FRACTAL PHYSICS THEORY - COSMIC SCALE NUCLEAR EXPLOSION COSMOLOGY

LEONARD J. MALINOWSKI

BASF Dispersions and Resins

Monaca, Pennsylvania, USA

Abstract

This second article, in a series of five, begins to discuss Big Bang Cosmology in terms of a cosmic scale nuclear explosion in a decelerated time frame relative to the human scale. The very successful Big Bang model of the universe has illuminated some difficult questions. What powered the Big Bang? What is dark matter? What preceded the Big Bang? Did the Universe start from a singularity? In an attempt to answer these profound questions, this article will first review the concept that nuclei, during the moment of the beta particle formation process of beta-decay, are fractally self-similar to most stars. The next topic describes the explosion. The remainder of the article draws attention to fractal self-similarities between astronomical observations and events occurring within a cosmic scale nuclear explosion.

1. Introduction

The first article of the Fractal Physics Theory series provides essential background information [1].

Consider stars:

 - have mass and radiate energy;

 - undergo fusion which alters their chemical composition;

 - have masses ranging over two orders of magnitude;

 - exist individually, in binary and more complex systems;

- can explode with tremendous energy as nova and supernova;

- are found in galaxies.

Nuclei that are in the process of the beta decay moment:

- have mass and radiate energy;

- undergo a change which alters their nucleon composition;

- have masses ranging over two orders of magnitude;

- exist individually, in binaries and more complex systems when capturing neutrons;

- can rapidly change releasing antineutrino energy and high kinetic energy β-particles;

- are found in radioactive materials.

The vast majority of stars are fractally self-similar to nuclei in the process of beta decay. Stars are cosmic scale nuclei in the process of beta-decay as observed in the human scale. The luminous output of a star over its life, its sum of electromagnetic radiation and neutrino output, is one cosmic scale antineutrino as observed in the human scale. Stable cosmic scale nuclei and cosmic scale atomic electrons must be in thermodynamic equilibrium with the microwave background radiation. Their "unseen" cold dark matter gravitational effects are observed in the human scale.

2. The Solar System is Fractally Self-similar to a Cosmic Scale (cs) Neutron Midway Through cs-beta Decay

1. Neutron, electron - relative mass data.

2. Neutron beta decay - relative energy data.

3. Wilkinson Microwave Anisotropy Probe (WMAP) dipole anisotropy solar system velocity data.

4. Nuclear explosions release over 10^{23} neutrons in the first second.

5. WMAP $30\,\mu K$ anisotropies as Doppler shifted cosmic scale neutron radial velocity indicators.

2.1. Neutron, electron - relative mass data

If the Sun is a cs-neutron in the middle of the process of cs-beta decay, then the cs-neutron's mass slightly exceeds the current mass of the solar system, calculated to

be 1.992×10^{30} kg. The mass of a neutron divided by the mass of an electron:

$$1.67492728 \times 10^{-27} \text{ kg} / 9.1093826 \times 10^{-31} \text{kg} = 1838.684.$$

The mass of a cosmic scale electron equals $1.992 \times 10^{30} \text{ kg} / 1838.684 = 1.083 \times 10^{27}$ kg.

The mass of Jupiter is 1.899×10^{27} kg, while the masses of the traditional nine planets total 2.669×10^{27} kg [2]. If the iron-nickel cores of the nine planets account for 41% of their total mass, then they can be the seeds of one forming cosmic scale electron.

2.2.1. Neutron beta decay - relative energy data

The Sun can be a cosmic scale neutron undergoing cosmic scale beta decay.

$$n \rightarrow p^+ + e^- + \text{antiv}_e.$$
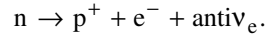
The neutron's mass minus the combined masses of the proton and the electron gives the amount of energy available from this decay process, the reaction Q_{value}.

Neutron mass:	$1.67492728 \times 10^{-27}$ kg
– Proton mass:	$-1.67262171 \times 10^{-27}$ kg
–Electron mass:	$-9.1093826 \times 10^{-31}$ kg
Q_{value}:	$1.39163174 \times 10^{-30}$ kg $= 780648$ eV

Within a large population of neutrons, a few will beta decay to form a proton and an electron, each with zero kinetic energy. In these events the antineutrino carries the maximum energy of 781 keV.

The energy scaling fractal, $¥\text{Energy} = 1.1895 \times 10^{57}$ [1]. $\hspace{2cm}$ (1)

$$¥\text{Energy} = \frac{(Q_{value} \text{ of cosmic scale neutron beta decay})}{(Q_{value} \text{ of quantum scale neutron beta decay})}.$$

Q_{value} of cosmic scale neutron beta decay

$$= (1.1895 \times 10^{57})(780.684 \text{ keV}) = 1.49 \times 10^{44} \text{ J}. \hspace{2cm} (2)$$

Estimate of solar energy over solar lifetime:

$$(\text{Solar luminosity} = 3.8515 \times 10^{26}\,\text{W})(9 \times 10^9\,\text{y}) = 1.09 \times 10^{44}\,\text{J}. \qquad (3)$$

Therefore the total estimated energy radiated by the Sun, which corresponds to the energy of one cs-antineutrino, falls within the expected cs-neutron beta decay Q_{value}. The remaining energy $(4 \times 10^{43}\,\text{J})$ will provide the kinetic energy to the newly formed cs-proton and cs-electron and additional cs-antineutrino energy (supernova radiation).

2.2.2. The Sun cannot be a cosmic scale triton undergoing cosmic scale beta decay

To demonstrate the significance of Subsection 2.2.1, consider the following:

$$T^+ \rightarrow\ ^3He^{2+} + e^- + anti\nu_e.$$
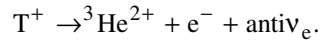
Tritium mass:	3.016049278 amu
–Helium 3 mass:	−3.016029319 amu

$$Q_{\text{value}}: \qquad 0.000019959\,\text{amu} \qquad = 18600\,\text{eV} = 18.6\,\text{keV}$$

In this example let the mass scaling fractal, $¥M = 1.992 \times 10^{30}\,\text{kg}\,/\,(\text{mass of triton in kg}) = 3.977 \times 10^{56}$, which equals the energy scaling fractal. As in Subsection 2.2.1, the total estimated energy radiated by the Sun is $1.09 \times 10^{44}\,\text{J}$, which the titanic scale $(\text{using } ¥E = 3.977 \times 10^{56})$ measures as $1.71\,\text{MeV}$.

Since $1.71\,\text{MeV} \gg 18.6\,\text{keV}$, the Sun cannot be a cs-triton undergoing cs-beta decay.

