Contribution ID: **150** Type: **Poster**

Joint cross-talk and Hanbury Brown and Twiss effect measurement with the LinoSPAD2 detector

Wednesday 3 July 2024 14:28 (1 minute)

In this work, we present measurements of the cross-talk probability and the Hanbury Brown and Twiss (HBT) effect with the single-photon sensitive LinoSPAD2 detector with a linear sensor of 512 channels and timing precision of 40 ps r.m.s. Such multichannel single-photon sensitive detectors with high timing precision are highly desirable tools in many fields of research. Apart from the common applications in the high-energy physics, these can cover quantum communications, fluorescent lifetime imaging, and in our case, even quantum assisted astronomy. Latest developments of single-photon avalanche diodes fulfill all the requirements, providing hundreds of independent channels and order of tens of picoseconds timing precision. Such devices, however, tend to have relatively high dark count rates and cross-talk probabilities between the separate channels. These downsides are especially impactful when the single-photon sensitivity is coupled with a low signal-to-noise ratio. Cross-talk is especially undesirable when working with light intensity correlations, such as in the measurements of the HBT effect — the correlation patterns in thermal photon count, where the cross-talk may produce similar results as the HBT effect. With LinoSPAD2 detector, we have measured the average cross-talk probability of 0.22% for two neighboring channels at room temperature and 4 V of excess bias, a median dark count rate of 120 cps/pixel, as well as the propagation of the cross-talk with increased distance between the noise-emitter and other channels. Moreover, we present the dependency of both effects on light intensity.

[1] Milanese, Tommaso, et al. "LinoSPAD2: an FPGA-based, hardware-reconfigurable 512× 1 single-photon camera system." Optics Express 31.26 (2023): 44295-44314.

[2] Jirsa, Jakub, et al. "Fast spectrometer near the Heisenberg limit with direct measurement of time and frequency for multiple single photons." arXiv preprint arXiv:2304.11999 (2023).

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Session Classification: Poster Session