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Impact of proton irradiation on SiPM dark current for high-energy space instruments

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As photon detection is a major issue in any high-energy astronomy instrumentation, many space missions combined photomultiplier tubes (PMTs) with scintillators, for converting incoming high-energy photons into visible light, which in turn is converted in an electrical pulse. The silicon photomultipliers (SiPM), instead of photomultiplier tubes (PMTs) which are bulky, fragile, and requiring a high-voltage power supply of up to several thousand volts, seem to be an encouraging alternative in the space field. We started a R&D program to assess the possibility of using SiPMs for space-based applications in the domain of high-energy astronomy. We already presented some results of the detector characterization to study the SiPM performance in a representative space environment, namely at low temperature and low pressure. For this purpose, we developed a dedicated vacuum chamber with a specific mechanical and thermal controlled system. After measuring dark current, dark count rate and PDE (Photon Detection Efficiency), we performed a first campaign of irradiation tests at UCL (Belgium) in order to understand the susceptibility of SiPM to radiation damage on two selected detectors (Ketek and SensL references) with a high level of fluence. Finally we led a new proton irradiation campaign based on several lower levels of fluence and two energies for further study. We then present the results of dark current measurements of irradiated SensL detectors.

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