2.3. Wilkinson Microwave Anisotropy Probe (WMAP) dipole anisotropy solar system velocity data

An object's velocity is scale invariant, that is the velocity scaling fractal $= ¥\text{velocity} = 1$. If a neutron in a nuclear fission reactor on the Earth has a velocity of $368\,\text{km/s}$ as measured in the human scale, then this same neutron will be measured by the lilliputian scale to have a velocity of $368\,\text{km/s}$. WMAP data of the cosmic microwave background radiation (CMBR) appear brighter or hotter on one

side of the sky and fainter or cooler on the opposite side. This dipole anisotropy is attributed to the relative motion of the solar system barycenter and the CMBR. The solar system's velocity is calculated to be $368 \, \text{km/s} \pm 2 \, \text{km/s}$, which corresponds to a solar system kinetic energy (E_k):

$$\text{Solar system } E_k = 0.5(1.992382 \times 10^{30} \, \text{kg})(368000 \, \text{m/s})^2 = 1.3491 \times 10^{41} \, \text{J.} \quad (4)$$

Using the energy scaling fractal, $¥E = 1.1895 \times 10^{57}$, the titanic scale measures $708 \, \text{eV}$ for the solar system's E_k. Fission neutrons released in a nuclear explosion have typical kinetic energies of $2 \, \text{MeV}$ and must undergo many collisions to slow to $708 \, \text{eV}$. Therefore the cosmic scale neutron destined to become the solar system existed for a relatively extended period of time, enduring several collisions, before beginning to decay. A nuclear explosion fission debris neutron velocity of $368 \, \text{km/s}$ is quite reasonable.

2.4. Nuclear explosions release over 10^{23} neutrons in the first second

A cosmic scale nuclear explosion will have an enormous flux of cosmic scale neutrons with a wide range of velocities, and a portion of which will be undergoing beta decay.

2.5. WMAP 30 µK anisotropies as Doppler shifted cosmic scale neutron radial velocity indicators

Anisotropies in the cosmic microwave background radiation have been detected by WMAP up to $30 \, \mu\text{K}$. These anisotropies could be caused by cosmologically local objects in motion with surface temperatures $= 2.725 \, \text{K}$. Applying the radial Doppler formula to a local source emitting radiation at $T = 2.725 \, \text{K}$ but measured at $T = 2.725 \, \text{K} \pm 30 \, \mu\text{K}$ could indicate an ambient flux of cosmologically local objects moving at $3.3 \, \text{km/s}$.

Data indicates that visible stars in the Milky Way galaxy's core rotate as if part of a titanic scale solid, while the stars in the Galaxy's disk spiral arms (including the solar neighborhood) appear to rotate as if part of a titanic scale liquid. If one models the "dark stars" in the solar neighborhood as cosmic scale molten Uranium dioxide, an upper limit can be set for the velocities of cs-Uranium and cs-Oxygen nuclei. UO_2 melts above $2800 \, \text{K}$. In U^{235} fueled thermal fission reactors where

temperatures are well below $2800\,K$, neutron velocities as low as $2.2\,km/s$ are common. In solid or molten UO_2 neither Uranium or Oxygen nuclei, nor any of their electrons have velocities of $3.3\,km/s$. About one second into an atomic explosion, the condensing very hot fission debris would have neutrons at velocities of $3.3\,km/s$.

3. Nuclear Explosion Moment and the History of the Observable Universe [1]

3.1. Cosmic scale nuclear explosion

After an atmospheric nuclear explosion the residual material quickly achieves thermal equilibrium [3]. About 70% of the fission energy is emitted as soft *X*-rays which are absorbed by the ambient air within a few feet. Some of this energy is reradiated as UV, but most of the energy goes into kinetic and internal energy of Nitrogen and Oxygen of the air, forming the fireball. The fireball reradiates some energy as $UV\,/\,Vis\,/\,IR$ with the rest of the energy converted into the blast wave. The fireball grows in mass by incorporating the surrounding air, which results in a decrease in temperature. As the fireball cools the gaseous material (fission products, unfissioned fuel, air) condenses to form a cloud containing solid particles of weapon debris and many water droplets. At this precise moment, if antineutrino energy could be imaged through femtometer apertures using femtosecond shutter speeds, the interior of this nuclear explosion would resemble our visible universe.

The author has proposed that our Big Bang universe is the interior contents of one cosmic scale nuclear explosion occurring on a supercosmic scale planet into a titanic scale (ts) Oxygen atmosphere [1]. Cosmic scale vaporized fission fragments and cs-unfissioned Uranium have already begun to condense, react with the cs-Oxygen and form crystals of cs-Uranium dioxide, spiral galaxy cores. Elliptical galaxies contain stars moving in random directions, the motion of which is fractally self-similar to particles suspended in a fluid. Cosmic scale vaporized fission fragments and cs-unfissioned Uranium have already begun to condense into ts-molten liquid drops and along with ts-water vapor droplets, capture cs-neutrons and cs-fission fragments to form elliptical galaxies. Fission fragment products are typically centered around two mass peaks, $A \sim 95$ and $A \sim 138$. These fission fragments undergo a series of beta decays before reaching a stable nuclear endpoint. Consequently most stars are cosmic scale fission fragments in the process of cs-beta decay. This cosmic scale nuclear explosion will have many cs-free neutrons in flux

colliding with cs-nuclei (suggested origin of gamma ray bursts), many cs-neutrons in the process of absorption by other nuclei (suggested origin of binary, and more complex star systems), and a percentage of cs-neutrons undergoing cs-beta decay (suggested identity of the solar system).

3.2. What powered the Big Bang?

The chain reaction rapidly releases tremendous energy that vaporizes the solid material into hot compressed gases, several tens of millions of degrees [3]. The gas violently expands creating a pressure wave in the ambient material. Not all the fissionable material available participates in the chain reaction; the efficiency < 100%. The fission chain is often considered as a series of generations. One generation corresponds to newly freed neutrons that are subsequently captured by nuclei. The average time from the release of a neutron by one nucleus until its absorption by another nucleus is called the generation time. The generation time for high energy neutrons is about 1×10^{-8} seconds which is referred to as a shake. The explosion time refers to the moment when the material begins to expand. The cosmic scale nuclear explosion time is when the Big Bang began. The expansion rapidly curtails the fission chain reaction, but some fissioning continues in the expanding material due to neutron capture.

Table 1 applies to fissioning Uranium 233, Uranium 235, and Plutonium 239 nuclei. It is generally accepted that about 180 MeV per fission are released during the immediate explosion.

Table 1. Average value of fission energy [3]

	Energy MeV
Kinetic energy of fission products	165 ± 5
Instantaneous gamma photons	7 ± 1
Kinetic energy of fission neutrons	5 ± 0.5
Beta particles from fission products	7 ± 1
Gamma photons from fission products	6 ± 1
Neutrinos from fission products	10
Total energy per fission	200 ± 6

For Uranium 235 the following formula is approximately true [3]:

$$N_t \approx N_0 e^n, \tag{5}$$

where N_0 = number of neutrons at time zero, set $N_0 = 1$ if the reaction begins with

1 neutron, N_t = number of neutrons at a later time, t, n = number of generations.

One mole $(6.0221415 \times 10^{23} \text{atoms})$ of Uranium 235 has a mass of 235.0439 g. If 1 mole of U^{235} nuclei fission, then 6.0221415×10^{23} nuclei $* 180$ MeV = 1.736736×10^{13} J = 4151 tons of TNT equivalent or 4.151 Kilotons of TNT are immediately available from the explosion (Table 2), where, 1 electron volt (eV) $= 1.60217653 \times 10^{-19}$ J, 1 MeV $= 1 \times 10^6$ eV, 1 gram of TNT = 4184 J, 1 ton of TNT $= 1 \times 10^6$ g of TNT = 4.184×10^9 J.

