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X-ray Irradiation Studies on the Monopix DMAPS in 150nm and 180nm

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Monolithic active pixel sensors with depleted substrates present a promising option for pixel detectors in high-radiation environments. High-resistivity silicon substrates and high bias voltage capabilities in commercial CMOS technologies facilitate depletion of the charge sensitive volume. TJ-Monopix2 and LF-Monopix2 are the most recent large-scale chips in their respective development line, aiming for the ATLAS Inner Tracker outer layer requirements.

LF-Monopix2 is designed in 150nm LFoundry CMOS technology and integrates all in-pixel electronics within a large charge collection electrode relative to the pixel pitch of 50 x 150 μm^2. This approach facilitates short drift distances and a homogeneous electric field across the sensor.
A tolerance to non-ionizing radiation without degradation of the detection efficiency has been demonstrated to levels of up to 2 x 10^{15} 1 MeV n_{eq} / cm^2.

TJ-Monopix2 is designed in 180nm TowerSemi CMOS technology and features a small charge collection electrode, with separated in-pixel electronics. Process modifications in form of an additional n-type implant minimize regions with low electric field and improve the charge collection efficiency impaired by the long drift distances. The detector capacitance of approximately 3 fF enables low-noise and low-power operation.

This contribution highlights the performance of both Monopix2 chips after X-ray irradiation to 100 Mrad evaluated in laboratory and test beam measurements.

Primary experiment

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