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Radiation hardness and development of a large electrode DMAPS design in a 150 nm CMOS process

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Monolithic CMOS active pixel sensors in depleted substrates (DMAPS) are an attractive development for pixel tracker systems in high-rate collider experiments. The radiation tolerance of these devices is enhanced through technology add-ons and careful design, which allow them to be biased with large voltages and collect charge through drift in highly resistive silicon bulks. In addition, the use of commercial CMOS technology would reduce the current production complexity and costs of large module areas.

LF-Monopix1 is the first fully functional large-scale DMAPS demonstrator chip with a column drain readout architecture. It was designed in a 150 nm CMOS process that made it possible to place and isolate each pixel's front-end circuitry within a charge collection electrode of a size comparable to the pixel area. This presentation will give an overview of the chip performance and focus on its radiation hardness. Measurements on neutron irradiated samples showed an in-time detection efficiency of $\sim 97\%$ after a NIEL dose of $1 \times 10^{15} n_{eq}/cm^2$. Moreover, gain did not degrade and noise increased by 25% after a X-ray TID dose of 100 MRad.

The presentation will end with a design overview and results from initial observations on the new functional LF-Monopix2 chip. This prototype reimplemented and improved successful front-end designs from LF-Monopix1 in a column length of 2 centimeters and a reduced pixel pitch of 150 x 50 μm^2.

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