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BabyMOSS stitched sensors: results of characterisation tests for ALICE ITS3 upgrade

During the Long Shutdown 3 (LS3, scheduled 2026-2030), the innermost 3 layers (Inner Barrel, or IB) of the present ALICE ITS2 will be replaced with 6 large-area, flexible, stitched CMOS 65 nm sensors, in the framework of the ITS3 upgrade project. For the first time in a High Energy Physics experiment, such large-scale sensors will be bent into a truly half-cylindrical shape, requiring little mechanical support. This will also help lowering the material budget: a reduction down to an average of 0.09% X0 per layer is expected, benefitting ITS tracking and vertexing capabilities especially at low momenta.
In the wafer yield and stitching assessment stage for ITS3 R&D, test devices from the Engineering Run 1 (ER1) submission were developed, including the MOnolithic Stiched Sensors (MOSS) and smaller variants of them (babyMOSS). In particular, babyMOSS is a single Repeated Sensor Unit (RSU) of a MOSS device: the chip is ˜14×30 mm2 in size, and consists of 8 digitally read out pixel matrices (regions) arranged in 2 rows, i.e. half-units (HUs).
BabyMOSS chip characterisation tests have been performed in laboratory and test beam environments. Laboratory tests include systematic functional scans to study the behaviour of front-end electronics over a range of different settings, whereas test beam measurements, under high-energy charged particle beams, were used to investigate the detection efficiency and spatial resolution.
In this contribution, we will present the babyMOSS chip characterisation campaign, with a focus on recent test beam results. So far, babyMOSS test beam results have been consistent with full MOSS, and confirmed that babyMOSS devices meet the ITS3 requirements: a detection efficiency > 99%, fake hit rate < 10-6 hits pixel-1event-1, and a spatial resolution < 6 μm.

Workshop topics

Detector systems

Author: STURNIOLO, Alessandro (University of Messina - INFN Catania)

Presenter: STURNIOLO, Alessandro (University of Messina - INFN Catania)