Zero-spin-photon hypothesis: ‘Zero-spin-photon generation in pair-production and its subsequent decay into neutrino and antineutrino’ - solves many-riddles of physics and universe

R. C. Gupta,1 Anirudh Pradhan,2 Ruchi Gupta,3 Sanjay Gupta,4 V. P. Gautam,5 B. Das,6 and Sushant Gupta6

1Institute of Technology (GLAITM), Mathura-281 406, India
2Department of Mathematics, Hindu Post-graduate College, Zamania-232 331, Ghazipur, India
3Cisco Systems, San Jose, California, USA
4True Demand, Los Gatos, California, USA
5Theoretical Physics, IACS, Calcutta, India
6Department of Physics, Lucknow University, Lucknow-226 007, India

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‘What is work and what is heat’ is re-investigated from the perspective of second law of thermodynamics. It is shown that the inevitable consequence of second law of thermodynamics and spin conservation necessitates the possible generation of zero spin photon in pair production process, and its subsequent decay explains the birth of neutrino and antineutrino. The proposed neutrino-genesis, solves many riddles of physics and universe. The riddles considered and explained are about: (i) mysterious neutrino (and antineutrino) and its bizarre properties such as handed-ness and parity-violation, (ii) questionable asymmetry/excess of matter over antimatter, (iii) possibility of existence of antimatter world and (iv) parity (P) violation and aspects of CP and CPT violation or restoration in the universe.

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I. INTRODUCTION

Science has progressed a lot, but leaves several unsolved riddles here and there. Any convincing ‘Proposal’ even at the level of ‘hypothesis’, which solves some of the riddles, should be welcomed. The authors propose such a hypothesis: ‘Zero-spin-photon generation in pair-production and its subsequent decay into neutrinos and antineutrinos’.

The riddles considered here are about:
(1) Mysterious neutrinos (and antineutrinos) and its bizarre properties?
(2) Is there a need of slight asymmetry of matter over antimatter (to explain extremely low value of nucleon to photon ratio) in early universe?
(3) Possibility of existence of anti-matter world?
(4) Parity-violation (and also about CP and CPT)?

These riddles could easily be explained with the ‘zero-spin-photon hypothesis’ considerations discussed in this paper. The proposed ‘zero-spin-photon’ is in fact attributed as a necessary out-come in pair-production process as-demanded-by the second-law-of-thermodynamics. Moreover, since the zero-spin-photon (boson with velocity c) does not exist in nature, it must be unstable to decay into two smaller half-spin particles such as neutrino and antineutrino (fermions with velocity c) conserving the spin. The hypothesis about ‘zero-spin-photon and its subsequent decay into half-spin neutrino and antineutrino’, clearly explains the genesis and bizarreness of neutrinos and solves several riddles.

II. ZERO-SPIN-PHOTON GENERATION IN PAIR-PRODUCTION AND ITS SUBSEQUENT DECAY INTO NEUTRINOS AND ANTINEUTRINOS

The authors have indicated in an earlier paper [1] the possibility of low-energy zero-spin-photon (γ0) generation from high-energy γ-ray-photon in pair production as γ = e− + e+ + γ0. To explain the essence of the paper [1], the re-understanding of ‘heat’ and ‘work’ in view of second-law-of-thermodynamics is necessary, which is explained as follows in section II(A).

A. Heat and Work

Second law of thermodynamics implies that ‘although work can be fully converted to heat, but heat cannot be fully converted to work’. For conversion of heat (radiation) to work (particle) some heat must go as waste. Efficiency of ‘work to heat conversion’ could be = 100%, but efficiency of ‘heat to work conversion’
must be < 100%. It may also be noted/remembered that though heat is considered as a statistical (bulk) aspect, but thermodynamics is equally applicable even for single-photon interactions, as shown and discussed in the earlier paper [1].

