm/(c^2 \cdot r)$ ].

We first wanted to find two quantities, the maximum observable universe mass and the minimum field mass quanta, known as the "Hubble" mass. Some have suggested that the Hubble mass may be the graviton (specifically a non-zero mass graviton) [25]. We make no such claim here. We merely wanted to reduce the universe into minimum mass quanta to demonstrate our concept of symmetry. We do not have a complete theory as to why this apparent symmetry exists other than the possible link to cosmological models such as the inflation theories. Our primary goal at this point is to show the symmetry and encourage further research.

Using known values for $c$, $h$, $G$, and $\mathrm{H}_0$ (Hubble constant), we can find the universe mass ($M_u$), the universe radius ($R_u$), and the Hubble mass ($m_H$).

Results from the Wilkinson Microwave Anisotropy Probe (WMAP) [26] give the recent best value for the Hubble constant to be $\mathrm{H}_0$=71 (+/-4) km/sec/Mpc. Using $\mathrm{H}_0$ = 71 km/sec/Mpc or $2.3\mathrm{x}10^{-18}\mathrm{sec}^{-1}$, we find the observable universe radius to be,

$$R_u = c / \mathrm{H}_0 \approx 1.3x10^{26} m\,. \tag{5.16}$$

And by Mach's equation we find the observable universe mass,

$$M_u = (c^2 \cdot R_u) / G \approx 1.76x10^{53} kg \tag{5.17}$$

Using Planck's equation we find a seemingly unreal, yet useful, Compton universe radius,

$$r_u = \hbar/(M_u \cdot c) \approx 2x10^{-96} m \tag{5.18}$$

And finally from Mach's equation we calculate the corresponding minimum Hubble mass:

$$m_H = (c^2 \cdot r_u)/G \approx 2.7x10^{-69} kg \tag{5.19}$$

The values we arrive at fit those expected from currently recognized cosmic parameters [22,26]. These values are driven primarily by the value of the Hubble constant, $H_0$ = 71 km/sec/Mpc. This is an important issue as we now use our electron model to derive the same universe mass, radius, and Hubble mass.

Before we begin we want to note that the new values obtained using our model will vary from (5.16) through (5.19) (currently recognized cosmic parameters) by a factor of:

$$\Omega_1 = \frac{\pi}{2} \cdot \left(\frac{24}{\alpha}\right)^{1/2} \approx 90.08 \tag{5.20}$$

This would require a Hubble constant $\approx 79 km/\sec/Mpc$ or $(2.56x10^{-20} \sec^{-1})$, which is outside current parameters. Why the difference? We do not have an answer to this question but we do find it most interesting that the difference is related to two of the three recurring numbers.

Using these three numbers, **N**, **24** and **α**, we calculate the universe mass,

$$M_u = m_e \cdot (\mathrm{N}^2/24)^2 \approx 1.58x10^{55} kg \tag{5.21}$$

And as we did earlier, by using Planck and Mach equations, we found the remaining values,

$$\begin{aligned} R_u &\approx 1.17x10^{28} m \\ m_H &\approx 2.99x10^{-71} kg \end{aligned} \tag{5.22}$$

Remember that our electron model also predicted the mass-quant. The relationship between the mass-quant and the electron mass is:

$$m_Q = m_e \cdot \left(\frac{24}{\alpha \cdot \mathrm{N}^2}\right)^{1/2} \approx 5.224x10^{-51} kg \tag{5.23}$$

And the difference between the mass-quant and the Hubble mass (using our model) is,

$$m_H = m_Q \cdot \left(\frac{24}{\alpha \cdot \mathrm{N}^2}\right)^{1/2} \approx 2.996x10^{-71} kg \tag{5.24}$$

And finally, the simple and interesting relationship between all three, the electron, the mass-quant and the Hubble mass is:

$$m_e = \frac{m_Q{}^2}{m_H} \tag{5.25}$$

This may be more than coincidence, especially if we compare Eq. (5.25) with our earlier discussion about gravitational radiation in Section (4.3.2), Eq. (4.9) and (4.19).

Figure 5 shows graphical outcome of my computations and reveals the symmetry between the very small and the very large. $[\Omega_1 = (\pi/2) \cdot (24/\alpha)^{1/2}]$ and $[\Omega_2 = \mathrm{N} \cdot (\alpha/24)^{1/2}]$ are the symmetry constants discussed earlier and @ is the inverse fine structure constant.

