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Direct Measurement of Optical Cross-Talk in SiPMs Using Light Emission Microscopy

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Silicon Photomultipliers (SiPMs) are attractive light detectors for high energy and astroparticle physics experiments. They are compact in size, have fast (few ns) response time, operate at lower voltage compared to classical photomultiplier tubes, are insensitive to magnetic fields, and the newer samples offer photon detection efficiencies of > 40%. The optical cross-talk effect, whereby light emitted during the initial avalanche breakdown process may be absorbed by neighboring cells causing additional breakdowns, can degrade the performance of SiPMs. We describe ongoing work at the Max Planck Institute for Physics in Munich where we constructed a light emission microscopy setup to directly measure the emission due to optical cross-talk in SiPMs. This method provides the most precise measurement of cross-talk as well as allows one to inspect and directly visualize the existence of hot cells, which could over-proportionally contribute to the noise of a SiPM chip. We will report on the comparison of the cross-talk measurements by using the method of light emission microscopy and the traditional "blind" measurement based on amplitude measurements. Also, by using the light emission microscopy, we are exploring the possible influence of the topology of a SiPM on the cross-talk; this could help developing methods for further reducing the cross-talk. We present an overview of our setup and measurements performed. This work is part of SENSE, a roadmap for the ideal low light level sensor development and funded by the European Commission under Future and Emerging Technologies Open Coordination and Support Action.

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