Fundamental J. Modern Physics, Vol. 2, Issue 1, 2011, Pages 73-88
Published online at http://www.frdint.com/

FRACTAL PHYSICS THEORY - NEUTRINOS AND STARS

LEONARD J. MALINOWSKI

BASF Dispersions and Resins
Monaca, Pennsylvania
USA

Abstract

This fifth and last article of the series applies Fractal Physics Theory to neutrinos and stars. A wealth of data has been amassed and significant theoretical progress has been made during the past 40 years centered on detecting and understanding solar neutrinos. The fractal nuclear antineutrino emission process is modeled after quantum scale stellar emission. The absorption and emission of antineutrino energy by stable nuclei and atomic electrons is discussed. Stable nuclei and atomic electrons are at lower lilliputian scale temperatures than decaying nuclei emitting antineutrino energy, consequently, stable matter absorbs relatively high subquantum scale frequency photons and emits relatively low subquantum scale frequency photons in increased numbers so that the total antineutrino energy remains constant.

1. Introduction

The first four articles of the Fractal Physics Theory series provide essential background information [1-4]. Fractal Physics Theory (FPT) proposes that most stars are cosmic scale nuclei undergoing cosmic scale beta decay. This cosmic scale nuclear beta decay is argued to occur exactly as nuclear beta decay occurs, the appearance of which differs because of the direction humans look “up” to larger scales or “down” to smaller scales of the Fractal Universe. Neutrinos and antineutrinos both arise during quantum scale nuclear fusion and as such are considered to be similar. The totality of a star’s radiated energy (electromagnetic

Keywords and phrases: fractal physics, neutrinos, starlight, subquantum.

Received April 4, 2011

radiation plus neutrinos) over its nuclear burning lifetime comprises one cosmic scale antineutrino. The vast majority of electromagnetic radiations are part of cosmic scale antineutrinos. Familiar antineutrino energy is observed by the lilliputian scale (ls) as electromagnetic radiation and neutrinos. The Sun's energy that constantly bathes the Earth is part of a single cosmic scale antineutrino. It is not so much a matter of "seeing" an antineutrino as to "see" with fractal antineutrino energy. Likewise, an antineutrino is the result of an ever spreading sphere of subquantum scale (sqs) photons, which are not in phase, and include a wide range of sqs-frequencies. Antineutrinos in FPT continuously delocalize as they propagate; this differs markedly from antineutrinos described by Modern Physics.

A typical star like the Sun is expected to shine in its current state for about 9 billion years (Figure 1), which the titanic scale (ts) measures as $750\,\mathrm{ns}$ [1]. A fractally self-similar qs-Sun radiates for $750\,\mathrm{ns}$ relative to the human scale and 9×10^9 y relative to the lilliputian scale. An antineutrino moving at the speed of light for $750\,\mathrm{ns}$ travels $225\,\mathrm{m}$ in the human scale. This nuclear radiated antineutrino is a spherical pulse $225\,\mathrm{m}$ in thickness and composed of a great multitude of sqs-photons and sqs-neutrinos. The spherical shell expanding in matter encounters atoms. The nuclei and electrons of the atoms encountered systematically alter the antineutrino energy.

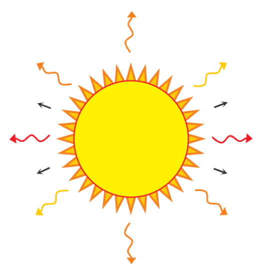

Figure 1. Cosmic scale antineutrino emission (typical shining star).

2. Antineutrino Quantum Scale Absorption

The sqs-photons of relatively high sqs-frequencies comprising the single antineutrino are absorbed by the exposed surfaces of the nuclei and the electrons they encounter. These qs-black bodies reradiate all absorbed sqs-photons spherically from their surfaces, at longer sqs-wavelengths and increased sqs-photon numbers. This spherically radiated "cooled" sqs-radiation has a net effect, over relatively short distances, of redirecting about half the number of sqs-photons absorbed from the antineutrino expanding shell's initial path. The energy of the antineutrino is initially and continually reduced as it travels short distances $(< 10\,\text{cm})$ through matter. This is similar to Beer's law in analytical chemistry which relates the absorption of electromagnetic radiation traveling through a dilute solution to properties of the solution. However, antineutrino energy is not expected to be reduced when traveling through relatively large volumes of matter. The net effect of continued absorption and emission of antineutrino energy by large volumes of stable matter enables all the "transformed" antineutrino energy (sqs-photons of lowered sqs-frequencies and increased numbers) to escape the matter.

$$\text{Antineutrino absorption: } A_\nu = abc, \tag{1}$$

$A_\nu =$ absorption of antineutrino energy by matter,

$a =$ atomic surface area exposed to incoming antineutrino energy,

$b =$ radial path length traveled by antineutrino energy through matter over short distances,

$c =$ atomic number density, $d{*}1000 * N_A / (MW)$,

$d =$ matter density (kg/m^3),

$N_A =$ Avogadro's number $(6.0221415 \times 10^{23})$,

$MW =$ molecular weight.

