Why there is no baryon asymmetry - differentiating matter from anti-matter

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The baryon asymmetry problem is resolved using a model where the difference between normal matter and anti-matter is defined within a pre-fermion loop-based system. Also explained is where anti-matter is hiding in plain sight. Within the loop system only the sign of net loop charge differentiates matter from anti-matter. If a proton, as a stack of two positively charged quark loops and one negatively charged quark loop, is defined to be matter then a negatively charged electron loop is anti-matter. A charge-neutral neutron, as a stack of two negatively charged quark loops and one positively charged quark loop, is also anti-matter. Stable nuclei are built with equal numbers of matter and anti-matter nucleon components. The neutrino could be defined as matter or anti-matter, however, with the difference between a neutrino and an anti-neutrino of at least 60 degrees of loop rotation, it is not a Majorana fermion. The overall charge-neutral universe has a balance of matter and anti-matter and therefore baryon symmetry overall, although some volumes may be composed primarily of matter or of anti-matter charged nucleons. The combination of matter and anti-matter does not annihilate on contact – no loops or loop components are ever destroyed. The historic inconsistencies of definitions and treatments of negative energy, negative matter and anti-matter are shown to derive from a limited point-like model of particles and the loose definition of energy.

Key words: Baryon asymmetry; Pre-fermion model; Matter; Anti-matter; Majorana fermion; Loops**;** Extreme energy-symmetry; Negative energy; Negative mass;

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I. INTRODUCTION

The treatment of matter and anti-matter has historically been built on various equations which treat particles as point-like objects whose attributes include mass, charge and spin. The occurrence of negative energy, negative matter or anti-matter within some equations has been an on-going source of theoretical research. The basic issue is the loose definition of which type of energy is being defined in a point-like particle model that has so far been presumed to have no physical structure.

The consideration of only point-like particles thus far means that the pre-fermion model builds from a more fundamental base in its ability to define what anti-matter, negative matter and negative energy mean.

The three main historic, inconsistent, definitions will be considered separately, the differences to the pre-fermion model explained and how there is extreme energy-symmetry in the pre-fermion model [1].

Dirac's solution [2] to the Schrodinger equation which produced solutions as particles with negative kinetic energy, meaning negative mass energy, was solved by treating them as a lack of a missing particle, within a "sea" of positive kinetic energy electrons, by proposing a negative kinetic energy, positively charged particle.

In this definition, the electron was later termed matter (positive kinetic energy) and the particle, subsequently called a positron, termed anti-matter (negative kinetic energy). Here the energy that is defined to be positive or negative is due to the sign of the mass energy.

In the pre-fermion model, which takes the definition of the proton to be a matter particle (for historic reasons, although by symmetry the definition could be reversed) and, as will be shown below, it is only the sign of charge of a charged particle that sets whether it is matter or anti-matter, it is the positron that is the matter particle and the electron which is the anti-matter particle, both with positive gravitational mass.

As will be explained below, our fermions are composites of fundamental building blocks in the form of rotating loops, and it is actually the sign of charge of the loop that differentiates matter from anti-matter.

The prevailing consensus, subsequent to Dirac, is that both matter and anti-matter have positive gravitational masses, therefore having positive mass energy, which has been shown experimentally [3], and that the specific charge sign is now what defines the sign of matter or anti-matter, although the current 'normal' matter particles are a mix of charge signs, being only what are the main constituents observed within our nuclei and atoms.

The pre-fermion model agrees with gravitational mass being positive for matter and anti-matter, but as will be shown below, it explains how and why that is the case.

The Isodual theory of anti-particles [4] is based on the idea that negative energy anti-particles travel backward in time and seeks to solve some of the issues apparent in the Dirac treatment. The theory has the same basis that quantum mechanics uses – that time is reversible – and does not produce the arrow of time that is observable in thermodynamics.

The pre-fermion model [5] is particle-based and proposes that the composites formed, loops, are the only directly observable objects in the universe – single loops are fermions. The electron and positron are two of the fermions constructed from three pairs of the basic building block particle and anti-particle pair. Photons are double-loop stacks of symmetric lepton loop and anti-loop - either electron and positron or neutrino and anti-neutrino - in each case with both loops rotating in the same sense.

This means that electrons, and positrons, can be boosted in total energy by stacking with a photon loop, for example in order to move between orbitals. Similarly, a stack of an electron and a photon that emits that photon can never have less energy than the electron alone [6].

One foundation of the pre-fermion model is that all systems always have zero total of all energies [7] and it is how much of each type of energy that objects have that sets how they interact due to that energy type. Nothing is destroyed in the model, there is no annihilation of particles – loops stack, as when the electron and positron combine to form a photon, or when a meon and anti-meon overlap completely – this letter pair each still exist in an unstable state ready to become a partially merged pair as part of the background.