Table 2. Fissioned Uranium nuclei energy yield

TNT equivalent Energy	Energy (Joules)	# of $^{235}U_{92}$ Nuclei required to fission	Uranium 235 Mass fissioned	# of generations	Time to Produce
1 Kiloton	4.184×10^{12}	1.451×10^{23}	0.0566 kg	53	0.53 µs
20 Kilotons	8.368×10^{13}	2.902×10^{24}	1.1326 kg	56	0.56 µs
1 Megaton	4.184×10^{15}	1.451×10^{26}	56.6325 kg	60	0.60 µs

The tremendous energy released that powers a 1-Megaton nuclear explosion takes place in 0.60 µs. From self-similarity, a cosmic scale nuclear explosion also releases its titanic scale 1-Megaton energy in titanic scale 0.60 µs. Scaling fractals readily convert an object's properties measured in scales separated by $\Delta n = +/- 2$ [1].

$$¥f(O) = \frac{[O,\ f(O)]_{2,0}}{[O,\ f(O)]_{2,2}}, \tag{6}$$

$$¥\text{time} = 3.789 \times 10^{23} = \frac{(\text{time in titanic scale, relative to human scale})}{(\text{time in titanic scale, relative to titanic scale})}.$$

A titanic scale time of 0.60 µs relative to the human scale equals $(3.789 \times 10^{23})(0.60\,\text{µs}) = 7.2 \times 10^9$ y. The energy that powered the Big Bang explosion was generated in about 7×10^9 y. Most of the energy, 99.9%, is released in the last 7 generations. Therefore most of the Big Bang energy was generated in the 840×10^6 y immediately preceding the Big Bang.

1-Megaton of TNT as measured in the titanic scale equals $(¥\text{Energy} = 1.19 \times 10^{57})(4.184 \times 10^{15}\,\text{J}) = 4.98 \times 10^{72}$ J as measured in the human scale. The energy

equivalent of $\sim 3 \times 10^{28}$ supernovae $(1.9 \times 10^{44}$ J/SN $)$ powered the Big Bang.

3.3. Quantum scale explosion as measured in the human scale

Assume 10% of the available fuel fissions to release 1-Megaton equivalent of TNT in a nuclear explosion. Let the initial mass equal 566.325 kg $= 2409$ moles of Uranium 235 with a density $= 19000$ kg $/ m^3$. Let the initial temperature $= 30 \times 10^6$ K, in an initial volume 0.0298 m^3. Just prior to the explosion moment, the initial pressure:

$$P = nRT/V = 2.02 \times 10^{13} \text{Pa}, \tag{7}$$

where $V = $ volume (m^3), $n = $ moles of fissionable material, $R = 8.314$ J/$(\text{mol} \cdot \text{K})$, $T = $ temperature (K).

3.4. Self-similar cosmic scale explosion as measured in the human scale

Using human scale data from Subsection 3.3., the initial size and density in the titanic scale fissionable material just prior to the Big Bang explosion, relative to the human scale, are estimated:

Just prior to the explosion moment, the ts-solid volume of ts-material equals $(\yen \text{Volume} = 5.438 \times 10^{70})(0.0298 \text{ m}^3) = 1.62 \times 10^{69} \text{ m}^3$, relative to the human scale. A sphere this size has a radius $= 7.70 \times 10^6$ ly.

Just prior to the explosion moment, the ts-solid density of ts-material equals $(\yen \text{Density} = 2.188 \times 10^{-14})(19000 \text{ kg} / m^3) = 4.157 \times 10^{-10} \text{kg} / m^3$ relative to the human scale.

After 0.5 seconds, a 20-Kiloton nuclear explosion has a fireball with a radius of 222.5 meters [3]. After 1.8 seconds, a 1-Megaton nuclear explosion has a fireball with a radius of 960 meters. Both these radii are nearing the maximum fireball sizes observed. If our visible universe is 13.6×10^9 y old, then it could have a radius $= ct$ $= 1.2867 \times 10^{26}$ meters. Using $\yen \text{Length} = 3.789 \times 10^{23}$, the titanic scale measures this radius as 340 meters. The Big Bang could be the result of a titanic scale 1-Megaton nuclear explosion that detonated less than one ts-second ago.

4. Largest Stellar Masses are Self-similar to the Largest Fission Product Masses
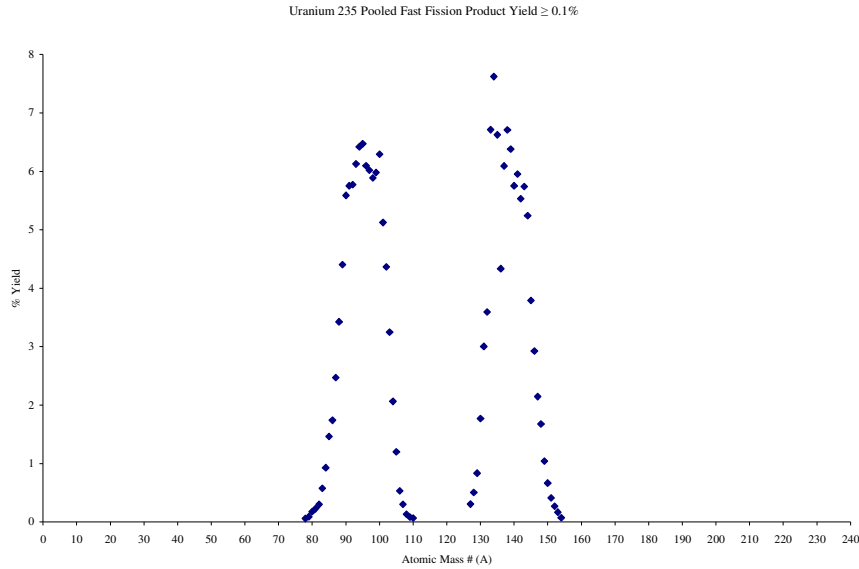
Uranium 235 Pooled Fast Fission Product Yield ≥ 0.1%

Figure 1. U^{235} pooled fast fission product yield $\geq 0.1\%$ (from Table 3 Data).

Cosmic scale fission fragments are the parent stars of a series of cosmic scale beta decay chains. The process of quantum scale beta decay does not significantly reduce the parent nuclear mass (see Table 4). The Uranium 235 pooled fast fission product yield should compare with the stellar mass distribution. In addition low mass stars either are free cosmic scale neutrons undergoing beta decay (~ few million currently in Milky Way), or are more likely captured cs-neutrons in binary orbits being absorbed by their cs-captor nuclei. The captor nuclei may not radiate above 2.7 K and therefore may not be visible. The current models of stellar mass transfer depict this cosmic scale neutron absorption process.

Currently unanticipated by Big Bang Theory, the majority of stars are involved in cosmic scale chemical bonds. Entire galaxies are completely bound together by their cs-chemical bonds which are far stronger than their collective gravitational bond. Current stellar mass distributions are potentially biased without including the effects of the cosmic scale chemical bonds. Very significant; the largest stellar masses are estimated at ~150 solar masses. This fits perfectly with the thermal fission mass yield profile listed in Table 3 below and plotted in Figure 1. Stellar masses should have a noticeable gap in the range 111 to 126 solar masses. Quantum scale

nuclear masses greater than $A = 239$ are not found naturally on the Earth. Fractal Physics theory predicts the largest stellar mass is about 239 solar masses, such as cosmic scale Uranium 239 in the process of cosmic scale beta decay.

