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Stimulated Light Emission of Silicon Photomultipliers Devices

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Silicon PhotoMultipliers (SiPMs) are increasingly used in next-generation, large area particle physics experiments to achieve single-photon resolution [1, 2, 3]. An array of Single Photon Avalanche Diodes (SPADs) within the SiPM reacts to incident photons through an avalanche process that creates a measurable current flow. This avalanche process generates secondary photons which must be characterized to understand the correlated noise between SPADs (internal cross talk) and between SiPMs (external cross talk). We developed the Microscope for the Injection and Emission of Light (MIEL) to measure this emitted light both passively and through stimulated emission at cryogenic temperatures. Imaging and spectroscopy of the Hamamatsu VUV4, FBK VUV-HD, and DarkSide FBK SiPMs have been completed, and recent light emission characterization of a Photon to Digital Converter designed by U.Sherbrooke and implemented at Teledyne-DALSA will inform the design of next-generation backside illuminated (BSI) digital SiPMs.

References

- [1] Falcone, A. et al. Cryogenic SiPM arrays for the DUNE photon detection system. Nucl. Instrum. Methods Phys. Res. Sect. A 2021, 985, 164648.
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- [3] Gallina, G. et al. Characterization of the Hamamatsu VUV4 MPPCs for nEXO. Nucl. Instrum. Methods Phys. Res. Sect. A 2019, 940, 371–379

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