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Simulation of a SiW pixel calorimeter

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A prototype of a digital pixel electromagnetic calorimeter, EPICAL-2, was designed and constructed. It consists of a sandwich construction of W absorbers and Si sensor layers, with a total thickness of approximately 20 radiation lengths and a cross section of $30\,\mathrm{mm} \times 30\,\mathrm{mm}$. This design is the next step in pixel calorimetry following up on a previous prototype using MIMOSA sensors [1]. The new EPICAL-2 detector employs the ALPIDE pixel sensors developed for the ALICE ITS upgrade. The pixel size is $29.24\,\mu\mathrm{m} \times 26.88\,\mu\mathrm{m}$, and the full detector consists of ~25 million pixels. This R&D is performed in the context of the proposed Forward Calorimeter upgrade (FoCal) for the ALICE experiment, but it also serves the general understanding of the principle of a fully digital calorimeter.

We have used the Allpix2 framework [2] to perform Monte Carlo simulations of the detector response and the shower evolution in EPICAL-2. The detailed detector geometry was implemented and simulation parameters were tuned to reproduce electron test beam results. The general performance of EPICAL-2 for electromagnetic showers was investigated, particularly in terms of energy resolution and linearity for both, the total number of pixel hits and the total number of clusters. In addition, more detailed microscopic features of the shower development and the propagation of particles were studied.

[1] JINST13 (2018) P01014.
[2] Nucl. Instr. Meth. A 901 (2018) 164 –172.

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