Contribution ID: **479** Type: **Poster**

Seasonal variation of in-ice radio emission from neutrinos due to fluctuating ice density

Tuesday, 18 June 2024 17:30 (2 hours)

Multiple experiments are utilizing the polar icecaps to detect ultra-high energy neutrinos via radio emission. They employ antennas embedded to depths of up to 200 metres. This places them within the firn layer, where the density and hence refractive index increase with depth. Glaciological models demonstrate that the firn density varies with time over a seasonal timescale. The resulting variable refractive index will transform the properties of in-ice radio signals, resulting in a systematic uncertainty in the reconstruction of the neutrino energy and arrival direction. An effort to quantify these uncertainties is underway by simulating radio propagation for a range of source and receiver positions at Summit station, Greenland, with the refractive index based on ice core measurements and glaciological modeling. Our first observation is that the amplitude and arrival time of the secondary or 'refracted' signal is generally variable, including for deep neutrino interaction depths on the order of the radio attenuation length.

Poster prize

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Session Classification: Poster session and reception 1

Track Classification: Astrophysical neutrinos