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Generalized equations in the (S,0)+(0,S) representations of the Lorentz group

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I present several explicit examples of generalizations in relativistic quantum mechanics which may be used in astrophysics and cosmology.

First of all, I discuss the generalized spin-1/2 equations for neutrinos. They have been obtained by means of the Gersten-Sakurai method for derivations of arbitrary-spin relativistic equations. Possible physical consequences are discussed. Particularly, we look for relations between the corresponding solutions and dark 4-spinorsin the Ahluwalia-Grumiller elko model. They are also not the eigenstates of the helicity. They may also be applied to the known helicity flip of neutrinos in stars.

Next, it is easy to check that both Dirac algebraic equation $\det(\hat{p}-m)=0$ and $\det(\hat{p}+m)=0$ for $u-$ and $v-$ 4-spinors have solutions with $p_0=\pm E_p=\pm\sqrt{\mathbf{p}^2+m^2}$. The same is true for higher-spin equations. Meanwhile, every book considers the equality $p_0=E_p$ for both $u-$ and $v-$ spinors of the $(1/2,0)\oplus(0,1/2))$ representation only, thus applying the Dirac-Feynman-Stueckelberg procedure for elimination of the negative-energy solutions. The recent Ziino works (and, independently, the articles of several others) show that the Fock space can be doubled. We reconsider this possibility on the quantum field level for both $S=1/2$ and higher spin particles.

The third example is: we postulate the non-commutativity of 4-momenta, and we derive the mass splitting in the Dirac equation. The applications are discussed.

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