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CMOS Pixel Sensors: Achievements and Perspectives for Subatomic Physics Experiments

ABSTRACT:

After more than a decade of R&D, CMOS Pixel Sensors (CPS) have proven to offer concrete answers to demanding requirements of subatomic physics experiments. Their main advantages result from their low material budget and high granularity, which go well beyond present LHC standards, and from their integrated signal processing circuitry, which allows coping with high particle rates. Moreover, their low cost has a significant impact when equipping large detector surfaces.

Sensors of the MIMOSA series have offered an opportunity for nuclear and particle physics experiments to address with improved sensitivity physics studies requiring an accurate reconstruction of short living and soft particles. The STAR-PXL detector, currently under construction, will be the first vertex detector based on CPS. The sensors feature an architecture originally developed for the EUDET beam telescope. They were manufactured in a 0.35 micron CMOS technology, and are far from exploiting the full potential of CPS. They are in particular not suited to their upcoming applications (CBM vertex detector, ALICE inner tracker system), which require faster or more radiation tolerant sensors. The exploration of a deeper submicron CMOS technology was therefore initiated, which gave its first results very recently, showing that CPS can be envisaged for detectors exposed to particularly demanding running conditions.

The talk will overview achieved performances of MIMOSA sensors and focus on their most recent developments, addressing the CBM-MVD, ALICE-ITS and ILD vertex detector. The talk will also shortly discuss the perspectives offered by the evolution of CMOS industry, which has taken directions towards sensors offering performances reflecting the full intrinsic potential of the technology. This important move allows envisaging CPS for the most demanding experimental requirements of the next decade (e.g. for the HL-LHC or CLIC).