Atomic nuclei and electrons are considered as spheres with surface area $4\pi R^2$. The expanding neutrino energy shell impinges upon half of the sphere's surface area it encounters.

Atomic surface area exposed, $a = (\#$ of atomic electrons)(0.5)(electron surface area) + (0.5)(nuclear surface area).

$$a = (Z)(2\pi R_e{}^2) + 2\pi(1.2\text{fm } A^{1/3})^2, \tag{2}$$

Z = atomic number of the neutral atom,

A = atomic mass,

R_e = electron's radius $(7.2314 \times 10^{-17}\,\text{m})$.

Example 1. Uranium 235 dioxide

$$a_{U235} = 92*2\pi(7.2314\times10^{-17}\,\mathrm{m})^2 + 2\pi[(1.2\times10^{-15}\,\mathrm{m})(235.043930)^{1/3}]^2$$

$$= 3.0228212\times10^{-30}\,\mathrm{m}^2 + 3.4459454\times10^{-28}\,\mathrm{m}^2$$

$$= 3.4761736\times10^{-28}\,\mathrm{m}^2 = 3.4762\,\mathrm{b},$$

$$a_{O16} = 8*2\pi(7.2314\times10^{-17}\,\mathrm{m})^2 + 2\pi[(1.2\times10^{-15}\,\mathrm{m})(15.994915)^{1/3}]^2$$

$$= 2.6285402\times10^{-31}\,\mathrm{m}^2 + 5.7437693\times10^{-29}\,\mathrm{m}^2$$

$$= 5.7700547\times10^{-29}\,\mathrm{m}^2 = 0.5770\,\mathrm{b},$$

$$a_{UO_2} = 3.4762\,\mathrm{b} + 2*0.5770\,\mathrm{b} = 4.6302\,\mathrm{b},$$

Density $= 10970\,\mathrm{kg/m^3}$ [5],

$MW = 267.033760.$

When the initial antineutrino energy is completely absorbed, $A_\nu = 1.000$, and the path length b, can be calculated.

$$b = 1/(a_{UO_2}c_{UO_2}) = 1/[(4.6302\times10^{-28}\,\mathrm{m}^2)(1.097\times10^7\ \mathrm{g/m^3}$$

$$*N_A / 267.033760)] = 0.08730\,\mathrm{m}.$$

A single nucleus emitting an antineutrino during beta decay within a solid mass of Uranium 235 dioxide will have its initial antineutrino energy completely absorbed by ambient atomic surfaces within a sphere of radius $8.73\,\mathrm{cm}$ centered on the decaying nucleus. The nuclear and electron surfaces that absorb the initial antineutrino energy as relatively high sqs-frequency photons immediately reradiate this antineutrino energy as relatively low sqs-frequency photons in increased numbers. A beta decaying process lasting $750\,\mathrm{ns}$ continuously emits antineutrino energy at a constant rate. At the end of $750\,\mathrm{ns}$, the antineutrino will be a spherical shell $225\,\mathrm{m}$ constant thickness increasing in size at the speed of light. As long as the decaying nucleus is within a large and dense enough mass, the resultant ever expanding antineutrino shell will be composed of the relatively lower sqs-frequency photons.

3. Antineutrino Quantum Scale Emission

The totality of all photons emitted from a star's surface comprises about 98% of the energy of a single cosmic scale antineutrino. The remaining 2% of energy is emitted from the star as neutrinos. Stellar surface temperatures range from $< 3500\,\text{K}$ to $> 25000\,\text{K}$. These temperatures are converted to their self-similar lilliputian scale stellar surface temperatures using the temperature scaling fractal [1]:

$$¥T = 2.187520 \times 10^{-14}$$

$$= [\text{star, surface temperature}]_{1,0} / [\text{star, surface temperature}]_{-1,0}$$

Nuclei in the process of beta decay have surface ls-temperatures, relative to the human scale, in the range $< 1.60 \times 10^{17}\,\text{K}$ to $> 1.14 \times 10^{18}\,\text{K}$, which is also the ls-temperature range of antineutrinos. It has also been proposed that the surfaces of stable cosmic scale nuclei and atomic electrons are in thermodynamic equilibrium with the microwave background radiation of temperature $= 2.275\,\text{K}$ [2]. The self similar subquantum scale microwave background radiation has a ls-temperature $= 1.246 \times 10^{14}\,\text{K}$, which is the ls-temperature of the "vacuum" of atoms.

