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Performance Evaluation and Simulation of Segmented SiC-Based Particle Detectors for Dosimetry and Real-Time Monitoring

In the last decade, SiC-based detectors have emerged as strong candidates for next-generation particle detection. This is due to several advantageous properties of the material, including its high breakdown field, high saturation velocity, wide band-gap, radiation hardness, strong mechanical resistance, and thermal stability [1–3]. Additionally, SiC has been proposed as a promising solution for easy-to-use, high-performance active dosimeters [4,5], thanks to its biocompatibility and relative insensitivity to light [6].
Within this context, as part of the SAMOTHRACE ecosystem [7], studies have been conducted to evaluate the performance of SiC devices for dosimetry and real-time monitoring. This research is part of a collaboration between the University of Catania's Department of Physics and Astronomy, the Laboratori Nazionali del Sud (LNS) of the Istituto Nazionale di Fisica Nucleare (INFN), and the INFN –Sezione di Catania. Proton, alpha beams and radioactive α-sources were used to characterize the performance of a segmented SiC detector, focusing on the interplay between different pads of the detector, as well as cross-talk, inter-pad contributions, and edge effects.
This contribution will focus on the evaluation of these effects from the simulation side, performed using Geant4 tools, modelling the expected behaviour of two different SiC detectors (10 μm and 100 μm thick) with the same 2×2 segmented geometry. The simulations considered variations in manufacturing and detector configurations. This step is crucial for gaining a deeper understanding of the detector's response in different regions, particularly in the inter-pad areas, where weaker signals and electric field interactions can significantly degrade the output, potentially leading to improper—or even missing—event reconstruction. Finally, a comprehensive evaluation of the electric field is currently underway.

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