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Advances in Additive Manufacturing of 3D-Segmented Plastic Scintillator Detectors for Particle Tracking and Calorimetry

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Plastic scintillator detectors with 3D granularity and sub-nanosecond time resolution offer simultaneous particle tracking, identification, and calorimetry. However, future enhancements necessitate larger volumes and finer segmentation, posing significant challenges in manufacturing and assembly due to high costs, extensive time, and precision requirements. The 3DET R&D collaboration has developed an innovative additive manufacturing approach, enabling the scalable production of 3D-segmented scintillating detectors. This method allows for the monolithic fabrication of 3D granular scintillators without additional production steps. A prototype, featuring a 5x5x5 matrix of optically isolated scintillating voxels made of transparent polystyrene, white reflectors, and 1 mm diameter orthogonal holes for wavelength shifting fibers, was produced.
We will discuss about the manufacturing process and performance evaluation of the prototype, using data from cosmic rays and CERN test beam exposures. This advancement offers a viable, time efficient, and cost-effective solution for producing next-generation scintillator detectors, maintaining high performance regardless of size and geometric complexity.

Working Group

WG 6: Detectors

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