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Experimental methods for measurement and analysis of quantum fluctuations and correlations in bright comb-like pulses

Previously, a quantum state reconstruction of a fs pulse, squeezed in a fibre by the Kerr effect, was not feasible due to the strong carrier pulse. This measurement is enabled here by the separation of both classical and quantum fluctuations from the carrier pulse. Based on the comb structure of fs pulses, emitted by mode-locked lasers, an adequate optical resonator is used for this spectral separation. Thereby the separated fluctuations can be analysed in a balanced homodyne detection (BHD) setup by a local oscillator (LO) pulse. Furthermore, the introduced setup allows to shape the LO pulse and thereby facilitates the characterisation of correlations between different parts of the pulse.

The separation resonator was experimentally characterised as its properties influences the observed interference patterns. Furthermore, for the evaluation of the BHD data, an approach was used that enabled necessary corrections as well as the simultaneous evaluation of the vacuum reference.

One mayor limiting factor for the observed squeezing was the phase noise from Brillouin scattering on thermally excited vibrational modes of the fibre. This was verified by observation a reduction in phase noise after submerging the fibre in liquid nitrogen.