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Collimated muon beam proposal for probing neutrino charge-parity violation

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The phenomenon of neutrino oscillation is of great theoretical and experimental interest for our understand of the nature of the neutrino and its implication for physics beyond the standard Model. Currently available neutrino oscillation experiments can already constrain neutrino mixing parameters with a confidence level up to 3 standard deviations (σ). However, it remains challenging to provide a deterministic constraint on the Charge-Parity (CP) violation phase of the neutrino mixing matrix. Here, we propose an experimental setup that exploits collimated muon beams to probe neutrino CP-violation. In our proposed acceleration experiment, a 45 GeV positron source with additional muon collimation, interfaces with near-future neutrino detectors like DUNE and T2K, to probe neutrino CP-violation phase with a significantly higher sensitivity than obtained with the neutrino detectors alone, and to determine tau neutrino properties. Simulations estimate the collection of 10 4 tau (anti-) neutrino in 5 years, and a sensitivity of over 7 standard deviations for $\delta_{CP} = |\pi/2|$ in 5 years. Collecting ν_τ appearance events from μ^- and μ^+ beams over 10 years can attain a 3-4 standard deviation sensitivity. This proposal may serve as a tau factory.

Working Group

WG 1: Neutrino Oscillation Physics

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