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Development of inner tracking systems equipped with CMOS pixel sensors for future collider experiments

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The physics goals of a growing number of subatomic physics experiments assume vertexing and tracking performances calling for a specific pixel technology, which offers a high data rate capability as well as precision, low power and cost standards departing from those of the most widely used devices. CMOS Pixel Sensors (CPS), and the ultra-light systems they equip, address this challenge.

Because of their micron level resolution, their 10-20 μm thin sensitive volume and their fully integrated, low power, FEE, CPS have already been chosen for vertex detectors of heavy ion collision experiments (STAR at RHIC, CBM at FAIR, ...). A new step was achieved in 2012 with the decision to base on CPS the upgrade of the whole, nearly 10 m2 wide, Inner Tracker System of the ALICE experiment at LHC. CPS are actually being considered for a number of AA, pp and e+e- collision experiments, where the reconstruction of displaced vertices and tracks calls for micrometric precision in a high hit density environment.

The capability of CPS to comply with the most ambitious of these requirements relies on a recently addressed CMOS technology, which was extensively tested with beam particles at the CERN-SPS in 2012. The test results confirm the possibility to deal with particle rates in the order of 10ˆ7/cm2/s and with radiation loads in the order of 1-10 MRad and 10ˆ13-10ˆ14 n_eq/cm2, depending on the operating temperature.

The proposed talk will provide an overview of the measured performances for these CPS prototypes and explain the proposed development path to reach real size sensors with full functionality. We will finally underline how the design of inner tracking systems could benefit from the CPS performances flexibility, through the combination of several layers equipped with CPS featuring different optimizations.

Primary author: RIPP-BAUDOT, Isabelle (IPHC Strasbourg, CNRS/IN2P3)

Presenter: RIPP-BAUDOT, Isabelle (IPHC Strasbourg, CNRS/IN2P3)

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