T 96: TestBeam, RadHard for Si and Pixel

Time: Wednesday 17:30–19:00 Location: WIL/A124

T 96.1 Wed 17:30 WIL/A124

Characterisation of a novel trigger and timing plane for the EUDET Telescopes — •Arianna Wintle[1], Lennart Huth[1], Francesca Maria Pofi[1], Felix Sefkow[1], Marcel Stanitzki[1], and Ivan Peric[2] — [1]DESY, Notkestraße 85, 22607 Hamburg — [2]Karlsruhe Institute of Technology (KIT)

The DESY Test Beam facility provides GeV beams for users and precise reference tracking systems, the EUDET telescopes. The telescope readout is triggered externally and multiple particles are recorded in one readout cycle, causing ambiguities as no time-stamping is provided.

TelePix is a 180 nm HV-CMOS sensor foreseen to be used in upgrades of the EUDET-style pixel beam telescopes allowing for fast timing and triggering on a region of interest. Here, characterisation results of TelePix are presented using the latest test beam results.

T 96.2 Wed 17:45 WIL/A124

Irradiation Studies on Silicon Sensors for the CMS Outer Tracker Sensor Production — •Umut Elicabuk, Tobias Barvich, Bernd Berger, Alexander Dierlamm, Ulrich Husemann, Markus Klute, Roland Koppenhöfer, Thomas Müller, Marius Neufeld, Hans Jürgen Simonis, and Pia Steck — Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT)

With the upcoming Phase-2 Upgrade of the CMS Outer Tracker, silicon sensors will be used to reconstruct the tracks of charged particles. The detector material continuously accumulates radiation damage at the level of the crystal lattice during operation. Due to the increased demands on radiation hardness with the HL-LHC upgrade, a sufficiently radiation hard sensor material is necessary.

Both during and before ongoing sensor production, it is therefore necessary to monitor the efficiency of the detectors under radiation exposure and to draw conclusions about subsequent performance in the detector.

Among other things, the ETP is investigating the sensor characteristics of these silicon sensors as part of the Phase-2 Upgrade. The talk will give an insight into the used measurement setups, investigated sensor characteristics and give an overview of the concept of irradiation studies in general.

T 96.3 Wed 18:00 WIL/A124

A High-Precision Irradiation Site for Silicon Pixel Detectors — •Pascal Wolf[1], Reinhard Beck[2], Jochen Dingfelder[1], and Dennis Sauerland[2] — [1]Physikalisches Institut, University of Bonn, Germany — [2]Helmholtz-Institut für Strahlen- und Kernphysik, University of Bonn, Germany

An irradiation site for radiation hardness studies of silicon pixel detectors is in operation at the isochronous cyclotron at the University of Bonn. The accelerator provides protons as well as other light ions with energies ranging from 7 to 14 MeV per nucleon and beam currents of up to 1 μA to the setup. Devices Under Test (DUTs) are irradiated in a temperature-controlled box, minimizing annealing, while being moved through the beam in a well-defined pattern, ensuring homogeneity. On-site beam diagnostics facilitate online monitoring of the beam parameters and enable a beam-driven irradiation procedure resulting in highly uniform damage profiles with relative uncertainties of typically 2%. The setup provides extensive data acquisition, visualization and control of all components allowing for flexible irradiation plans (DUT powering & R/O, pausing, etc.), post-irradiation corrections and precise damage analysis. In this talk, the irradiation site and its operational parameters are introduced in detail. Energy simulations for light ions are presented, showing the total ionizing dose (TID) as well as non-ionizing energy loss (NIEL) damage capabilities. Measurements of the applied particle fluence, using different techniques, are presented and their precisions are compared. Furthermore, an overview of the recently performed irradiation campaigns is given.

T 96.4 Wed 18:15 WIL/A124

Radiation hardness studies of the ULTRASAT space mission — •Vlad Dumitru Berlea — DESY, Zeuthen, Germany

ULTRASAT (ULtraviolet TRansient Astronomy SATellite) is a wide-angle space telescope that will perform deep time- resolved surveys in the near ultraviolet spectrum. ULTRASAT is led by the Weizmann Institute of Science (WIS) in Israel and the Israel Space Agency (ISA) and is planned for launch in 2026. The telescope implements a backside-illuminated, stitched pixel detector. The pixel has a dual-gain 4T architecture with a pitch of 9.5 μm and is produced in the 180 nm process by Tower Semiconductor. As part of the space qualification for the sensors, radiation tests are to be performed on both test sensors provided by Tower and the final flight design of the sensor. One of the main contributions to sensor degradation due to radiation for the ULTRASAT mission is Total Ionizing Dose (TID). TID measurements on the test sensors have been performed with Co-60 gamma source at Helmholz Zentrum Berlin (HZB) and CC-60 facilities at CERN, and preliminary results are presented in this talk.

T 96.5 Wed 18:30 WIL/A124

Test-Beam Performance Results of the FASTPIX Sub-Nanosecond CMOS Pixel Sensor Demonstrator — •Justus Braach[1,2], Eric Buschmann[1], Dominik Dannheim[1], Katharina Dort[1,3], Thanushan Kugathasan[4], Magdalena Munker[1], Walter Snoeys[1], Peter Švihra[1], and Mateus Vicente Barreto Pinto[4] — [1]CERN (CH) — [2]Universität Hamburg (DE) — [3]Justus-Liebig-Universität Giessen (DE) — [4]Université de Genève (CH)

Within the ATTRACT FASTPIX project, a monolithic pixel sensor demonstrator chip has been developed in a modified 180 nm CMOS imaging process technology, targeting sub-nanosecond timing precision for single ionising particles. It features a small collection electrode design on a 25 μm-thick epitaxial layer and contains 32 mini matrices of 68 hexagonal pixels each, with pixel pitches ranging from 8.66 μm to 20 μm. Four pixels are transmitting an analog output signal and 64 are transmitting binary hit information. Various design variations are explored, aiming at accelerating the charge collection and making the timing of the charge collection more uniform over the pixel area. Signal treatment of the analog waveforms, as well as reconstruction of time and charge information, is carried out off-chip.
This contribution introduces the design of the sensor and readout system and presents performance results for various pixel designs achieved in recent test-beam measurements with external tracking and timing reference detectors. A time resolution below 150 ps is obtained at full efficiency for all pixel pitches.

T 96.6 Wed 18:45 WIL/A124

Reconstruction of high track density beams in beam tests — •Christopher Krause, Jens Weingarten, and Kevin Kröninger — TU Dortmund, Dortmund, Deutschland

The Inner Tracker of the ATLAS experiment requires the optimal performance of its pixel sensors. To test their efficiency, a reliable track reconstruction and analysis for testbeam data is necessary to ensure the precise detection of particles. The quality of data from testbeam campaigns are influenced by many factors, including high beam densities, which can impair the track reconstruction.

To analyse and evaluate the data taken at beam tests, the track reconstruction software Corryvreckan is used. It is now the predominant reconstruction framework for beam tests and was developed with the intention to reduce external dependencies without reducing the quality and versatility of track reconstruction in complex environments.

In beam tests, high density beams lead to many hits on the sensors in short periods of time. The reconstruction of particle tracks with too many hits becomes increasingly difficult due to the ambiguity of track fits. In order to differentiate between false and true reconstructed tracks, a machine learner is implemented, which is trained on simulated testbeam data, generated by the Allpix2 software.

This talk presents results of the track reconstruction of high track density using Corryvreckan and the performance of a machine learner for true track tagging. Both simulated data and real testbeam data is investigated.