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AstroPix: A novel HV-CMOS pixel sensor for space-based experiments

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A new application for monolithic pixel detectors is NASA's AMEGO-X project, which is a low-orbit gamma ray observatory for multimessenger astrophysics, proposed as a 3 to 5 year mission. For the 40-layer gamma-ray telescope, which will consist of over 64000 sensors with a total area of more than 25 m², a new low power and high dynamic range monolithic active pixel sensor named AstroPix is currently being developed.

The first two versions, AstroPix v1 a 5 x 5 mm² test chip with 200 x 200 μm² pixels and AstroPix v2 a 1 x 1 cm² test chip with 250 x 250 μm² pixels have already been designed and fabricated. The energy resolution and the SEU and latchup performances required for the usage in space are currently studied in test beams. The newest version AstroPix v3, has been submitted for fabrication in July 2022 and received back in January 2023.

This prototype is the first full reticle chip with 500 x 500 μm² large pixels. It features a new guard ring design which is expected to withstand a depletion voltage of over 300 V, which is needed to fully deplete the substrate of 500 μm. Being able to deplete thick sensors would also enable new applications of HV-CMOS sensors for detection of high energy photons and direct energy measurement of charged particles.

Primary author: STRIEBIG, Nicolas (KIT - Karlsruhe Institute of Technology (DE))

Presenter: STRIEBIG, Nicolas (KIT - Karlsruhe Institute of Technology (DE))

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