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AstroPix: Low power high voltage CMOS active pixel sensors for space and collider experiments

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High voltage CMOS (HV-CMOS) sensors are novel monolithic CMOS active pixel sensors designed for future particle tracking detectors satisfying exceptional performance requirements. These sensors have the advantages of a fully monolithic structure, low manufacturing cost, low material budget, fast charge collection, and high radiation tolerance. Derived from ATLASPix3 (for High-Luminosity Large Hadron Collider), AstroPix is an HV-CMOS monolithic silicon sensor designed using a 180 nm CMOS process for NASA's AMEGO-X (All-sky Medium-Energy Gamma-ray Observatory eXplorer) mission concept, a low-orbit medium energy gamma-ray observatory for multi-messenger astrophysics.

To ensure high precision and sensitivity, a next-generation Pair/Compton telescope (ComPair2 prototype for AMEGO-X) targeting a medium-energy (MeV) γ -ray from extreme explosions and accelerators requires detectors with good energy and position resolution in three dimensions with a low energy threshold. AstroPix provides low-power operation with large sensitive areas, low noise, wide dynamic range, and good energy/spatial resolution. These features synergies with an electromagnetic shower environment. Consequently, AstroPix is the baseline silicon sensor for the imaging part in the barrel imaging calorimeter (BIC) for the Electron-Proton/Ion Collider experiment (ePIC) at the Electron-Ion Collider (EIC). At AMEGO-X, 40 tracking layers with a total area of 40 m^2 are designed with AstroPix sensors. The prototype tracker detector, ComPair2, comprising 10 layers of AstroPix, will be integrated next year. Whereas imaging layers in the BIC at ePIC cover an area of over 100 m^2 . The speaker will describe the integration of the AstroPix MAPS sensor in the ComPair2 prototype for AMEGO-X and BIC at ePIC. The presentation will highlight the characterization and performance evaluation results of the AstroPix sensor.

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