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Standard Model Tests with Coherent Neutrino Scattering

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Neutrinos with sufficiently low energy (E < 50 MeV) have a wavelength that is larger than its scattering target nuclei, and the neutrino can engage in pure coherent elastic neutrino-nucleus scattering with very low neutral current momentum transfer. At these energies, the coherent scattering cross section dominates, but because it deposits very little energy, low detection thresholds (˜10 keV) are required for observation. Recent progress in direct WIMP dark matter searches has led to detector technologies that are capable of a first direct measurement with accelerator and reactor neutrino sources. Future, precision, coherent neutrino scattering measurements are important in the understanding of supernovae dynamics and detection, as a probe of weak nuclear form factors at low Q^2, measuring the weak mixing angle, and searching for non-standard interactions and neutrino magnetic moments. Furthermore, coherent scattering of atmospheric and solar neutrinos will be an irreducible background for direct WIMP dark matter searches with 10-ton scale detectors. The list of candidate detector technologies to search for coherent neutrino scattering is nearly as diverse as that used to directly search for WIMP dark matter, because their detection signal is very similar. Ambient neutron backgrounds and those correlated with the neutrino source are considered to be the most difficult impediments to a first coherent scattering measurement. Minimizing the correlated neutron flux drives the shielding and source selection requirements for these measurements. In this talk, I will give a broad overview of the unique physics that is accessible with coherent neutrino scattering, review the most prominent detector technologies being developed, and discuss ongoing efforts to measure neutron backgrounds at low-energy neutrino sources.

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