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In-situ Measurements of Ice Properties for the Radar Echo Telescope for Cosmic Rays

The upper 20 meters of the polar ice sheets exhibit significant density inhomogeneity, causing significant fluctuations in the in-ice signal amplitude as a function of depth. Understanding these effects is crucial for radio-based ultra-high-energy neutrino searches using ice as a detection medium. We present in-situ measurements of density (ρ) and refractive index (n) in the upper 13 meters of ice at the Radar Echo Telescope for Cosmic Rays (RET-CR) site near Summit Station on the Greenland ice sheet, taken during the summer of 2024. The resulting $n(z)$ profiles were broadly consistent with previous measurements at Summit, but revealed complex layering near the surface. Additionally, a frequency-modulated continuous-wave signal was broadcast from an in-ice transmitter and measured at various depths inside a borehole. These signals were compared with simulations based on finite-difference time-domain methods utilizing ice models derived from the in-situ $n(z)$ measurements.

Collaboration(s)

Radar Echo Telescope

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