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Radio Arrays for Detecting Ultra-high Energy Cosmic Neutrinos

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Ultra-high energy (UHE, >10^18 eV) cosmic neutrinos are anticipated to reveal the most distant, most obscured, and highest energy particle accelerators in the Universe. An almost guaranteed flux of UHE neutrinos is predicted from the interactions of UHE cosmic rays with the cosmic microwave background, and additional contributions may arise from prompt emission at individual sources. The spectrum of UHE neutrinos is a sensitive discriminator of the cosmological evolution of UHE sources, as well as the composition of UHE cosmic rays. At the same time, UHE neutrinos will enable several tests of fundamental physics, including constraints on the neutrino-nucleon interaction cross section at center-of-momentum energies ~100 TeV, and searches for Lorentz invariance violation.

Theoretical predictions and subsequent laboratory measurements of coherent radio emission from showers initiated by neutrino interactions in dielectric media (e.g., ice, sand, salt, lunar regolith) have motivated diverse experimental approaches involving “detectors” comprised of up to millions of cubic kilometers of natural materials. I will review experimental progress in the search for UHE cosmic neutrinos with an emphasis on experiments using polar ice as the detection medium (e.g., ANITA, EVA, ARA, ARIANNA, and GNO) and the complementarity of these radio arrays with IceCube.

Summary

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