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Characterization of ALPIDE silicon sensors with inclined tracks

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The planned upgrade of the ALICE Inner Tracking System (ITS) aims at improving the capabilities of ALICE in terms of read-out rate as well as track pointing resolution and track finding efficiency, especially for particles
with low transverse momenta. The new ITS will be a low material budget detector with high granularity and read-out speed. It comprises seven concentric layers of Monolithic Active Pixel Sensors (MAPS) with a total active surface of about 10 m^2. The developed MAPS are based on the TowerJazz 180 nm CMOS technology. The sensor is called ALPIDE. A single sensor with dimensions $15\ mm \times 30\ mm$ contains half a million pixels distributed in 512 rows and 1024 columns. The detection efficiency of the sensors is higher than 99\%, fake-hit rate is orders of magnitude lower than the required 10^{-6} /pixel/ event, and spatial resolution is within the required 5 μm.
These sensors maintain this performance
while being radiation hard to some 10^{13} 1 MeV n_{eq} cm^{-2} (NIEL), which ten times exceeds the expected radiation load during the detector lifetime.
A series of beam tests were performed to verify this
and to prove that the design requirements are completely fulfilled.
In the poster, we will present the setup used for measurements with inclined tracks and we will discuss the sensor efficiency obtained using π beams with a momentum of 6 GeV/c at the Proton Synchrotron (PS) at CERN. Some sensors were irradiated before the beam
test using the cyclotron facility of the Nuclear Physics Institute of the Czech Academy of Sciences (NPI CAS) to induce radiation damage to the sensor. Measurements at different operating points (thresholds, bias voltages) provide important information about cluster-shape frequencies, needed to tune the ALICE Monte-Carlo generators.
Very good agreement between test-beam data and simulations is obtained.

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