The Behavior of Matter: Its Form

Section 4, *The Origin of Matter: Its Cause* resolved the origin of the matter of the universe as follows.

> The universe exists. It had to come into being from a prior nothing. That had to happen while avoiding an infinite rate of change. Conservation had to be maintained. *Ergo* equation *4-16* repeated below.

(4-16) $U(t) = \pm U_0 \cdot [1 - \text{Cos}(2\pi \cdot f \cdot t)]$

Thus the hypothesis is that the interruption that started our universe, the interruption of what would otherwise have been an infinite duration of the primordial absolute nothing, an interruption because an essentially infinite amount of opportunity operated on a non-zero though minute probability, was the starting of a matched pair of spherical oscillations:

- Present to us at a very high frequency,

- Of the general *[1 - Cosine]* form, and

- Together equal to the original nothing because of having
  matching amplitudes $+U_0$ and $-U_0$.

That analysis yielded an initial event, the origin oscillations, as in Figure 5-1. [All of the unavoidably planar depictions of the spherical oscillations are of the spherical phenomenon, interpretable as a radial versus time depiction.]
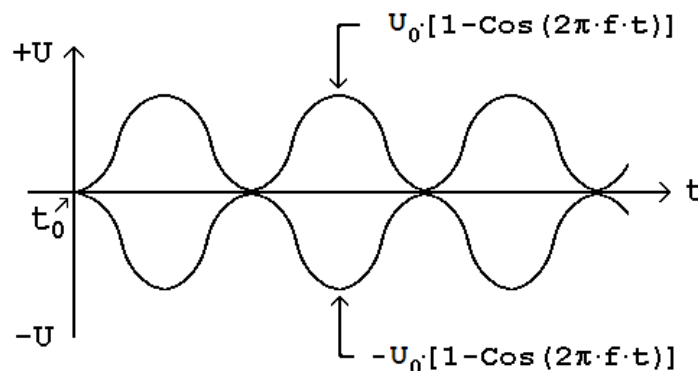

Figure 5-1

HOW THE ORIGINAL OSCILLATIONS BECAME THE UNIVERSE

Examination of the waveform of Figure 5-1 reveals two problems. One, that it is an immediate mutual annihilation, will be dealt with shortly below. Of concern now is that an infinite rate of change still remains; the envelope of the oscillation has an infinite rate of change at $t = t_0$ as can be seen in Figure 5-2, below, which displays the envelope.

Viewed in a mathematical or graphical sense without any consideration of the physical reality represented, the envelope discontinuity at $t=t_0$ is not a difficulty. The only quantity that actually exists and is varying is the overall $U(t)$. The envelope is merely our perception of a characteristic of the waveform. The actual varying quantity, per Figure 5-1, has no discontinuity at $t=t_0$
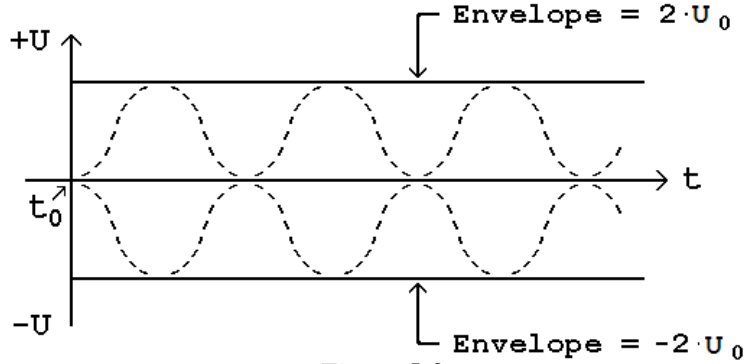

Figure 5-2

However, looking at the situation in a physical sense rather than purely mathematically, such oscillations as depicted in Figure 5-1 are all that there is to account for the effects which we call *energy*, *mass* and *charge*. Therefore, this *energy / mass / charge / oscillation* is something other than nothing. It is a physical reality that did not exist prior to the Origin. It can no more leap from zero to a finite non-zero amount than could the original $U(t)$ so leap.

That infinite rate of change in the amount of *energy / mass /charge* at $t=t_0$ is no more acceptable than was the infinite rate of change encountered in the original analysis of the beginning and it must be corrected by the same kind of reasoning as was then pursued: the envelope, also, had to originate as a *[1 - Cosine]* form of oscillation, which is the only form that avoids an infinite rate of change and matches the requirements of the situation.

