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# Design and Implementation of Irradiation Test Circuit for Low grade HERD-TRD Components

The High Energy Cosmic Radiation Detection (HERD) facility is scheduled for deployment on the China Space Station in 2027. A key load subsystem of the HERD, the Transition Radiation Detector (TRD), requires high-precision energy calibration and astronomical observations in the TeV energy range. However, the reliability of low-grade commercial off-the-shelf (COTS) chips used in the TRD under space radiation environments has not been adequately validated. These chips may be susceptible to risks of single-event latch-up (SEL) and single-event upset (SEU). To address this concern, this study proposes designing an anti-radiation test system with a modular architecture consisting of a master control board and some devices under test (DUTs). This system facilitates irradiation experiments on critical TRD chips, including high-voltage modules, ASIC chips, TVS diodes, precision operational amplifiers, and temperature-pressure sensor chips. The separation of the master control board and DUT ensures signal isolation and minimizes interference, enabling rapid testing of various chip types. China's major SEE test platforms are the single event effect experiment terminal at the Heavy Ion Research Facility in Lanzhou (HIRFL) and Space Environment Simulation and Research Infrastructure (SESRI). It utilizes a centimeter-level uniformly distributed beam for chip irradiation. Real-time monitoring of electrical parameters (such as output current and voltage drift) and functional states of the chips under irradiation allows for assessing SEL trigger thresholds and SEU occurrence rates. The separated architecture effectively isolates radiation interference between the master control system and the DUT, preserving the integrity of test data. This study provides an experimental validation method for assessing the radiation resistance of low-grade COTS chips in the TRD subsystem. It offers a framework for the reliability assessment of COTS chips in space detectors more broadly. Future work will incorporate long-term irradiation data to develop chip failure prediction models, ensuring the stability of HERD during its decade-long in-orbit operation. The electronics test system has been manufactured and is undergoing comprehensive electrical performance testing in preparation for anti-radiation testing. The test results will be reported at the forthcoming conference.

## Workshop topics

Front-end electronics and readout

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