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Phased Radio Arrays for Ultra-high Energy Neutrino Detectors

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The detection of ultra-high energy neutrinos is an important step towards understanding the most energetic cosmic accelerators and would enable tests of fundamental physics at energy scales that cannot be easily achieved on the Earth. Radio detector arrays such as ANITA, ARA, and ARIANNA exploit the Askaryan effect and the radio-transparency of glacial ice, which together enable hundred-cubic-kilometer volumes of ice to be monitored with sparse instrumentation. Thus far, the global trigger thresholds of these experiments have been governed by the rate of coincidences occurring between single-antenna triggers due to thermal noise. One possibility to enhance the sensitivity of in-situ radio detector stations is to correlate the analog signals from individual antennas in hardware prior to the trigger decision. We have simulated the response of such phased arrays in a variety of configurations and find that the reduced trigger threshold would (1) increase event rates of cosmogenic neutrinos and (2) could lower the energy threshold to the PeV scale to provide meaningful overlap with optical-Cherenkov neutrino detectors. A prototype phased array will be deployed in summer 2015 to test the practical implementation of this concept as part of the Greenland Neutrino Observatory (GNO).

Collaboration

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Primary author: BECHTOL, Keith

Co-authors: VIEREGG, Abigail (University of Chicago); ROMERO-WOLF, Andrew (Jet Propulsion Laboratory, California Institute of Techology); WISSEL, Stephanie (UCLA)

Presenter: BECHTOL, Keith

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