Fractal Stephen-Boltzmann equation:

$$[P(r)]_{m,n} = [\sigma]_{m,n}\varepsilon[A]_{m,n}[T]_{m,n}{}^{4}, \tag{3}$$

$[P(r)]_{m,n} =$ scaled power radiated,

$[\sigma]_{m,n} =$ scaled Stephen-Boltzmann constant,

$\varepsilon =$ emissivity $(0 < \varepsilon < 1)$, $\varepsilon = 1$ for black bodies,

$[A]_{m,n} =$ scaled surface area $= 4\pi R^2$,

$[T]_{m,n} =$ scaled surface temperature,

m = object scale location,

n = observer scale location.

Example 2. Power radiated by a qs-star fractally self-similar to the Sun

$$[P(r)]_{-2,0} = [\sigma]_{-3,0}\varepsilon[A]_{-1,0}[T]_{-2,0}{}^{4} = 1.223 \times 10^{-7}\,\text{W}, \tag{4}$$

$$[\sigma]_{-3,0} = (5.6704\times 10^{-8}\,\mathrm{Wm^{-2}K^{-4}})/(¥\sigma = 9.553091\times 10^{40})$$

$$= 5.935670\times 10^{-49}\,\mathrm{Wm^{-2}K^{-4}},$$

$$\varepsilon = 1,$$

$$[R]_{-1,0} = (6.95\times 10^{8}\,\mathrm{m})/(¥\mathrm{Length} = 3.788566\times 10^{23}) = 1.8345\,\mathrm{fm},$$

$$[A]_{-1,0} = 4.2291\times 10^{-29}\,\mathrm{m}^2,$$

$$[T]_{-2,0} = (5780\,\mathrm{K})/(¥T = 2.187520\times 10^{-14}) = 2.642\times 10^{17}\,\mathrm{K}.$$

This beta decaying neutron radiates its antineutrino at the rate of $1.2\times 10^{-7}\,\mathrm{W}$ for $750\,\mathrm{ns}$.

Example 3. Power radiated and absorbed by a stable U^{235} nucleus

$$[P(r)]_{-2,0} = [\sigma]_{-3,0}\varepsilon[A]_{-1,0}[T]_{-2,0}{}^4 = 9.860\times 10^{-20}\,\mathrm{W},$$

$$[\sigma]_{-3,0} = 5.935670\times 10^{-49}\,\mathrm{Wm^{-2}K^{-4}},$$

$$\varepsilon = 1,$$

$$[R]_{-1,0} = 1.2\,\mathrm{fm}(235.043930)^{1/3} = 7.4057\,\mathrm{fm},$$

$$[A]_{-1,0} = 6.8919\times 10^{-28}\,\mathrm{m}^2,$$

$$[T]_{-2,0} = (2.725\,\mathrm{K})/(¥T = 2.187520\times 10^{-14}) = 1.246\times 10^{14}\,\mathrm{K}.$$

Example 4. Power radiated and absorbed by a ground state atomic electron

$$[P(r)]_{-2,0} = [\sigma]_{-3,0}\varepsilon[A]_{-1,0}[T]_{-2,0}{}^4 = 9.402\times 10^{-24}\,\mathrm{W},$$

$$[\sigma]_{-3,0} = 5.935670\times 10^{-49}\,\mathrm{Wm^{-2}K^{-4}},$$

$$\varepsilon = 1,$$

$$[R]_{-1,0} = 7.2314\times 10^{-17}\,\mathrm{m},$$

$$[A]_{-1,0} = 6.5714\times 10^{-32}\,\mathrm{m}^2,$$

$$[T]_{-2,0} = (2.725\,\mathrm{K})/(¥T = 2.187520\times 10^{-14}) = 1.246\times 10^{14}\,\mathrm{K}.$$

Stable nuclei and atomic electrons constantly exchange antineutrino energy with the vacuum. The self-similar local cosmic microwave background radiation is essentially the Sun's reflection off of many ambient liquid Helium mirrors.

