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Developments of stitched monolithic pixel sensors towards the application in the ALICE ITS3

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The ALICE collaboration is pursuing the development of a novel and considerably improved vertexing detector called ITS3, to replace the three innermost layers of the Inner Tracker System during the LHC Long Shutdown 3.

The primary goals are to reduce the material budget to the unprecedented value of 0.05% X_{0} per layer, and to place the first layer at a radial distance of 18 mm from the interaction point. These features will boost the impact parameter resolution by a factor two over all momenta and drastically enhance the tracking efficiency at low transverse momentum.

The new detector will consist of true cylindrical layers. Each half-cylinder is based on curved wafer-scale monolithic pixel sensors. The bending radii are 18, 24 and 30 mm, and the length of the sensors in the beam direction is 27 mm.

The sensors will be produced using a commercial 65 nm CMOS Imaging technology and a recent technique called stitching. This allows to manufacture chips reaching the dimensions of 27 cm x 9 cm on silicon wafers of 300 mm diameter. The chips will be thinned down to 50 um or below.

The ITS3 concept foresees cooling by air flow, ultra-light carbon foam support elements and no flexible printed circuits in the active area. This demands a power density limit of 20 mW/cm^{2} for the sensor, and the need to distribute supply and transfer data over the entire sensors towards circuits located at the short edges of the chip.

This contribution will summarise the status of the microelectronic developments and present selected results from the characterisation of the first prototype chips.

Furthermore, it will describe the ongoing efforts on the design of a first wafer-scale stitched sensor prototype, the MOSS (Monolithic Stitched Sensor) chip.

Collaboration

ALICE Collaboration

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