In thermodynamic-process ‘heat’ and ‘work’ are generally obvious, but there are some misconceptions too. The so-called ‘heat of a hot-body’, as per second law of thermodynamics, is in fact not ‘heat’ but ‘work’ as it is due to vibration/motion of atoms/molecules. In electronic process where usually ‘energy’-transfer/transition/conversion take place, recognition of heat and work is even more difficult. What is energy? Is Energy ‘heat’ or ‘work’? A little thermodynamics considerations [1], however, will reveal that all energies such as potential energy, kinetic energy, electrostatic energy, chemical energy, nuclear energy, mass energy $mc^2$ etc. are in a way ‘work’, except the radiation energy $h\nu$ which is the real ‘heat’. In fact ‘heat’ is the energy carried by the mass-less particle such as photon radiation waves, whereas energy carried by massive particle is ‘work’. In other words, boson (Photon) carries the ‘heat’ as radiation waves, whereas fermion (electron or fermion-groups as atoms/molecules) carries ‘work’ as kinetic, potential energy and other energy of particle(s). With this understanding that the photon (radiation $h\nu$) is ‘heat’ and that the particle mass (energy $mc^2$) is work; the two ‘mass and energy conversion’ process namely ‘annihilation’ and ‘pair-production’ [2-4] of electron and positron are reexamined from thermodynamics point of view, as follows.

B. Annihilation and Pair-Production

1. Annihilation

A particle(say, electron $e^-$) and an antiparticle (say, positron $e^+$) can annihilate each other giving two $\gamma$-ray photons i.e.,

$$e^- + e^+ = 2\gamma.$$  \hfill (1)

The total mass energy 1.02 MeV plus kinetic energy of the particles fully converts 100% to the energy of the photons. The full conversion of work (mass energy) to heat (radiation) is well permissible under second law of thermodynamics; the exact-reverse, however, is not permissible as discussed in next Section II B(2) and this is the key point of this paper.

2. Pair-production and pairs-production

If a $\gamma$-ray of radiation energy (heat) of $h\nu = 1.02$ Mev exactly could have to produce the electron and positron pair $2mc^2$ (work), then it would be 100% conversion of heat to work against the second law of thermodynamics, thus impossible. To save (satisfy) the validity of the second law of thermodynamics, a higher energy ($h\nu > 1.02$ MeV) photon is required and that some other object such as nucleus is involved in the pair-production process to carry-away part of initial photon-energy (and momentum), thus only less than 100% photon’s energy (heat) is utilized in producing the ‘electron positron’ pair $2mc^2$(work).

(a) Zero-spin-photon hypothesis

The authors propose the hypothesis that: ‘if pair-production is ever to happen in empty space (such as in early universe), then it would be like $\gamma = e^- + e^+ + \gamma_0$ giving a zero-spin-photon(\(\gamma_0\)) of low energy out of the mother $\gamma$-ray photon of high energy of more than 1.02 MeV, in-accordance with second law of thermodynamics and spin consideration’. The hypothesis of zero-spin-photon as given in Eq. 2 is a necessity in pair-production in empty-space to save (satisfy) the second law of thermodynamics and to conserve spin.

$$\gamma = e^- + e^+ + \gamma_0.$$  \hfill (2)

Note that pair-production simply as $\gamma = e^- + e^+$ (especially in empty space) is thermodynamically wrong, thus not possible. There are, however, four or five possibilities of pair-production to save(satisfy) second-law of thermodynamics, as follows:

$$\gamma+1 = e^-_{+\frac{1}{2}} + e^+_{+\frac{1}{2}} + \gamma_0.$$  \hfill (3)

or

$$\gamma-1 = e^-_{-\frac{1}{2}} + e^+_{-\frac{1}{2}} + \gamma_0.$$  \hfill (4)

$$\gamma+1 = e^-_{+\frac{1}{2}} + e^+_{+\frac{1}{2}} + \gamma_{+1}.'$$  \hfill (5)

$$\gamma+1 = e^-_{+\frac{1}{2}} + e^+_{+\frac{1}{2}} + \gamma_{-1}.'$$  \hfill (6)

$$\gamma-1 = e^-_{-\frac{1}{2}} + e^+_{-\frac{1}{2}} + \gamma_{+1}.1.$$  \hfill (7)

or

$$\gamma-1 = e^-_{-\frac{1}{2}} + e^+_{-\frac{1}{2}} + \gamma_{-1}.$$  \hfill (8)

$$\gamma+1 = e^-_{-\frac{1}{2}} + e^+_{-\frac{1}{2}} + \gamma_{+2}.$$  \hfill (9)

or

$$\gamma-1 = e^-_{+\frac{1}{2}} + e^+_{+\frac{1}{2}} + \gamma_{-2}.$$  \hfill (10)