That original envelope oscillation was at a lesser frequency than the original wave by the definition of a waveform envelope. If it were at a greater frequency then the roles (envelope and wave) would be reversed. If it were at the same frequency it would not act as an envelope and the infinity problem would remain. If we designate the envelope frequency as f_{env} and the frequency of the wave oscillation within the envelope as f_{wve} then the envelope would be of the following form.

(5-1) $U_{env} = [1 - Cos(2\pi \cdot f_{env} \cdot t)]$

The wave is, as before, of the form

(5-2) $U_{wve} = \pm U_0 \cdot [1 - Cos(2\pi \cdot f_{wve} \cdot t)]$

and the envelope modulating the wave is then

(5-3) $U(t) = [U_{env}] \cdot [U_{wve}]$

$= \pm U_0 \cdot [1 - Cos(2\pi \cdot f_{env} \cdot t)] \cdot [1 - Cos(2\pi \cdot f_{wve} \cdot t)].$

That waveform appears in Figure 5-3.

However, the form of $U(t)$ of equation *5-3* and Figure 5-3 still does not resolve the problem of an infinite rate of change at t_0. The *[1 - Cosine]* envelope is itself an oscillation that begins at t_0 with a sudden step from zero to its full amplitude. Figure 5-3 shows the first *2* cycles of the envelope oscillation, which if only the envelope is considered, is a simple oscillation

at the envelope frequency, even though visually, in the Figure, it is only the trace of the peaks of the overall complex oscillation.
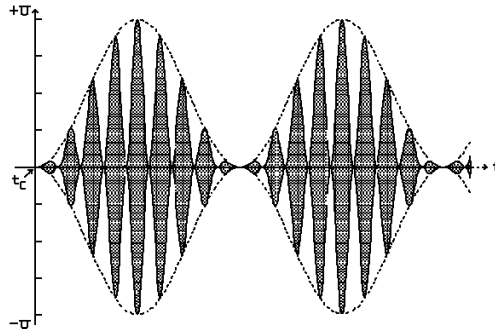

Figure 5-3

It is *energy / mass / charge* that begins suddenly in its full amount at t_0 just as, in Figure 5-1, the oscillation of equation *5-1* begins at t_0. Therefore, it is again necessary to introduce an envelope of *[1 - Cosine]* form to prevent the infinite rate of change at t_0 in the prior envelope. That correction will in turn require still another such correction and so *ad infinitum*. An (apparently at this point) infinite string of envelopes thus results as a necessity of the situation.

The resulting $U(t)$ then is

(5-4)

$$U(t) = \pm U_0 \cdot \prod_{i=1}^{i=\infty} \Big[[1- Cos(2\pi \cdot f_{env_i} \cdot t)] \Big] \cdot \quad \cdots$$

$$\cdots \quad \cdot \Big[[1- Cos(2\pi \cdot f_{wve} \cdot t)] \Big]$$

where the $\prod$ symbol (a large π, Greek "p")
means the product of the indicated factors.

While an envelope frequency must be less than the frequency of the wave that it modulates so that the various f_{env} must be less than f_{wve}, each successive envelope may be at the same frequency, as the prior. The reason is as follows.

If each envelope frequency must be different then each must be at least slightly smaller than the prior. With an infinite set of envelopes and only the frequency range from slightly less than that of the wave down to slightly above zero being available each successive envelope could only be at an infinitesimally lower frequency than its predecessor in any case. Infinitesimally less is essentially the same as identical.

Then how did other than an infinite string of envelopes come about ?

Each additional envelope factor in equation *5-4* results in a higher frequency content in the overall expression. That is, as each envelope is added the expansion of the exponentiated cosines expression into a sum of individual frequency cosine terms becomes longer and acquires higher frequency terms. But, the oscillation could not have had an actual component at infinite frequency.   The real universe original $U(t)$ had an enormous set of envelopes but not an infinite set; they were "cut off" at some point.

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The *Medium* of these oscillations being the only reality and, therefore, being what sets the limit on the speed of light with which we are familiar, the *Medium* also sets a limit on the highest frequency / lowest wavelength waves that can propagate. As a result the series of envelopes, of factors in equation *5-4*, was limited to some finite but quite large amount as developed in Appendix B, *The Limitation of the Original Envelopes*).

