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The ν-cleus experiment: Gram-scale cryogenic calorimeters for a discovery of coherent neutrino scattering

We investigate new gram-scale cryogenic detectors, 1-2 orders of magnitude smaller in size than previous devices. These are expected to reach unprecedentedly low energy thresholds, in the 10 eV-regime and below. This technology allows new approaches in rare-event searches, including the search for MeV-scale dark matter, detection of solar neutrinos and a rapid discovery of coherent neutrino-nucleus scattering (CNNS) at a nuclear reactor.

We show a simple scaling law for the performance of cryogenic calorimeters, allowing the extrapolation of existing device performances to smaller sizes. Measurement results with a 0.5 g sapphire detector are presented. This prototype reached a threshold of 20 eV, which is one order of magnitude lower than previous results with massive calorimeters.

We discuss an experiment, called ν-cleus, which enables a 5-σ discovery of CNNS within about 2 weeks of measuring time at 40 m distance from a power reactor. In a second stage, this experiment enables precision measurements of the CNNS cross-section and spectral shape for new physics beyond the Standard Model.

Primary authors: STRAUSS, Raimund; OBERAUER, Lothar (TUM); SCHOENERT, Stefan; SCHIECK, Jochen (Austrian Academy of Sciences (AT)); ROTHE, Johannes (Max-Planck-Institut für Physik, Munich)

Presenter: STRAUSS, Raimund

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