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The PMNS matrix in the minimal 3-3-1 Model

The so called 3-3-1 models, with gauge symmetry SU(3)c X SU(3)L X U(1)x, are interesting extensions of the standard model (SM). The main feature of these models is that, by choosing appropriately the representation content, the triangle anomalies cancel out and the number of families has to be a multiple of three, moreover because of the asymptotic freedom this number is just three. In particular, the minimal version of this class of models (m3-3-1 for short) has other interesting predictions: it explains why sin2(w)< 1/4 is observed and at the same time, when sin2(w) =1/4 it implies the existence of a Landau-like pole at energies of the order of few TeVs; the existence of this Landau-like pole also stabilizes the electroweak scale avoiding the hierarchy problem; the model allows the quantization of electric charge independently of the nature of the massive neutrinos. One important feature, that distinguishes the model from any other one, is the prediction of extra singly charged and doubly charged gauge boson bileptons and also exotic charged quarks, while the lepton sector is the same as that of the SM. Right-handed neutrinos are optional in the model. They are not needed neither to generate light active neutrinos nor the Pontecorvo-Maki-Nakagawa-Sakata (PMNS) mixing matrix. Those exotic charged particles may have effect on the two photon decay of the SM-like Higgs scalar.

The three lepton generations trasnform under the 3-3-1 symmetry as a = (a la lac)LT ~ (1, 3,0), and we do not introduce right-handed neutrinos. The yukawa interactions in the Lepton sector have two main yukawa matrices: one antisymmetric ando one symmetric, and couples to the same field , which couples to quarks and couples also with a sextet S, S ~ (1, 6, 0) which does not couple to quarks. Under SU(2)L X U(1)y the sextet transforms as S = 1+2+3 and we see that there is a doublet and a triplet wich gives mass to charged leptons and active left-handed neutrinos, respectively. However, although the sextet is enough to give Majorana to the neutrinos and Dirac mass to the charged leptons, it does not give the PMNS mixing matrix (VPMNS = ULł U), since when only the sextet is the sorce of the lepton mass we have that UL = U, once the interactions with the triplet is mandatory, and this is fixed by the quaks mass and mixing.

Therefore, if this is the only way to obtain the leptons mass and mixing in the minimal 3-3-1 model, we've excluded the model, But we are able to prove that is possible adjust the lepton mixing and mass if a dimension five operator allowed by symmetry and matter content is taken into consideration, this operator ensures that the 331 model is not excluded by the data and can even lead to new interactions.

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