High Energy Physics - Phenomenology

From Generalized Dirac Equations to a Candidate for Dark Energy

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We consider extensions of the Dirac equation with mass terms m1+i*gamma5*m2 and i*m_1+gamma*m2. The corresponding Hamiltonians are Hermitian and pseudo-Hermitian ("gamma5 Hermitian"), respectively. The fundamental spinor solutions for all generalized Dirac equations are found in the helicity basis and brought into concise analytic form. We postulate that the time-ordered product of field operators should yield the Feynman propagator (i*epsilon prescription), and we also postulate that the tardyonic as well as tachyonic Dirac equations should have a smooth massless limit. These postulates lead to sum rules that connect the form of the fundamental field anticommutators with the tensor sums of the fundamental plane-wave eigenspinors and the projectors over positive-energy and negative-energy states. In the massless case, the sum rules are fulfilled by two egregiously simple, distinguished functional forms. The first sum rule remains valid in the case of a tardyonic theory and leads to the canonical massive Dirac field. The second sum rule is valid for a tachyonic mass term and leads to a natural suppression of the right-handed helicity states for tachyonic particles, and left-handed helicity states for tachyonic spin-1/2 antiparticles. When applied to neutrinos, the theory contains a free tachyonic mass parameter. Tachyons are known to be repulsed by gravity. We discuss a possible role of a tachyonic neutrino as a contribution to the accelerated expansion of the Universe ("dark energy").

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