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Do cosmic rays produce in-ice Askaryan radiation? A study with the Askaryan Radio Array

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Radio detection is the most promising experimental strategy to study the extremely low flux of EeV-scale neutrinos from the cosmos. Neutrinos interacting in the polar ice sheets produce electromagnetic radiation through the Askaryan mechanism, which is detectable at long distances by radio antenna arrays embedded in the ice. While Askaryan radio emission from neutrinos has yet to be observed, cosmic rays provide an opportunity to understand the characteristics of this emission in nature.

In this contribution, we use data from the Askaryan Radio Array (ARA) to present a detailed experimental study targeting radio emission from high-energy particle cascades in glacial ice. We analyze events consistent with near-vertical cosmic-ray air showers impacting the ice near the detector, which would typically be considered a background in neutrino searches. Our analysis determines polarization, frequency content, and signal shape of the observed candidate events and performs comparisons with ab-initio simulations of in-ice radiation from a dense shower core. If confirmed, these findings would provide direct experimental validation of the Askaryan emission mechanism central to ARA and other radio neutrino observatories.

Collaboration(s)

ARA

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