Table 3. Uranium 235 pooled fast fission products $\geq 0.1\%$ yield [4]

Mass (A)	% Yield	Mass (A)	% Yield	Mass (A)	% Yield
78	0.05708	99	5.9804	136	4.3340
79	0.09078	100	6.2916	137	6.0919
80	0.1749	101	5.1249	138	6.7081
81	0.2287	102	4.3619	139	6.3799
82	0.3002	103	3.2480	140	5.7519
83	0.5754	104	2.0618	141	5.9516
84	0.9265	105	1.2020	142	5.5292
85	1.4615	106	0.5328	143	5.7386
86	1.7384	107	0.3019	144	5.2400
87	2.4718	108	0.1303	145	3.7898
88	3.4238	109	0.08138	146	2.9241
89	4.4022	110	0.06522	147	2.1433
90	5.5879	127	0.3038	148	1.6765
91	5.7520	128	0.5037	149	1.0390
92	5.7739	129	0.8350	150	0.6661
93	6.1262	130	1.7680	151	0.4119
94	6.4190	131	3.0030	152	0.2702
95	6.4706	132	3.5930	153	0.1672
96	6.0933	133	6.7123	154	0.07210
97	6.0174	134	7.6213		
98	5.8882	135	6.6236		

Table 4. Example fission fragment beta decay chains [2]

	Parent		Daughter					MeV	$t_{1/2}$
1	$_{95}Rb^{37}$	$\rightarrow$	$_{95}Sr^{38}$	+	e^-	+	antiv$_e$	9.30	0.377 s
2	$_{95}Sr^{38}$	$\rightarrow$	$_{95}Y^{39}$	+	e^-	+	antiv$_e$	6.08	25.1 s
3	$_{95}Y^{39}$	$\rightarrow$	$_{95}Zr^{40}$	+	e^-	+	antiv$_e$	4.42	10.3 m
4	$_{95}Zr^{40}$	$\rightarrow$	$_{95}Nb^{41}$	+	e^-	+	antiv$_e$	1.125	64.02 d
5	$_{95}Nb^{41}$	$\rightarrow$	$_{95}Mo^{42}$	+	e^-	+	antiv$_e$	0.926	34.97 d
			Stable						
1	$_{138}Te^{52}$	$\rightarrow$	$_{138}I^{53}$	+	e^-	+	antiv$_e$	6.4	1.4 s
2	$_{138}I^{53}$	$\rightarrow$	$_{138}Xe^{54}$	+	e^-	+	antiv$_e$	7.8	6.5 s
3	$_{138}Xe^{54}$	$\rightarrow$	$_{138}Cs^{55}$	+	e^-	+	antiv$_e$	2.77	14.1 m
4	$_{138}Cs^{55}$	$\rightarrow$	$_{138}Ba^{56}$	+	e^-	+	antiv$_e$	5.37	32.2 m
			Stable						

5. Cosmic Rays

5.1. Cosmic scale fissioning nuclei

Fissioning nuclei almost always split into two large fragments of unequal masses plus a few neutrons (Figure 2) [5]. From conservation of momentum the lighter group of fragments receives more energy than the heavier group. The distribution of fission fragment kinetic energies exhibits two peaks. The lighter group with atomic mass number peaking at A ~ 95 receives kinetic energy ~ 100 MeV within the range from 88 to 112 MeV. The heavier group with atomic mass number peaking at A ~ 140 receives kinetic energy ~ 67 MeV within the range from 50 to 88 MeV. Once formed, the fission fragments rip through the electron cloud of the original fission nucleus as they pass into the surrounding medium. The new born fission fragments appear as highly energetic and highly ionized atoms. The average charge of the lighter group is $\sim^+20e$, the average charge of the heavier group is $\sim^+22e$. The specific ionization due to fission fragments is very high and their range is correspondingly short. The lighter, more energetic fragments are more penetrating (Table 5).

Figure 2, Uranium 236 Fission

Nuclear radii, kinetic energies, velocities
Neutron: 1.20 fm, 2.5 MeV, 0.0728 c
A^{139}: 6.22 fm, 67 MeV, 0.0322 c
A^{95}: 5.48 fm, 100 MeV, 0.0475 c
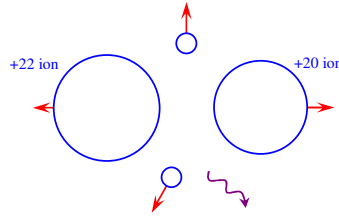Photon: $\lambda = 177$ fm, 7 MeV, $c = 3 \times 10^8$ m/s

+22 ion   +20 ion

Figure 2. Uranium 236 fission.

Table 5. Fission fragment (A ~ 95) ranges [5]

Object	$[A \sim 95, \text{Range}]_{0,0}$	$[A \sim 95, \text{Range}]_{0,-2}$	$[A \sim 95, \text{Range}]_{2,0}$
Aluminum	14×10^{-6} m	561 ly	561 ly
Copper	5.9×10^{-6} m	236 ly	236 ly
Silver	5.3×10^{-6} m	212 ly	212 ly
Uranium	6.6×10^{-6} m	264 ly	264 ly
U_3O_8	14×10^{-6} m	561 ly	561 ly

Both fission fragments come to rest within a few hundred light years of their parent cosmic scale U^{236}. Along these decelerating paths, the cs-fission fragment

ions capture cs-electrons from surrounding cs-atoms until the cs-ions are neutralized. A whole cascade of cs-electron reshuffling occurs, with cosmic scale photons being absorbed and emitted. Traveling at a velocity of 4.75 % c, a cosmic scale $^{+20}A^{95}$ ion travels 30 AUs in 3.6 days, creating a current:

$$i = +20\,(3.4013 \times 10^{21}\,\text{C})/315165\,\text{s} = 2.16 \times 10^{17}\,\text{A}.$$

The magnetic field created at points a distance R normal to the direction of a current in a long straight wire:

$$\mathbf{B} = \mu_0 i / (2\pi R). \tag{8}$$

At $R = 1\,\text{AU}$ the magnetic field, $\mathbf{B} = (2 \times 10^{-7}\,\text{Tm/A})(2.16 \times 10^{17}\,\text{A})/(1.496 \times 10^{11}\,\text{m}) = 0.289\,\text{T}$.

5.2. High energy cosmic rays

Both the larger and the smaller cs-fission fragments emerge from the cs-fissioned atom very highly ionized, with high velocities. Any quantum scale atoms in their paths will have their positive nuclei blasted away. The Greisen-Zatsepin-Kuz'min (GZK) cut off process applies to the highest energy cosmic rays interacting with the 2.7 K CMB radiation through photoproduction or photodisintegration [2]. Cosmic ray energies greater than $5 \times 10^{19}\,\text{eV}$ that travel over $150 \times 10^6\,\text{ly}$ will have their flux noticeably reduced due to these interactions. Therefore the highest energy cosmic rays must be accelerated by cosmologically local sources.