Depending on the spin considerations; possibilities given in equations (9) and (4) show emission of low energy zero-spin-photon ($\gamma_0$), whereas possibilities
given in equations (5) to (8) show emission of usual /normal (but weaker) spin one photon (γ′) and that possibilities in equations (9) and (10) indicate the possible graviton (γ′′) emission. Note that though process are given in equation (5) to (10) are possible (single) pair-production, but not considered any further; whereas the interesting process given in equation (3) and (4) can lead to (double) pairs-production after subsequent decay of the zero-spin-photon γ₀ to neutrino and antineutrino (Eq. (11)) as shown in Figure 1 and in Eq. (12) or (13). Combination of the above equations, such as

\[ \gamma = e^- + e^+ + \gamma_0 + \gamma', \]

are also possible but not considered further because our concentration is only on Eq. (2) or on (3) and (4) to emphasize the importance of γ₀ and its subsequent decay via Eq. (11).

\[ \gamma_{\pm 1} = (e_{\mp \frac{1}{2}} + e_{\mp \frac{1}{2}}) + (\nu_{-\frac{1}{2}} + \bar{\nu}_{+\frac{1}{2}}). \]

III. THE RIDDLES RESOLVED

A. Neutrino (antineutrino \( \bar{\nu} \)) and its bizarre properties such as handedness (helicity) etc.

1. Birth of ν and \( \bar{\nu} \) and its handedness (helicity)

The most mysterious and elusive of all particles are neutrinos and antineutrinos \([5]\). However, only the basic and fundamental aspects of it are considered here. It is not very much clear - why and how these are produced specially with such left or right handedness and with bizarre characteristics.

It is remarkable to mention here that in Eqs. (3) and (4), the zero-spin-photon \( \gamma_0 \) is one of the extra outcome of pair-production, necessary to save the second law of thermodynamics. It is also observed from Eq. (11) that this zero-spin-photon (moving with velocity \( c \)) subsequently decays into neutrino and antineutrino (also moving with velocities \( c \) in same direction), the birth of neutrino \( \nu \) (and antineutrino \( \bar{\nu} \)), is re-written as follows indicating the spins.

\[ \gamma_0 = \nu_{-\frac{1}{2}} + \bar{\nu}_{+\frac{1}{2}}. \]

The reason why one of the \( \nu \) is left-handed \( (\nu_{-\frac{1}{2}}) \) and the other \( (\bar{\nu}) \) is right-handed \( (\bar{\nu}_{+\frac{1}{2}}) \) is explained as follows. As shown in Figure 2, \( \gamma_0 \) moves in a direction with velocity \( c \), and when it decays into neutrinos and antineutrinos both must move in same direction to conserve momentum and both must have spin-rotation in opposite direction to conserve spin. Thus to conserve momentum and spin, one (neutrino) is left-handed \( (\nu_{-\frac{1}{2}}) \) and other (antineutrino) is right-handed \( (\bar{\nu}_{+\frac{1}{2}}) \). This is so- is known to be true experimentally and is famous as parity-violation \([2, 5, 6]\).

2. Nomenclature and characteristics

Neutrinos (and antineutrinos) are born out of decay of the latent zero-spin-photon \( \gamma_0 \) as per Eq. (11) or (14). This zero-spin-photon could also be named as mesonic-photon. Is zero-spin-photon not like ‘Goldstone-boson’ \([2]\)? It seems, it is so; and if it is so, it should have linkage with Higg’s mechanism \([2]\).

The appropriate names of neutrinos and antineutrinos could be ‘half-spin-photon’ where half-spin
FIG. 2: Handedness (Helicity) of Neutrinos and Antineutrinos

implies $-\frac{1}{2}$ for neutrinos and $+\frac{1}{2}$ for antineutrinos. The neutrino (and antineutrino) alias half-spin-photon seems to have mixed properties /characteristics of photon and fermion. From spin consideration it is fermion (lepton), as commonly believed. But since it moves with velocity of light $c$, it has characteristic of photon. This mixed dilemma is in-fact not a dilemma but is solution for many bizarre properties such as ‘handedness’ (helicity) as just explained ( in Section IIIA(1), Figure 2). Hence, the neutrino (and antineutrino) could be named as ‘photon-with-handedness’, or simply as ‘fermionic-photon’ which indicates that it has both the aspects ($v = c$ and spin half) of photon and of fermion. It is more of a photon that fermion, thus appropriate to be named as ‘fermionic-photon’ with an optional prefix of left or right to show the handedness as listed in Table-1 (along with some other familiar particles/antiparticles and its characteristics such as charge, $z$-component of spin, handedness, possible speed, stability/decay etc.).

