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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 °C and +20 °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_bd^I-V_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_bd^I-V_bd^G difference is presented.

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