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Particle identification in high-granularity 3D calorimeters for space-borne applications

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High granularity 3D calorimeters offer the potential to precisely reconstruct the 3D topology of electromagnetic and hadronic showers originating from isotropic sources. This distinctive capability creates the opportunity for applying reconstruction and analysis methods that could yield additional information compared to those based on the traditional layer-by-layer energy deposit analysis common in particle and astroparticle physics experiments utilizing calorimeters with layer segmentation.

In this study, we present a strategy for analyzing the energy deposit in a crystal array calorimeter, utilizing the three-dimensional parametrization of both longitudinal and transversal shapes of showers to implement likelihood tests on single events. This test has the potential to serve as a robust tool for discriminating signals from electrons and positrons against those from hadronic particles—an essential feature expected by calorimeters in cosmic-ray measurements in space. Prospects for employment of artificial intelligence algorithm for the analysis of the shower footprint image in the crystal array will also be presented.

While this analysis was specifically developed using the High Energy cosmic Radiation Detector (HERD) calorimeter as a case study, its applicability may extend to any high granularity, homogeneous, isotropic calorimeter employed in particle physics experiments.

Collaboration

HERD

Role of Submitter

I am the presenter

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