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Neutrino mass

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Abstract

The place of the neutrino in atomic theory and the mass of this particle are two problems that have received considerable attention for many decades. In spite of the heavy investment recourses, human material, theses problems have remained intractable. It turns out that geometrization of matter is a necessary prerequisite for the resolution of many problems of considerable current interest. In this paper we discuss the geometrization of matter, and deduce therefore the mass of the neutrino.

1.0 Introduction

By the early 1930s it had become quite well established that the atom consisted of two parts, the "lepteus" where electrons reside and the nucleus where nucleons reside. It had also become established at the time that the fundamental interactions of nature are gravitation, electromagnetism, weak and strong nuclear interactions. The nature of classical gravitation and electromagnetism was well understood at the time. The basic challenge physicists faced was to unravel the nature of the weak and strong nuclear interactions. It was assumed that a resolution of this problem would explain the stability of atoms. Later in the 20th Century and with this basic problem still unresolved, attention was shifted to the problem of the unification of these fundamental interactions.

Again by the 1930s quantum mechanics and special relativity had become firmly established as two independent theories. There was, however, the outstanding problem of how these two great theories could be reconciled. The resolution of these problems has followed, over the years, what may be described as the "dynamic" scenario. This approach involves bashing micro-particles together and explaining the results of the experiments in terms of the so called quantum filed theory and quark model. Quantum filed theory and the quark model, the current arrowheads of fundamental physics research, have been with us for about five decades. These are robust model-based methods of theoretical physics research which have yielded important results. In spite of their multifarious achievements, however, the aforementioned fundamental problems have remained palpably unresolved.

In this paper we discuss the "static" or geometrical scenario. It turns out that this approach resolves these problems comprehensively; as well as other problems of contemporary interest in Physics.

2.0 The Geometrization of space and time

In a certain sense Newtonian Physics is best understood from the point of view of geometrization of each of coordinate and momentum space. Geometrically, the phase space is seen to be a 6-dimensional world which is completely reducible to two 3-dimensional Euclidean sub-worlds of 3-coordinate $\left(x^i\right)$ and 3-momentum $\left(p^i\right)$; so that a point in phase space id denoted mathematically by $\left(x^i, p^i\right),\ i = 1,2,3.$ Similarly, the rest frame of the Newtonia world is a 6-dimensional world is completely reducible to two 3-dimensional Euclidean subworlds of 3-coordinate (x^i) and anti 3-ccordinatie $\left(-x^i\right) - x^i$ and $-\left(x^i\right)$ describe the world and antiwolrd of the Newtonian world. The world and anti-world are symmetric under parity (P) transformation. In this description the time is universal and the energy depends on the variables of the phase space. The above prescription provides adequate tools for the description of classical gravitation and electrostatics. As is well known electromagnetism could not be accommodated within the Newtonian geometrical framework. This observation forced special relativity on physics. It required the ingenuity of Einstein, Lorentz, Minkowski and others to replace the

Newtonian world by the Einsteinian world. Geometrically the phase space of this world is 8-dimensional, and is completely reducible to two 4-demensional pseudoeuclidean subworlds of 4-coordinate $(\times^{\mu})$ and 4-mometum (p^{μ}); so that a point of phase space is represented by $(\times^{\mu}, p^{\mu})$. Similarly the rest frame of the Einsteinian world is an 8-dimaensional world which is also completely reducible to two 4-dimensional pseudoeuclidean subworlds of 4-dimensional space-time subworld $(\times^{\mu})$ and 4-dimensional anti space-time subworld $(-\times^{\mu})$. The space-time subworld and anti space-time subworld are symmetric under PT (T, time reversal) transformations. In this geometrical description space and time as well as momentum and energy have become separately unified. The basic physical requirement for these unifications is the constancy of the speed of light (independent of the inertial frame of reference).

3.0 The geometrization of matter

The above geometrical prescription is adequate for the description of a free macroscopic particle-the Newtonian world for a non-relativistic particle and the Einsteinian world for a relativistic particle. The situation is completely different if the particle under consideration is a microscopic particle. The drawback here is that the free microscopic particle is endowed with additional degrees of freedom arising from its spin; and being a relativistic particle only eight of the quantities can be prescribed simultaneously. In other words the dimensionality of the microparticle world is eight. Fortunately we have the Dirac theory of the electron which serves as a guide to the resolution of this problem. We call the description of an electron in terms of an 8-demensional world the geometrization of the electron (matter).