Efficiency of ‘heat to work conversion’ in pair-production, according to second law of thermodynamics, would be less than 100% but it could be as high as, say 99.9999%; thus a $\gamma$-ray photon (with energy $h\nu > 1.02$ MeV) could produce a Zero-spin-photon $\gamma_0$ (of energy $\sim 1$ eV), which subsequently splits into tiny (of mass $\sim 0.5eV/c^2$) particles: neutrino and antineutrino (Figures 1 and 2).

High penetrating power of the sharp-tiny (but with small mass) neutrinos and antineutrinos (moving with velocity of light) could be due to its unidirectional spin, resulting in its deep drilling action.

B. Is there a need of slight asymmetry (excess) of matter over antimatter (to explain extremely low value of nucleon to photon ratio $10^{-9}$ ) in the early universe?

Present approach:
It is well known that our universe contains much more number of photons ($\sim 10^9$) for each nucleon. This is explained in the past and contemporary physics as follows. It is assumed that during particles-production in the early universe there was slight asymmetry (excess) of matter over antimatter i.e., more matter particles (e.g., one billion plus one) were produced as compared to antimatter particles (one billion). The one billion of each matter and antimatter particles annihilated to produce two billion photons leaving behind one matter particle, in each turn. Thus the slight excess of matter particles survived ultimately giving rise to our matter universe in which nucleon to photon ratio is $10^{-9}$.

Alternative approach:
Another explanation, however, is possible without the need of any asymmetry of matter over antimatter, is given as follows. For it, it is considered that due to symmetry, in early universe exactly same amount of matter and antimatter were produced (e.g., one billion plus one, for each). The one billion each of matter and anti-matter annihilated to produce two billion photons. Out of these, one billion photons with one matter particle every time went to create matter world; whereas one billion photon with one antimatter particle every time went to produce antimatter world. Thus there seems a possibility of creation of antimatter world.

C. Possibility of creation, separation and existence of antimatter world

Interpretation of Fitch-Cronin experiment of Kayon-decay in both ways: as evidence against and in-favour-of existence of antimatter-world

The present model of Big-Bang assumes that there was a slight excess of matter (asymmetry-hypothesis) over antimatter in early universe perhaps 1 part in $10^9$. The alternative possibility (as explained in the previous Section III(B)) based on symmetry-hypothesis is that: matter and antimatter were produced in exact-equal quantity, but later some how antimatter-world separated from the matter-world. There is no (not enough) evidence either in favour or against the possibility of symmetry-hypothesis. There is, however, the key evidence (Fitch-Cronin experiment, as reported in 10) in favour of symmetry-hypothesis is decay of neutral kaon; but that is particularly not a strong evidence and that the same kaon decay can be reinterpreted otherwise in favour of symmetry-hypothesis as well, explained as follows.
Fitch-Cronin experiment of kaon decay: totality in both-worlds rather supports possibility of antimatter-world:

In our matter-world (as in Fitch-Cronin experiment \(2\) \(10\)) the long-lived neutral kaon \(k_L\) can decay into (i) \(\pi^+ + e^- + \bar{\nu}_e\) or (ii) \(\pi^- + e^+ + \nu_e\). For supporting symmetry-hypothesis both (i) and (ii) should decay with equal probability, but it is found (experiment in our matter-world) that probability of mode (ii) is very slightly higher, indicating a possible excess of matter in our matter-world. It can be argued that if Fitch-Cronin experiment is done in antimatter-world, the neutral \(k_L\) would decay but therein probability in mode (i) would be very slightly higher, indicating a possible excess of antimatter in antimatter-world. Considering both the matter-world and antimatter-world in totality, the whole universe would be perfectly symmetrical with equal amount of matter and antimatter. Thus it can be further argued that the decay of kaon, is not against antimatter-world, but rather is in its favor if both the matter and antimatter worlds are considered in totality.

