Contribution ID: **137** Type: **ORAL**

Low power, high resolution MAPS for particle tracking and imaging

Wednesday, 3 September 2014 11:30 (25 minutes)

This contribution describes a Monolithic Active Pixel Sensor (MAPS) specifically designed to improve current MAPS state of the art for particle tracking when very high speed, low power consumption and/or small pixels (down to micron size) are required. The low power target is especially important as one of the design goal is to provide a cheaper and easier to implement alternative to present state of the art strip sensors in large volume tracking detectors.

The key innovation implemented to improve performance is the OrthoPix architecture, a compressing readout scheme specially developed for tracking high rate particles over large area pixel detectors. Such architecture has been specifically designed to read out with efficiency the large area (10 cmˆ2 or bigger) MAPS which stitching technique now allow to produce. Being the compression passive, with no active elements embedded into the pixel cell, the pixel size can shrink down to the micron level (if necessary) and power dissipation over the matrix area is minimal. Depending on pixel pitch, a particle rate of many tens of MHz / cmˆ2 can be sustained at full efficiency.

To demonstrate the validity of this novel design a 255 × 255 pixel array (10 µm pitch) prototype has been realized in the Tower-Jazz 0.18 µm quadruple-well CMOS process on a 18 µm thick high resistivity (1 kΩ cm) epitaxial layer. The epitaxial layer can therefore be reverse biased at low bias voltages (<10 V) and used as the sensitive volume. Measurements which highlights the device actual performances will be shown, discussed, and compared with simulations to assess the potentiality of future developments. An overview of how the proposed technology could find applications in High Energy Physics, Medical Imaging, and Electronic Microscopy will be also discussed.

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Session Classification: Pixel Front End Electronics Development