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TANGERINE –Test beam characterization of Monolithic Active Pixel Sensors

Tracking detectors are key parts of the instrumentation in high energy physics experiments, and their majority is making use of silicon pixel sensors to detect charged particles. A new generation of Monolithic Active Pixel Sensors (MAPS), produced in a 65 nm CMOS imaging process, promises higher densities of on-chip circuits and hence smaller pixel sizes or more sophisticated circuitry. MAPS offer the possibility to build cost-effective and light silicon detectors with a low power consumption.

The TANGERINE project aims for a sensor with a spatial resolution below 3 μm, temporal resolution between 1 ns to 10 ns and a physical thickness below 50 μm, suitable for future Higgs factories or as beam telescope in beam-test facilities, to serve as reference for other detector developments. To optimize the layout of the new sensor, an extensive program of simulations is pursued, which needs to be validated in terms of comparison to measurements.

A batch of test chips, produced in the same 65 nm CMOS imaging process, was tested at the DESY II Test Beam facility early summer 2022. DESY II provides electrons with an energy of up to 6 GeV at rates on the order of 10 kHz. To reconstruct reference tracks, a EUDET-type beam telescope was used. A track based analysis of the data set is performed using the CORRYVRECKAN framework –a standard tool for the analysis of test beam data –to reconstruct observables like hit efficiency, cluster size, spatial and temporal resolution. Within this framework, advanced algorithms for the reconstruction of the particle hit position will be employed.

The student will learn the basics of hit reconstruction in segmented detectors, particle tracking, and pixel sensor characterization. The analysis will be based on the open source software frameworks ROOT and COR-RYVRECKAN, both written in C++. Prior knowledge in linux, shell, C++ and ROOT will be helpful but are not required.

Field

B3: Development of experimental particle physics equipment (hardware-oriented)

DESY Place

Hamburg

DESY Division

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