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Simulation Study of the Observed Radio Emission of Air Showers by the IceTop Surface Extension

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Multi-detector observations of individual air showers are critical to make significant progress to precisely determine cosmic-ray quantities such as mass and energy of individual events and thus bring us a step forward in answering the open questions in cosmic-ray physics. An enhancement of IceTop, the surface array of the IceCube Neutrino Observatory, is currently underway and includes adding antennas and scintillators to the existing array of ice-Cherenkov tanks. The radio component will improve the characterization of the primary particles by providing an estimation of Xmax and a direct sampling of the electromagnetic cascade, both important for per-event mass classification. A prototype station has been operated at the South Pole and has observed showers, simultaneously, with the three detectors types. The observed radio signals of these events are unique as they are measured in the 100-350 MHz band, higher than many other cosmic-ray experiments. We present a comparison of the detected events with the waveforms from CoREAS simulations, convoluted with the end-to-end electronics response, as a verification of the analysis chain. Using the detector response and the measurements of the prototype station as input, we update a Monte-Carlo-based study on the potential of the enhanced surface array for the hybrid detection of air showers by scintillators and radio antennas.

Keywords

IceCube; IceTop; Radio;

Collaboration

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Subcategory

Experimental Results

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