An Illusion of Periodic Changes in Survival Probability for Neutrino Oscillations

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Abstract: Here we showed that the atom-like structure of baryons described within the Scale-Symmetric Theory (SST) leads to an illusion of periodic changes in survival probability for neutrino oscillations.

1. Introduction

It is assumed in the orthodox physics that neutrino oscillation is due to mixing between the flavour eigenstates (e, μ, τ) and mass eigenstates (1, 2, 3) of neutrinos.

On the other hand, the Scale-Symmetric Theory (SST) shows that neutrinos cannot change their flavours because of the tremendous non-gravitating energy frozen inside them [1]. An illusion of neutrino oscillation is due to three processes i.e. due to exchanges of neutrinos on the neutrinos in the cosmic neutrino background (CNB) [2] or on the neutrinos in the neutrino-antineutrino pairs the Einstein spacetime and hadrons and charged leptons consist of [1], and due to the weak decays of tau-neutrino into three different lighter neutrinos (or into an electron-neutrino and a photon) [3]. In reality, the PMNS matrix is a result of mixing of masses characteristic for the atom-like structure of baryons whereas the mixing angles are the ratios directly proportional to number of neutrinos in characteristic associations of neutrinos (1, 4, 5 or 6) and inversely proportional to the characteristic energy of neutrinos produced in the core of baryons [4], [3].

In reality, the quark model and neutrino oscillations are the pure mathematical models which are not realized by Nature but they partly mimic the SST which is the lacking part of the Theory of Everything.

Here we showed that the atom-like structure of baryons described within SST [1] leads to an illusion of periodic changes in survival probability for neutrino oscillations described in papers [5], [6] and [7].

The different size scales in Nature and the CP violation lead to the very simple initial conditions in SST [1]. Such initial conditions lead to the atom-like structure of baryons [1]. Bare baryons (i.e. their core; $H^{+,-}$ = 727.44 MeV and H^{o} = 724.78 MeV) contain a torus (it is the electric charge carrying half-integral spin) and central condensate Y of the Einstein spacetime (ES) which is responsible for the nuclear weak interactions of baryons with coupling constant equal to $\alpha_{w(proton)} = 0.0187229$ [1]. Outside the core of baryons, due to the electroweak interactions, there are created the Titius-Bode (TB) orbits which are embedded in the nuclear strong field – their radii are: $R = A + \mathrm{d}B$, where $A \approx 0.7$ fm, $B \approx$

0.5 fm, and d = 0, 1, 2 and 4 for the last orbit [1]. In nucleons, on the d = 1 TB orbit is relativistic pion W: $W^{+,-}$ = 215.76 MeV and W^o = 208.64 MeV [1]. The fine-structure constant calculated within SST is $\alpha_e = 1/137.036$ [1].

2. Calculations

In the KamLAND experiment, the ratio of observed to expected (assuming no $\nu_{e,anti}$ oscillations) number of events was [5], [7]

$$(N_{Observed} - N_{Background\text{-}and\text{-}Geoneutrino}) / N_{No\text{-}Oscillation} = 0.611 \pm 0.085 \pm 0.041 . \quad (1)$$

On the other hand, in SST, the electromagnetic interactions inside baryons slow down the weak decays of neutrons because they force the exchanges of the lepton pair $e^-\nu_{e,anti}$ (or pair $e^+\nu_e$) between the relativistic pion W in the d = 1 state and the core of baryons, so number of observed neutrinos should be lower than expected according to following relation

$$f = (N_{Observed} / N_{Expected})_{SST} = (\alpha_{w(proton)} - \alpha_e) / \alpha_{w(proton)} = 0.6102 . \quad (2)$$

According to SST, maximum number of neutrinos inside a real or virtual neutral pion is $N_{\nu,max} = 2 \cdot 4^{32}$ – see Paragraph **12** in [1]. We need the smallest ranges so we consider here the maximum number of neutrinos because range of particles is inversely proportional to their mass. Mass of lightest neutrino in its ground state (i.e. its spin does not rotate) is $m_{\nu,lightest} = 3.335 \cdot 10^{-67}$ kg [1]. Calculate the de Broglie length $\lambda_{de\text{-}B}$ of such dark neutral pion

$$\lambda_{de\text{-}B} = 2\pi \hbar / (c\, 2 \cdot 4^{32}\, m_{\nu,lightest}) = 180 \text{ km} . \quad (3)$$

According to SST, in such a distance number density of created $e^-e^+ \approx 1.02$ MeV virtual pairs is highest [8]. It leads to conclusion that the de Broglie length of a quantum with energy of E_o = 1 MeV is L_o = 184 km – it leads to an invariant $F = L_o/E_o$ = 184 km/MeV.

