13th International "Hiroshima" Symposium on the Development and Application of Semiconductor Tracking Detectors (HSTD13), Vancouver, Canada

Contribution ID: **90** Type: **Poster**

Single event effect in ATLAS ITk Strip readout chips

The ATLAS experiment will build an all-silicon tracker in the Phase II upgrade for the High Luminosity LHC(HL-LHC) at CERN. For the silicon strip detector of the Inner Tracker (ITk), a new readout system has been designed to cope with the increased occupancies and harsher radiation environment. This readout system is comprised of the ABCStar (ATLAS Binary Chip), the analog front-end chip, and the HCCStar (Hybrid Controller Chip), the active interface chip between the ABCStars on the hybrid and the off-detector electronics. ABCStar ASIC is fabricated using 130 nm CMOS technology to read out signals from 256 sensor strips through binary readout channels. HCCStar ASIC is the digital interface for the ITk Strips hybrids, both in the endcap and in the barrel, they operate together to perform detector readout and control, up to 11 ABCStars are connected to a single HCCStar. The injection of high-energy particles into the chip will cause single event effects (SEEs) such as bit flips of electronic devices. Special considerations have been made in the design to reduce digital state changes and ensure reliable operation, we tested the effectiveness of the protection by running separate chips inside the proton beam, and layout is that all chips concurrently fit into a 20 mm beam spot. This report will introduce the study of the SEE effects of ABCStar V1 and HCCStar V1 with a single-chip test system at the proton beam platform of the China Spallation Neutron Source (CSNS). The study of SEE in registers and data transfer is carried out under different energies (80MeV, 60MeV, 40MeV, 20MeV). Relative to ABCStar V0 chip, bit flips in the ABCStar V1 significantly reduced as expected, the total ionizing dose effect is monitored as well during the experiment.

Submission declaration

Original and unplublished

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Track Classification: ASICs