

The Standard Model of particle physics with Diracian neutrino sector

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The minimally extended standard model contains three right handed or sterile neutrinos, coupled to the active ones by a Dirac mass matrix and mutually by a right-handed Majorana mass matrix. In the pseudo-Dirac case, the Majorana masses are small and maximal mixing of active and sterile states occurs, which is generally excluded by solar neutrinos.

We introduce a “Diracian” limit wherein the 6 physical masses become pairwise degenerate and the neutrinos attain a Dirac signature. Within each pair the maximal mixing then does not lead to oscillation and can be circumvented. Since 2 Majorana phases become physical Dirac phases and 3 extra Majorana masses occur, a better description of data is possible. The standard neutrino model is recovered in the limit of vanishing Majorana masses.

Oscillation problems are worked out in vacuum and in matter, as are pion, neutron and muon decay. The model exhibits a very weak rate of neutrinoless double beta decay. It naturally allows the large mixing angles that explain the 2 ultra high energy upward EeV events detected by ANITA in terms of Earth traversing mostly-sterile neutrinos.

- [1] T. M. Nieuwenhuizen, The Standard Model of particle physics with Diracian neutrino sector, arXiv:1810.04613.