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Simulation of MAPS in a 65 nm CMOS Imaging Technology

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Future lepton and electron-ion collider concepts rely heavily on silicon sensors as primary tracking devices. The Tangerine Project at DESY is actively investigating monolithic active pixel sensors (MAPS) developed using 65 nm CMOS imaging technology for future experiments.

This project provides a comprehensive overview of the research and development of these sensors, covering their design, simulation, and testing. It includes the characterization of chip prototypes and simulations of sensor behavior using a genetic algorithm approach. The simulation strategy integrates Monte Carlo methods with electrostatic field simulations via Technology Computer-Aided Design (TCAD) and is validated against test beam data.

One of the sensors under study is the DESY Chip V2 (also known as DESY ER1), a four-pixel analog test structure with direct access to the analog amplifier output. Simulation studies of a sensor with the same dimensions as DESY Chip V2 have been conducted to analyze sensor behavior and guide test beam campaigns.

Additionally, a hexagonal pixel grid is explored as an alternative to traditional square or rectangular layouts, with performance assessed for various pixel sizes. Hexagonal pixels are particularly interesting as they may enable shorter drift paths while maintaining sufficient area for circuitry in the p-well, as well as reducing the number of neighboring pixels. While results for a thin epitaxial layer of 10 um show limited improvements in efficiency, cluster size, and spatial resolution, further simulations are discussed to address design limitations and explore potential advantages, such as enhanced timing performance.

The investigations in this work analyze the performance of the hexagonal pixel grid in MAPS for high-energy physics experiments. Moreover, simulations of the DESY Chip V2 explore both the advantages and challenges when comparing simulated results with real data.

Will the talk be given in person or remotely?

In person

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