The Neutron Meta-Particles and their Decay as Viewed in the Planck Vacuum Theory

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Abstract—The mean life of the free neutron is about fifteen minutes, after which it decays into a proton plus an electron and an electron-neutrino. According to the Planck vacuum (PV) theory, however, it is the neutron and "antineutron" meta-particles (MP)s that decay, in roughly fifteen minutes, into the stable electron and proton cores. The electron and proton core spins remain constant during the transformations—so there is no need for the neutrino spin correction during the decay process, bringing into question the validity of the neutrino itself.

Calculations estimate the mean life (15.3 minutes) for the free neutron and "antineutron" MPs, and show that those MPs do not form a particle-antiparticle pair.

Index Terms—Neutron, Antineutron, Neutron Meta-Particles, Neutron Mean Life.

I. INTRODUCTION

THIS paper derives the MP equations for the free neutron and "antineutron" MPs, and shows that the corresponding meta-state does not form a particle-antiparticle pair.

The theoretical foundation [1] [2] [3] of the PV theory rests upon the unification of the Einstein, Newton, and Coulomb superforces:

$$\frac{c^4}{G}\left(=\frac{m_*c^2}{r_*}\right)=\frac{m_*^2 G}{r_*^2}=\frac{e_*^2}{r_*^2} \tag{1}$$

where the ratio c^4/G is the curvature superforce that appears in the Einstein field equations. G is Newton's gravitational constant, c is the speed of light, m_* and r_* are the Planck mass and length respectively [4, p.1234], and e_* is the massless bare (or coupling) charge. The fine structure constant is given by the ratio $\alpha \equiv e^2/e_*^2$, where e is the observed electronic charge magnitude.

The two particle/PV coupling forces

$$F_e(r)=\frac{e_*^2}{r^2}-\frac{m_e c^2}{r} \quad \text{and} \quad F_p(r)=\frac{e_*^2}{r^2}-\frac{m_p c^2}{r} \tag{2}$$

the electron core $(-e_*, m_e)$ and the proton core (e_*, m_p) exert on the invisible PV state; along with their coupling constants

$$F_e(r_e)=0 \quad \text{and} \quad F_p(r_p)=0 \tag{3}$$

and the resulting Compton radii

$$r_e=\frac{e_*^2/c}{m_e c} \quad \text{and} \quad r_p=\frac{e_*^2/c}{m_p c} \tag{4}$$

lead to the important string of Compton relations

$$r_e m_e c=r_p m_p c=e_*^2/c=r_* m_* c \quad (=\hbar) \tag{5}$$

for the electron and proton cores, where $\hbar$ is the reduced Planck constant. The Compton relation to the right of e_*^2/c comes from equating the Einstein and Coulomb superforces from (1). To reiterate, the equations in (2) represent the forces the free electron and proton cores exert on the invisible PV space, a continuum that is itself pervaded by a degenerate collection of Planck-particle cores $(\pm e_*, m_*)$ [5], leading to a bifurcated vacuum state with one positive branch (e_*, m_*) and one negative branch $(-e_*, m_*)$. The positron and antiproton cores are (e_*, m_e) and $(-e_*, m_p)$ respectively.

The Lorentz invariance of the coupling constants in (3)(4)(5) and (6) leads to the energy and momentum operators of the quantum theory [5] [6].

Section II starts with the 2x1 spinor equations derived from the covariant Dirac equation, and derives the superposition of the core and anticore equations that reflect the experimental fact that the core and anticore form a particle-antiparticle pair. Section III derives the equations for the neutron and "antineutron" MPs using the equations of Section II. Finally, Section IV calculates the mean life of the neutron and "antineutron" MPs.

II. DIRAC CORES

To start with, it is important to note that the Dirac equation is an equation of state, rather than an equation of motion. Consider the proton for example:

$$E=m_p c^2=\hbar \cdot \omega_p=\frac{e_*^2}{c} \cdot \frac{c}{r_p} \tag{6}$$

where $m_p c^2$ is the spin energy, e_*^2/c is the spin coefficient, and $\omega_p=c/r_p$ is the radian frequency associated with the spin energy. Furthermore, the following equations are equations of state in a 7-dimensional spacetime that consists of two separate 4-dimensional spacetimes [7].