The level at which negative energy appears in the pre-fermion model is in the building blocks, not the loops subsequently formed, and is always accompanied by the same amount of positive energy, whether due to mass or charge. So it is vital that each energy type is specified precisely, rather than loosely as has been done previously.

The positive building block, a 'meon' is hypothesised to have fundamental positive mass and fundamental positive charge of Planck size and opposite type. The negative building block, an 'anti-meon' is hypothesised to have fundamental negative mass and fundamental negative charge of Planck size and opposite type. When the meon and anti-meon overlap completely, they are merged and no fundamental mass or fundamental charge fields exist beyond their Planck size radius.

The model is also symmetric in that fundamental negative mass attracts fundamental negative mass in the same way as fundamental positive masses attract fundamental positive masses, or normal gravitational loop masses, do, and that opposite type fundamental masses chase/are chased in a Bondi-type runaway motion from rest [8].

It is only in the actions between the building blocks that negative mass energy acts, but the total energy of each building block is always zero and the total energy of the

fundamental masses and charges within a stationary or rotating loop are always zero.

It is the rotational rate of the loop which produces the energy that we term the mass of the loop and the spin of the loop [9], both of equal size and opposite type. The effect of gravity is due to how the loop interacts with the background, which is a myriad of the meon and anti-meon pairs that are still partially merged (defined as the 'background'), and is the same attractive action whether the loop is matter or anti-matter, because the attached partially merged pair chains are the same structure for each loop.

Negative energy does not imply negative time, as in time going backwards. The viscosity of the partially merged pair background takes energy from all loops, in terms of their rotational rate, and shares it throughout that background – where the partially merged pairs have the capacity to absorb both positive energy in their meon components and negative energy in their anti-meon components producing extra motions that could be described as heat. Motion by loops in one direction loses energy, as does the reversal of that motion, so there is no lossless motion within the background and an arrow of time exists there.

The extreme symmetry of the pre-fermion model [10] means that if the definition of matter and anti-matter loops were reversed in another system, such as a galaxy, no difference could be observed at a remote distance. All energy levels of atoms, in a system with the same three-pair loops and inflation amounts to produce the same size particles, would be the same. Only on contact could the difference be observed, but both systems could still claim to be the matter system.

This scenario is possible for many galaxies across the universe, although the equal number of meon and anti-meon pairs unmerged, always with zero total charge, would mean that the total universe will have zero charge overall, but individual galaxies could be primarily based on either matter or anti-matter charged nucleons.

Therefore this paper looks from a physical structure viewpoint at how loops form and interact and accepts the theoretical mathematics and equations at the loop level, and argues that the idea of negative mass energy should not be dismissed because there is always an equal and opposite amount of positive mass energy to balance it, in all systems.

The inconsistencies of the historical nature of the definition and treatment of anti-matter are overcome by looking at the lower pre-fermion level where all energy types always sum to zero overall and it is only the relevant amount of each type of energy in each system that produces the interaction of those systems due to that energy type.

The result is that there is no hadron asymmetry across the universe, although there may be within some volumes.

The three points to make clear before proceeding to the new pre-fermion definition of matter and anti-matter are:

1 There is no negative gravitational mass, matter or anti-matter, at loop level
2 There is no negative mass energy at loop level
3 Anti-matter loops differ only in sign of charge from matter loops

The superiority of the loop-based pre-fermion model and its basis [11, 12] arises because there are more degrees of freedom in the composite structures, and motions within those loops, which allow for many more mirroring changes between matter and anti-matter properties. This paper shows how those extra degrees of freedom result in a different definition of which loops are matter and which anti-matter, and thus where anti-matter is hiding in plain sight.

Loops of three pairs are our fermions, being either 3-fold asymmetric (quarks and some neutrino isomers) or symmetric (leptons and some neutrino isomers). Loops of other pair number have different asymmetries and

symmetries so are unable to bind stably through frequency matching of inter-loop charge and mass forces (called stacking) with our 3-pair loops and are dark matter.

II. SIGNIFICANCE and OBJECTIVE

The significance is in explaining, in terms of a physical pre-fermion-based model of loops, what underlies the similarities and differences between normal matter and anti-matter and why neutrinos are not Majorana fermions.

The historical inconsistencies in anti-matter, negative matter and negative matter are shown to be artifacts of the lack of a pre-fermion model, able to provide a consistent set of definitions, and to a loose definition of the energy of point-like particles.

The objective is in showing clearly why there is no baryon asymmetry and where anti-matter can be found within our nuclei and atoms.