A physical interpretation of the invariant F is that the dark pion moves a quantum with a mass of 1 MeV to a distance of 184 km but increasingly heavier leptonic pairs are transferred to smaller distances.

The first model looks as follows.

Calculate range per energy $F_n = (L_o/E_o)(E_o/|E|) = F\, E_o/|E|$ for processes characteristic for the atom-like structure of nucleons for which we should observe excess or deficiency of the electron-antineutrinos. Emphasize that the leptonic pairs decay first of all at the distance $F_n E_o$.

For $W^o \rightarrow W^-$ is $E = \Delta W = W^o - W^- \approx -7.12$ MeV so the electron-antineutrinos are absorbed so there should be a deficiency of such neutrinos (a minimum). It leads to

$F_{7.12} = F\, E_o/|E|$ = 26 km/MeV (minimum)

For $\pi^- \rightarrow \pi^o$ is $E = \Delta\pi = \pi^- - \pi^o \approx +4.59$ MeV so the electron-antineutrinos are emitted so there should be an excess of such neutrinos (a maximum). It leads to

$F_{4.59} = F\, E_o/|E|$ = 40 km/MeV (maximum)

For $K^+ \rightarrow K^o$ is $E = K^+ - K^o \approx -3.93$ MeV so the electron-antineutrinos are absorbed so there should be a deficiency of such neutrinos (a minimum). It leads to

$F_{3.93} = F\, E_o/|E| = 47$ km/MeV (minimum)

For $H^- \rightarrow H^o$ is $E = H^- - H^o \approx +2.66$ MeV so the electron-antineutrinos are emitted so there should be an excess of such neutrinos (a maximum). It leads to

$F_{2.66} = F\, E_o/|E| = 69$ km/MeV (maximum)

For $p \rightarrow n$ is $E = p - n \approx -1.293$ MeV so the electron-antineutrinos are absorbed so there should be a deficiency of such neutrinos (a minimum). It leads to

$F_{1.293} = F\, E_o/|E| = 142$ km/MeV (minimum)

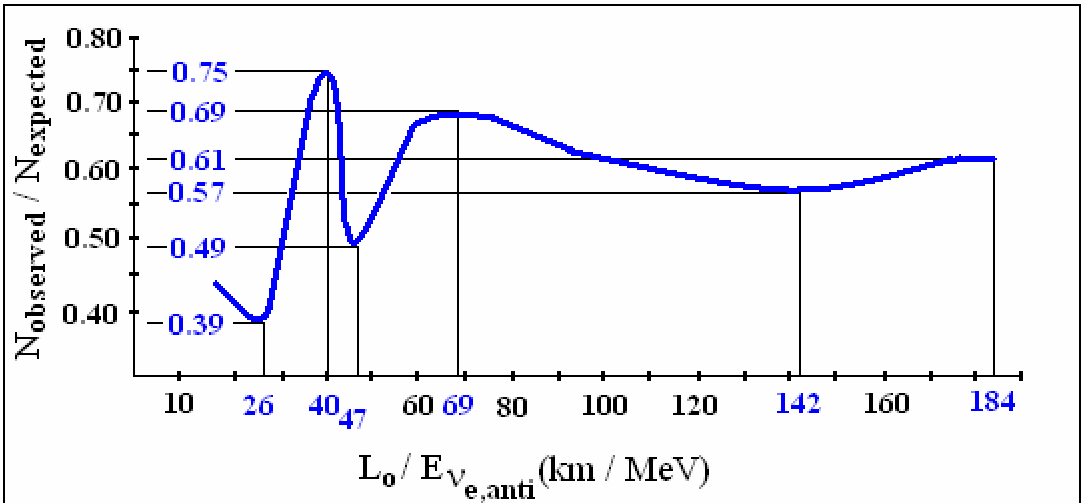

Fig.1
The periodic dependence on the electron-antineutrino energy from the atom-like structure of baryons on assumption that the mean relative abundance is 0.61.

The first minimum concerns the W pions so for the minimum is

$$\text{Minimum}(1) = f\, \Delta\pi / |\Delta W| = 0.394 \approx 0.39$$

so amplitude A_n is

$A_{7.12} = f - f\, \Delta\pi / |\Delta W| = 0.216$ and it corresponds to 7.12 MeV.