Possible creation of both matter and antimatter worlds and its separation

In this and next paragraphs it is briefly discussed that how matter and antimatter worlds were formed, and how it separated out. After the big bang for each \(10^9 + 1\) matter-particles, \(10^9 + 1\) antimatter particles were generated. The \(10^9\) each from matter and antimatter annihilated to form photons. The remainder small number of matter and antimatter particles formed the corresponding two worlds. Besides large number of photons, matter world mainly consist of proton \(p^+\), electron \(e^-\), and neutron \((n = p^+ + e^- + \bar{\nu})\); whereas antimatter world would consist of antiproton \(p^-\), positron \(e^+\) and antineutron \(n' (n' = p^- + e^+ + \nu)\). There would be large number of neutrinos and antineutrinos around. But all the free neutrinos \(\nu\) would go along with matter sensing (from neutron decay) that as - if neutron contains its counterpart antineutrinos \(\bar{\nu}\). Similarly all the free antineutrinos would go along with antimatter. That is why our matter-world contains free abundant neutrinos (all left-handed); antineutrino comes out only in neutron-decay or in such weak interactions indicating parity-violation. Similarly, antimatter world would contain free abundant antineutrinos; neutrino would come out there as in antineutrino-decay indicating parity-violation there too.

Many physicists don’t deny and some even agree to the possibility of existence of antimatter world but wonder why and how it got separated from our world. Why matter-world and antimatter-world separated out is difficult to explain because the reason is not known. But, possibly, it can be explained as follows. An alternative novel gravity-theory recently proposed by Gupta \(11\) explains: how ‘gravity is the residual net electrostatic attraction/repulsion (due to second-order relativistic effect) between the charged-constituent of otherwise-neutral matter-atoms’5. Interestingly, it is shown in the paper \(11\) that Newton’s gravitational formula is derivable from Coulomb’s formula if applied between the constituents of atoms of two bodies and if special relativity considerations are taken into account. This gravity theory \(11\) also suggests (predicts) that though elementary particles and antiparticles attract each other but atoms (of matter-world) and anti-atoms (atoms of antimatter-world) would repel each other. This repulsion between the matter and antimatter could be the cause of separation of antimatter-world from the matter-world!

From Einstein’s gravity theory (General Relativity)-point of view also, this repulsion of matter from antimatter seems possible, if interpreted as follows. Matter creates a concave dimple (valley) around it in space-time fabric. The test-matter-mass around this valley tends to fall into the valley, creating an apparent
gravitational attraction. To the test-antimatter-mass, residing on the other side of the fabric (horizon), the dimple (valley) would appear from the other side as a mole (hill); hence the test-antimatter-mass will fall away from the cliff, creating an apparent repulsion between matter and antimatter.

D. Parity violation and also about CP and CPT

In Section IIIA(1) it is explained how neutrinos (and antineutrinos) are born due to decay of the zero-spin-photon as $\gamma_0 = \nu_{\frac{1}{2}} + \bar{\nu}_{\frac{1}{2}}$. Also explained there, is the fact that why neutrinos are left handed ($-\frac{1}{2}$) and antineutrinos are right handed ($+\frac{1}{2}$), both move in same direction with spin in different directions to conserve spin, $+\frac{1}{2} + -\frac{1}{2} = 0$. Thus all neutrinos (free and abundant in our matter world) are left handed and all antineutrinos (free and abundant there in antimatter world) are right handed. This is full (maximal) parity violation (in weak interaction) as observed [2, 5, 6] experimentally too.

Parity (P), and charge-conjugation (C) taken together, CP seems well restored initially. But from Fitch-Cronin experiment [2, 10] of kaon decay, a very small CP violation does seem to occur in matter world thus favoring small asymmetry as mentioned in Section IIIIC. But in the same section, it is also argued that similar violation (in other way) could occur in antimatter world too again favoring small asymmetry but in opposite way. Thus in totality (for both worlds considered together) the symmetry seems to be restored/retained.

For time-reversal symmetry (T) there are compelling reasons that time-reversal cannot be a perfect symmetry, especially in view of thermodynamic-irreversibility (or second law of thermodynamics) creating thermodynamic arrow of time [8]. Thus T must be violated [12] even though it may be very slight, even unnoticeable. The slightest violation of CP in each world and slight violation of T together; could yield TCP restoration in each world and in totality too. The ‘beauty’ is that the two slight asymmetries (CP and T violations) make an exact symmetry (TCP restoration). Nature prefers symmetry in the whole universe. The suggested way of TCP restoration is well in accordance with the ‘beautiful’ TCP theorem [13] which states that ‘combined effect of T, C and P (in any order) is an exact symmetry of any interaction’. Brief description for quick look of violation/Restoration of P, CP, T and CPT are tabulated in Table-2 (at appropriate page).

