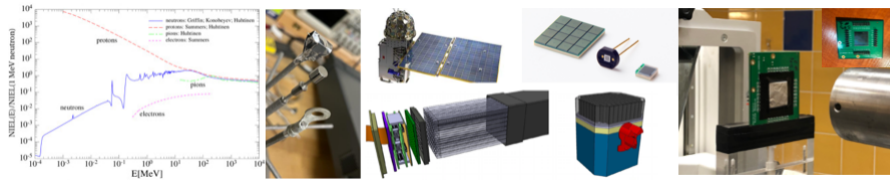


SiPM Radiation: Quantifying Light for Nuclear, Space and Medical Instruments under Harsh Radiation Conditions



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Characterization of performance parameters of irradiated SiPMs

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SiPMs performance parameters such as dark count rate, the average number of detected photons, cross-talk and after-pulsing, gain and gain fluctuations, are usually extracted from

the pulse-height spectra obtained in the dark or response to low-intensity light illumination.

This method works for non-irradiated SiPMs. The most critical effect of radiation on SiPMs is the increase of the dark count rate, which makes it impossible to resolve signals generated by a single photon from the noise. Once the single photo-electron (SPE) resolution is lost the SiPM gain cannot be directly determined as the separation of the peaks in an SPE distribution. Additionally, the breakdown voltage of the SiPM cannot be determined using the widely applied method of linear dependence of the gain versus bias voltage. In these conditions, current-voltage characteristics are used to access the deterioration of performance parameters.

A dedicated single-cell SiPM structure with a 15 μm pitch is designed and measured to investigate the radiation damage effects on the performance parameters of SiPMs exposed to a reactor neutron to a fluence up to $5 \times 10^{13} \text{ cm}^{-2}$. The first results of direct gain and breakdown voltage measurements for highly irradiated SiPMs are presented.

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