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ALPIDE, the Monolithic Active Pixel Sensor for the ALICE ITS upgrade

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A new Inner Tracking System based on seven concentric layers of Monolithic Active Pixel Sensors will be installed in the ALICE experiment during the second long shutdown of LHC in 2018-2019. It is based on 10m^2 of pixel sensors that will be fabricated using the 180nm CMOS Imaging process of TowerJazz. The ALPIDE design takes full advantage of a particular process feature, the deep p-well, which allows for CMOS circuitry within the pixel matrix, while retaining the full charge collection efficiency. Together with the small structure size, this allowed placing a continuously active, low-power front-end into each pixel and using an in-matrix sparsification circuit that sends only the addresses of hit pixels to the periphery. This approach led to a design with a power consumption of <40mW/cm^2, a spatial resolution of ~5um, and a peaking time of ~2us, while being radiation hard to some 10^3 1MeV n-eq, perfectly matching or superseding the requirements of ALICE.

Over the last years of R&D, several prototype circuits have been used to verify radiation hardness and to optimise pixel geometry and in-pixel front-end circuitry. The positive results led to submissions of full-scale (3x1.5 cm^2) sensor prototypes in 2014. They are being characterised in a thorough campaign that includes several irradiation and beam tests. This contribution will give a comprehensive summary of the results obtained and prospects towards the final sensor to instrument the ALICE Inner Tracking System.

Collaboration

on behalf of the ALICE collaboration

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