The charge of a cosmic scale electron is $3.4013 \times 10^{21}\,\text{C}$ [1]. Consider the potential energy between a proton and a cosmic scale $^{+}22$ fission fragment separated by 30 AU:

Coulomb potential energy U_c = (k)(charge 1)(charge 2)/(separation distance) (9)

$$U_c = (8.9876 \times 10^9\,\text{Nm}^2/\text{C}^2)(1.6022 \times 10^{-19}\,\text{C})(22)(3.4013 \times 10^{21}\,\text{C})/30\,\text{AU}$$

$$= 24.0\,\text{J} = 1.5 \times 10^{20}\,\text{eV}.$$

This energy is the same order of magnitude measured for very high energy cosmic rays! Furthermore, due to the interaction of cosmic rays with CMB photons, the requirement of a cosmologically local accelerator is met.

5.3. Qualitative abundances of cosmic rays

Cosmic scale negative charges are restricted mainly to one unit of cs-charge, namely, $-3.4 \times 10^{21}\,C$, while cs-fission fragments have cs-positive charges up to $(22)(+3.4 \times 10^{21}\,C)$. In Cosmic Scale Nuclear Explosion Cosmology an over abundance of positively charged cosmic rays should be expected, which is observed. Only ~1% of cosmic rays are electrons, while 99% are positive nuclei.

With the enormous abundance of highly charged, spinning, spherically distributed cosmic scale electrons, it is readily apparent why cosmic rays are observed to arrive at earth from all directions.

5.4. Cosmic scale gamma photon

In Figure 2 notice a gamma photon is emitted during fission. The energy of a cosmic scale 7 MeV gamma photon in the human scale is $1.3341 \times 10^{45}\,J$. The human scale measures this cs-gamma photon's wavelength as $6.7103 \times 10^{10}\,m = 0.45\,AU$. This cs-gamma photon is made out of 4.507×10^{80} photons each also of wavelength $= 6.1703 \times 10^{10}\,m$ but the minute energy of $1.85 \times 10^{-17}\,eV$. This multitude of ultra radio waves are moving in the same direction and are coherent, they amplify to create the cs-gamma photon. The human scale will not be able to detect these photons; they must remain coherently part of the cs-photon. A cs-photon colliding with the solar system would presumably be catastrophic.

6. Cosmic Scale Molten Uranium Dioxide Solar Neighborhood

6.1. Cosmic scale solar neighborhood

The ceramic UO_2 is often used in modern fission reactors due to its high melting point and structural integrity. The Milky Way galaxy, in this article, is considered to be cosmic scale fission explosion debris. The majority of mass of the Galaxy is unfissioned cs-Uranium that has bonded with cs-Oxygen of the ts-atmosphere and condensed to a ts-crystalline core surrounded by cs-molten Uranium dioxide (UO_2). Cosmic scale neutron rich cs-fission fragments have also condensed within the cs-crystalline UO_2 core and in spiral patterns along a disk within cs-molten UO_2. The cs-fission fragments parent, at various rates, a series of cs-beta decays, which appear to the human scale as stars. The solar system, in this article, is

considered to be a cosmic scale neutron about midway through the process of cs-beta decay, traveling through cs-molten UO_2.

Nuclear fission typically launches neutrons with energies of a few MeV, corresponding to velocities a few percent of the speed of light. These undergo dozens of collisions with nuclei in thermal reactors, reducing their kinetic energies to thermal values of 0.025 eV, corresponding to velocities of $2.2\,km/s$. The velocity of the solar system barycenter is $368 \pm 2\,km/s$ relative to cosmic microwave background radiation (CMBR). The solar system's precursor cs-neutron must have had many collisions with cs-nuclei to slow it down to its present velocity. The last collision occurred over five billion years ago setting the direction and velocity measured by WMAP. The solar system, in a very real sense, is a ts-neutron experiment, with yearly periodicity observed in solar system phenomena revealing details about the structure of the local cs-molecular structure.

The UO_2 crystal system is cubic; the structure type is fluorite [2]. The human scale length of the cell's edge at room temperature $= 5.4682 \times 10^{-10}\,m$. Multiplying this value by the length scaling fractal yields the cosmic scale UO_2 crystal cell's edge length. Compare the average distance between the Sun and the Earth, one astronomical unit, 1 AU, to this cosmic scale cell length:

$$(5.4682 \times 10^{-10}\,m)(¥Length = 3.788565912 \times 10^{23})$$

$$= 2.0717 \times 10^{14}\,m = 1385\,AU. \tag{10}$$

Figure 3 is an example of the Fluorite crystal packing structure of UO_2. The positions of 14 cs-Uranium cations are depicted as blue spheres while the positions of 8 cs-Oxygen anions are depicted as green spheres. Even though the solar neighborhood is proposed to be cs-molten UO_2, a very striking connection can be made between the cs-crystal cell lengths and the distance traveled by the solar system in one solar cycle period. The distance the solar system travels at 368 km/s in one solar cycle of 22.2 years is depicted as a red arrow. The solar cycle periodicity is proposed to reflect its passage through the cs-molten UO_2 lattice cells. The collective gravitational and Coulombic potentials of the cs-crystal lattice will have recurring positions of maximum and minimum values that the solar system, traveling through at a constant velocity will encounter periodically. Together with the solar cycle, the regular spacing of the planetary orbits (Titus-Bodes rule), and the periods

of Jupiter's and Saturn's orbits, are all possibly connected to the gravitational and Coulombic potential of the ambient cs-crystal lattice. Furthermore, the million or so other currently co-decaying cs-neutrons traveling about the Milky Way may all share similar structures with our solar system, due to similar cs-crystal lattice forces.
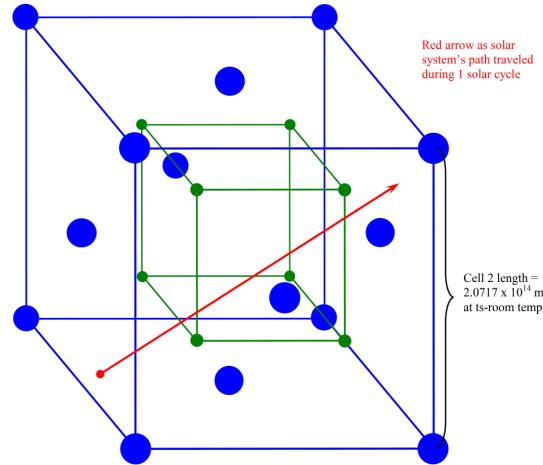

Figure 3. Cosmic scale Uranium dioxide, UO_2, Fluorite crystal structure, inner cube 1 with 8 cosmic scale oxygen anions in simple cube lattice, outer cube 2 with 14 cosmic scale Uranium cations in cubic closest packed lattice.

6.2. The sunspot cycle [6]

The Sun's photosphere contains sunspot groups, areas of dark, irregular shaped patterns that travel with the Sun's surface rotation. The average number of sunspots varies over an 11 year period, called the sunspot cycle. After sunspot minimum, sunspots first appear at 30° latitudes north and south of the Sun's equator. Individual sunspots remain at the same latitude. But as the years into the cycle proceed, new sunspots occur closer and closer to the equator. The middle of the cycle sees the sunspot maximum at 10° to 15° latitudes north and south of the equator. At the end of the 11 year cycle, the sunspots appear on the equator. Powerful magnetic fields pass through the sunspots inhibiting the normal convection flow, which allows the sunspots to cool about 1000 K compared to the surrounding photosphere.

