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Characterisation of backscattering effects in CALET due to hadronic showers generated in the calorimeter

The Calorimetric Electron Telescope (CALET) on board the International Space Station (ISS) is a space-based instrument consisting of a CHarge Detector (CHD) made of plastic scintillators, a thin (3 radiation lengths, X0) tungsten-scintillating fibre IMaging Calorimeter (IMC) for accurate particle tracking and identification, and a thick (27 X0, 1.3 nuclear interaction length) Total AbSorption Calorimeter (TASC) consisting of PWO crystal logs.
Hadronic showers generated by cosmic-ray (CR) nuclei interacting in the TASC produce a large number of secondary particles that propagate backwards to the IMC and CHD. These backscattered particles are particularly dangerous because the resulting high multiplicity of hits in the detectors can lead to systematic errors in both the charge measurement and the reconstruction of the arrival direction of the primary CR.
In this paper, we present a characterisation of the backscattering effect by comparing flight data collected during over 9 years of CALET operation with simulations. By exploiting the fine granularity of the IMC, it is possible to study the multiplicity of hits, the deposited energy distributions and the lateral profiles of backscattered particles as a function of the energy deposited in the TASC by different nuclear species. This information can be used to refine Monte Carlo simulations to correctly reproduce the backscatter effect, and to improve the design of detectors for the next generation of CR space missions in order to reduce the impact of backscatter on their performance.

Collaboration(s)

CALET

Author: FORESI, Andrea (Universita Siena & INFN Pisa (IT))

Co-author: Prof. MAESTRO, Paolo (Universita degli studi di Siena (IT))

Presenter: FORESI, Andrea (Universita Siena & INFN Pisa (IT))

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