4. Solar Neutrinos - Brief Background

Luminosity constraint - a sum of the product of solar neutrino fluxes and the energies released by their respective fusion reactions must equal the solar constant, if light element nuclear fusion powers the Sun [6].

$$\Sigma\Phi_i a_i = L_\odot / [4\pi(1\text{AU})^2]. \quad (5)$$

Table 1 lists the important solar fusion reactions producing the significant portion of electron neutrinos. Included are the average neutrino energies and the amount of reaction energies produced per reaction.

Table 1. Solar neutrino flux [6]

Flux (Φ_i)	Reaction[a]	$\langle E_\nu \rangle_\odot$ (MeV)	a_i (MeV)[b]
$\Phi(pp)$	$p + p \rightarrow {}^2H + e^+ + \nu_e$	0.2668	13.0987
$\Phi(pep)$	$p + e^- + p \rightarrow {}^2H + \nu_e$	1.445	11.9193
$\Phi(hep)$	${}^3He + p \rightarrow {}^4He + e^+ + \nu_e$	9.628	3.7370
$\Phi({}^7Be)$	${}^7Be + e^- \rightarrow {}^7Li + \nu_e$	0.814[c]	12.6008
$\Phi({}^8B)$	${}^8B \rightarrow {}^8Be + e^+ + \nu_e$	6.735	6.6305
$\Phi({}^{13}N)$	${}^{13}N \rightarrow {}^{13}C + e^+ + \nu_e$	0.706	3.4577
$\Phi({}^{15}O)$	${}^{15}O \rightarrow {}^{15}N + e^+ + \nu_e$	0.996	21.5706

[a] Recognized since Hans Bethe's work on fusion reactions that power the sun.

[b] a_i - amount of energy provided to the star by the nuclear fusion reactions associated with the solar neutrino fluxes, Φ_i.

[c] 89.7% at 0.8631 MeV and 10.3% at 0.3855 MeV.

Table 2 lists important solar neutrino fluxes at the Earth predicted from seven solar models.

Table 2. Predicted solar neutrino fluxes from seven solar models [7]

Model	pp	pep	hep	^{7}Be	^{8}B	^{13}N	^{15}O	^{17}F
BP04(Yale)	5.94	1.40	7.88	4.86	5.79	5.71	5.03	5.91
BP04(Garching)	5.94	1.41	7.88	4.84	5.74	5.70	4.98	5.87
BS04	5.94	1.40	7.86	4.88	5.87	5.62	4.90	6.01
BS05 (^{14}N)	5.99	1.42	7.91	4.89	5.83	3.11	2.38	5.97
BS05(OP)	5.99	1.42	7.93	4.84	5.69	3.07	2.33	5.84
BS05(AGS, OP)	6.06	1.45	8.25	4.34	4.51	2.01	1.45	3.25
BS05(AGS, OPAL)	6.05	1.45	8.23	4.38	4.59	2.03	1.47	3.31
$(\mathrm{cm}^{-2}\mathrm{s}^{-1})$	$\times 10^{10}$	$\times 10^{8}$	$\times 10^{3}$	$\times 10^{9}$	$\times 10^{6}$	$\times 10^{8}$	$\times 10^{8}$	$\times 10^{6}$

Table 3 calculates the average neutrino power radiating from the Sun using the average neutrino energies from Table 1 and the BP04(Yale) Solar Model neutrino fluxes from Table 2.

Table 3. Average neutrino power radiated from the Sun

Flux (Φ_i)	Φ_i at 1AU $(\mathrm{cm}^{-2}\mathrm{s}^{-1})^{a}$	# of ν_e / second leaving the Sun^{b}	$\langle E_\nu \rangle_\odot (\mathrm{MeV})^{c}$	Average ν_e power radiated from Sun $(\mathrm{J/s})^{d}$
Φ(pp)	5.94×10^{10}	1.670503×10^{38}	0.2668	7.140742×10^{24}
Φ(pep)	1.40×10^{8}	3.937211×10^{35}	1.445	9.115215×10^{22}
Φ(hep)	7.88×10^{3}	2.216088×10^{31}	9.628	3.418482×10^{19}
$\Phi(^{7}\mathrm{Be})$	4.86×10^{9}	1.366775×10^{37}	0.814	1.782509×10^{24}
$\Phi(^{8}\mathrm{B})$	5.79×10^{6}	1.628318×10^{34}	6.735	1.757063×10^{22}
$\Phi(^{13}\mathrm{N})$	5.71×10^{8}	1.605820×10^{36}	0.706	1.816402×10^{23}
$\Phi(^{15}\mathrm{O})$	5.03×10^{8}	1.414584×10^{36}	0.996	2.257347×10^{23}

