

Study of the HV-CMOS active strip sensor (CHESS2) for future silicon trackers

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CMOS active pixel sensor technology has become extremely attractive for charged particle tracking at High Energy Physics experiments. It integrates both the sensing element and the signal processing circuitry on one single chip. It promises high spatial resolution, low cost and low material budget that are desirable for high performance tracking. Sensors fabricated with high voltage (HV)-CMOS technology can achieve deeper depletion region and enable charge collection by drift that leads to faster charge collection and improved radiation hardness. These attractive features make HV-CMOS sensor a promising solution for the next generation large area silicon trackers at future collider experiments.

CHESS (CMOS HV/HR Evaluation for Strip Sensor) chip design aimed to evaluate CMOS sensors as an alternative solution to conventional micro-strip sensor for the ATLAS inner tracker upgrade. Intensive tests were carried out with the first prototype (CHESS1) to evaluate individual devices at analogue level, and results were used to optimize the second prototype (CHESS2).

CHESS-2 fabricated with the AMS-H35 high voltage process, was implemented with large matrix of pixel cells. Each pixel has its own amplifier and digitalization circuit embedded. The amplifier circuit has several bias currents for tuning its performance. Several prototype sensors have been wire-bonded to carrier boards and tested in laboratory. Tests results with different signal sources will be presented. Tuning of the in-pixel circuit using laser signal will be included as well. With the tests performed, some basic characteristics of the chip were identified. For the tests with the laser, different configurations of in-pixel circuit and laser were tried, and a better understanding of the chip was achieved by comparing the tests results with the simulation results. For example, the tests results showed that the amplifier response is larger with faster/narrower laser signal which is consistent with the circuit simulation results.

More tests with radioactive sources and laser with different injecting direction are foreseen to be done to achieve further understanding of the CHESS2 prototype sensors performance.

Submission declaration

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Author: HAN, Yubo (Chinese Academy of Sciences (CN))

Presenter: HAN, Yubo (Chinese Academy of Sciences (CN))

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