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A full and customizable simulation of a scintillation tile equipped with SiPMs for Plastic Scintillator Detectors in the next generation of satellite experiments

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Satellite experiments employ plastic scintillators to discriminate charged from neutral particles in order to correctly identify gamma-rays and nuclei. The latest results in the field of cosmic rays and dark matter highlight the necessity of new experiments covering energies beyond the TeV with improved performance compared to present satellite experiments. The Plastic Scintillators Detector (PSD) needs to have a very high detection efficiency for the charged cosmic rays, which constitute the main background in the identification of gamma rays, and also a very good capability in identifying charged nuclei.
In order to reduce the back-splash effect due to secondary particles generated within the satellite, a highly segmented PSD is required and the optimization of its geometry is crucial to maximize the detection efficiency.
Next-generation space missions will likely employ Silicon Photomultipliers (SiPMs) instead of classical Photomultiplier Tubes to read-out the scintillator light emission, to exploit their smaller sizes and lower power consumption.
We implemented a full and customizable simulation framework based on GEANT4 to investigate the performance of a segmented PSD made of scintillator tiles coupled to SiPMs. The purpose of this simulation is to study the effects of the scintillator optical properties and the coupling with SiPMs in order to be able to choose the best geometry of the tile and the best design for the SiPM-based readout system.
We simulated a single tile equipped with SiPMs with the possibility to customize the tile and the SiPMs dimensions and position in respect to the tile facets. We will present the results of this simulation, together with the study of the scintillation photons collected by the SiPMs, especially in terms of the spatial density of the detected photons and of their collection time.

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