The next amplitude is

$$A_{4.59} = A_{7.12}\, 4.59 / 7.12 = 0.139$$

so for the first maximum is

$$\text{Maximum}(1) = f + A_{4.59} = 0.749 \approx 0.75$$

The next amplitude is

$$A_{3.93} = A_{7.12}\ 3.93 / 7.12 = 0.119$$

so for the second minimum is

$$\text{Minimum}(2) = f - A_{3.93} = 0.491 \approx 0.49$$

The next amplitude is

$$A_{2.66} = A_{7.12}\ 2.66 / 7.12 = 0.081$$

so for the second maximum is

$$\text{Maximum}(2) = f + A_{2.66} = 0.691 \approx 0.69$$

The next amplitude is

$$A_{1.29} = A_{7.12}\ 1.29 / 7.12 = 0.039$$

so for the third minimum is

$$\text{Minimum}(3) = f - A_{1.29} = 0.571 \approx 0.57$$

Calculated here values are collected in the Figure 1. Obtained results are consistent with the results presented in papers [6] and [7].

Now I will describe the second model which should be realized by Nature with even higher probability than the above one.

Nucleons first of all interact strongly but to be electrically neutral, the neutron more frequently couples to the neutral pion whereas proton to the negative pion. On the other hand, in the decays modes of neutral pion, there appear two neutrinos i.e. the even number of them, while in the decays modes of negative pion, there appear(s) one or three neutrinos i.e. the odd number of them [9].

In the nuclear-reactor interactions, the leptonic pairs (here it is electron plus electron-antineutrino) are first of all from the weak decays of neutrons so there are quanta with energy equal to $E_{np} = 1.2933$ MeV which can be entangled in a quantum way. Such entangled quanta couple to the leptonic pairs so there is emitted field containing neutrinos with energy equal to nE_{np}, where $n = 1, 2, 3, 4, 5, 6, \ldots$.

But the neutrinos with energy $1E_{np}$, $3E_{np}$ or $5E_{np}$ should be more frequently absorbed in the $p \rightarrow n$ transitions because of the odd number of neutrinos in the charged pions which couple to the protons. It leads to conclusion that there should be minima for the relative abundance of neutrinos depending on their energies.

On the other hand, the neutrinos with energy $2E_{np}$, $4E_{np}$ or $6E_{np}$ should be more frequently emitted in the $n \rightarrow p$ transitions because of the even number of neutrinos in the neutral pions which couple to the neutrons. It leads to conclusion that there should be maxima for the relative abundance of neutrinos depending on their energies.

We apply the same formulae and methods as in the first model. We showed that $\text{Minimum}(3) = f - A_{1.29} \approx 0.57$. Applying this value and formula $F_{nE(np)} = F\, E_o/(nE_{np})$ we obtain following results.

The first maximum for the relative abundance concerns the neutrinos with energy $6E_{np}$:

$$\text{Maximum}(1)_{6E(np)} \approx 0.85 \text{ and } F_{6E(np)} = F\, E_o/(6E_{np}) = 24 \text{ km/MeV}$$

The second maximum concerns the neutrinos with energy $4E_{np}$:

$$\text{Maximum}(2)_{4E(np)} \approx 0.77 \text{ and } F_{4E(np)} = F\, E_o/(4E_{np}) = 36 \text{ km/MeV}$$

The third maximum concerns the neutrinos with energy $2E_{np}$:

$$\text{Maximum}(3)_{2E(np)} \approx 0.69 \text{ and } F_{2E(np)} = F\, E_o/(2E_{np}) = 71 \text{ km/MeV}$$

