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CMOS sensors with high resistivity epitaxial layer

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CMOS Pixel Sensors (CPS) are foreseen to equip vertex detectors where priority is given to granularity, material budget and power consumption, potentially at the expense of read-out speed and radiation tolerance. Being initially developed for an experiment at the ILC, the sensors came out to be well suited to Heavy Ion Collision experiments (STAR at RHIC, CBM at FAIR, ...) and their intrinsic potential offers attractive perspectives for the vertex detector to be operated at the SuperB factory. Another trend motivating their continuous development concerns trackers, where granularity is less an issue but material budget, power consumption and fabrication costs may be significantly reduced when using CMOS pixel sensors intead of usual semi-conducting devices.

For many years, CPS were manufactured with commercial wafers featuring exclusively low resistivity (i.e. typically 10 ohm.cm) epitaxial layers. The interest of industry for high resistivity epitaxial layers is a rather recent event, with a considerable impact on the potential of the CPS (e.g. a typical signal-to-noise ratio of about 35-40). Several sensors were fabricated since early 2010 with a 400 ohm.cm resistivity epitaxial layer, available in a 0.35 mum process, and tested on particle beams. Their detection performances were assessed extensively, mainly in perspective of their implementation in the two internal layers of the STAR-HFT. Featuring a total material budget per layer of 0.37 % of radiation length, the HFT is foreseen to start data taking in 2013/2014.

The talk will summarise the test results of the STAR-HFT sensor and provide insight of the next steps of the R&D, which are based on an emerging CMOS technology using a 0.18 mum feature size and offering a >= 1 kohm.cm epitaxy. Moreover, the development of a very light ladder equipped on both faces with 50 mum thin sensors, as well as supportless pixelated systems featuring < 0.15 % of radiation length, will be described. Finally, the evolution of the R&D, exploiting specific features of the 0.18 mum technology, will be overviewed, including a large area beam telescope for the EU-FP7 project AIDA.

Author: BESSON, Auguste (IReS)

Orateur: Dr BESSON, auguste (Institut Pluridisciplinaire Hubert Curien)

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