PART II -- THE UNIVERSAL EXPONENTIAL DECAY

- *Analytic Proof: Particles' Central Core
     and Outward Flow*

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Particles' Central Core and Outward Flow

THE PARTICLE "CORE"

Each of the particles of which atoms of matter are made: protons, neutrons and electrons, has at its center a minute dense "core" as follows.

Gravitational Equivalent Frequency

Consider a small individual particle such as a proton or a neutron. The gravitational action of a massive body is the collective effect of the individual action, below, in each of its such particle components.

Newton's law of gravitation expressed in terms of m_{source} and $m_{acted-on}$ and with both sides of the equation divided by $m_{acted-on}$ is, of course,

(2-1) $\qquad a_{grav} = G \cdot \left[\dfrac{m_{source}}{d^2} \right]$

stating that gravitation is a property of a body's mass.

However, mass and energy are equivalent, so that a mass, m, is proportional to a frequency, f, that is characteristic of that mass. That is

(2-2) $\qquad m \cdot c^2 = h \cdot f \quad$ or $\quad f = [c^2/h] \cdot m$

so that the m_{source} of equation *(2-1)* has a corresponding equivalent frequency, f_{source}.

That being the case, the gravitational acceleration, a_{grav}, can be expressed in terms of that frequency as the change, Δv, in the velocity, v, of the attracted mass per time period, T_{source}, of the oscillation at the corresponding frequency, f_{source}, as follows.

(2-3) $\qquad a_{grav} = \Delta v / T_{source} = \Delta v \cdot f_{source}$

Gravitation and the Planck Length

It can then be reasoned using equation *(2-3)* = equation *(2-1)* as follows .

(2-4) $\qquad a_{grav} = \Delta v \cdot f_{source} = G \cdot \left[\dfrac{m_{source}}{d^2} \right]$

Equation *(2-5)*, below, is obtained by using that frequency is proportional to mass so with f_p and m_p as the proton frequency and mass then $f_{source} = [m_{source} / m_p] \cdot f_p$.

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(2-5) $\quad \Delta v \cdot \left[\dfrac{m_{source}}{m_p} \right] \cdot f_p = G \cdot \left[\dfrac{m_{source}}{d^2} \right]$

Rearranging and canceling m_{source} on both sides of the equation,

(2-6) $\quad \Delta v = \dfrac{G \cdot m_p}{d^2 \cdot f_p} \quad$ per cycle of f_{source}.

Then substituting, per equation *(2-2)*, $m_p = [h \cdot f_p] / c^2$,

(2-7) $\quad \Delta v = \left[\dfrac{G}{d^2 \cdot f_p} \right] \cdot \left[\dfrac{h \cdot f_p}{c^2} \right]$

$\qquad = \dfrac{G \cdot h}{d^2 \cdot c^2} \quad$ per cycle of f_{source}.

The Planck Length, l_P, is defined as

(2-8) $\quad l_P \equiv \left[\dfrac{h \cdot G}{2\pi \cdot c^3} \right]^{\frac{1}{2}} \quad$ so that $\quad G = \left[\dfrac{2\pi \cdot c^3 \cdot l_P{}^2}{h} \right]$

Substituting G as a function of the Planck Length from equation *(2-8)* into G as it is in equation *(2-7)*, the following is obtained.

(2-9) $\quad \Delta v = \left[\dfrac{2\pi \cdot c^3 \cdot l_P{}^2}{h} \right] \cdot \left[\dfrac{h}{d^2 \cdot c^2} \right]$

$\qquad = c \cdot \dfrac{2\pi \cdot l_P{}^2}{d^2} \quad$ per cycle of f_{source}.

This result states that:

- the velocity change due to gravitation, Δv,

- per cycle of the attracting mass's equivalent frequency, f_{source},

    which quantity, $\Delta v \cdot f_{source}$, is the gravitational acceleration, a_{grav},

- is a specific fraction of the speed of light, c, namely the ratio of:

    - 2π times the Planck Length squared, $2\pi \cdot l_P{}^2$, to

    - the squared separation distance of the masses, d^2.

That squared ratio is, of course, the usual inverse square behavior.

This also means that at distance $d = \sqrt{2\pi} \cdot l_P$ from the center of the source, attracting mass, the acceleration, Δv, per cycle of that attracting mass's equivalent frequency, f_{source}, is equal to the full speed of light, c, the most that it is possible to be. In other words, at that [quite close] distance from the source mass the maximum possible

gravitational acceleration occurs. That is the significance, the physical meaning, of l_P or, rather, of $\sqrt{2\pi} \cdot l_P$.

