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Irradiation Test Results of the ALICE SAMPA ASIC

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This paper will present the irradiation test results performed on the first two prototypes (MPW1 and V2) for the new readout ASIC (SAMPA). The SAMPA chip is aimed to be used in the ALICE Time Projection Chamber detector (TPC) and ALICE Muon Chamber (MCH) detector during RUN3 starting in 2021. The irradiation tests have been performed using proton beams of 180 MeV.

Summary

During RUN3 at LHC, the expected interaction rate of the lead ions for the ALICE experiment will be increased from 10 kHz to 50 kHz. The present readout electronics does not cope with the higher collision rates for the TPC and MCH detectors. Thus a new custom-made, trigger-less and continuous readout chip SAMPA is currently being developed to replace the current readout electronics in both detectors.

The SAMPA chip is designed in a 130 nm TSMC technology with a nominal supply voltage of 1.25 V. SAMPA includes 32 data processing channels, each containing a charge-sensitive pre-amplifier, a shaper, a 10-bit 10 MHz SAR ADC followed by a Digital Signal Processor (DSP). The data readout takes place, either in continuous or triggered mode, by enabling up to eleven 320 Mbps SLVS serial links, allowing a data throughput of up to 3.2 Gbps.

With the increased interaction rate expected during RUN3, the radiation load on the new SAMPA chip will consequently also increase. SAMPA needs to withstand a dose up to 2.1 krad and High Energy Hadron (HEH) flux of 3.4 kHz/(cm^2). HEH is the primary source of radiation induced Single Event Effects (SEE) in the ALICE readout electronics. SEE can be expected mainly in clock distribution elements, memories and registers in the DSP part of the SAMPA, which covers more than 60 % of the chip area. Irradiation campaigns are therefore necessary to investigate the radiation tolerance of the SAMPA.

This paper will focus on the irradiation qualification of the SAMPA chip with respect to the relevant radiation environment. Two proton beam irradiation campaigns were conducted for SAMPA MPW1 and V2 prototypes at The Svedberg Laboratory (TSL) in Uppsala and Center of Advanced Radiation Technology (KVI) in Groningen respectively. The results from both campaigns will be compared and presented.

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