

Study of the breakdown voltage of SiPMs

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The breakdown behaviour of prototype SiPMs (Silicon Photomultiplier) with pixel sizes of 15×15 , 25×25 and $50 \times 50 \mu\text{m}^2$ manufactured by KETEK has been investigated. The I-V (current-voltage) characteristics and the PA (pulse-area) spectra have been measured as a function of bias voltage in dark conditions, as well as with the SiPM illuminated with an LED with a wavelength of 470 nm. The measurements were made in the temperature range between $-20 \text{ }^\circ\text{C}$ and $+20 \text{ }^\circ\text{C}$. From the PA spectra the gain, $G(V)$, and from a linear fit to $G(V)$, the gain-breakdown voltage, V_{bd}^G , have been obtained. From fits to the I-V curves with and without LED illumination below and above breakdown, the current-breakdown voltage, V_{bd}^I , has been determined. It is found that there is a significant difference between V_{bd}^G and V_{bd}^I . The difference $V_{\text{bd}}^I - V_{\text{bd}}^G$ is positive and increases with decreasing pixel size. We explain this difference by the difference between the turn-on and the turn-off voltage of the Geiger discharge. A possible model of the $V_{\text{bd}}^I - V_{\text{bd}}^G$ difference is presented.

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