

A search for Majoranality of neutrinos in muon decay using a positron polarimeter

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It is an unsolved problem of prime importance whether the neutrinos are Dirac or Majorana particles. The Majoranality of neutrinos is predicted in the presence of V+A interactions. It appears as a time-reversal (T) symmetry breaking term in the general form of the differential decay rate of muons [1]. Positrons from muon decays are mostly polarized in the longitudinal direction. However, the T-violating term results in the transverse polarization of the positron which is perpendicular to both the muon spin and the positron momentum. It gives a clear evidence of the Majoranality of neutrinos without contributions of the standard model background. The polarization of positrons can be analyzed via the spin dependence of the annihilation-in-flight with electrons [2]. Towards a search for the T-violating effect, we propose a new experiment to measure the decay positron's polarization with a magnetized foil, a segmented calorimeter, and high-intensity pulsed muon beam at J-PARC. A positron polarimeter for the experiment is designed using GEANT4-based Monte-Carlo simulation. In this presentation, a measurement method and details of the polarimeter will be discussed.

[1] M. Doi, T. Kotani, H. Nishiura, K. Okuda, and E. Takasugi, Progress of Theoretical Physics 67, 281 (1982).

[2] N. Danneberg et al., Phys. Rev. Lett. 94, 021802 (2005).

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