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A two-Higgs doublet solution to the LSND, MiniBooNE and muon $g-2$ anomalies

We show that one of the simplest extensions of the Standard Model, the addition of a second Higgs doublet, when combined with a dark sector singlet scalar, allows us to: $i)$ explain the long-standing anomalies in the Liquid Scintillator Neutrino Detector (LSND) and MiniBooNE (MB) while maintaining compatibility with the null result from KARMEN, $ii)$ obtain, in the process, a portal to the dark sector, and $iii)$ comfortably account for the observed value of the muon $g-2$. Three singlet neutrinos allow for an understanding of observed neutrino mass-squared differences via a Type I seesaw, with two of the lighter states participating in the interaction in both LSND and MB. We obtain very good fits to energy and angular distributions in both experiments. We explain features of the solution presented here and discuss the constraints that our model must satisfy. We also mention prospects for future tests of its particle content.

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