III. OUTLINE

The paper considers the number of degrees of freedom available when forming loops composed of unmerged meons and anti-meons that may form either matter or anti-matter fermion loops.

IV. DEFINING MATTER AND ANTI-MATTER

Currently the historic basic assumption on matter/anti-matter asymmetry is that somehow there is an excess of matter over anti-matter caused by mutual interaction during the big bang and only a matter excess survived. The currently defined 'normal' matter particles include the proton, electron and neutron, despite the opposite charge sign of the first two. This is not the case in the model discussed here where the latter two are anti-matter particles, if the proton is defined to be a matter particle.

The starting point in defining the difference between matter and anti-matter is to consider a chain of pairs, of meons and anti-meons, of any number travelling across a theoretically-existing flat surface following a Bondi-type motion with each pair chasing/being chased in line. The chain then encounters an obstacle which deflects it either right or left so that it catches its own tail to form a loop. One loop version will become a clockwise rotating loop and the other an anticlockwise rotating loop, each relative to the flat surface. If the clockwise rotating loop, knocked to the right in this thought experiment, is defined to be spin +½ then the anticlockwise will be spin -½ . It is also apparent that the spin energies of each loop are the same and so are their mass energies.

They are both the product of Planck's constant (angular momentum) ½ *h* and the loops' rotational frequencies since each component meon and anti-meon has Planck mass size. The overall charges of the loops will also be the same since the meons and anti-meons have not changed twist orientation, which latter is the spiral combination of axial spinning of the meons/anti-meons along their direction of travel that defines the sign of one-sixth electron-sized charge each meon or anti-meon generates. This stage has produced two loops of the same size mass, same sign charge but different spin signs.

The next stage is to define a matter or an anti-matter loop by considering all possible mirror properties that can be performed on those loops by switching each in turn, for time, spatial and identity properties. Firstly the initial direction of travel of the chain and the twist orientation of each meon/anti-meon needs to be reversed. Then the underlying identity of each meon has to become an anti-meon and vice versa.

So now, for example, a meon twisting right hand screw along one spatial direction (forwards), generating negative one-sixth electron size charge, will become an anti-meon also twisting right hand screw along the opposite spatial direction (backwards), generating positive one-sixth electron size charge.

A spatial difference is also that the chain previously deflected right will now be deflected left to form a spin -½ loop instead of the earlier spin +½ loop since the chain travel direction is reversed and the obstacle is in the way of its new path. The last spatial change is that this loop itself must be flipped over to become a spin + ½ loop.

These switches in time, identity and spatial orientation constitute the degrees of freedom for defining matter or anti-matter in a pre-fermion loop-based system and are greater in number than currently considered in the amorphous point-like view of particles.

The result is that the only property that provides an unambiguous definition that can be used to define loop matter and anti-matter is the sign of charge of the loop. This means that if the positively charged proton, or positron loop, is defined to be matter, then the negatively charged electron makes it an anti-matter loop, as would be all other negatively charged loops. Therefore all stable atoms contain equal numbers of matter and anti-matter charged nucleons and orbital charged leptons, and all atomic photon emission energies will be identical whether the atoms are composed of neutrons and positively charged protons or anti-neutrons and negatively charged anti-protons with balancing electrons or positrons emitted/absorbed respectively.

The neutrino loop could be defined as either matter or anti-matter since it has no overall charge. Even if a specific position, and meon/anti-meon identity, for the starting point of a symmetric neutrino loop is defined, so that it would be possible to call one matter and the other anti-matter (and rotating either loop by 60 degrees would convert one to the other), this would not be observable. However, this difference is enough to negate the neutrino as a Majorara fermion, even if the difference is not observable.

The anti-loop of a positively charged spin +½ loop is a negatively charged spin +½ loop. Therefore a photon, being loop and anti-loop rotating parallel in the same sense (and stacked/merged together), is a perfectly balanced composite of matter and anti-matter. This means that matter and anti-matter do not annihilate on contact, but form composite loop stack systems.

With this loop-based definition of which is matter or anti-matter, it means that in the nucleus, the three core quarks in a loop-stack that defines a proton have two positively charged quark matter loops and one loop of negatively charged quark anti-matter. This presumes that the choice has already been made to define the positively charged positron to be the positive (normal) matter particle, although the opposite could be chosen. In the neutron, the opposite is the case for its core stack-loops, with two anti-matter quark loops and one matter quark loop, and this means that, although the neutron is charge-neutral, it is an anti-matter particle overall.

Therefore nuclei build up generally by balancing matter core loop-stacks (protons) with anti-matter core loop-stacks (neutrons) and are more likely to be stable when the number of matter and anti-matter nucleon components is equal. The same is the case for a galaxy in which the nuclear core nucleons are anti-matter anti-protons and matter anti-neutrons, so anti-matter, in our current definition, is there the primary charged nucleon.

