To simulate the realistic setup, we have used a more rigourous model in which the initial state (either Eq. (1) or Eq. (7)) is transformed through a beam splitter with a reflectivity of 5%, displaced and finally measured with the projector $\Pi = 1 - |0\rangle\langle 0|$. The results (both for the single mode and the two-mode squeezed state) are shown in Fig. 7. It is obvious from the figures that the trend of the LN as a function of the initial average photon numbers is identical to the trend for the ideal distillation scheme in Fig. 2(a), but the amount of entanglement is slightly lower in the former case. Another crucial parameter for characterizing the performance of the distillation protocols is the success probability. This is plotted in Fig. 7(b). At first it seems counter-intuitive that the success probability decreases when displacement is included, but it can be understood as follows. The rate of the initial photon detection in mode A is indeed increased when displacement is introduced. However, photon subtraction from a squeezed state *increases* its average photon number, so the displacement (which is experimentally implemented by admixture of a coherent state) leads to a *lower* increase in the photon number of mode B after the subtraction in mode A. Furthermore, the displaced photon subtraction results in a state which has a small displacement in phase space (as opposed to the zero-mean of the initial state). The subsequent displacement of mode B before the photon detection there is opposite in direction of the state's displacement, leading to destructive interference in the detected mode. As a result of these two effects, the success probability of the second photon detection is considerably lower with displacement than without, outweighing the increased probability of the first detection.

In conclusion, we have theoretically investigated a displacement-enhanced distillation scheme of entangled states that are produced by a single squeezed mode. We have found that a simple Gaussian displacement operation prior to photon subtraction increases the entanglement of the distilled state. Similar conclusion has been found for the two-mode squeezed state scheme, but in contrast to the previous proposals, the experimental realization of our scheme is much simpler as it does not require the control and phase locking of two independent squeezed beams. An experimental realization is therefore feasible with current technology [30–32]. On the other hand, our analysis also shows that if the entanglement distribution channels are sufficiently lossy, it is still advantageous to use two-mode squeezing at the initial stage. This may also be required if a Gaussian-like two-mode squeezing is required for a given protocol.

Acknowledgments

We acknowledge financial support from the Danish Agency for Science Technology and Innovation.

fl˘fl ı f 5HFHLYHG fl-DQfl flUHYLVHG fl0DUfl flDFFH