Without our active control loops the noise suppression would reach the same values, however, only stable over short time scales. For instance, in Ref. [22], where φ_{ent} was not locked, the measurement time was only 200 μs. The stability of our phase lock was not limited to the 10 s being presented in the figure. Indeed, we observed the stable production of our entangled states for more than 15 min. In principle, our active control loops allow an extension of the measurement time to arbitrary duration if the dynamic ranges of the used piezo actuators are large enough to compensate for thermal drifts.

The optical loss of our squeezed-light sources was slightly asymmetric with an outcoupling efficiency of about 96 % for the first and about 97.5 % for the second source. The fringe visibility at the entangling beam splitter was about 99.5 %. Taking into account the 1 % loss introduced by the tap-off in one arm for the phase lock at the entangling beam splitter and together with a fringe visibility of about 99.5 % at the homodyne detectors' beam splitters, the quantum efficiency of about 99 % and propagation losses of about 1 %, the observed values for the Duan and EPR-Reid criterion are reproduced quite well. We observed no evidence for phase noise, showing the good performance of the implemented control scheme.

4. Conclusion

In conclusion we have demonstrated a phase control scheme for two-mode squeezed vacuum states at the telecommunication wavelength of 1550 nm. Using this scheme we generated states which showed a Duan inseparability value of 10.45 dB and an EPR-Reid value of $0.0309 < 1$. The demonstrated control scheme allowed for arbitrary phase angles between the squeezed modes and for arbitrary homodyne angles, while introducing only 1 % optical loss in one arm. No evidence for phase noise introduced by the locks was found. The observed states are highly suitable for demanding experiments like CV superactivation and a CV quantum cryptography proof-of-principle experiment showing security against most general coherent attacks including finite size effects. Indeed a positive key rate for more than 4×10^7 samples (after sifting) is feasible with the present state [13]. For very large numbers of samples the key rate would reach about 0.8 bits/sample. The wavelength of 1550 nm makes the states compatible with existing telecommunication fiber networks. The good mode shape, as shown by the high visibility of 99.5 % at both homodyne detectors, allows high coupling efficiencies to optical fibers as demonstrated in Ref. [30].

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