

Neutrino–Nucleus Interactions from Reactors to the Cosmos: Precision Measurements and New Physics Opportunities

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Understanding neutrino–nucleus cross sections has become central to modern neutrino physics, providing a powerful means to probe fundamental neutrino properties and to search for physics beyond the Standard Model. At MeV energies, the observation of coherent elastic neutrino–nucleus scattering (CEvNS) from a variety of sources has opened new opportunities to test light mediators and non standard interactions, while exploring neutrino cross sections at higher energies offers the possibility of identifying new neutrino sources. In this talk, I will show how precise cross section measurements across these regimes advance three interconnected goals: determining intrinsic neutrino properties, enabling searches for new physics, and identifying or characterizing new neutrino sources, including astrophysical ones. Leveraging the capabilities of current and upcoming detectors, I will discuss how sources such as reactor antineutrinos and the Diffuse Supernova Neutrino Background (DSNB) can contribute to this broader program, and how accurate modeling of neutrino cross sections is essential to fully unlock the scientific potential of low energy neutrino measurements.