Any simplistic definition of matter and anti-matter by sign of charge alone, rather than by net loop charges, would not treat neutral particles appropriately. The change in definitions of matter and anti-matter will require a change in how each particle is named because, for example, our current definition of the neutron as a matter particle is no longer appropriate. Should it be termed an ‘anti-neutron’ since it is an anti-matter particle, so that our definition of nuclei would become groups of matter protons and anti-matter anti-neutrons? A similar change for the anti-matter electron to be called an anti-matter anti-electron might be a step too far.

Since in the big bang there was a balance of fundamental charges of the meons and anti-meons, as well as of one-sixth electron-sized charges in the twisting meon and anti-meon pairs, there can be no charge or matter/anti-matter imbalance in the universe, even though there may not be an exact balance in the number of matter and anti-matter loops subsequently formed.

Taken overall, the symmetry of the definition of matter and anti-matter is such that even if it were reversed, there would be no difference that could be measured. Only when two environments, composed mainly of different overall charge sign in the proton stack, came into contact could it be observed that they were different. But each could equally well claim to be the matter version.

V. CONCLUSIONS

The main difference to the current definition of matter and anti-matter is that now if a loop or composite particle is net positively charged, it will be matter, and if it is net negatively charged, it will be anti-matter.

If a loop, or loop-stack, is charge-neutral it may be either matter or anti-matter depending on the loop meon/anti-meon configuration or on the net loop charge numbers.

The specifically defined energy types means that the historic inconsistencies in definitions of anti-matter, negative matter and negative energy can be relegated to history.

For a symmetric neutrino or anti-neutrino loop, the difference between the two being at least 60 degrees of rotation means that although the two cannot be Majorana fermions, the difference is not observable.

It is the pre-fermion composite loop based model that enables increased degrees of freedom in defining the difference between matter and anti-matter. Using such a loop system shows that our current definition of ‘normal’ matter particles is unsupportable and that anti-matter neutrons and electrons are both vital components in nuclei and atoms. There is no baryon asymmetry problem.

VI. REFERENCES

1 Lawrence M “Extreme Energy-Symmetry Model and its fundamental tenets”. (pre-print) Researchgate (2024)

2 Dirac, P. A. M. (1930). "A Theory of Electrons and Protons". Proc. R. Soc. Lond. A. **126** (801): 360–365. Bibcode:1930RSPSA.126..360D. doi:10.1098/rspa.1930.0013. JSTOR 95359.

3 Andersson, E. K.; Baker, C. J.; Bertsche, W.; Bhatt, N. M. (27 September 2023). "Observation of the effect of gravity on the motion of antimatter". Nature. **621** (7980): 716–722. Bibcode:2023Natur.621..716A. doi:10.1038/s41586-023-06527-1. PMC 10533407. PMID 37758891

4 Santilli M R “Problematic aspects of 20th century antiparticles and their apparent resolution via the isodual branch of hadronic mechanics” (private correspondence) (2024)

5 Lawrence M “A Hypothetical Pre-Fermion Particle Theory of Everything In 95 Theses”. (pre-print) Researchgate (2018)

6 Lawrence, M.: “A Hypothetical Pre-Fermion Particle Theory of Everything in Diagrammatic Form”. (pre-print), Researchgate, (2022)

7 Lawrence M “Extreme Energy-Symmetry Model and its fundamental tenets”. (pre-print) Researchgate (2024)

8 Bondi, H. (1957). "Negative Mass in General Relativity" (PDF). Reviews of Modern Physics. **29** (3): 423–428. Bibcode:1957RvMP...29..423B. doi:10.1103/RevModPhys.29.423

9 Lawrence M “Black hole laws and potential energy reinterpreted” (pre-print) Researchgate (2024)

10 Lawrence M (2016) “A Viscosity Hypothesis – That the Presence or Absence of Viscosity Separates Relativistic and Quantum Systems Based on the Simplest Possible Theory of Everything.” J Phys Math 7: 200. doi: 10.4172/2090-0902.1000200

11 Lawrence M. A Hypothetical Pre-Fermion Particle Theory of Everything in Diagrammatic Form. Maldwyn Theoretical Physics Journal. 2022 118 2 ISSN 1353-1204

12 Lawrence M. Eliminating the gravitational constant, G, and improving SI units, using two new Planck-unit frameworks with all parameters as ratios of only h, c and α. In: Amoroso RL, Kauffman LH, Rowlands P, editors. The physics of reality – space, time, matter, cosmos. World Scientific, Singapore; 2013 pp. 60-70. ISBN: 978-981-4504-77-5