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Neutrino masses in a multi-Higgs model with A_4 symmetry

Presently we know that neutrino oscillation data are well described by massive neutrinos which makes the flavor problem still more interesting: why is there a mixing angle hierarchy in the quark sector but not in the lepton sector? In an attempt to answer this and others open questions we propose a multi-Higgs extension of the standard model with Abelian and non-Abelian discrete symmetries. In this model the fermionic degrees of freedom (plus right-handed neutrinos) of the standard model gauge symmetry also transform non-trivially under the discrete symmetries $A_4 \otimes Z_3 \otimes Z_3' \otimes Z_3''$. The flavor problem is be solved since due to discrete symmetries each charge sector has its own Higgs scalars and the mass matrix entries depend mainly on VEVs. In this situation the VEVs related to the neutrino masses are small, in the range of keV-MeVs, and it would imply the existence of light scalars or pseudoscalar that may be in trouble with experimental and theoretical results. In order to avoid this and also problems with flavor changing neutral currents in the quark sector, we allow the soft breakdown of the A_4 symmetry with diagonal and non-diagonal μ^2-terms. Although the model has many scalar doublets, triplets and singlets, we analyzed the scalar potential with three doublets, having all of them small VEVs, and we show in which conditions all scalars are massive enough to be in agreement with the experimental and theoretical point of views.

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