Time-correlated single-photon counting

Time-correlated single photon counting (TCSPC) is based on the detection of single photons and the measurement of their arrival time with high time resolution. In this application note we demonstrate a commercially available TCSPC setup with a record breaking low jitter using a Single Quantum Eos SNSPD system and a Swabian Instruments Time Tagger X.

MEASUREMENT SETUP

Short optical pulses are generated with a laser operating at a wavelength of 1064 nm and 50 MHz repetition rate. The emission is attenuated to a level of << 1 photon/pulse. A Time Tagger X is used to measure the correlation between the detector output and the laser sync signal (multiple-start-multiple-stop). We compare two measurement modes: In a first run, each photon event is correlated to its corresponding laser sync event. In a second run, the laser sync drives the Time Tagger's SoftwareClock to erase the jitter of the laser sync channel. The result of the Time Tagger is compared to an oscilloscope measurement with an acquisition time of 2 min, compared to 1 s for the Time Tagger measurements.

RESULTS

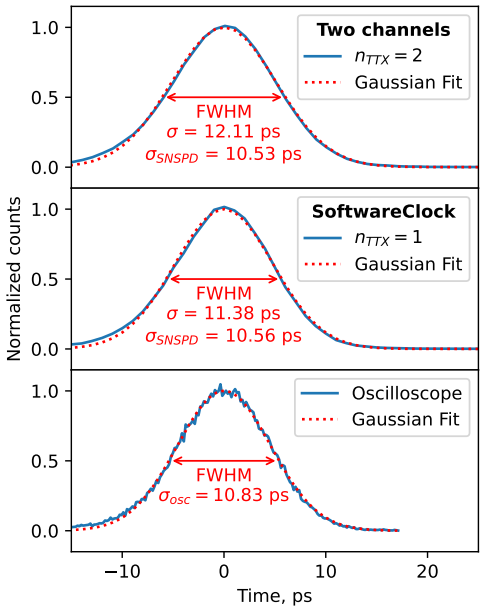
The high time resolution of the Single Quantum Eos SNSPD system and the Time Tagger X results in a record-breaking total jitter of only 12 ps FWHM for the time-correlated single-photon counting measurement.

The experimental data (blue) is very closely approximated by a Gaussian (red dashes). The total jitter is determined by the jitter of the SNSPD and the detection jitter of the Time Tagger, while contributions from the laser system are negligible in this case:

$$\sigma^2 = \sigma^2_{SNSPD} + n_{TTX} * \sigma^2_{TTX}$$

σ_{SNSPD}:	the FWHM jitter of the SNSPD
n_{TTX}:	number of Time Tagger X channels involved
σ_{TTX} = 4.2 ps:	the FWHM jitter of a single Time Tagger X channel

The precise agreement of the resulting σ_{SNSPD} for the two Time Tagger measurements demonstrates the jitter reduction by exploiting the periodicity of the laser.



For questions regarding the SNSPDs used in this experiment, please contact sales@singlequantum.com

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