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**Machine Learning in Cosmic Ray Reconstruction with IceCube**[1]
ROY WOOD, FRANK MCNALLY, TYLER SLEDGE, Mercer Univ, ICECUBE COLLABORATION — Deep neural networks can display increased performance when trained on low-level data, as opposed to high-level physics parameters. We present a test of the effectiveness of this approach as applied to cosmic ray reconstruction. IceTop, the surface component of the IceCube Neutrino Observatory, consists of 81 stations that detect air showers produced by cosmic ray interactions with the atmosphere. An accurate energy estimator for IceTop is essential for studying the nature of the cosmic ray spectrum around the knee (300 TeV - 1 EeV). Using over 400,000 simulated events, an array of convolutional deep neural networks (CNNs) was trained to reconstruct the energy of a cosmic ray primary based on the charges and arrival times detected at the surface. Preliminary results show that these CNN models can deliver an energy resolution better than 10%. This result is consistent with independent energy reconstructions used by IceCube, and indicates the promise of a deep-learning approach.

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