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A detailed study of Stitched Passive CMOS Strip Sensors

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Silicon tracking detectors are by now the standard for the inner tracking layers of most collider physics experiments. A promising technology for future silicon particle detectors is CMOS sensor. One issue with CMOS sensors is the limited size of the reticules around 4cm^2 used, which is adapted to the typical ASIC sizes in industrial applications but far too small for the 100cm^2 sensors used in e.g. ATLAS and CMS Phase-II tracker upgrades. One way to overcome the size limitation is to stitch many individual reticules together to a large sensor.
The CMOS project presented here is investigating stitched passive CMOS strip sensors fabricated by LFoundry in a 150 nm technology, with an additional backside processing from IZM Berlin. The sensors have a thickness of 150 µm, a resistivity of 3-5 kΩ cm and a strip pitch of 75.5 µm. By employing the stitching technique two different strip lengths have been realised, with the short format having three and the long having five stitches. A total of three different strip sensor designs have been investigated. They each vary in doping concentration and width of the n-well to study various depletion concepts and electric field configurations. Unirradiated as well as irradiated sensors sensors have been studied with several measurement techniques, including probestation characterisation, lab measurements with lasers and Sr90-sources and test beam campaigns. This presentation will provide an overview of simulation results, summarize the laboratory measurements and in particular present the test beam results for irradiated and unirradiated passive CMOS strip sensors. We will demonstrate that large area sensors with sufficient radiation hardness can be obtained by stitching in this CMOS process, and present our plans for the next CMOS submission in the framework of this project.

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