The following four 2x1 spinor equations are derived by coupling the covariant Dirac equation [7] [8, p.90] to the PV state: ($x^0=ct$ and the sum is over $j=1,2,3$)

$$i\frac{e_*^2}{c}(u', v')=m_e cu' \tag{7}$$

$$-i\frac{e_*^2}{c}(v', u')=m_e cv' \tag{8}$$

and

$$i\frac{e_*^2}{c}(u'', v'')=m_p cu'' \tag{9}$$

$$-i\frac{e_*^2}{c}(v'', u'')=m_p cv'' \tag{10}$$

which, from top to bottom, describe the electron, positron, proton, and antiproton cores respectively. The us and vs are the 2x1 spinor wavefunction solutions to the equations. Furthermore, equations (7)and(9) and (8)and(10) belong in the observed and unobserved 4-dimensional spacetimes respectively [7]. The gradient operator

$$(U, V) \equiv \left(\frac{\partial U}{\partial x^0} + \sigma_j \frac{\partial V}{\partial x^j} \right) \quad (11)$$

is used for convenience. Some feeling for the equations can be found in Appendix A.

The ratio e_*^2/c is the spin coefficient, where

$$\overrightarrow{S} = \frac{e_*^2}{c} \overrightarrow{\sigma} \quad \longrightarrow \quad \frac{e_*^2}{c} \sigma_j \frac{\partial}{\partial x^j} \quad (12)$$

is the relativistic spin of the electron or proton cores. The Pauli spin vector is $\overrightarrow{\sigma}$. The second expression is the scalar-product sum of $\overrightarrow{S}$ with the gradient operator $\partial/\partial x^j$; that is, the PV gradient $\partial/\partial x^j$ in the jth direction weighted by the relativistic spin in that direction. The spin coefficient can be positive or negative (see Appendix B).

Superposition [7], i.e. adding the separate components $[e_*^2/c, u, v, m_e, m_p]$ from the electron and proton cores (7)–(10), leads to:

$$(7) \oplus (8) =$$

$$i \overbrace{\left(\frac{e_*^2}{c} - \frac{e_*^2}{c} \right)}^{0} (u' + v', v' + u') = m_e c(u' + v') = m_e c \widehat{0} \quad (13)$$

for the electron-positron, and

$$(9) \oplus (10) =$$

$$i \overbrace{\left(\frac{e_*^2}{c} - \frac{e_*^2}{c} \right)}^{0} (u'' + v'', v'' + u'') = m_p c(u'' + v'') = m_p c \widehat{0} \quad (14)$$

for the proton-antiproton, where $(u + v) = \widehat{0}$ is the 2x1 null spinor solution to (13) and (14). *Equations (13) and (14) constitute the electron and proton annihilation equations in the PV theory—reflecting the experimental fact that the core and anticore form a particle-antiparticle pair.*

A notation that is followed in all of the particle equations can be seen in equation (13): in the spin coefficient parenthesis, the first and second spins belong to the u' and v' respectively on the left of the comma in the gradient operator.

Essentially, *it is the failure to generate the 2x1 null spinor solution $\widehat{0}$ that leads to the decaying MPs in the following calculations.*

III. META-PARTICLE EQUATIONS

In searching for an equation to model the free neutron state, it seems reasonable to use the superposition idea of Section II since the neutron decays essentially into an electron and a proton core. Thus the electron-proton superposition that defines the neutron MP in the PV theory is

$$(9) \oplus (8) =$$

$$i \overbrace{\left(\frac{e_*^2}{c} - \frac{e_*^2}{c} \right)}^{0} (u'' + v', v' + u'') = m_p c u'' + m_e c v'. \quad (15)$$

The corresponding superposition for the invisible "antineutron" MP state is

$$(10) \oplus (7) =$$

$$i \overbrace{\left(-\frac{e_*^2}{c} + \frac{e_*^2}{c} \right)}^{0} (v'' + u', u' + v'') = m_p c v'' + m_e c u'. \quad (16)$$

The two simultaneous equations (15) and (16) represent the free neutron-"antineutron" meta-state.

