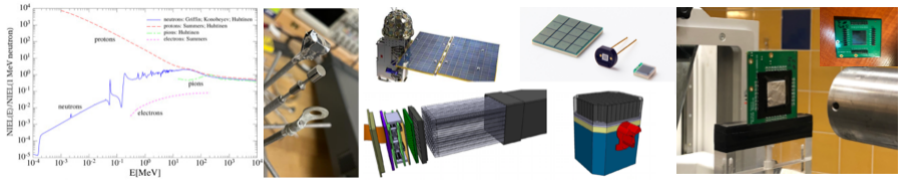


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# Radiation damage study of SensL J-series SiPMs using 101.4 MeV protons

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Radiation damage of J-series SiPMs has been studied in the context of using these photodetectors in future space-borne scintillation detectors. Several SiPM samples were exposed to 101.4 MeV protons, with fluences ranging from 1.0e8 p/cm$^2$ (1 MeV neutron equivalent fluence of 1.3e8 neq/cm$^2$, absorbed dose of 9.8 rad) to 9.3e9 p/cm$^2$ (1.2e10 neq/cm$^2$, 908 rad). An increase in the dark current and noise up to several orders of magnitude was observed for the irradiated SiPMs, which may pose problems for long-running space missions in terms of power consumption, thermal control and detection of low-energy events. As a result of 3-month room-temperature annealing following the irradiation, the dark current decreased by a factor of 3. Measurements performed with a CeBr3 scintillator crystal showed that after the SiPM exposure to 1.2e10 neq/cm$^2$ followed by the room-temperature annealing, the dark noise of a single 6x6 mm$^2$ SiPM at room temperature increased from 0.1 keV to 2 keV. Because of the large SiPM noise, the gamma-ray detection
threshold increased to approximately 20 keV for a CeBr3 detector using a 4-SiPM array and 40 keV for a detector using a 16-SiPM array. Only a small effect of the proton irradiation on the average detector signal was observed, suggesting no or little change to the SiPM gain and photon detection efficiency.

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