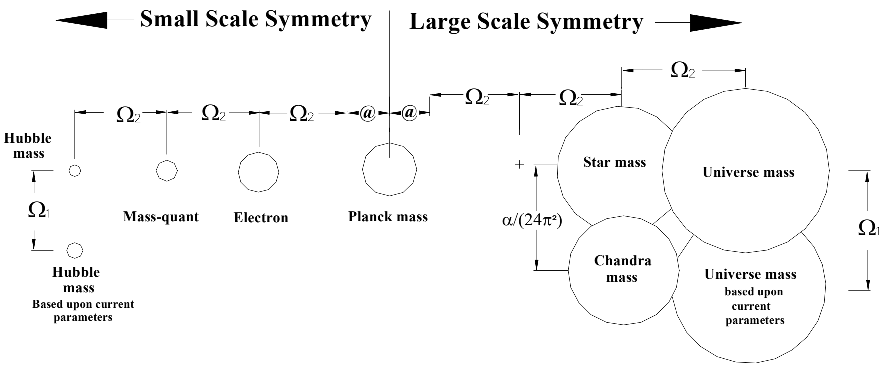



Figure 5: Large and Small Scale Symmetry Revealed by Large Number, N, 24, and fine structure constant, α.

# 6. Conclusions

The very small electron, like no other particle of matter, has been shown to have a unique symmetry mirroring that of the very large universe.

Though the electron has benefited mankind for centuries, its true structure has remained a mystery. Our model provides additional insight into this important particle. By applying the theory of Quantum Thermodynamics (QTD), combined with the principle theory of Relativity (GR) and Maxwell's Electro Dynamics (ED), the dual wave-particle nature of the electron is explained, as well as the its mass, charge, spin, magnetic moment and even its shape.

Several important new discoveries presented by this electron model suggest the need for more research and experimental verification:

1. The **large number, $N=10^{22}$**, came about from the internal dynamic structure of a single free electron and is liken to but more basic than Dirac's large number. The number is applicable to the micro as well as the macro scale and reveals a wonderful symmetry that seems to exist in our universe.

2. **Gravitational radiation** at a specific power of about $2x10^{-33}$ watts is emitted and absorbed according to our electron model. This radiation, which we call the mass-quant, has an energy mass equivalency of $5.224x10^{-51}$ kg. If mass-quant radiation is emitted from the electron and if it is gravity related then the ability to manipulate or even shield it may be a real possibility.

3. **Hydrogen sub-levels may be a new energy source**. One very important outcome of this electron model is our conjecture that N/2 and/or N/3... (*depending on the N with its total 22 digits*) are possible. If so, then we would expect to find energy sub-levels in the hydrogen atom, as shown in figure 6. The most interesting result for mankind is that if sub-levels do exist then this gravitational radiation process will allow us to store additional energy in the hydrogen atom. So that 1kg Hydrogen atoms might replace 45000 liters of oil and more. Experiments by Mills and Ray [27] appear to support our idea as they have measured the radiation wavelength 30.39nm when the hydrogen atom is interacting with a special catalyst independently of each other. It is easy to predict the correct wavelength (30.39nm) by our theory. We only need to correct the result below by using a special relativity mass-correction while assuming that the internal velocity of the electron is also the first Bohr orbit velocity vB=alpha*c=v(internal). This shifts 30.83nm to 30.39nm. The latest news comes from Chris Fuman [28] a member of the British Gardner Watts team. He claims that their thermal energy device, based upon the idea of sub-ground state energy levels in the hydrogen atom, is now creating up to 1.5KW excess power. Related story can be found at [29].

