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Monolithic Pixel on High Resistance Substrate and Sparsifying Redaout Architecture

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We start by presenting the latest results on the LePix sensor, an innovative Monolithic Active Pixel Sensor (MAPS) aimed at tracking/triggering tasks where high granularity, low power consumption, low material budget, radiation hardness, and production costs are a concern. The detector is built in a 90nm CMOS process on a substrate of moderate resistivity. This allows charge collection by drift while maintaining the other advantages usually offered by MAPS, like having a single piece detector and using a standard CMOS production line.

The collection by drift mechanism, coupled to the low capacitance design of the collecting node made possible by the monolithic approach, provides an excellent signal to noise ratio straight at the pixel cell together with a radiation tolerance far superior to conventional un-depleted MAPS. We will illustrate the detector design and present measurement results obtained with first prototypes from radioactive sources, laser probing and beam test experiments. The excellent signal-to-noise performance is demonstrated by the device ability to separate the 6 keV 55Fe double peak at room temperature.

Ensuing the excellent pixel cell performances (sensitivity, size, power consumption) and considering that stitching is commercially available for such process, we will then introduce novel architectural approaches departing from the two nowadays most widely adopted solutions in pixel detectors ("rolling shutter"for the monolithic and the "intelligent pixel"for the hybrids). The potential of having single-piece, large area, high granularity and low power pixel detectors puts a premium on architectures exploiting that at most, especially from a power-consumption (and hence material budget) point of view. While illustrating the proposed architectures, a complete review of both detector behaviors and physics goals, together with quantitative references and simulations of real-word experimental scenarios, will highlight the advantages of the proposed solution for many applications in both the High Energy Physics and applied sciences field.

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