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A Hybrid Radiative-Seesaw Model for Neutrino Masses and Dark Matter

We study an extension of the Standard Model consisting of an inert Higgs doublet and three sterile right-handed neutrinos. In contrast to Ma's scotogenic model, the imposed Z_2 symmetry is assigned only to the inert scalar doublet and one of the right-handed neutrinos, while the remaining two neutrinos are Z_2-even. As a result, the light neutrino masses receive two distinct contributions: a purely radiative one involving only the Z_2-odd heavy neutrino, without mixing effects, and a second contribution arising from the mixing of the two Z_2-even heavy neutrinos through a seesaw-like mechanism. Depending on the region of parameter space, either the Z_2-odd heavy neutrino or one of the inert scalar states can provide a viable dark matter candidate. We investigate the generation of neutrino masses, the dark matter phenomenology, and the radiative effects of the new particles on Standard Model processes, taking into account relic density requirements as well as constraints from direct and indirect dark matter detection experiments.

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