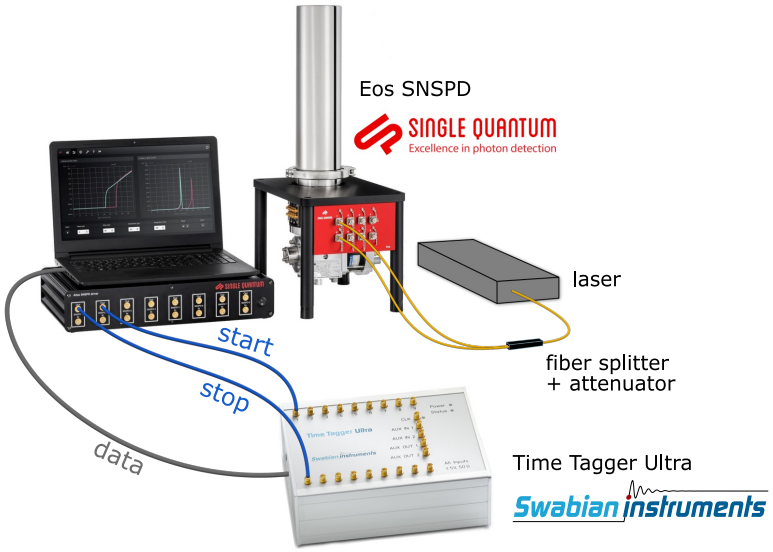
Time-correlated single-photon counting

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 Ultra with HiRes Core.

MEASUREMENT SETUP

Short optical pulses of 4 ps duration are generated with a laser operating at a wavelength of 1064 nm. The laser output is attenuated and coupled to a fiber splitter that delivers pulses to two SNSPDs. A Time Tagger Ultra 18 is used to measure a full correlation of the detector outputs (multiple-start-multiple-stop). The highest possible time resolution is unleashed by using only two inputs, each combining 9 physical channels of the correlator.



RESULTS

The high time resolution of the Single Quantum Eos SNSPD system and the Time Tagger Ultra results in a record-breaking total jitter of only 18 ps FWHM for the full time-correlated single-photon counting measurement. The measured response function is shown below.

The experimental data (blue) is very closely approximated by a Gaussian (red dashes). The total jitter has a number of independent contributions from the system components that under gaussian approximation can be expressed as

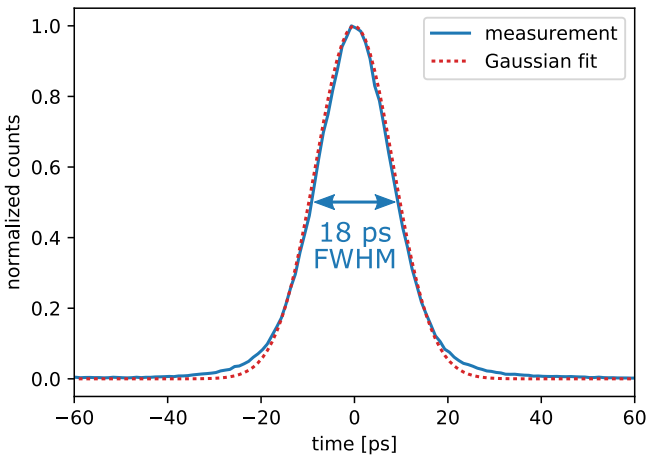
$$\sigma^2 = 2*\sigma^2_{laser} + 2*\sigma^2_{correlator} + \sigma^2_{SNSPD1} + \sigma^2_{SNSPD2}$$

σ^2_{laser} = 4.2 ps, is the laser pulse duration

σ^2_{SNSPD1} = 9.5 ps, is the FWHM jitter of the first SNSPD

σ^2_{SNSPD2} = 10 ps, is the FWHM jitter of the second SNSPD

$\sigma^2_{correlator}$ = 6.4 ps, is the FWHM jitter of the Time Tagger Ultra with 9 combined input channels.



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