This yields a revised *U(t)*, the original oscillation, the Cosmic Egg, as equation *5-5*, below. N_0 is the number of envelopes, all at the same frequency, f_{env}.

$$(5-5) \qquad U(t) = \pm U_0 \cdot \left[1 - \text{Cos}\left[2 \cdot \pi \cdot f_{env} \cdot t\right]\right]^{N_0} \cdot \left[1 - \text{Cos}\left[2 \cdot \pi \cdot f_{wve} \cdot t\right]\right]$$

The waveform *[1 - Cos(x)]^n* converges to an increasingly narrower peak as *n* increases, Figure 5-4, below. For very large *n*, that is very large N_0 of equation *5-5*, the converging of the waveform into a single narrow peak proceeds to a momentary "spike" per cycle. Figure 5-5, below, shows the appearance of the waveform for extremely large *n*, that is for *n = N_0* – what the waveform of the original "Cosmic Egg", the start of our universe, "looked like". (N_0 is found further below to be about *10^{84}*.)
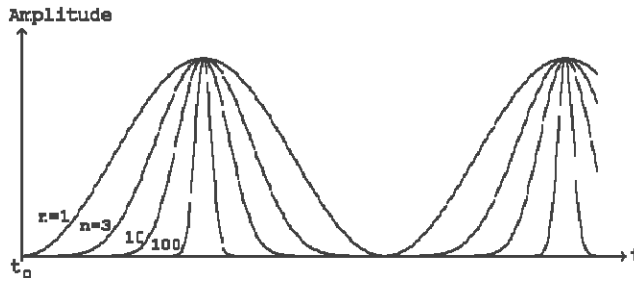

Figure 5-4 [1 - Cos(x)]^n For n = 1, 3, 10, 100
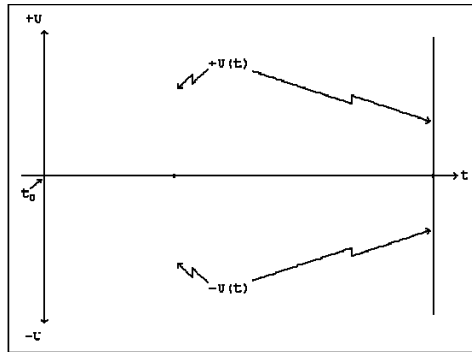

Figure 5-5
The U(t) "Cosmic Egg" Waveform

This discussion of *U(t)*, the original oscillation the start of which was the start of the universe, has dealt so far only with the problems of the Origin, the problems of the transition from nothing to something. The something was, of course, the first instant of the entire universe. As such it must have contained in itself all of the *mass / energy / positive and negative charge* of the universe.

Figures 5-1, 5-3, and 5-5 all indicate that the original pair of oscillations, *+U* and *-U,* should have immediately mutually annihilated, canceled out, reverted to the primal nothing. But,

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clearly that did not happen. The only explanation of that not happening is that each was unstable, so unstable that they exploded more immediately than they were able to mutually annihilate. They immediately proceeded to an immense explosion of energy and pieces of their oscillation, the event now called the "Big Bang". See Appendix A, *Why No Immediate Mutual Annihilation.*

In terms of the $U(t)$ as depicted in Figure 5-5, the so immediate explosive decay undoubtedly occurred after only a minute portion, an infinitesimal portion, of the very first cycle had passed. It had to have been long before the first "spike". In that sense the initial event was very small, tenuous, hardly more than nothing because the instantaneous amplitude of $U(t)$ at that moment (the height of the curve above zero at that moment long before the first "spike") was also infinitesimal. It was hardly more than, essentially zero.

In that sense, the way that the universe started at all becomes a little more comprehensible. To avoid an infinite rate of change there was essentially almost no difference between "nothing", on-going absolute nothing, and the first infinitesimal moment of the original $U(t)$, the original oscillation.

Yet, it contained the entire universe.

THE FORM OF MATTER AS GENERATED BY THE "BIG BANG"

What did that "Cosmic Egg" explode into ?   It could only explode into pieces of what it was made of, pieces of *[1 – cosine]* form spherical oscillations, pieces like equation *4-16*, above.

