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Effects of Neutron and Gamma Radiation on SiPMs

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The effects of radiation damage in SiPMs from gamma rays has been measured and compared with the damage produced by neutrons. SiPMs were exposed to ^{60}Co gamma rays at the Solid State Gamma-Ray Irradiation Facility at Brookhaven National Lab and the Institute for Nuclear Research (Atomki) in Debrecen, Hungary. The gamma ray exposures ranged from 1 krad to more than 1 Mrad and the neutron exposures ranged from 109 n/cm^2 to 1012 n/cm^2 . The main effect of gamma ray damage is an increase in the noise and leakage current in the irradiated devices, similar to what is seen from neutron damage, but the level of damage is considerably less at comparable high levels of exposure. In addition, the damage from gamma rays saturates after a few hundred krad, while the damage from neutrons shows no sign of saturation, suggestive of different damage mechanisms in the two cases. The change in optical absorption in the epoxy window of the SiPMs due to radiation was also measured, as well as the effect of thermal heating due to the increased dark current on the breakdown voltage. These various effects due to radiation and a comparison between neutrons as gammas are discussed in this paper, as well as discussion of the possible effects mechanisms for producing this damage in both cases.

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