Sunspots usually occur in pairs and the pairs have opposite polarity. All sunspot pairs in the same solar hemisphere have the same magnetic orientation. If the leading spot (in the direction of the Sun's rotation) has one polarity, then all the leading spots in that hemisphere have the same polarity. Furthermore, concurrently, all the sunspot

pairs in the other hemisphere have the opposite polarity. During the 11 year cycle, all the leading spots in the northern hemisphere have the same polarity, but the polarity reverses during the next 11 years. The full magnetic sunspot cycle is 22 years.

The solar sunspot record notes an extended period of low sunspot activity called the Maunder minimum from 1645 to 1715. This is 70 years or about the time it takes the solar system to transit 3 cs-UO_2 crystals. It is possible that the Maunder minimum is a record of the solar system transiting cs-molten distortions or cs-impurities in the otherwise orderly cs-molten crystal array. At the beginning of a solar cycle, sunspots appear on the Sun at latitude ~ 30° which may reflect the angle the solar system velocity vector makes relative to an axis of the cs-UO_2 lattice. As the solar cycle progresses, the sunspots travel down towards the Sun's equator. This may indicate the "upwards" motion of the solar system as it passes points of maximum gravitational or electric potential in the cs-UO_2 crystal.
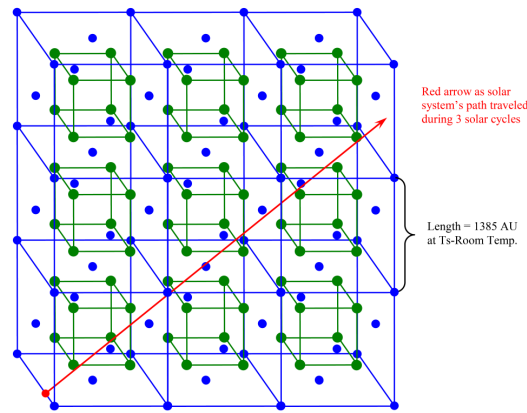

Red arrow as solar system's path traveled during 3 solar cycles

Length = 1385 AU at Ts-Room Temp.

Figure 4. Cosmic scale UO_2, 9 crystals, inner green cubes occupied by cosmic scale Oxygen anions, outer blue cubes occupied by cosmic scale Uranium cations.

Figure 4 shows the symmetry of a 3×3 matrix of cosmic scale UO_2 crystals. The red arrow indicates the distance and possible path the solar system travels through three cs-Uranium dioxide crystals in three full solar cycles.

Figure 5 shows the solar neighborhood of a 3×3×3 cs-Uranium dioxide crystal array. The cs-nuclei are all "dark stars" which do not shine in the visible part of the electromagnetic spectrum. There are 172 cs-Uranium nuclei in blue, with 235 and 238 solar masses. There are 216 cs-Oxygen nuclei in green, each having 16 solar masses. Not shown in Figure 5, but necessarily present, are an orderly packing of

17552 cs-electrons, each with 0.6 Jupiter masses. It is reasonable to expect the solar neighborhood, a cs-molten crystallizing ceramic of UO_2 to be the fractal equivalent of very hot. The cs-atoms composing the cs-UO_2 crystal cells experience a thermal volume expansion (Table 6, Figure 6).
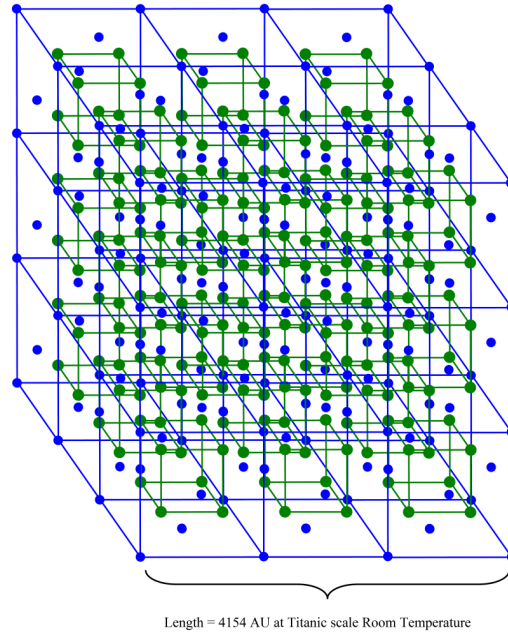

Length = 4154 AU at Titanic scale Room Temperature

Figure 5. Solar neighborhood as cs-UO_2, 27 crystals of the Fluorite structure, outer blue cubes occupied by 172 cs-uranium cations, cubic closest packed, inner green cubes occupied by 216 cs-oxygen anions, simple cubic.

6.3. Solar system angle traveled through cs-molten UO_2 neighborhood

Table 6. Recommended linear thermal expansion of UO_2 [7]

Temp (K):	1000	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100
$\Delta L/L$ (%):	0.730	0.948	1.062	1.181	1.305	1.436	1.573	1.718	1.871	2.034	2.206

Temp (K):	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100	3120
$\Delta L/L$ (%):	2.388	2.582	2.788	3.006	3.238	3.484	3.745	4.021	4.314	4.624	4.688

Scalativity postulates the laws of physics, including this thermal expansion, hold for all scales.

The solar system's velocity $= 368\,km/s$. During one solar cycle of 22.2 yrs, the solar system moves a distance, $X = 2.5828 \times 10^{14}\,m = 1726\,AU$. At ts-room

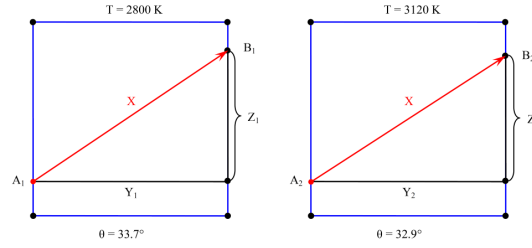temperature the cs- UO_2 crystal cell edge length $= 2.0717 \times 10^{14}$ m.

Figure 6. Solar system path through a cs- UO_2 crystal, $X = (368\,\text{km/s})(22.2\,\text{yrs}) = 1726$ AU.

At temperature $= 2800\,\text{K}$, the length of a UO_2 crystal expands by 3.745%, therefore at the fractal equivalent temperature of $= 2800\,\text{K}$, in Figure 6 above, $Y_1 = 2.1492 \times 10^{14}$ m and $Z_1 = 1.4323 \times 10^{14}$ m.

At temperature $= 3120\,\text{K}$, the length of a UO_2 crystal expands by 4.688%, therefore at the fractal equivalent temperature of 3120 K, in Figure 6 above, $Y_2 = 2.1688 \times 10^{14}$ m and $Z_2 = 1.4025 \times 10^{14}$ m.

If Fractal Physics Theory accurately describes the observable universe, then anisotropies detected in CMBR - human scale temperature fluctuations, also measure the solar neighborhoods' titanic scale temperature.

