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Radiation effects on charge collection in HV-CMOS detectors

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The HV-CMOS concept for the next generation silicon detectors for high energy physics at hadron colliders aims to integrate the sensor and the readout electronics on the same chip using commercially available CMOS processes. This will significantly simplify the detector production. In addition the technology has a potential for significant improvement of the spatial resolution and for reducing the amount of material in the tracking volume, thereby improving the tracking performance.
For sufficiently high readout speed and radiation hardness charge collection by drift is necessary and a combination of high voltage and high wafer resistivity is required to achieve a sizeable depleted depth.
Extensive studies of charge collection properties of detectors after irradiation with high fluences of fast hadrons must be carried out before they can be used in a HEP experiment. In this work we will present irradiation studies on a set of test structures on the CHESS-2 chip developed by the Strip CMOS Collaboration. The chip was manufactured by AMS in a 350 nm CMOS technology. The samples were produced on p-type silicon wafers with different initial resistivities of 20, 50, 200 and 1000 Ohm-cm in a process allowing a maximal high voltage of 120 V.
Samples were irradiated with neutrons and protons up to 2e15 neq/cm2. The Edge-TCT method with an infrared laser was used to estimate the depleted depth from which effective dopant concentration was extracted and studied as a function of irradiation fluence and initial dopant concentration. Recent measurements with n- in- p detectors have shown that the depleted depth can increase after irradiation due to an effective removal of initial acceptors and evaluation of acceptor removal parameters will be presented in this contribution. A comparison between proton and neutron irradiated samples revealed a larger depletion depth and collected charge after proton irradiation in certain range of fluences and initial resistivities.
The collected charge caused by a passage of MIP-like electrons from a Sr90 beta source was measured with an external amplifier and compared to the charge expected from known depleted depth measured by Edge-TCT.

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