

## APPENDIX E

### The Universal Exponential Decay

Since the “Big Bang” the *Propagated Outward Flow* has been gradually depleting the original supply of *medium* in the core of each *Spherical-Center-of-Oscillation*. That process, an original quantity gradually depleted by flow away of some of the remaining quantity, is an exponential decay.

#### THE NATURE OF THE DECAY

Of the three fundamental dimensions of length  $[L]$ , mass  $[M]$ , and time  $[T]$  only length can decay. Time being the independent variable of material reality, whether it decays, varies, or is rigorously constant is beyond our ability to detect. Likewise, mass cannot decay, it being proportional to frequency, the inverse of time.

The dimension that is decaying is length, the  $[L]$  dimension in the dimensions of, for example: the Planck Constant,  $h$ ,  $[M \cdot L^2 / T]$ ; the speed of light,  $c$ ,  $[L / T]$ ; and the Newtonian Gravitational Constant,  $G$ ,  $[L^3 / M \cdot T^2]$ . The decay process involves the fundamental constants ( $c$ ,  $q$ ,  $G$ ,  $h$ , etc.) and decay of any of those must be dimensionally consistent with the decay of the others.

The *Propagated Outward Flow* is in Coulomb’s Law the equivalent of  $q^2$ . Using the notation “ $\{x\}$ ” to mean the dimensional units of “ $x$ ”, the dimensional units of *Propagated Outward Flow* i.e. *medium* are  $[M \cdot L]$  per equation (E-1).

$$^{(E-1)} \quad \{\text{Force}\} = \{\text{Mass}\} \cdot \{\text{Acceleration}\} = M \cdot \frac{L}{T^2} = \{\text{Coulomb Force}\} = \frac{\{Q \cdot Q\}}{\{2\pi \cdot R^2\}} = \frac{\{Q^2\}}{L^2}$$

$$\{c \cdot q\} = \{Q\} = \frac{\sqrt{M \cdot L^3}}{T} = \frac{L}{T} \cdot \sqrt{M \cdot L}$$

$$\{q^2\} = M \cdot L = \{\text{Propagated Outward Flow}\}$$

The *Propagated Outward Flow* carries energy and momentum. Planck’s constant,  $h$ , is the fundamental energy-related constant of physics. The ultimate reality that is within the *Spherical-Center-of-Oscillation*’s core is its supply of *medium* of dimensions  $[M \cdot L]$ . To so be as  $h$ -based energy it is  $h/c$  which is of dimensions  $[M \cdot L]$ .

The core’s outer boundary is a surface of area  $4\pi\delta^2$ . It lacks the power to restrain or contain anything. However, the only way the content of the core can leave and flow outward is through the core’s surface. That flow is subject to the speed limit of light speed. That sets the flow at  $[4\pi\delta^2] \cdot c$ .

THE RATE OF THE DECAY

A process which the core decay resembles is the pumping of gas out of a chamber to create a vacuum. In this case the "gas" is the medium, the chamber is the core, and the pumping is the loss of medium, through the surface boundary of the core, to outward propagation. The process of the pumping, whether of gas out of a vacuum chamber or medium out of the core is such that:

- The rate of change of the amount of medium remaining in the core equals
- The amount per volume of medium remaining, times
- The pumping speed, that is the volume per time of the propagation.

This is based on the conceptualization of the process as:

- The medium is uniformly distributed in the core;
- A minute increment of volume is then pumped out in a minute time;
- The remaining medium then redistributes uniformly within the core,
- and the cycle repeats over and over.

From this the rate of change of the amount of medium present within the core is as follows.

$$(E-1) \quad \begin{array}{l} \text{Medium} \\ \text{Rate of} \\ \text{Change} \end{array} = - \left[ \begin{array}{l} \text{Amount} \\ \text{per} \\ \text{Volume} \end{array} \right] \times \left[ \left[ \begin{array}{l} \text{Pumping} \\ \text{Speed} \end{array} \right] = \left[ \begin{array}{l} \text{Surface} \\ \text{of Core} \end{array} \right] \times \left[ \begin{array}{l} \text{Flow} \\ \text{Speed} \end{array} \right] \right]$$

$$\frac{dv}{dt} = - \frac{v}{\frac{4}{3} \cdot \pi \cdot \delta^3} \times \left[ \left[ 4 \cdot \pi \cdot \delta^2 \right] \times [c] \right] = - \frac{3 \cdot c}{\delta} \cdot v$$

The pumping takes place over the entire surface of the core and the rate at which the outward flow takes place is the speed of medium travel, the speed of light,  $c$ . [ Both  $c$  and  $\delta$  are functions of time, each decaying in its dimensional unit [L]; however, their decay rates are identical so that their ratio, as in equation (E-1) is constant.]

Therefore, rearranging equation (E-1) and integrating:

$$(E-2) \quad \frac{dv}{v} = - \frac{3 \cdot c}{\delta} \cdot dt$$

$$\ln(v) = - \frac{3 \cdot c}{\delta} t + C$$

$$v(t) = v_0 \cdot \epsilon^{-\frac{3 \cdot c}{\delta} \cdot t} \quad [\epsilon^C \text{ evaluated as } v_0]$$

Therefore, the decay time constant,  $\tau$  is

$$(E-3) \quad \tau = \frac{\delta}{3 \cdot c}$$

However, that result cannot be correct. Equation (E-3) yields a value of about  $4.5 \cdot 10^{-44}$  seconds. That is completely inconsistent with the universe having an already accomplished life time of billions of years.