Average solar neutrino luminosity, $\Sigma L_\odot \nu = 9.439383 \times 10^{24}$ W

[a]From Table 2, BP04(Yale) solar model

[b]From $(\text{Table 3, column 2})*4\pi(1.495979 \times 10^{13}\,\mathrm{cm})^2$

[c]From Table 1, column 3

[d]From (Table 3, column 3)*(Table 3, column 4)

The right side of the luminosity constraint, equation (5), is the solar constant.

$$\text{Solar constant} = L_{\odot} / [4\pi(1\text{AU})^2] = 1366.07 \text{ W} / \text{m}^2,$$

$L_{\odot} = 3.8418 \times 10^{26}\,\text{W}$, solar luminosity [5],

$1\text{AU} = 1.495979 \times 10^{11}\,\text{m}$, 1 astronomical unit is the average earth - sun distance [5].

The left side of the luminosity constraint, equation (5), is calculated in Table 4.

Table 4. Luminosity constraint summation

Flux Φ_i	$a_i(\text{MeV})^a$	Φ_i at 1 AU$(\text{m}^{-2}\text{s}^{-1})^b$	$a_i\Phi_i(\text{W}/\text{m}^2)^c$
$\Phi(\text{pp})$	13.0987	5.94×10^{14}	1246.594
$\Phi(\text{pep})$	11.9193	1.40×10^{12}	2.674
$\Phi(\text{hep})$	3.7370	7.88×10^{7}	0.000
$\Phi(^{7}\text{Be})$	12.6008	4.86×10^{13}	98.117
$\Phi(^{8}\text{B})$	6.6305	5.79×10^{10}	0.062
$\Phi(^{13}\text{N})$	3.4577	5.71×10^{12}	3.163
$\Phi(^{15}\text{O})$	21.5706	5.03×10^{12}	17.384
		$\Sigma a_i\Phi_i =$	1367.994

[a]From Table 1, column 4

[b]From Table 2, BP04(Yale) solar model

[c]From (Table 4, column 2)*(Table 4, column 3)

It is concluded that the luminosity constraint is met because the solar constant compares with the sum in Table 4. Therefore, the fusion reactions, neutrino fluxes, and neutrino energies listed in the above Tables are accurate representations of solar energy production. Table 5 lists the cs-antineutrino solar lifetime energy.

Table 5. Solar cosmic scale antineutrino energy over 9×10^9 y

Solar Radiation	Power (W)	Energy (J)	% Energy
Photons	3.8418×10^{26}	1.0911×10^{44}	97.60
Neutrinos	9.4394×10^{24}	2.6810×10^{42}	2.40
Total	3.9362×10^{26}	1.1179×10^{44}	100.00

The titanic scale identifies this total solar energy radiated as $0.587\,\text{MeV}$ of a single antineutrino.

In Fractal Physics Theory, an antineutrino located in the cosmic scale is measured by the human scale as mostly quantum scale electromagnetic radiation and a few percent quantum scale neutrinos:

$$[\text{antineutrino, composition}]_{1,0} =\sim 98\%[\text{photons}]_{-1,0} + \sim 2\%[\text{neutrinos}]_{-1,0}$$

The $\sim 2\%$ neutrinos can be further subdivided into mostly subquantum scale photons and a few percent sqs-neutrinos:

$$\sim 2\%[\text{neutrinos}]_{-1,0} =\sim 1.96\%\,[\text{photons}]_{-3,0} + \sim 0.04\%\,[\text{neutrinos}]_{-3,0}$$

This process of subdividing the neutrinos into lower scales of photons and neutrinos continues indefinitely.

5. Solar Neutrino Transformation

The Sun's photon luminosity over 9×10^9 y is scaled down to approximate the emission of a single neutrino.

Fractal Wien's displacement law:

$$[\lambda_m]_{m,n}[T]_{m,n} = [b]_{m,n}, \tag{6}$$

$[\lambda_m]_{m,n}$ = scaled wavelength of maximum intensity,

$[T]_{m,n}$ = scaled surface temperature,

$[b]_{m,n}$ = scaled Wien's constant,

$[b]_{0,0} = 2.8977685 \times 10^{-3}$ mK [5],

m = object scale location,

n = observer scale location.

