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High-Voltage Pixel Detectors in Commercial CMOS Technologies for ATLAS, CLIC and Mu3e Experiments

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High voltage particle detectors in commercial CMOS technologies are detector family that allows implementation of low-cost, thin and radiation-tolerant detectors with good time resolution. The unique property of these detectors is that the pixel electronic is embedded inside sensor diodes. For this reason, we refer to the detector type as the "smart diode"array - SDA. In the R/D phase of the development, we have demonstrated a radiation tolerance of 10ˆ15 n_eq/cmˆ2, nearly 100% detection efficiency and a spatial resolution of about 3 micrometers.
Since 2011 SDAs have first applications: The technology is presently the main option for the pixel detector of the planned Mu3e experiment at PSI (Switzerland). Two 50-micrometer thin detector layers with 200 million pixels are planned. A prototype sensor with small pixel matrix has been designed in the standard AMS 180nm HV CMOS process and successfully tested. First tests with the thinned sensors will be performed soon.
Thanks to its high radiation tolerance, the SDA technology is also seen at CERN as a promising alternative to the standard options for ATLAS upgrade and CLIC.
In order to test the concept, within ATLAS upgrade R&D, we are currently exploring an active pixel detector demonstrator HV2FEI4; also implemented in the AMS 180nm HV process. This detector has a pixel pitch of 33 um x 125 um. A group of three detector pixels is coupled to one FE-I4 pixel readout channel. The contacts between the detector- and readout chip can be established either capacitively or by bump-bonding. The first measurements with the capacitively coupled pixel detectors will be performed in May and a test beam measurement is planned for June 2012.

We will present the current status of the projects and the experimental results.

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