IV. DISCUSSION

Thermodynamics and Relativity Linked

The generation of zero-spin-photon $\gamma_0$ in pair-production is the inevitable consequence of second law of thermodynamics and spin-conservation, as mentioned in the Section IIIB2(a). It is also interesting to note, as mentioned in the other paper [1], that diverse phenomena such as ‘second law of thermodynamics (heat-to-work ratio, efficiency $\eta = (1 - \beta^2)$’ and ‘special-relativity (velocity ratio $\frac{v}{c} = \beta < 1$)’ are intimately linked or in other words are two faces of the same coin. Subsequent decay of zero-spin-photon $\gamma_0$ (moving with c) into neutrino and antineutrino as half-spin-photon (both moving with c in the same direction) is discussed in the Section IIIB2(b). The half-spin-photons (fermionic-photons) have dual property of photons ($v = c$) and of fermions (half spin). It seems that for both: zero-spin-photon and half-spin-photon, the key is relativity (or thermodynamics) along with spin-conservation.

Super-symmetry: A new possibility of self-super-symmetry

The half-spin-photons alias fermionic-photons are commonly known as neutrinos and antineutrinos. If the fermionic-photon is thought (renamed) as fermionic-boson, its dual nature (and name) reminds of super-symmetry. Super-symmetry [2] is a novel concept, which states that every fermion could have its bosonic partner and vice versa and is an important ingredient of super-string theory. Is the neutrino as fermionic-boson is super-symmetric partner of itself, and the antineutrino too as fermionic-boson is a super-symmetric partner of itself? It opens-up a new possibility of a particle being self-super-symmetric.

$E = mc^2$ re-interpreted

Re-consideration of energy as work or heat as discussed in Section II(A) indicates that mass energy $mc^2$ is like work and radiation energy $\gamma$ is heat. The famous mass-energy equation $E = mc^2$ needs to be re-expressed for annihilation and for pair-production differently (as follows) in the light of the second law of thermodynamics validity. For annihilation it is as $mc^2 = \gamma$, but for pair-production (Eqs. (3)–(8)) it should be as $\gamma = mc^2 + \gamma^*$ or $\gamma = mc^2 + \gamma_0$, where $\gamma$ and $\gamma^*$ are normal spin-one high and low energy photons and $\gamma_0$ is the low energy zero-spin-photon.

Possible by-products in pair(s)-production

The input ingredient for pair-production is the high energy $\gamma$-ray photon whereas the output products are electron and positron with some possible by-products such as listed herein: (i) low energy normal spin-one
Table 2: Violation/Restoration of P, CP, T and CPT

| Matter World | Antimatter World | Whole universe containing both matter and antimatter worlds |
|--------------|------------------|---------------------------------------------------------------|
| **(P)**      | Maximally violated. | Maximally violated. |
| All neutrinos are left, free and abundant. | All neutrinos are right handed, free and abundant. | Parity violation necessary, since the left handed neutrinos and right handed antineutrinos are born out of decay of zero spin-photons. |
| **(CP)**     | Nearly restored but very slight violation suggests asymmetry (slight excess) of matter over antimatter. | Nearly restoration but very slight violation to suggest asymmetry (slight excess) of matter over antimatter. | Symmetry of matter and antimatter in totality, with slight violation of CP but differently in both worlds. |
| **(T)**      | Violation (may be slight) due to thermodynamic arrow of time. | Violation (may be slight) due to thermodynamic arrow of time. | Violation (may be slight) due to thermodynamic arrow of time. |
| **(CPT)**    | Restored. | Restored. | Restored. |

photon $\gamma'$ (see Eqs. (3)-(8)), (ii) low energy novel zero-spin photon $\gamma_0$ (mesonic-photon) as in Eqs. (3) and (4), (iii) the $\gamma_0$ decays/splits (Eqs. (11) and (14) and Figures 1 and 2) into half-spin photons (fermionic-photons) or i.e., into neutrino and antineutrino ($\nu$ and $\bar{\nu}$) and (iv) bi-spin-photon ($\gamma''$ in Eqs. (9) and (10), possibly as graviton!).

