

The upgrade of the ALICE Inner Tracking System with the Monolithic Active Pixel Sensor ALPIDE

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The ALICE experiment at CERN LHC schedules a major upgrade of its apparatus for the long shutdown 2 of LHC in 2019/20. One its pillars is the replacement of the inner tracking system by a detector entirely made of Monolithic Active Pixel Sensors fabricated in the 0.18 μ m TowerJazz process. It will comprise seven concentric layers around the beam pipe at radii from 2.2-40 cm and lengths between 29 and 150cm, covering an eta range (90% most-luminous) of ± 1.22 , making a total active area of 10m² covered by 24,000 chips with 500k channels each. Its material budget is as low as $X/X_0=0.3\%$ for the innermost three layers to limit the multiple scattering and to improve momentum and position resolutions especially for low-momentum tracks.

It will be the first application of this technology at the LHC and only became feasible after an intensive R&D program that led to the design of a new chip, the « ALPIDE », that pushes power consumption (<35mW/cm²), radiation tolerance (NIEL: >1.7 $\times 10^{13}$, TID: >300krad), and integration/readout time (<10 μ s) to unprecedented values. Its latest full-scale prototype, « pALPIDE-3 », includes all functionalities and has been thoroughly characterized at several institutes and test beam campaigns and is now being integrated into larger detector building blocks.

The presentation summarizes the state of the key detector building blocks (mechanics, sensor, readout) and details results on the performance of the sensor as a standalone circuit as well as integrated into detector modules.