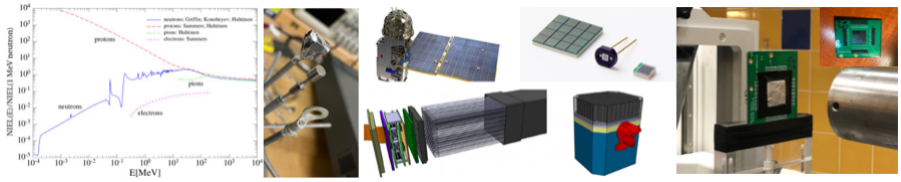

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Quantitative measurement and analysis of in-orbit radiation damage of SiPMs in GRID-02 CubeSat detector

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Silicon photomultiplier (SiPM) has recently been used in several space-borne missions for scintillator readout, thanks to its solid state, compact size, low operating voltage and insensitivity to magnetic fields. However, a known issue of operating SiPM in space environment is the radiation damage and thus the performance degradation. In-orbit quantitative study of these effects is still very limited. In this work we present in-orbit SiPM characterization results obtained by the second detector of Gamma-Ray Integrated Detectors (GRID-02), which was launched on Nov. 6, 2020. A linear fitting is used to describe the increase of dark current with radiation damage, with the compensation for the temperature coefficient of dark current based on the FE-SRH model. A daily noise level measurement of the SiPM was done with charge injection, and its result (sigma) was fitted in good accordance with the dark current. The increasing rate of ~100 μA/year per SiPM chip (model SensL MicroFJ-60035-TSV) at 28.5 V and 5℃ is observed, and consequently the overall noise level (sigma) of GRID-02 detector increases ~7.5 keV/year. This effect is estimated to be ~50 μA/year per SiPM chip at -20℃, which indicates good effect of using a cooling system. Recently, two subsequent detectors of GRID have been launched in 2022 and the new characterization data are under analysis.

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