The physical significance of $\sqrt{2\pi} \cdot l_P$ is that it sets a limit on the minimum separation distance in gravitational interactions and it implies that a "core" of that radius is at the center of fundamental particles having rest mass. That is, equation *(2-11)* clearly implies that it is not possible for a particle having rest mass to be approached closer than that distance.

That physical significance of $\sqrt{2\pi} \cdot l_P$, is so fundamental to gravitation and apparently to particle structure, that it more truly represents a fundamental constant than does l_P. For those reasons that length should replace l_P as a fundamental constant of nature as follows.

(2-10)   The fundamental distance constant, δ

$$\delta^2 \equiv 2\pi \cdot l_P^2$$

$$\delta = 4.051,34 \times 10^{-35} \text{ meters} \qquad [2006 \text{ CODATA Bulletin}]$$

Equation *(2-11)* then becomes equation *(2-13)*.

(2-11) $\Delta v = c \cdot \dfrac{\delta^2}{d^2}$ per cycle of f_{source}

a quite pure and precise statement of gravitation, that gravitation is a function of the speed of light, *c*, and the inverse square law, in the context of the oscillation frequency, *f_source*, corresponding to the attracting, source body's mass. It makes clear that an oscillation is an integral part of gravitation

THE PARTICLE'S

There being a need for each gravitationally acting [attract**ing**] particle to communicate to each gravitationally acting [attract**ed**] particle the direction from the attract**ed** particle to the attract**ing** one and the magnitude of the attract**ing** particle's gravitational attraction, there must be something flowing, continuously, carrying that information, spherically outward, from every gravitating particle to every other gravitating particle. That flow-communication is the gravitational field, an active process not a static state.

Furthermore, the necessity for gravitation that an oscillation and its frequency are closely involved in the effect [equations *(2-9)* and *(2-11)*] and therefore in what is communicated by the flow means that the flow itself must be oscillatory.

For such a flow to persist and to have persisted the billions of years since the "Big Bang" there must be a supply of that outward flowing substance in every particle. And, that "supply" must be an extremely concentrated reservoir of that which flows outward [concentrated relative to the outward flow].

Having now just determined:

- That δ sets a limit on the minimum separation distance in gravitational interactions and therefore implies that a "core" of that radius is at the center of fundamental particles;

- That there must be something flowing, continuously from every gravitating particle to every other gravitating particle, that flow being oscillatory;

- And that an extremely concentrated reservoir supply of that which is flowing outward is required at the center of each particle to support the billions of years of the outward flow;

The only reasonable conclusion is that that reservoir is a spherical *core* of radius δ at the center of all particles;

And that its impenetrability is due to its immense concentration [billions of years worth of flow] of the flow substance [hereinafter *medium*] in the extremely minute [$\delta = 4.05134 \times 10^{-35}$ meters per equation *(2-10)*] radius *core* at the center of every particle having rest mass.

But, what "contains" that *core*'s supply or why doesn't it all just quickly "slosh" out and be gone ? The answer is that it is trying to do just that, to "slosh" out, as hard as it can. It cannot help propagating outward because it has no container. But it can only propagate outward at the limiting rate determined by its surface area, $4 \cdot \pi \cdot \delta^2$ and the fastest speed possible for it to flow, the speed of light, c.

Having established the supply of medium flow and its on-going outward flow serving the role of gravitational field as a property of every particle exhibiting rest mass, the question arises, "What of the electric field, much stronger than gravitation and co-present with gravitational field whenever the gravitating particle has electric charge ?"

Just as is the case for gravitation every particle having electric charge has a need to communicate its "message" to every other such particle: the direction back from the encountered particle to the transmitting one, the magnitude of the transmitting particles' charge, and the nature of the charge, whether positive or negative. That flow-communication is the electric field, an active process not a static state.

Furthermore, for that flow to persist and to have persisted the billions of years since the "Big Bang" there must be a supply of that which is flowing outward for it at the center of every particle. And, that "supply" must be an extremely concentrated [relative to the outward flow] reservoir of that which flows outward.

Two such simultaneous flows constituting the two fields, gravitational and electric, and two supporting reservoirs supplying the flows is clearly untenable. There can only be one reservoir in each particle's *core* and one resulting flow producing both the gravitational field and the electric field if for no other reason than because two supply reservoirs would mutually interfere with comprehensive spherically outward flow of each.

The process of that *Propagated Outward Flow* gradually depleting the *medium* remaining in the *core*, as that which is flowing and its supply in the *core* will be referred to, is:

The Universal Exponential Decay as in Section 3.