Example 5. Subquantum scale λ_m of sqs-photons radiated by a qs-star fractally self-similar to the Sun

$$[\lambda_m]_{-3,0} = [b]_{-2,0} / [T]_{-2,0} = 1.323 \times 10^{-30}\,\text{m},$$

$$[b]_{-2,0} = (2.8977685 \times 10^{-3}\,\text{mK}) / (¥\text{Wie} = 8.287564 \times 10^{9}) = 3.496526 \times 10^{-13}\,\text{mK},$$

$$[T]_{-2,0} = 5780\,\text{K} / (¥T = 2.187520 \times 10^{-14}) = 2.642 \times 10^{17}\,\text{K}.$$

Fractal photon frequency-wavelength relation:

$$[\lambda]_{m,n}[f]_{m,n} = c, \tag{7}$$

$[\lambda]_{m,n}$ = scaled photon wavelength,

$[f]_{m,n}$ = scaled photon frequency,

$c = 299792458\,\text{m/s}$,

m = object scale location,

n = observer scale location.

Example 6. Sqs-frequency of sqs-photons radiated by a qs-star fractally self-similar to the Sun

$$[f]_{-3,0} = c / (1.323 \times 10^{-30}\,\text{m}) = 2.266 \times 10^{38}\,\text{Hz}.$$

Fractal photon energy relation:

$$[E]_{m,n} = [h]_{m,n}[f]_{m,n}, \tag{8}$$

$[E]_{m,n}$ = scaled photon energy,

$[h]_{m,n}$ = scaled Planck's constant,

$[h]_{-1,0} = 6.6261 \times 10^{-34}\,\text{Js}$,

$[h]_{-3,0} = (6.6261 \times 10^{-34}\,\text{Js}) / (¥h = 4.5066 \times 10^{80}) = 1.470 \times 10^{-114}\,\text{Js}$,

$[f]_{m,n}$ = scaled photon frequency,

m = object scale location,

n = observer scale location.

Example 7. Human scale observed energy of sqs-photons radiated by a qs-star fractally self-similar to the Sun

$$[\text{photon, E}]_{-3,0} = [h]_{-3,0}(2.266\times10^{38}\,\text{Hz})$$

$$= 3.332\times10^{-76}\,\text{Joules} = 2.08\times10^{-57}\,\text{eV}.$$

Individual subquantum scale photon energies comprising the bulk of a neutrino are infinitesimal!

Example 8. Approximate # of sqs-photons composing 1 neutrino emitted by a qs-star fractally self-similar to the Sun

From Example 2

neutrino energy = (power $= 1.223\times10^{-7}$ W)(750 ns) $= 9.172\times10^{-14}$ J,

# of sqs-photons $= (9.172\times10^{-14}\,\text{J})/(3.332\times10^{-76}\,\text{J}) = 2.753\times10^{62}$.

Example 9. Let all the sqs-photons of the neutrino of Example 8 be absorbed and reemitted by stable atomic surfaces. Stable atomic surfaces radiate sqs-photons with the following properties:

$$[T]_{-2,0} = (2.725K)/(¥T = 2.187520\times10^{-14}) = 1.246\times10^{14}\,\text{K},$$

$$[\lambda_m]_{-3,0} = 2.806\times10^{-27}\,\text{m},$$

$$[f_m]_{-3,0} = 1.068\times10^{35}\,\text{Hz},$$

$$[\text{photon, } E]_{-3,0} = 1.570\times10^{-79}\,\text{J} = 9.80\times10^{-61}\,\text{eV}.$$

Example 10. Approximate # of sqs-photons composing the reemitted neutrino energy

# of sqs-photons $= (9.172\times10^{-14}\,\text{J})/(1.570\times10^{-79}\,\text{J}) = 5.842\times10^{65}$.

Fractal Physics Theory proposes that solar neutrinos do not “oscillate” but have their energies transformed by interactions with stable atomic surfaces that reduce the initial individual sqs-photon energies to $1.570 \times 10^{-79}\,\mathrm{J}$, and increase the # of initial sqs-photons by a factor proportional to

$$[\text{fusing nuclei, surface temperature}]_{-2,0} / [1.246 \times 10^{14}\,\mathrm{K}].$$

6. Neutrino Subquantum Scale Electromagnetic Radiation Spectrum

The Sun emits electromagnetic radiation approximately as Planck's radiation law; therefore the majority component of neutrino energy is modeled with a lilliputian scale (ls) version of Planck's radiation law.

