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Study of mass composition of cosmic rays with IceTop and IceCube

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The IceCube Neutrino Observatory is a multi-component detector at the South Pole which detects high-energy particles emerging from astrophysical events. These particles provide us with insights into the fundamental properties and behaviour of their sources. Besides its principal usage and merits in neutrino astronomy, using IceCube in conjunction with its surface array, IceTop, also makes it a unique three-dimensional cosmic-ray detector. This distinctive feature helps facilitate detailed cosmic-ray analysis in the transition region from galactic to extragalactic sources. We will present the progress made on multiple fronts to establish a framework for mass-estimation of primary cosmic rays. The first technique uses advanced methods in Graph Neural Networks to use the full in-ice shower footprint, in addition to global shower-footprint features from IceTop. The second technique relies on a likelihood-based analysis of the surface signal distribution and improves upon the standard reconstruction technique. A comparison between the two methods for composition analysis as well as a possible extension of the analysis techniques for sub-PeV cosmic-ray air-showers will also be discussed.

Keywords

Cosmic Rays; Cosmic Ray Composition; Deep Learning; Graph Neural Network; Machine Learning; IceCube Observatory;

Collaboration

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other Collaboration

Subcategory

Experimental Results

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