

Physics opportunities with kaon decay-at-rest neutrinos: search for sterile neutrino and non-standard interactions

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The decay-at-rest of charged kaons produces monoenergetic muon neutrinos with an energy of 236 MeV. The study of these neutrinos at short baselines allows us to constrain new neutrino interactions. In this work, we study kaon decay-at-rest (KDAR) neutrinos at the JSNS experiment where the J-PARC Spallation Neutron Source (JSNS) will produce such types of neutrinos with decay-at-rest processes of pions, muons, and kaons. We use KDAR neutrino data from the experiment to probe the non-standard interactions of leptons with strange particles and demonstrate for the first time that JSNS can put very stringent bounds on the source NSI parameter $\epsilon_{\mu e}^s$; i.e. $|\epsilon_{\mu e}^s| < 0.03$ (0.005) at 99% C.L. with current (future) statistics. We also explore the reach of the JSNS experiment to constrain the sterile neutrino parameters using KDAR neutrinos and compare our results with the other oscillation experiments. We find that the constraint on active sterile mixing can be as small as $|U_{\mu 4}|^2 \sim 10^{-3}$ for $\Delta m_{41}^2 > 2 \text{ eV}^2$.

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