Each oscillation is three-dimensional, thus spherical, because three dimensions is the minimum number that can involve space part of which is not its own boundary.

But, what did the "Cosmic Egg" explode into ? It primarily exploded into what we know our universe to mainly consist of: myriad protons - Hydrogen atom nuclei, and myriad electrons - maintaining overall charge neutrality with the protons, and the antimatter forms of both, negaprotons and positrons – maintaining conservation.

[Those might also be expected to have mutually annihilated but did not. Their survival rather than annihilation is analyzed in full in Appendix A, *Why No Immediate Mutual Annihilation*. Suffice it here to observe that each product piece was initially ejected radially outward at extreme velocity and energy, on paths slightly diverging, such that initially annihilations could not occur.]

Then, what was the nature, the form of those product pieces that the "Cosmic Egg" exploded into ? Because of the two frequencies of $U(t)$, f_{wve} and f_{env}, and that the explosion source was of two equal but opposite polarities, $+U_0$ and $-U_0$, the "Big Bang" resulted in myriad pieces of four different forms of *[1 – cosine]* form spherical oscillations , equations *5-6* .

(5-6) $U_{Form\ 1}(t) = +U_c \cdot [1 - Cos(2\pi \cdot f_{wve} \cdot t)]$ the proton

$U_{Form\ 2}(t) = -U_c \cdot [1 - Cos(2\pi \cdot f_{env} \cdot t)]$ the electron

$U_{Form\ 3}(t) = -U_c \cdot [1 - Cos(2\pi \cdot f_{wve} \cdot t)]$ the anti-proton

$U_{Form\ 4}(t) = +U_c \cdot [1 - Cos(2\pi \cdot f_{env} \cdot t)]$ the anti-electron

Each of those has a specific value of its mass. Per the data provided by NIST, the National Institute of Standards and Technology those masses are:

(5-6a)   ■ the proton and the antiproton $m_p = 1.672\ 621\ 898 \cdot 10^{-27}\ kg$

■ the electron and the anti-electron $m_e = 9.109\ 383\ 56 \cdot 10^{-31}\ kg.$

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Using the mass-energy relationship, $m \cdot c^2 = h \cdot f$ the frequency, f, of those particles can be calculated. Those frequencies are:

(5-6b) ■ the proton and anti-proton: $f_{wve} = 2.268,731,818 \cdot 10^{23}$ hz

        ■ the electron and anti-electron: $f_{env} = 1.235,589,965 \cdot 10^{20}$ hz.

Finally, the mass of those four fundamental particles having now been resolved, their electric charge remains. They all have the same magnitude of their oscillation, $|U_c|$, which by default is the magnitude of their electric charge. [U_c is the particle oscillation amplitude per equation 5-6. U_0 is the original pre-explosion oscillation amplitude.] The magnitude of the oscillation is in two opposite polarities; therefore clearly, where q is the fundamental electric charge per NIST, then:

(5-7) $q = 1.602,176,621 \times 10^{-19}$ c

        $+U_c = +q$

        $-U_c = -q$

Judging by its result, the "Cosmic Egg" was not unlike an immense atom, a very unstable immense atom [as are all of the atomic species of atomic number exceeding 83 which the cosmic egg would have immensely exceeded]. Its "Big Bang" was a kind of explosive nuclear radioactive decay ultimately ending in the myriad stable elements of today's Periodic Table plus those unstable with half lives long enough to be in detectable quantities today. Such decays follow a chain:

- From a heavy and complex composition,

- To various multiple less heavy less complex product pieces,
      · · · · ·
- Until they arrive at many multiple stable forms.

Some of those "multiple less heavy less complex product pieces" having long half lives are present to us still today still decaying as what we term "radioactive" species.

The vast majority of those resulting stable forms are the protons and electrons of the material world and their anti-particles. They are of the equation *5-6* form spherical oscillation, and will be referred to as *Spherical-Centers-of-Oscillation*.

SUMMARY

The form of matter is not that of the "particles" of classical modern physic's Standard Model. Rather the form of matter is *Spherical-Centers-of-Oscillation*, spherical oscillations of *[1 - Cosine]* form as equation *5-6*.

[For the action of matter in the various laws of physics see R. Ellman, "On the Nature of Matter" 2018, The-Origin Foundation, Inc., available at Amazon.com.]