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Characterization of an Innovative Silicon Pixel Sensor Prototype for the ALICE ITS3 Upgrade

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The ALICE Collaboration is developing the next-generation ultra-thin, curved monolithic silicon tracker (ITS3) to further reduce the material budget and enhance low-momentum tracking performance. As part of this R&D program, characterization studies were carried out at the University of Padova on an Analog Pixel Test Structure (APTS) prototype using a monochromatic 55-Fe source. The detector response was systematically evaluated for different back-bias voltages and acquisition thresholds, employing dedicated ITS3 readout electronics and standardized calibration procedures. Analysis of energy spectra, cluster-size distributions, charge-sharing patterns, and noise behavior confirmed full depletion of the epitaxial layer even at low bias, together with the expected signal increase at higher voltages due to reduced input capacitance. Anomalous features observed at intermediate bias were identified and discussed. These results provide useful feedback for the optimization of pixel-sensor design and operating parameters for the forthcoming ITS3 upgrade.

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