Contribution ID: **149** Type: **Talk-To-Poster**

Modeling Neutrino and Background Signals for the Payload for Ultrahigh Energy Observations (PUEO) Experiment

In the current age of multimessenger astronomy, Very High Energy (VHE) cosmic neutrinos (E>1PeV) represent a unique observation window into the most extreme astrophysical events in the universe. Measurements of the neutrino flux in this high energy regime provide information regarding the distribution and composition of Ultra-High Energy Cosmic Rays (UHECR), details of source acceleration mechanics, and definitive tests of physics beyond the standard model. Observations in multiple different detection channels (e.g. optical, radio, direct particle counting) are being explored to extend the sensitivity to neutrinos above PeV energies.

The Payload for Ultrahigh Energy Observations (PUEO) is a long duration balloon experiment that builds on the successes of the Antarctic Impulsive Transient Antenna (ANITA) experiment to probe the cosmic neutrino flux above EeV energies. PUEO, like ANITA, seeks to measure coherent radio emission in the form of Askaryan emission from in-ice neutrino interactions and both geomagnetic and Askaryan emission from Extensive Air Showers (EAS) produced by the decays of Earth-emergent τ-leptons sourced from τ neutrinos.

To evaluate the sensitivity of PUEO (and other detectors) to a given flux of neutrinos, it is necessary to accurately model i) the propagation of neutrinos through the Earth ii) the emission generated from the neutrino-sourced particle shower iii) the detector performance to a generated signal and iv) relevant backgrounds. Numerous software frameworks exist to model these different mechanisms independently, but can often require significant work to use together.

nuSpaceSim is an open source, end-to-end neutrino simulation package that models these described mechanisms for an arbitrary detector geometry in both the optical and radio emission channels. For a given experimental design, nuSpaceSim is designed to model the sensitivity to both the cosmogenic neutrino flux and to astrophysical neutrino transient events. The highly modular design of nuSpaceSim allows for comparison and exploration of different physics models within the same code base.

In this contribution, we detail the state of the nuSpaceSim code as it pertains to modeling the sensitivity of the PUEO experiment, and highlight the mechanisms necessary to perform this calculation. We also describe the near-term improvements to the radio emission calculation in nuSpaceSim and the modeling of the most relevant backgrounds for PUEO: the direct (above-the-limb) cosmic rays, and the indirect (ice-reflected) cosmic ray signals.

Primary author: CUMMINGS, Austin (Pennsylvania State University)

Co-authors: KRIZMANIC, John (NASA/GSFC); WISSEL, Stephanie (Pennsylvania State University)

Presenter: CUMMINGS, Austin (Pennsylvania State University)