Contribution ID: **10** Type: **Talk**

Detecting SN neutrinos with RES-NOVA archaeological Pb cryogenic detectors

The RES-NOVA project will hunt neutrinos from core-collapse supernovae (SN) via coherent elastic neutrino-nucleus scattering (CEνNS) using an array of archaeological lead (Pb) based cryogenic detectors. The high CEνNS cross-section on Pb and the ultra-high radiopurity of archaeological Pb enable the operation of a high statistics experiment equally sensitive to all neutrino flavors with reduced detector dimensions in comparison to existing neutrino observatories. The first phase of the RES-NOVA project is planned to operate a detector with a volume of $(60\ \mathrm{cm})^3$. It will be sensitive to SN bursts from the entire Milky Way Galaxy with >3σ sensitivity while running $PbWO_4$ detectors with 1 keV energy threshold. RES-NOVA will discriminate core-collapse SNe from black-holes forming collapses with no ambiguity even with such small volume detector. The main SN parameters can potentially be constrained with a precision of few % while looking at $\nu_{\mu/\tau}/\overline{\nu}_{\mu/\tau}$. We will present the performance of the first prototype detectors, and sensitivity projections for the full detector. We will demonstrate that RES-NOVA has the potential to lay the foundations for a new generation of neutrino observatories, while relying on a very simple and modular experimental setup.

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Session Classification: Experiments