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Direct Experimental Constraints on the Spatial Extent of a Neutrino Wavepacket from Measurements of 7Be Electron Captures with the BeEST Experiment

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The spatial width of neutrino wave packets produced by radioactive sources is a debated topic. It has been shown that a sufficiently small neutrino width would have detectable effects for Standard Model neutrinos in JUNO and improve eV-scale sterile neutrino model fits to current data. Predictions for the neutrino width from radioactive sources vary by several orders of magnitude, depending on the underlying assumptions about the scale of parent localization. The experimental limits extracted from reactor neutrino oscillation data are too broad to exclude any models. The BeEST experiment extracts properties of neutrinos via energy measurements of entangled 7Li recoil nuclei from the electron capture decay of 7Be implanted into superconducting sensors. The high resolution of the BeEST recoil spectrum and quantum uncertainty principles are used to set limits on the scale of parent localization and the spatial width of the electron-neutrino wave packets. Assuming the spatial widths are a similar order of magnitude for anti-electron-neutrinos produced in reactor sources, our extracted number from the BeEST experiment excludes the possibility of detecting decoherence effects due to wave packet separation.

Poster prize

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