7. Local Baryonic Matter Emitting Cosmic Microwave Background Radiation

7.1. Cosmic scale objects emitting radiation at 2.725 K

This article proposes that CMBR is radiated by ultra cold baryonic matter that is cosmologically local. The temperature implied by the radiation truly reflects the temperature of the surface of the matter emitting the radiation. The solar neighborhood is considered in this article as part of cs-crystallizing UO_2. This radiation will experience a slight gravitational redshift as it leaves their surface. This radiation can also experience a Doppler shift due to the cs-lattice vibration motion. Nuclear explosions contain a large flux of free neutrons moving in random directions and at various energies.

Radiation emitted from the Sun is close to a black body curve; it is reasonable to

expect radiation emitted at 2 to 4 K would fit a black body curve. Stellar spectra imply a majority of Hydrogen and Helium present. In Earth labs with surface gravity $= 9.81 \, \text{m}/\text{s}^2$, Helium has a normal boiling point at $T = 4.2221 \text{K}$ with atmospheric pressure $= 101325 \, \text{Pa}$, and a superfluid transition temperature at $T = 2.1768 \text{K}$ with saturated vapor pressure $= 3130 \, \text{Pa}$ [2]. From WMAP anisotropy data, cosmic scale neutrons moving at $3.3 \, \text{km}/\text{s}$ are considered to emit the CMBR at 2.725 K. A cs-neutron has mass $1.992 \times 10^{30} \, \text{kg}$ with surface gravity $= 926 \, \text{m}/\text{s}^2$ and is composed primarily of solid Hydrogen with a surface layer of liquid Helium. At 2.725 K, any other elements present will be solid phase. Only an atmosphere of Helium could be present.

7.2. WMAP anisotropies

Anisotropies in WMAP data of CMBR might arise from Doppler effects of cs-neutron translational velocities. Using Wien's displacement law, $\lambda_{\text{max}} T = 2.8977685 \times 10^{-3} \, \text{mK}$, if a source at $T_e = 2.725 \text{K}$ emits radiation at $\lambda_e = 1.063401284 \times 10^{-3} \, \text{m}$, and an observer measures this radiation at $T_{\text{o}} = 2.725 \text{K} - 30 \, \mu\text{K} = 2.72497 \text{K}$ or $\lambda_{\text{o}} = 1.063412992 \times 10^{-3} \, \text{m}$, a redshift $z = (\lambda_{\text{o}} - \lambda_e)\lambda_e$ is:

$$z = (1.063412992 \times 10^{-3} \, \text{m} - 1.063401284 \times 10^{-3} \, \text{m}) / (1.063401284 \times 10^{-3} \, \text{m})$$

$$= 1.1009955 \times 10^{-5}.$$

A relative velocity of 3301 m/s is calculated, using

$$v/c = [(z + 1)^2 - 1] / [(z + 1)^2 + 1]. \tag{11}$$

An anisotropy of $30 \, \mu\text{K}$ in CMBR data corresponds to a $3.3 \, \text{km}/\text{s}$ translational velocity of cs-neutrons, very close to ideal thermal neutron velocities for a fission reactor. This proposal can be tested because radar focused at the anisotropies should be reflected back to human scale detectors, within weeks for the nearer cosmic scale nuclei. There should be a parallax shift in the location of the anisotropies as the solar system travels through the cosmic scale unfissioned uranium and free neutrons.

8. Cosmic Scale Neutron Collisions with cs-nuclei and Gamma Ray Bursts

8.1. Gamma ray bursts

Cosmic ray protons striking a cs-neutron's surface hydrogen will transmute

protons into deuterium and tritium. If the Big Bang reflects a cosmic scale nuclear explosion, then cs-neutrons must be colliding with cs-nuclei within the Milky Way with a random, even distribution plotted in galactic coordinates. Imagine cs-neutrons with a high concentration of deuterium and tritium coating their surfaces colliding with cs-Uranium or cs-Oxygen nuclei. It is reasonable to expect the deuterium and tritium to quickly fuse from this impact and radiate a burst of gamma rays. The amount of explosives available, the kinetic energies involved, and the collision angles are all variable quantities, but estimates can be made for their ranges. It should be possible to correlate this data and compare it with known gamma ray burst data.

Not all cosmic scale collisions necessarily result in a gamma ray burst. Gamma-ray bursts are currently detected by orbiting satellites about once a day or once per 86400 seconds. Therefore the

- Cosmic scale neutron collision rate $= 1.157 \times 10^{-5}$ collisions/s as measured in the human scale.

- Cosmic scale neutron collision rate $= 4.384 \times 10^{18}$ collisions/s as measured in the cosmic scale, which is fractally self-similar to neutron collision rates in solid fissioning material just prior to explosion time.

The most powerful telescopes can not see the stars thought to be responsible for gamma ray bursts. This information fits a model of colliding cold dark stars at cosmologically local distances. Gamma ray bursts do have redshifts and free cs-neutrons are moving very fast. A cs-neutron slows but not by more than 50% after a collision. Cosmic scale Uranium nuclei are cs-radioactive so they must eventually increase in temperature. Cosmic rays should also transmute the surfaces of these massive cs-nuclei which would contribute to the variety in gamma ray burst spectra.

8.2. Neutron beta decay

The ocean layer of liquid Helium atop the cs-neutron provides a thermonuclear engine coolant (Figure 7). It is proposed that the statistical nature of neutron beta decay is due to a lack of information pertaining to the precise ls-chemical composition of each neutron. If the percentage of sqs-Helium available in a particular neutron and the ambient sqs-cosmic ray flux are known, then the specific neutron beta decay moment can be calculated.
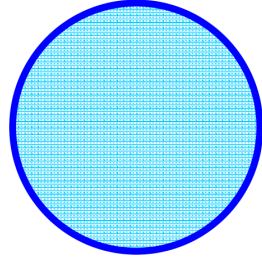
Figure 7. Cross section of cs-neutron with outer layer shallow ocean of liquid Helium coating solid H_2.

Superfluid liquid Helium conducts heat very well. To increase the temperature of a planetary mass of liquid Helium from 2.7 K to 4.2 K would take a large amount of energy. The liquid Helium ocean at 4.2 K will further absorb energy while boiling.

Assume about 1×10^{18} cosmic ray atomic nuclei enter the Earth's atmosphere each second with energies near 1×10^9 eV. Let the radius r of a sphere containing Earth's atmosphere be $6378 \, km + 63 \, km = 6441 \, km$. The Earth's atmosphere then presents a surface area of $5.213 \times 10^{14} \, m^2$ to the influx of cosmic rays. The estimated power per unit area cosmic rays impart to an unprotected surface:

$$(1 \times 10^{18} \, \text{cosmic rays} / s)(1 \times 10^9 \, eV)(1.6022 \times 10^{-19} \, J/eV) / (5.213 \times 10^{14} \, m^2)$$

$$= 3.073 \times 10^{-7} \, W / m^2.$$

If this power per area impinges upon the surface of a cosmic scale neutron, cosmic rays will deliver:

$$\text{Cosmic ray power} = (3.073 \times 10^{-7} \, W / m^2)(2.5973 \times 10^{18} \, m^2) = 7.982 \times 10^{11} \, W.$$

Cosmic rays colliding with cs-neutron surface atoms resulting in fusion and particle showers will also generate heat.