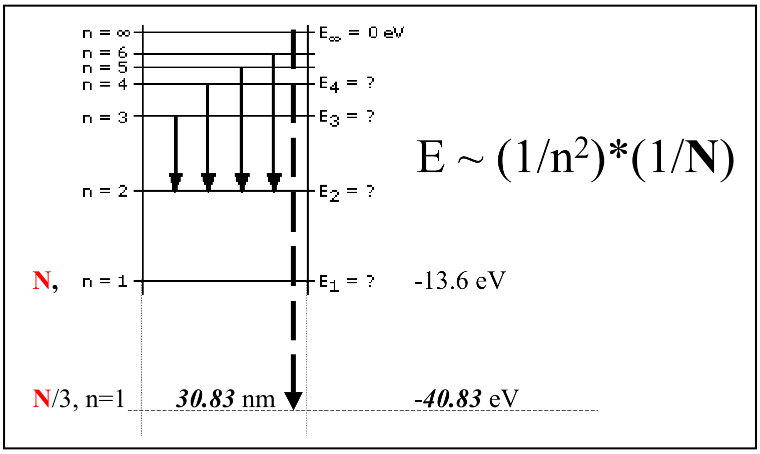



Figure 6: Hydrogen sub-level due to N/3

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# APENDIX A
## Inflation/Grand Unified Theory Model

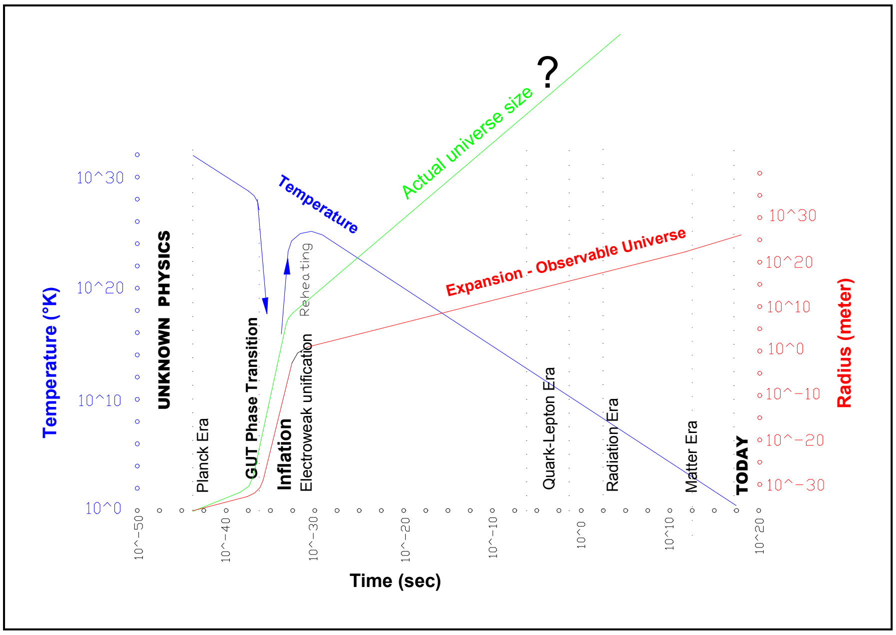


Figure 7: Cosmology timeline

According to basic Inflation/Grand Unified Theory models, the primordial universe experienced a rapid expansion during the GUT phase transition. Up to that point universe mass had increased from Planck scale, $10^{+19}$GeV, up to $10^{+23}$GeV, an increase factor equal to about $\alpha^2$. Minimum field mass quanta decreased from Planck scale down to $10^{+14}$GeV by the same factor, $\alpha^2$, where $\alpha$ is the fine structure constant. This occurred from around $5.4\text{x}10^{-44}$ sec after Big Bang through $10^{-35}$ sec., a factor of about ($\alpha * N$). Here we see $N = 10^{11}$. Temperature decreased from Planck era temperature ($10^{+32}$ °K) down to about $10^{+28}$ °K during this same time. Universe radius expanded from $10^{-35}$ meter to about $10^{-26}$ meter, by the same factor as time ($\alpha * N$).

But, at the start of the GUT phase transition the temperature plummeted and the universe experienced a tremendous inflation period. The universe radius expanded from $10^{-26}$m to about $10^{-4}$m a factor of about $N^2$ within a very short period of time. By $10^{-32}$ sec the inflation was back to "normal" rate and temperature had rebounded to $10^{27}$ °K, from where it began the decrease to today's < 3 °K.

Today, the observable universe greater mass is about $1.8\text{x}10^{53}$ kg and radius of $1.3\text{x}10^{26}$ meter. The minimum mass (Hubble mass) is about $10^{-69}$ kg.

We have greatly simplified this process of expansion, only so we might show a possible connection between the large number coincidence and the inflationary period.

The occurrence of this large number and its square, ($N^2 = N_{Geilhaupt}$), forms the basis of our presentation as we show the extraordinary similarity between the very **small electron** and the very **large universe**.