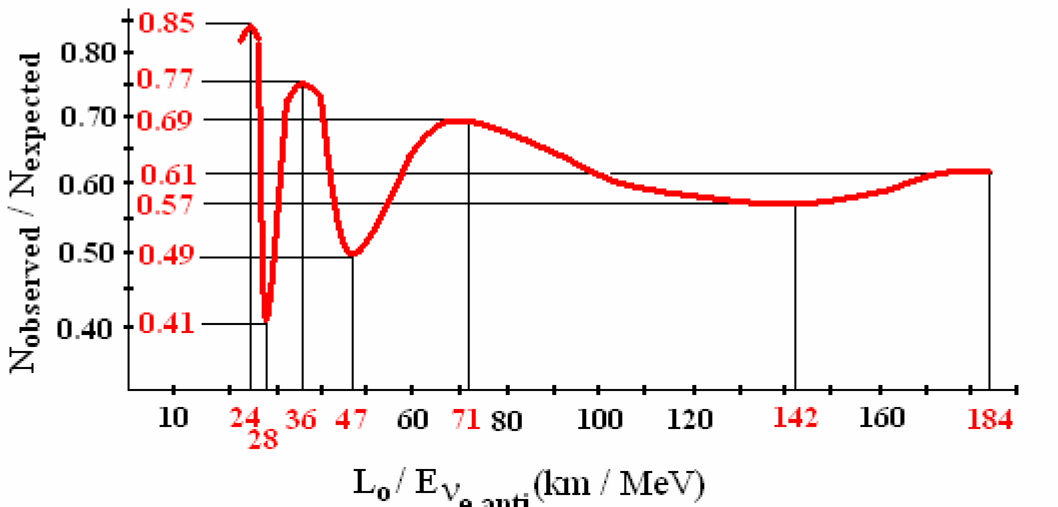

Fig.2
The periodic dependence on the electron-antineutrino energy from the atom-like structure of baryons on assumption that the mean relative abundance is 0.61.

The first minimum concerns the neutrinos with energy $5E_{np}$:

$$\text{Minimum}(1)_{5E(np)} \approx 0.41 \text{ and } F_{5E(np)} = F\, E_o/(5E_{np}) = 28 \text{ km/MeV}$$

The second minimum concerns the neutrinos with energy $3E_{np}$:

$$\text{Minimum}(2)_{3E(np)} \approx 0.49 \text{ and } F_{3E(np)} = F\, E_o/(3E_{np}) = 47 \text{ km/MeV}$$

The third minimum concerns the neutrinos with energy $1E_{np}$:

$$\text{Minimum}(3)_{1E(np)} \approx 0.57 \text{ and } F_{1E(np)} = F\, E_o/(1E_{np}) = 142 \text{ km/MeV}$$

We collected the above results in Figure 2. We see that consistency of the SST second model with experimental data [6] is even better than results obtained within the first model because of the second maximum for 36 km/MeV.

Emphasize that the KamLAND experiment concerned the reactor electron-antineutrinos with energy below 8 MeV and a prompt-energy analysis threshold of 2.6 MeV. This leads to conclusion that the SST predictions concerning the region outside the range of the KamLAND experiment can be used to test the two SST models.

In papers [5] and [6], the survival probability is the ratio of the background- and geoneutrino-subtracted electron-antineutrino spectrum to the predicted one without oscillations. We showed that it is untrue that KamLAND observed a periodic dependence on the neutrino energy of the electron-antineutrino survival probability expected from neutrino oscillations.

3. Summary

Here we showed that both ideas the neutrino oscillations and periodic changes in survival probability from neutrino oscillations are scientific fiction. In reality, the function Survival-probability = $f\,(L_o/E_{\nu(e,anti)})$ follows from the atom-like structure of baryons.

Some people care about their scientific career, so they duplicate the evil ideas invented by their predecessors because only then is there a chance to publish papers on theoretical particle physics and theoretical cosmology in renowned scientific journals. But the future (maybe distant) will show that such tactic will bring rejection and condemnation. Sisyphean works are and will be useless.

The quark model of hadrons and neutrino oscillations will sooner or later embarrass the scientific community.

References

[1] Sylwester Kornowski (23 February 2018). "Foundations of the Scale-Symmetric Physics (Main Article No 1: Particle Physics)"
http://vixra.org/abs/1511.0188

[2] Sylwester Kornowski (18 December 2015). "Cosmic Neutrino Background"
http://vixra.org/abs/1307.0048

[3] Sylwester Kornowski (13 August 2016). "The PMNS Neutrino-Mixing Matrix within the Scale-Symmetric Theory"
http://vixra.org/abs/1608.0145

[4] Sylwester Kornowski (21 June 2019). "The Relationship Between CKM and PMNS Matrices in the CP-Violation Sectors"
http://vixra.org/abs/1901.0226

[5] K. Eguchi *et al.* (KamLAND Collab.).
Phys. Rev. Lett. **90**, 021802 (2003)

[6] A. Gando *et al.* (KamLAND Collab.).
Phys. Rev. **D83**, 052002 (2011)

[7] Esteban, Ivan *et al.* (January 2018). "Parameter Ranges"
NuFIT.org. Three-neutrino fit (NuFIT 3.2 ed.)
http://arxiv.org/pdf/1611.01514.pdf

[8] Sylwester Kornowski (1. January 2019). "Classical Interpretation of Quantum Mechanics"
http://vixra.org/abs/1812.0408

[9] K. A. Olive (2016). "*Review of Particle Physics*"
Chin. Phys. **C40** (2016) 100001