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Neutrino masses and mixed dark matter from doublet and singlet scalars

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We consider the extension of the Standard Model with an inert scalar doublet, three right-handed neutrinos, and singlet scalar fields, φ and S. In this model, neutrino masses are zero in the limit of the unbroken Z_4 discrete symmetry. We show that when the singlet scalar field φ gets a VEV, the Z_4 symmetry is broken to Z_2, and neutrino masses are generated at one-loops due to the mixings between the neutral components of the inert scalar doublet and the singlet scalar field S. There is a dark matter candidate from the lightest neutral scalar field, which is a mixture of the inert scalar doublet and the singlet scalar field S, in general. The Z_4 breaking mass terms are constrained by electroweak precision data and direct detection (DD) bounds for dark matter, favoring small mixings or almost degenerate masses for the DM scalars. As a result, we discuss the implications of the results for small neutrino masses and DD-safe dark matter.

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