

SNOWMASS2021 Letter of Interest

Search for Muon Neutrino Magnetic Moment at Future High Intensity Muon Neutrino Beam Experiments

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Extensions to the Standard Model predict neutrino magnetic moments[1-3], regardless of whether neutrinos are Dirac or Majorana particles. Future Fermilab experiments such as ICARUS, SBND and DUNE (“near detector”) will be exposed to intense ν_μ beams that present an excellent venue to search for a muon neutron magnetic moment by comparing the observed rate of electron shower events with that predicted by the clean theoretical process of Standard Model (SM) weak elastic $\nu_\mu - e$ scattering. A neutrino magnetic moment enhances the electron scattering rate[4] over the SM weak process at low electron shower energies ($\mathcal{O}(10 - 100)$ MeV) and at far forward angles. The above experiments are all based on liquid argon time projection chambers that characteristically have excellent spatial and energy resolution, as well as very good particle identification. Since these experiments are designed to measure ν_e appearance in a ν_μ beam, searching for a low energy excess in electron shower events at far forward angles is well aligned to their experimental program. Such an unambiguous excess could be interpreted, for example, as evidence[3] for the Majorana nature of the neutrino.

References

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