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# Executive Summary: ICRC2021 NU ID#248

## EAS optical Cherenkov signatures of tau neutrinos for space and suborbital detectors

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- Multi-messenger observations of transient astrophysical sources have the potential to characterize the highest energy accelerators and the most extreme environments in the Universe. Neutrino oscillations over cosmic distances mean $\nu_\tau + \bar{\nu}_\tau$ are messengers.
- The second-generation Extreme Universe Space Observatory on a Super-Pressure Balloon (EUSO-SPB2) balloon-borne mission and the proposed space-based Probe of Extreme Multi-Messenger Astrophysics (POEMMA) mission aim to detect optical Cherenkov signals from up-going extensive air showers from tau decays that originate from tau neutrinos with $E_\nu > 10$ PeV that skim the Earth and interact.
- At an altitude of 525 km and over 5 years, POEMMA has a ~100-fold advantage in projected sensitivity to the diffuse astrophysical neutrino flux over EUSO-SPB2, which will be at 33 km for as long as 100 days. A 360° azimuthal coverage for POEMMA would be required for diffuse neutrino flux sensitivities comparable to planned ground-based instruments.
- For transient neutrino sources (targets of opportunity or ToO), POEMMA and EUSO-SPB2 have more comparable sensitivities to the neutrino fluence (see figure), especially for short neutrino bursts of t=$10^3$ s. Sources in nearby galaxies will be accessible. POEMMA overall has better sensitivities and for longer bursts, full sky coverage.
- Improved up-going extensive air shower modeling yields better projected high energy flux sensitivities.
- Uncertainties include modeling of the energy loss of taus in the Earth.

Figure1: Long (left) and short (right) burst all-flavor neutrino fluence sensitivities for POEMMA (blue) and EUSO-SPB2 (violet) assuming instruments can slew over 360° in azimuth.