It must be concluded that medium empties from the core at only a minute amount of the volumetric pumping speed used above or, alternatively, that the core volume contains, as medium, an immense supply of volume, of "highly concentrated volume" so to speak.

In Section 2, *The Behavior of Matter: Its Form*, under the subtitle “The Particle Core’s Propagated Outward Flow”, it was stated:

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

However thought of, it must be from the foregoing that an additional factor that reduces the rate of change of the core medium must be used in equation (E-3) so that it becomes

$$(E-4) \quad \begin{array}{l} \text{Medium} \\ \text{Rate of} \\ \text{Change} \end{array} = - \left[ \begin{array}{c} \text{Amount} \\ \text{per} \\ \text{Volume} \end{array} \right] \times \left[ \left[ \begin{array}{c} \text{Pumping} \\ \text{Speed} \end{array} \right] = \left[ \begin{array}{c} \text{Surface} \\ \text{of Core} \end{array} \right] \times \left[ \begin{array}{c} \text{Flow} \\ \text{Speed} \end{array} \right] \right] \cdot \left[ \begin{array}{c} \text{Concentration} \\ \text{Factor} \end{array} \right]$$

$$\frac{dv}{dt} = - \frac{v}{\frac{4}{3} \cdot \pi \cdot \delta^3} \times \left[ \left[ 4 \cdot \pi \cdot \delta^2 \right] \times c \right] \cdot \frac{1}{F} = - \frac{3 \cdot c}{\delta \cdot F} \cdot v$$

where  $F$  is the additional factor. Equations (E-2) and (E-3) then become (E-5) and (E-6) as follows.

$$(E-5) \quad \frac{dv}{v} = - \frac{3 \cdot c}{\delta \cdot F} \cdot dt$$

$$\ln(v) = - \frac{3 \cdot c}{\delta \cdot F} \cdot t + C$$

$$v(t) = v_0 \cdot \varepsilon^{-\frac{3 \cdot c}{\delta \cdot F} \cdot t} \quad [\varepsilon^C \text{ evaluated as } v_0]$$

Therefore, the decay time constant,  $\tau$  is

$$(E-6) \quad \tau = \frac{\delta \cdot F}{3 \cdot c}$$

The values of  $\delta$  and  $c$  are known, but what is the value of  $F$  ?

The gradually decaying medium contained within the core is not merely the geometric core physical volume as viewed from our world; it is “highly concentrated volume”, the capability if freed into space outside the core to be myriad core physical volumes, the volume of space.

That difference distinguishes the physics of the core’s internal “Core Domain” vs. the outside “World Domain”.

The ratio to the world view geometrical volume of that “*highly concentrated volume*” of medium to be propagated is designated  $F$ .

$$\begin{aligned}
 (E-7) \quad F &= \frac{\text{Volume Equivalent of Core Medium Supply}}{\text{Geometric Core Volume}} \\
 &= \frac{h/c}{\frac{4}{3}\pi\delta^3} \frac{\text{Units [M}\cdot\text{L]}}{\text{Units [L}^3\text{]}} = 7.938,010,000 \cdot 10^{60}
 \end{aligned}$$

F is a pure number just as are  $\frac{4}{3}$  and  $\pi$  of equation (E-7). Saying the core is medium [M·L] vs. volume [L<sup>3</sup>] is like saying a year is [days] vs. [seconds].

The factor  $F$  spans two different regimes of material reality:

- 1 - The natural world regime in which we exist and function;
- 2 - The interior of the core of each particle, the supply of highly concentrated medium, minute portions of which are propagated outward in each cycle of the particle's oscillation, gradually depleting the supply.

The factor  $F$  spans the relationship between the “Core” and “World Domains”; it expresses the connection of the physical volume of the core and the concentrated-volume medium filling the core. It converts expressing the interior of the core, its substance, between units of volume, [ $\frac{4}{3}\pi\delta^3$ ] { Length<sup>3</sup> }, and units of medium [ $h/c$ ] { Mass · Length }, as propagated outward.

From equation (E-6) with the value for F of equation (E-7) the value of  $\tau$ , the universal decay time constant is

$$\begin{aligned}
 (E-8) \quad \tau &= 3.57532 \cdot 10^{17} \text{ seconds} \\
 &\approx 11.3373 \cdot 10^9 \text{ years}
 \end{aligned}$$

[See the scientific article *On Five Independent Phenomena Sharing a Common Cause*, available at the physics archive at [www.arXiv.org](http://www.arXiv.org), paper [arXiv:physics/0101003](https://arxiv.org/abs/physics/0101003) [pdf].

The paper describes a succession of five different independent astronomical phenomena each the result of a common underlying cause that produces an unaccounted-for acceleration that is: quite small, centrally directed in the system exhibiting each phenomenon, non-gravitational, distance independent, and of a common magnitude.

It demonstrates that the underlying common cause of the five otherwise unexplained phenomena is the Universal Exponential Decay.]