Fractal Planck's radiation law:

$$[I(\lambda, T)]_{m\,n} = A[\lambda]_{m,n}{}^{-5}(e^{x} - 1)^{-1}, \tag{9}$$

$[I(\lambda, T)]_{m\,n} =$ scaled intensity radiated per unit λ at a given T,

$A = 2\pi c^2 [h]_{m,n}$,

$x = [h]_{m,n} c / ([\lambda]_{m,n} [k]_{m,n} [T]_{m,n})$,

$[h]_{m,n} =$ scaled Planck constant,

$[\lambda]_{m,n} =$ scaled wavelength,

$[k]_{m,n} =$ scaled Boltzmann constant,

$[T]_{m,n} =$ scaled temperature,

m = object scale location,

n = observer scale location.

$$[I(\lambda, T)]_{-2,0} = A[\lambda]_{-3,0}{}^{-5}(e^{x} - 1)^{-1}, \tag{10}$$

$[I(\lambda, T)]_{-2,0}$ = ls-intensity radiated per unit λ at a given T,

$A = 2\pi c^2 [h]_{-3,0}$,

$x = [h]_{-3,0} c / ([\lambda]_{-3,0} [k]_{-3,0} [T]_{-2,0})$,

$[h]_{-3,0} = 1.4702953 \times 10^{-114}\,\mathrm{Js}$,

$[\lambda]_{-3,0}$ = sqs-wavelength,

$[k]_{-3,0} = 2.5389796 \times 10^{-94}$ J/K,

$[T]_{-2,0}$ = ls-temperature,

$c = 299792458$ m/s,

$e = 2.718281828$.

Equation 10 is used to generate data in Tables 6 and 7 at the lilliputian scale temperatures self-similar to 2.725 K and 5780 K. Figures 2 and 3 plot the data from Tables 6 and 7, respectively, for sqs-wavelengths versus intensity radiated per sqs-wavelength. At first glance the power densities listed in Tables 6 and 7 may appear startling high. However, this just reflects the minute scales of sqs-wavelengths, nuclear surface areas, and emission times involved. Consider:

$$(1.438\times10^{51}\ \mathrm{W/m^3})(1.32\times10^{-30}\,\mathrm{m})(4.23\times10^{-29}\,\mathrm{m^2})(7.50\times10^{-7}\,\mathrm{s}) = 0.4\,\mathrm{MeV},$$

is reasonable for neutrinos.

Table 6. Neutrino lilliputian scale radiation $[2.725\ \mathrm{K}]_{-2,0} = 1.2457 \times 10^{14}$ K

$[\lambda]_{-3,0}(\times 10^{-27}\,\mathrm{m})$	$A[\lambda]_{-3,0}{}^{-5}(\mathrm{m}^{-5})$	$(e^x - 1)^{-1}$	$[I(\lambda, T)]_{-2,0}(\mathrm{W/m^3})$
0.80	2.5338×10^{39}	0.00000	6.888×10^{31}
1.20	3.3367×10^{38}	0.00001	3.017×10^{33}
1.50	1.0934×10^{38}	0.00009	1.009×10^{34}
1.70	5.8476×10^{37}	0.00028	1.610×10^{34}
2.00	2.5946×10^{37}	0.00094	2.445×10^{34}
2.81	4.7391×10^{36}	0.00707	3.348×10^{34}
4.15	6.7451×10^{35}	0.03605	2.432×10^{34}
5.00	2.6569×10^{35}	0.06563	1.744×10^{34}
6.00	1.0678×10^{35}	0.10865	1.160×10^{34}
7.00	4.9401×10^{34}	0.15817	7.814×10^{33}
9.00	1.4061×10^{34}	0.26995	3.796×10^{33}
12.50	2.7207×10^{33}	0.48797	1.328×10^{33}
17.50	5.0587×10^{32}	0.82137	4.155×10^{32}
23.00	1.2900×10^{32}	1.20054	1.549×10^{32}
30.00	3.4168×10^{31}	1.69120	5.778×10^{31}

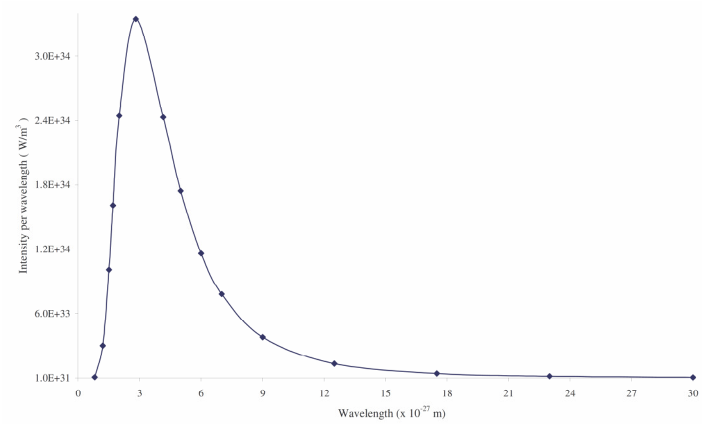

Figure 2. Single neutrino lilliputian scale radiation spectrum from Table 6 data; Neutrino lilliputian scale radiation $[T = 2.725\,\mathrm{K}]_{-2,0} = 1.246 \times 10^{14}\,\mathrm{K}$.

