Contribution ID: **112** Type: **Mini Oral and Poster**

Thermal neutron induces Single-Event Upsets in the FPGA used in particle physics experiments

Thursday 25 April 2024 12:35 (20 minutes)

Many particle physics experiments utilize FPGAs in intense radiation environments, and they are concerned about SEUs. An SEU is a soft error that occurs when a charged particle plunges into the part of an SRAM or flip-flop that holds the data. Neutrons also have the possibility of causing SEUs because they can generate charged particles by interacting with atoms in semiconductor devices. We investigated SEUs particularly caused by thermal neutrons. The study employs a 28-nm CMOS FPGA from Xilinx Inc., implementing Soft Error Mitigation (SEM) Controller firmware to detect and correct SEUs. We performed a neutron irradiation test at the tandem accelerator to measure SEUs in various settings, including shielding with polyethylene blocks or ones containing Boron trioxide. To measure the fast- and thermal-neutron doses separately, we used a solid-state track detector CR39 (allyl diglycol carbonate). Results show successful reduction of fast neutrons in certain settings, affirming control measurements and we concluded thermal neutrons caused SEUs. In this presentation, we report details on the SEUs in FPGAs caused by thermal neutrons.

Minioral

Yes

IEEE Member

No

Are you a student?

Yes

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Session Classification: Poster B

Track Classification: Front-End Electronics, Fast Digitizers, Fast Transfer Links & Networks