8.3. The weak nuclear force

The Earth is shielded from many cosmic rays due to its ambient magnetic field. Consider the cs-proton. Its ambient positive charge will repel 99% of incoming positive charged cosmic rays, while its ambient magnetic field will deflect the 1% of incoming negative charged cosmic rays. The cs-proton truly has a force field protecting its surface from cosmic rays that would otherwise initiate thermonuclear

fusion (cs-proton decay). It should be possible to correlate the amount of proton induced shielding of nuclei along with the amount of sqs-engine coolants potentially available versus the ambient sqs-cosmic ray bombardment, with nuclear beta decay half-lives.

9. Formation of the Solar System - Qualitative

About five billion years ago thermonuclear fusion began, perhaps by continued cosmic ray bombardment of the cold dark star's surface. Fusion continued until a percentage of Iron formed. The spinning Sun was overheated and swelled to a swirling disk of radius ~30 AU in order to cool. Heavier elements like Iron, due to centrifugal forces, distributed mainly towards the outer edges of this large swirling, cooling star. The now cooled, mostly lighter elements contracted inwards due to their mutual gravitational attraction. Shells of excess heavy masses, the proto-planetary material, along with excess heat and angular momentum, remained behind and formed the planets. The contracted Sun at the center of the solar system continued fusing hydrogen into helium at a stable rate.

10. Quantum-Cosmic Unification (QCU) Summary - Self Similar Fractal objects

1.a. Quantum - ~ one second into a 1-Megaton nuclear explosion.

1.b. Cosmic - visible expanding universe arising from a Big Bang.

2.a. Quantum - condensing explosion particles, water droplets and dust, containing nuclear fission products, and free neutrons in the moment of the beta decay process.

2.b. Cosmic - galaxies.

3.a. Quantum - explosion particles with condensing fission products beta-decaying, water vapor droplets retaining free neutrons, separated by and flowing with relatively low density atmospheric winds.

3.b. Cosmic - large scale structure of the universe with galaxy super clusters, great walls, and massive voids.

4.a. Quantum - fission fragments with masses peaking at A ~ 96 and A ~ 138 that parent beta decay chains. A nuclear neutron changes into a proton and an electron while radiating antineutrino energy.

4.b. Cosmic - the vast majority of visible stars.

5.a. Quantum - large flux of neutrons in the process of being captured and absorbed by other nuclei.

5.b. Cosmic - plethora of binary stars.

6.a. Quantum - unfissioned nuclei, masses A ~ 16 amu and A ~ 238 amu, surrounding fission fragments.

6.b. Cosmic - the missing mass, a multitude of 2.7 K dark stars in excess of bright stars.

7.a. Quantum - large flux of free neutrons colliding with stable nuclei of the condensing explosion particles, molecules of water vapor, and atmospheric gases.

7.b. Cosmic - large flux of free cs-neutrons flowing throughout the visible universe, coated with surface layers of varying amounts of deuterium and tritium, colliding with massive dark stars, sparking with gamma-ray bursts.

8.a. Quantum - stable atomic nuclei with lilliputian scale surface temperatures in thermodynamic equilibrium with the subquantum scale microwave background radiation.

8.b. Cosmic - stable cosmic scale atomic nuclei with surface temperatures in thermodynamic equilibrium with the microwave background radiation.

9.a. Quantum - large flux of free neutrons flowing in random directions with ls-surface temperatures in thermodynamic equilibrium with the sqs-microwave background radiation with many neutrons flowing at 3.3 km/s.

9.b. Cosmic - large flux of free cosmic scale neutrons flowing in random directions with surface temperatures in thermodynamic equilibrium with the CMBR. WMAP fluctuations of ~30 μK in the CMBR result from cs-neutrons flowing at 3.3 km/s.

10.a. Quantum - moment of $_{92}U^{236}$ fission explosion into $(A \sim 96)^{+20}$, $(A \sim 136)^{+22}$, 2-3 neutrons and gamma photon.

10.b. Cosmic - explosion moment not visible. Cosmologically local highly charged cosmic scale ionized fission fragments linearly accelerate cosmic rays to 10^{20} eV.

11.a. Quantum - a planet with at least one nuclear explosion in process.

11.b. Cosmic - supercosmic scale planet that contains the cosmic scale nuclear explosion (visible universe), and to a far greater extent, dark stars of the greater contiguous universe.

12.a. Quantum - nuclear explosion debris and water vapor flying apart.

12.b. Cosmic - Hubble galactic starlight redshift-distance relation.

13.a. Quantum - beta decay explosion moment.

13.b. Cosmic - supernovae and novae.

14.a. Quantum - newly emitted beta particles, and newly emitted fission neutrons.

14.b. Cosmic - quasars are cosmologically local cosmic scale beta particles and cosmic scale fission neutrons that are "born" hot and radiate to cool their excess internal energy. These "stars" have low density gaseous atmospheres, but are not undergoing thermonuclear fusion. Cs-neutrons have initial translational velocities of a few percent of c, and cs-beta particles have initial translational velocities close to c, with large transverse "spin" Doppler redshifts superimposed upon their translational velocities. Cs-beta particles large polar magnetic fields have debris electrons and ions spiraling around them emitting jets of radio waves.

15.a. Quantum - ~ one second into a nuclear explosion that is still accelerating.

15.b. Cosmic - Distant Type Ia supernovae luminosity determined distances and nonlinearity of Hubble redshift relation for same distant Type Ia supernovae illustrating the accelerated expansion of the universe.

16.a. Quantum - free neutrons (some in the midst of the beta decay process) flowing through molten UO_2.

16.b. Cosmic - the solar system flows at 368 km/s with a solar cycle period of 22 y that is correlated to passage through cosmic scale molten UO_2.

11. Conclusion

I. What powered the Big Bang?

A cosmic scale nuclear explosion of cs-Uranium 235 powered the Big Bang. Perhaps 10^{60} generations of cs-fission occurred in less than one titanic scale

microsecond. Tremendous titanic scale temperatures and pressures were achieved that ts-vaporized the ts-material and exploded outwards.

II. What is dark matter, the halos predicted to exist around galaxies because of their gravitational effects?

Dark matter is cosmic scale Uranium crystallizing with cosmic scale Oxygen, as well as cosmic scale condensing water vapor droplets. The matter is ultra cold, dark and baryonic. Cosmic scale chemical bonds are a major contributor to "dark matter gravity".

III. What preceded the Big Bang?

The cosmic scale atoms may have existed on the supercosmic scale planet for titanic scale billions of years prior to the nuclear explosion of the Big Bang. Three billion titanic scale years equals 1×10^{33} human scale years. For all practical purposes this is forever to the human scale. However, there was a time prior to this. The supercosmic scale planet must have formed perhaps from a scale $m = 3$ nuclei undergoing scale $m = 3$ beta decay (scale $m = 0$ is the human scale). This scale $m = 3$ beta decay may be part of a long series of scale m = 3 radioactive decay. The point is matter-energy, space-time, the laws of physics, chemistry, etc., appear to have always existed. The Fractal Universe always was and always will be; it fills everything, everywhere. The Fractal Universe just exists.

IV. Did the universe start from a singularity, a point approaching zero volume and infinite density? No.

The titanic scale solid material that exploded in a Big Bang had a relatively large volume, a sphere with radius ~ 8 million light years, and density of $4 \times 10^{-10} \text{kg} / \text{m}^3$ as viewed from the human scale.

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