Neutrinos (and antineutrinos): the three known brands and other possible brands

Equations (11) and (14) and Figures 1 and 2 show how neutrinos and antineutrinos are created. The zero-spin-photon $\gamma_0$ is born-out in pair-production. The $\gamma_0$ is, as if, also a pair of Siamese-twins (of $\nu$ and $\bar{\nu}$) joined at hip, which (the $\gamma_0$) subsequently decays (splits) into two separate particles $\nu$ and $\bar{\nu}$. Before the split the rotation (spin) is restricted to zero but after the split these two rotate (spin) in opposite way (see, Figure 2) while moving in same direction with same velocity $c$. The $\nu$ and $\bar{\nu}$ therein (Section II B(2)) have been considered, mainly in reference to understand how ‘electron-type’ neutrinos and antineutrinos are born. The same concept may, similarly, be extended for generation of ‘muon-type’ and ‘tau-type’ neutrinos and antineutrinos too, but correspondingly higher energy level would be required.

Furthermore, it appears that similarly as per Eq. (12), other brands of neutrinos (and antineutrinos) such as, say, proton-type or meson-type could also be born. But no such brand of it are known. The reasons for its absence could be that: (i) no one has cared-for/noticed it, (ii) these probably unstable brands of neutrinos (and antineutrinos) may have decayed into the three known stable neutrinos (and antineutrinos), (iii) its corresponding zero-spin-photon never decayed to produce such brands and remained quiet, thus these undecayed zero-spin-photons could be still around us unnoticed but may account for mysterious [9, 14] dark matter (or part of it).

Heavier particles synthesis: Elementary or Composite?

The present paper, though capable of explaining many riddles, seems speculative at several places. The other speculative possibility is that neutrons ($e^- + p^+ + \bar{\nu} = n$) and antineutrons ($e^+ + p^- + \nu = \bar{n}$), are not elementary particles but composite particles (as indicated in the brackets), and are created only after the various pair-production processes have created its constituent-ingredients. Similarly, other particles such as pions ($\mu^- + \bar{\nu}_\mu = \pi^-$, $\mu^+ + \nu_\mu = \pi^+$) could possibly also be composite particles. If it is so that the heavy particles are composite ones, the primordial nucleo-synthesis have to be re-investigated!

Antimatter World

The possibility of existence of antimatter-world and its separation from matter-world is discussed in some details (in Sections III(B) and III(C)) with consideration of equal amount of matter and antimatter without any need of asymmetry in it. Possible existence of the two worlds (mirror universe) may seem speculative, but is less speculative than that for the much-advocated multi-universe or parallel-universes and warped passages [15].
P, CP, T and CPT violation/restoration

As mentioned (in section III(D) and in Table-2); parity (P) is necessarily maximally violated in both matter and antimatter worlds. Parity with charge conjugation (CP) is very slightly violated but differently in both worlds. Thermodynamically essential slight violation of time-reversal (T) indicates thermodynamic arrow of time. In totality, as well as in each world separately, CPT is always restored (in agreement to CPT theorem [13]).

The only real asymmetry, separately in both worlds and in totality as well, is thermodynamic irreversibility (violation of time-reversal) which is the origin of thermodynamic arrow of time [8]. Without it there would be no past, present or future, hence nothing would exist or can be perceived. Thus, the key to our-existence (or anthropic principle [16] ) is the ‘second law of thermodynamics’.

V. CONCLUSIONS

Second law of thermodynamics seems to be the key to many secrets of physics and universe. As shown, the second law of thermodynamics (with spin conservation)‘demands’ generation of a low energy zero-spin-photon $\gamma_0$ in pair-production as $\gamma = e^- + e^+ + \gamma_0$. This $\gamma_0$, being unstable, decays/splits into neutrino and antineutrino. This neutrino-genesis not only solves many mysteries of neutrinos and antineutrinos but also explains a few riddles of physics and universe. The novel concept of ‘generation of zero-spin-photons in pair-production and its subsequent decay into neutrinos and antineutrinos’ could open new avenues and vistas for search of truth in wide fields ranging from particle-physics [17] to astrophysics and cosmology [18].

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