The two terms on the right side of equations (15) and (16) cannot lead to a 2x1 null spinor because of the differing masses; so *the neutron-"antineutron" MPs do not form a particle-antiparticle pair, and so they must decay.*

IV. CONNECTIONS

The string of Compton relations in (5) shows that the electron and proton cores are very similar in nature—a fact that allows the neutron to be constructed from these cores. For example, from (5) the following relationships obtain:

$$\frac{m_p c^2}{m_e c^2} = \frac{\omega_p}{\omega_e} \equiv \frac{c/r_p}{c/r_e} \approx 1836 \quad (17)$$

where $\hbar\omega_p = m_p c^2$ and $\hbar\omega_e = m_e c^2$.

The parameter 1836 that connects the electron and proton cores in (17) has been around for a long time—it is usually thought of as the ratio of the proton mass to the electron mass. Equation (17) shows that that constant is much more than the simple mass ratio. In addition to (17), it appears that 1836

$$\frac{1836}{60} = 30.6 = 2(15.3) \quad (18)$$

may even connect the the decay rates of the MP-state and the neutron and "antineutron" MPs themselves. If 1836 is a decay time in seconds; 30.6 is the overall decay time in minutes for the MP-state followed by the MPs; where 15.3 is the decay time in minutes for the separate MPs to decay into the electron and proton cores. In other words, it takes 15.3 minutes for the coupling between equations (15) and (16) to break apart; then 15.3 additional minutes for (15) and (16) to decay into (9)and(8) and (10)and(7) respectively.

From this 1836 constant, then, the PV theory concludes that 15.3 minutes is the mean life of the neutron and "antineutron" MPs.

APPENDIX A
HARMONIC SOLUTION

Some feeling for the physics of equations (7)–(10) can be had from discarding their second coupling terms. For example, discarding the positron coupling term, the electron equation (7) leads to

$$i \frac{e_*^2}{c} \left(\frac{\partial u'}{\partial x^0} + \sigma_j \frac{\partial v'}{\partial x^j} \right) = m_e c u' \quad \longrightarrow \quad (A1)$$

$$i \frac{e_*^2}{c} \left(\frac{\partial u'}{\partial x^0} \right) = m_e c u' \quad (A2)$$

whose simple harmonic solution is

$$u' \sim \exp(-im_e c^2 x^0/e_*^2) = \exp(-ix^0/r_e)\,. \qquad \text{(A3)}$$

APPENDIX B
SPIN COEFFICIENT

The structure of the spin coefficient is given by

$$\frac{e_*^2}{c} = \left[\frac{(\pm e_*)(\pm e_*)}{c}\right] \qquad \text{(B1)}$$

where the first parenthesis contains the charge of the free core and the second parenthesis contains the charges of one of the two PV branches.

Using the above structure, the spin coefficients for the electron and positron are

$$+\frac{e_*^2}{c} = \left[\frac{(-e_*)(-e_*)}{c}\right] \quad \text{and} \quad -\frac{e_*^2}{c} = \left[\frac{(e_*)(-e_*)}{c}\right] \quad \text{(B2)}$$

positive for the electron and negative for positron. Both of these particles are coupled to the negative PV branch.

The spin coefficients for the proton and antiproton are

$$+\frac{e_*^2}{c} = \left[\frac{(e_*)(e_*)}{c}\right] \quad \text{and} \quad -\frac{e_*^2}{c} = \left[\frac{(-e_*)(e_*)}{c}\right] \quad \text{(B3)}$$

positive for the proton and negative for antiproton. Both of these particles are coupled to the positive PV branch.

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