Table 7. Neutrino lilliputain scale radiation $[5780\,\mathrm{K}]_{-2,0} = 2.6423{\times}10^{17}\,\mathrm{K}$

$[\lambda]_{-1,0}(\times 10^{-30}\mathrm{m})$	$A[\lambda]_{-1,0}{}^{-5}(\mathrm{m}^{-5})$	$(e^x - 1)^{-1}$	$[I(\lambda, T)]_{-1,0}(\mathrm{W/m}^3)$
0.50	2.6569×10^{55}	0.00000	5.218×10^{49}
0.62	9.0629×10^{54}	0.00002	2.264×10^{50}
0.96	1.0183×10^{54}	0.00107	1.086×10^{51}
1.10	5.1554×10^{53}	0.00255	1.316×10^{51}
1.32	2.0461×10^{53}	0.00703	1.438×10^{51}
1.61	7.6634×10^{52}	0.01720	1.318×10^{51}
1.90	3.3532×10^{52}	0.03252	1.090×10^{51}
2.40	1.0427×10^{52}	0.06920	7.216×10^{50}
3.00	3.4168×10^{51}	0.12601	4.305×10^{50}
4.00	8.1082×10^{50}	0.23990	1.945×10^{50}
5.00	2.6569×10^{50}	0.36748	9.764×10^{49}
7.00	4.9401×10^{49}	0.64250	3.174×10^{49}
9.00	1.4061×10^{49}	0.93011	1.308×10^{49}
11.00	5.1554×10^{48}	1.22369	6.309×10^{48}
13.00	2.2362×10^{48}	1.52055	3.400×10^{48}

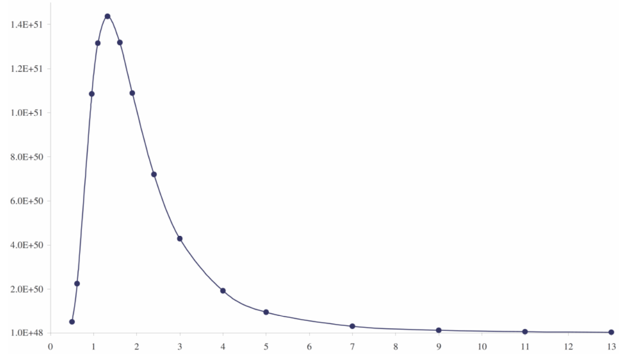

Figure 3. Single neutrino lilliputian scale radiation spectrum from Table 7 data; Neutrino quantum scale radiation $[T = 5780\,\mathrm{K}]_{-2,\,0} = 2.642 \times 10^{17}\,\mathrm{K}$.

7. Conclusion

This fifth article of the series applies Fractal Physics Theory to neutrinos and stars. Several human scale radiation equations are generalized to scale, while the lilliputian scale radiation equations are used to model neutrino emission. The subquantum scale electromagnetic radiation portion of solar core produced neutrinos should arrive at the Earth similar to the plots in Figure 2.

References

[1] L. J. Malinowski, Fractal Physics Theory - Foundation, Fundamental J. Modern Physics 1(2) (2011), 133-168.

[2] L. J. Malinowski, Fractal Physics Theory - Cosmic Scale Nuclear Explosion Cosmology, Fundamental J. Modern Physics 1(2) (2011), 169-195.

[3] L. J. Malinowski, Fractal Physics Theory - Electrons, Photons, Wave-Particles, and Atomic Capacitors, Fundamental J. Modern Physics 1(2) (2011), 197-221.

[4] L. J. Malinowski, Fractal Physics Theory - Nucleons and the Strong Force, Fundamental J. Modern Physics 2(1) (2011), 23-72.

[5] D. R. Lide, editor, Handbook of Chemistry and Physics, CRC Press, Boca Raton, FL, 2006.

[6] John N. Bahcall, The luminosity constraint on solar neutrino fluxes, Physical Review C, Volume 65, 025801.

[7] John N. Bahcall et al., New solar opacities, abundances, helioseismology, and neutrino fluxes, Astrophys. J. 621 (2005), L85-L88.