A point of the "phase space" of the electron is characterized by $(\gamma^{\mu}, \mathrm{P}^{\mu})$, where α^{μ} are the Dirac matrices. Geometrically the "phase space" of the electron world is 8-demensional, and is completely reducible to two 4-dimensional pseudoeucidean subworlds of 4-momentum (P^{μ}) and 4-spin (γ^{μ}). The rest frame is also an 8-dimensional world. The Dirac theory, however, prescribes a 4-dimensional pseudoeuclidean world (γ^{μ}): a 2-dimensional subworld juxtaposed with a 2-dimensional anti-subworld-the subworld and anti subworld being symmetric under C. field theoretic analysis shows that the subworlds are symmetric under CPT[1].

We conclude from the foregoing that the Dirac theory is incomplete! The Dirac electron therefore has a partner in the rest frame which has a geometrical structure similar to that of the electron. The partner must be a neutral spin $\frac{1}{2}$ particle to ensure electrical neutrality of the rest frame. The electron neutrino is only known lepton that satisfies these requirements. We represent the electron rest frame symbolically as follows: 2 (world): 2 (anti-world) for the electron and similarly for the electron neutrino, the number 2 denoting the dimension of the world (anti-world).

The nuclear world can be tackled in a similar fashion. Experiments have established that nucleons, mesons, and may be other particles reside in the nucleus. Theoretical physicists have speculated that any number of nuclear particles, including supersymmetric particles, actually reside in the nucleus. The geometrization scenario will now be used to settle this matter.

The basic geometrical structure of the rest frame of any nuclear system is that its dimensionality is 8. The question that arises is how many distinct nuclear systems can one construct subject to the physical requirement that the spin is elementary (i.e. not composite). This problem is similar to that which engineers and architects face from time to time. Here, given a brief any number of designs is possible depending on the available resources. In the nuclear physics cases only three distinct geometrical configurations are possible, subject to the above brief. To enumerate these we adopt the notation a: b where "a" and "b" stand for the number of dimensions in the world and anti-world respectively, to represent a sub-configuration. A configuration of 8 dimensions is then represented by $a:b+c:d$, with $(a + c)$ and $(b + d)$ dimensions in the world and anti-world respectively. The allowed configurations are

$$2 : 2 + 2 : 2 \qquad (3.1)$$

$$1 : 3 + 3.1 \qquad (3.2)$$

The third and final configuration is of the form $(a+b):c$ or $a:(b+c)$, with $(a+b)$ and c dimensions in the world and anti-world respectively, or a and $(b+c)$ dimensions in the world and anti-world respectively, i.e.

$$2+3:3 \text{ or } 3:3+2 \qquad (3.3)$$

(3.1) is similar to the electron structure and so represents a fermion system; or the nucleon subworld of the nuclear world, (3.2) represents a boson system, or the boson subworld of the nuclear world, and (3.3) represents a fermion-boson system, or the fermion-boson subworld of the nuclear world.

The mathematical structure of the nucleon system (fermions) is similar to that of the lepton system. The mathematical structure of the boson system is distinct. However, like fermions they are characterized by γ-matrices(γ', γ''), called Nduka's matrices, which satisfy the boson condition $\gamma'_\mu \gamma'^\mu = 0, \gamma''_\mu \gamma''^\mu = 0$. The mathematical structure of the fermion-boson system is complicated-mathematically the system consists of a set of 6×6 and 2×2 matrices. This set of matrices is not completely reducible to a set of 4×4 matrices by mere juxtaposition. Unlike the fermion and boson systems which represent states of bliss, the fermion-boson system represents a state of therefore an unstable system, and must disappear via weak and strong nuclear interactions [1]. Unlike (3.1) which is symmetric under *CPT*, (3.2) and (3.3) are asymmetric under *CPT*.

In terms of the fundamental particles of nature the lepton system is described by $e^-:e^+ + \nu_e:\bar{\nu}_e$; while the nuclear systems are described are described by $p:\bar{p} + n:n$ for nucleons, $\gamma: \bar{w}+w^+:\rho$ for bosons, and $\nu_e(n)+w^+ \bar{w}:w^+ \text{ or } \bar{w}:\bar{w}+\bar{\nu}_e(\bar{n})$ for fermion-bosons. Consequently the W particle is capable of strong or weak interaction. The α accounts for electromagnetic interaction and its change quantum is *e*. It must then follow that Z^o accounts for gravitational interaction, with the mass of Z^o the mass quantum-Z^o is therefore the elusive Higgs particle. The lepton system and nucleon system are distinguished by their coupling constants-the leptons for weak and the nucleons for strong interactions [1].

