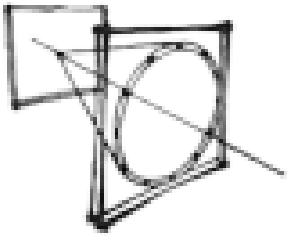

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Radiation hardness assurance of the CLARO8 front-end chip for the LHCb RICH detector upgrade

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The increase in luminosity planned for the next LHC experiments upgrade is such that even detectors far from the interaction region will be exposed to considerable amount of radiation. The LHCb experiment at CERN is preparing for an important upgrade to be achieved in the years 2019-2020 in order to sustain higher instantaneous luminosities and read out the detectors at 40 MHz. The LHCb electronics and trigger systems will be completely modified: in particular the RICH hybrid photo-detectors will be replaced by commercial multi-anode photomultiplier tubes using a new external front-end electronics based on the CLARO8 chip. The CLARO8 chip is an application specific integrated circuit designed for single-photon counting: it features 8 channels, a peaking time of 5 ns, a recovery time better than 25 ns and a configuration register protected against Single Event Upsets by triple modular redundancy. Each channel is made of a charge amplifier with 2-bit settable attenuation, plus a comparator with a 6-bit settable threshold, and exhibits a power consumption of about 1 mW.
A careful assessment of the CLARO8 performance under high radiation fields is fundamental to ensure stable operation of the upgraded RICH detectors over the expected lifetime of the experiment after the upgrade. According to FLUKA simulations, the photo-detectors region of the RICH detectors will be exposed to a total ionizing dose of 200 krad, a neutron fluence of 3×10ˆ12 1 MeV neq/cm2 and a high energy hadrons fluence of 1.2×10ˆ12 cm2. Systematic irradiation campaigns have been performed using ions, protons and mixed-field high-energy hadron beams, assuming a safety factor of more than 10 on the above radiation levels. This contribution describes the complete radiation hardness campaign of the CLARO8 chips and the results of its extensive characterization.

Registered

Yes

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