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Study of the heating of SiPMs

For SiPMs, the main effect of radiation damage is a dramatic increase of the dark current. The power dissipated, if not properly cooled, heats the SiPM, whose performance parameters depend on temperature. Therefore, the knowledge of the SiPM temperature is necessary to understand the changes of its parameters with irradiation. The heating studies were performed with a KETEK SiPM, 15×15 μm^2 pixel size, mounted on an Al_2O_3 substrate, which was either directly connected to the temperature controlled chuck of a probe station, or through layers of material with well-known thermal resistance. The SiPM was illuminated by a 470 nm LED operated in DC-mode. The SiPM current was measured at different voltages, LED currents, chuck temperatures, and thermal resistivities for a number of measurement cycles. The data are used to determine the steady-state temperature as a function of dissipated power and thermal resistance, as well as the time dependencies for heating and cooling. This information can be used to correct the parameters determined for radiation-damaged SiPM for the effects of self-heating. The method can also be employed for packaged SiPMs with unknown thermal contact to a heat sink.
The presentation describes the experimental layout, the data taking, the analysis methods, the results obtained and a comparison to thermal simulations. Finally, the application of the method for the study of radiation-damaged SiPMs and its use in actual experiments is discussed.

Primary experiment

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