The nuclear world has a total of three distinct families, with a total electric change (+3e) in the world and (-3e) in the anti-world. To insure electrically neutral universe we must have three distinct lepton families namely $(\nu_e, \bar{\nu}_e), (\nu_\mu, \bar{\nu}), \text{and } (\nu_\tau, \bar{\nu}_\tau)$ these atomic particles are distinct-protons never transform to neutrons and vice-versa, and neutrino oscillations do not occur, etc., and those enumerated above are the only fundamental particles that exist in the universe. Baryon resonances and mesons of course exist, but these are the derivatives of (3.3) [1].

4.0 The Neutrino mass

The forgoing description of the microworld is absolute in that it does not involve space and time. Thus the primordial universe consisted of helium and anti-helium atoms, a fully integrated force particles, and excess of each of neutrino (antineutrino), neutron (anti-neutron), W, and Z^0 in equilibrium at 0^0K. The universe was then nudged out of equilibrium at $t = 0^+$ by weak and strong nuclear interactions (in complete agreement with Eddington's hypothesis-the difference being that Eddington did not know what caused the expansion of the universe). Consequently the universe must warm up (thermodynamically) as it expands, and this process can only be accelerated by terrestrial activities that give rise to these nuclear interactions. The helium atom consists of two electrons, two electron neutrinos and an alpha particle. By a well known experimental process the helium atom can be stripped of the leptons leaving the alpha particle. The neutrino mass is then obtained from the formula

$$2m_{\nu_e} = M_{H_e} - M_\alpha - 2m_e + E_i, \qquad (4.1)$$

where E_i is the energy required to remove the leptons. On substituting the known values of $M_{H_e}, M_\alpha, m_e \text{ and } E_i$, we obtain

$$m_{\nu_e} = 7.710\times 10^{-5} m_e \qquad (4.2)$$

if we make the plausible assumption that $m_{\nu_e}/m_e = m_{\nu_\mu}/m_\mu/ = m_{\nu_\tau}/m_\tau = 7.710\times10^{-5}$, we immediately deduce the masses of ν_μ and ν_τ.

5.0 Concluding remarks

In a recent series of experiment with hydrogen plasmas Randy Mills and co-workers have observed a range of phenomena which can only be explained by the existence of new states in the ground state of the hydrogen atom [2]. If this result is confirmed by other laboratories it would serve as an experimental confirmation of our theory.

The geometrization scenario that is the description of physical processes in terms of 4-operators (3-vectors in Newtonian world), is a powerful method for constructing physical theories. It has produced many important results including (1) unified field (particle) theory of the fundamental interactions, (2) fundamental theory of weak and strong unclear interactions, (3) formal theory of the periodic table of the chemical elements, and (4) fundamental theory of gravity [1]. There is, however, the need to generalize Hilbert-Dirac space theory somewhat [1]. Further, quantum dynamics can now be constructed entirely in terms of geometrical entities. For example, elastic processes imply the conservation of geometry, and inelastic processes the change of geometry.

Figures 1 and 2 give a geometrical representation of the fermion and boson subworlds respectively –each "cell" of the figures represents 1-dimension. The micro-particles occupy these cells (states).

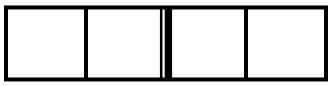

Figure 1: Fermion Sub-world

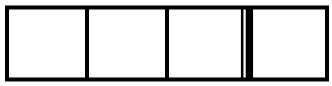

Figure 2: Boson Sub-world

It is seen from figure 1 that only one (free) fermion can occupy each cell because there is room for the next fermion even outside the primordial fermion world [1],-this is a proof of Pauli's exclusion principle. The same is not true of bosons because for any number of $\gamma(Z^0)$ occupying the single $\gamma(Z^0)$ state, any number of W_S can occupy the W states-this is a proof of the Bose principle.

Finally the "vector" sum of the fermion world and anti-fermion world gives a world of 0-dimension. Physically, this implies that particle –antiparticle annihilation yields pure energy. Therein lies mankind's ultimate source of energy; hydrogen-anti hydrogen, and helium-anti helium being the most practical sources.

References

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