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Characterization of light yield non-proportionality in plastic scintillator-based detectors for satellite cosmic-ray experiments

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Scintillators are among the most common detectors employed for characterization and spectroscopy of a wide variety of radiations, with applications ranging from cosmic-ray experiments to nuclear medicine. Quenching effects degrade the scintillation light yield proportionality, inevitably affecting the instrument performance and posing a layer of complexity to its precise calibration. Detailed characterization of the quenching effects is of crucial importance for a proper interpretation of the detector response.

In satellite experiments, plastic scintillator detectors are a common choice to provide an anti-coincidence shield for gamma-rays and for identifying charged nuclei species.

In the performance studies of plastic scintillator-based instruments for space applications, through dedicated beam test campaigns carried out at CERN SPS, we probed non-proportionality effects within plastic scintillators by inspecting the response of scintillator tiles of different materials and sizes to a beam of ions. The tested tiles were equipped with Silicon Photomultipliers (SiPMs) to detect the scintillation light and their design was optimized for providing charge-tagging capabilities in a vast dynamic range and high charge resolution to both low- and high-Z nuclei.

In this contribution, we present the main results of the characterization of plastic scintillators quenching effects resulting from a wide range of particle energy releases, from minimum ionizing particles (MIPs) to charged nuclei heavier than iron. These effects impact on the charged nuclei identification performances of current and future space-based high-energy cosmic-ray experiments.

Collaboration

Role of Submitter

I am the presenter

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