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MightyPix: An HV-CMOS pixel chip for LHCb's Mighty Tracker

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In the coming years the Large Hadron Collider (LHC) at CERN is being upgraded to work at higher luminosities, leading to the High-Luminosity LHC. The HL-LHC will reach luminosities up to $5 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ collecting at least 3000 fb⁻¹ of data in its lifetime. To handle the increased luminosity and data rate, the experiments at the LHC will be upgraded as well.

One of the proposed changes is the installation of the Mighty Tracker, a new hybrid tracking system for the LHCb detector. It would consist of scintillating fibres in the outer regions and silicon sensors in the inner regions, where the hit density is the highest. The proposed baseline technology for the silicon sensors are High-Voltage CMOS detectors, which meet the requirements for radiation hardness and granularity. These pixel chips combine sensing element and readout logic in a single device and prototypes for the ATLAS and Mu3e experiments have already proven successful.

The HV-CMOS pixel chip currently being developed for the Mighty Tracker is called MightyPix. A first test chip has already been designed, fabricated, and studied at a test beam at DESY. The first LHCb compatible prototype has been submitted for fabrication in June and is expected back this winter. It has a full column height of 2 cm and is 0.5 cm wide, one fourth of the final width. It can already handle the Timing and Fast Control signals coming from LHCb and has an I2C interface, needed for the lpGBT readout chips used by LHCb. The first full-sized prototype with a reticle size of 2 cm x 2 cm will follow next year.

Eventually, over 46000 MightyPix sensors would be installed in the Mighty Tracker to cover an area of 18 m².

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