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Developing a simulation for estimation of SiPM optical crosstalk levels

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SiPMs are photodetectors capable of single photon counting and are widely used in particle physics experiments, like neutrino or dark matter detectors. One of the biggest issues in developing new SiPMs is considering their optical crosstalk levels. Its characterization and understanding are of extreme importance for future detector development.
In this work, we develop a simulation based on Geant4 that estimates optical crosstalk for a given SiPM geometry. First, we propagate the charge carrier created in the silicon bulk. Then, using Geant4, we simulate avalanches and track the propagation of the photons created in the avalanches. Lastly, we analyze this data and calculate optical crosstalk levels as the function of overvoltage. We also obtain the light distribution of the secondary photons emitted from the surface of a SiPM.
The code is verified by comparing the obtained cross talk levels and light distributions with the measured data of Hamamatsu VUV4 and FBK HD3 SiPMs and will be used to predict and find the optimal geometry parameters to minimize crosstalk levels of possible future SiPM designs.

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