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Fermion Masses and Mixings and Dark Matter Constraints in a Model with Radiative Seesaw Mechanism

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We formulate a predictive model of fermion masses and mixing based on a $\Delta(27)$ family symmetry. In the quark sector the model leads to the viable mixing inspired texture where the Cabibbo angle comes from the down quark sector and the other angles come from the up quark sector. In the lepton sector the model generates a predictive structure for charged leptons and, after radiative seesaw, an effective neutrino mass matrix with only one real and one complex parameter.
We carry out a detailed analysis of the predictions in the lepton sector, where the model is only viable for inverted neutrino mass hierarchy, predicting a strict correlation between θ_{23} and θ_{13}. We show a benchmark point that leads to the best-fit values of θ_{12}, θ_{13}, predicting a specific $\sin^2\theta_{23} \simeq 0.51$ (within the 3σ range), a leptonic CP-violating Dirac phase $\delta \simeq 281.6^\circ$ and for neutrinoless double-beta decay $m_{ee} \simeq 41.3$ meV.
We turn then to an analysis of the dark matter candidates in the model, which are stabilized by an unbroken $\mathbb{Z}_2$ symmetry. We discuss the possibility of scalar dark matter, which can generate the observed abundance through the Higgs portal by the standard WIMP mechanism. An interesting possibility arises if the lightest heavy Majorana neutrino is the lightest $\mathbb{Z}_2$-odd particle. The model can produce a viable fermionic dark matter candidate, but only as a feebly interacting massive particle (FIMP), with the smallness of the coupling to the visible sector protected by a symmetry and directly related to the smallness of the light neutrino masses.

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