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Active pixel sensors in ams H18/H35 HV-CMOS technology for the ATLAS HL-LHC upgrade

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Deep submicron HV-CMOS processes offer the opportunity for sensors built by industry standard techniques while being HV tolerant, making them good candidates for drift-based, fast collecting, thus radiation-hard pixel detectors.
We are investigating active pixel sensors, implementing amplifier and discriminator stages directly in insulating deep n-wells, which also act as collecting electrodes.
The deep n-wells allow for bias voltages to up to 150 V leading to a depletion depth of several $10\,\mu m$ after irradiation.

Several prototype sensors in the ams H18 180nm and H35 350nm HV-CMOS processes have been manufactured, acting as a potential drop-in replacement for the current ATLAS Pixel sensors, thus leaving higher level processing such as trigger handling to dedicated read-out chips.

Sensors were thoroughly tested in lab measurements as well as in testbeam experiments.
Irradiations with X-rays and protons revealed a tolerance to ionizing doses of over 1 GRad.
A depletion zone of around $15\,\mu m$ was deduced from Sr-90 measurements, which grows to up to about $100\,\mu m$ after irradiation according to Edge-TCT studies.
This is attributed to an acceptor removal effect, eventually resulting in a higher collected charge, which partly counteracts trapping effects.
Sensors showed high detection efficiencies after neutron irradiation to $10^{15} n_{eq} cm^{-2}$ during testbeam experiments last year, while new testbeam measurements will yield results for sensors at high bias voltages and new prototypes with timewalk compensating discriminators.
Also prototypes in ams H35 technology with a simplified circuit are studied.

A full size demonstrator chip, implemented in the H35 process is being submitted.
Radiation hardness is expected to be comparable to the current sensors, while the timing behavior will be improved by new discriminator designs.

Measurement and test results as well as the current status of the project including the demonstrator design will be presented.

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