Continuous variable quantum teleportation via entangled Gaussian state generated by a beam splitter

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Introduction

We theoretically implemented the protocol of continuous variable quantum teleportation wherein Alice and Bob share a state built by a beam splitter as general two-mode Gaussian entangled state.

Model Formulation

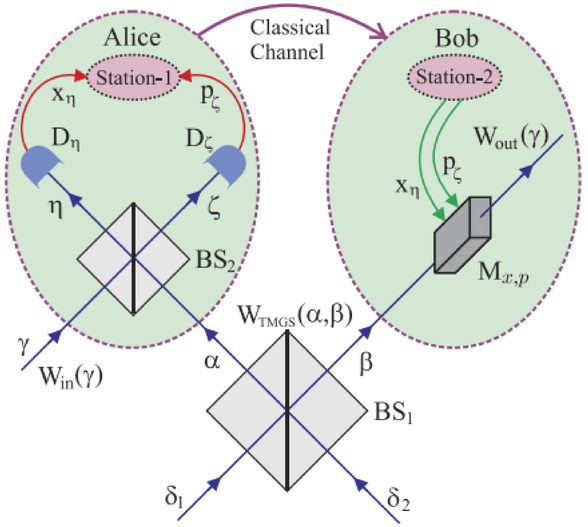

Fig. 1: Schematic of the teleportation process.

Input Covariance Matrix:

$$V_{\text{in}} = \begin{pmatrix} V_1 & 0 \\ 0 & V_2 \end{pmatrix}$$

Fidelity [1]:

$$F = \pi \int \mathrm{d}^2\beta W_{\text{in}}(\beta)\, W_{\text{out}}(\beta)$$

Results

a) The maximum of the fidelity increases with increase in the non-classicality of the input states.
b) The fidelity enhances with purity in the entire regime of ϑ.
c) The line-width of the fidelity sharpens when any of phase space quadratures (x or p) of the squeezed coherent state with Alice increases.
d) Maximal fidelity requires minimal squeezing in the desired input state, since the squeezing parameter decreases the efficiency of the quantum state teleportation.

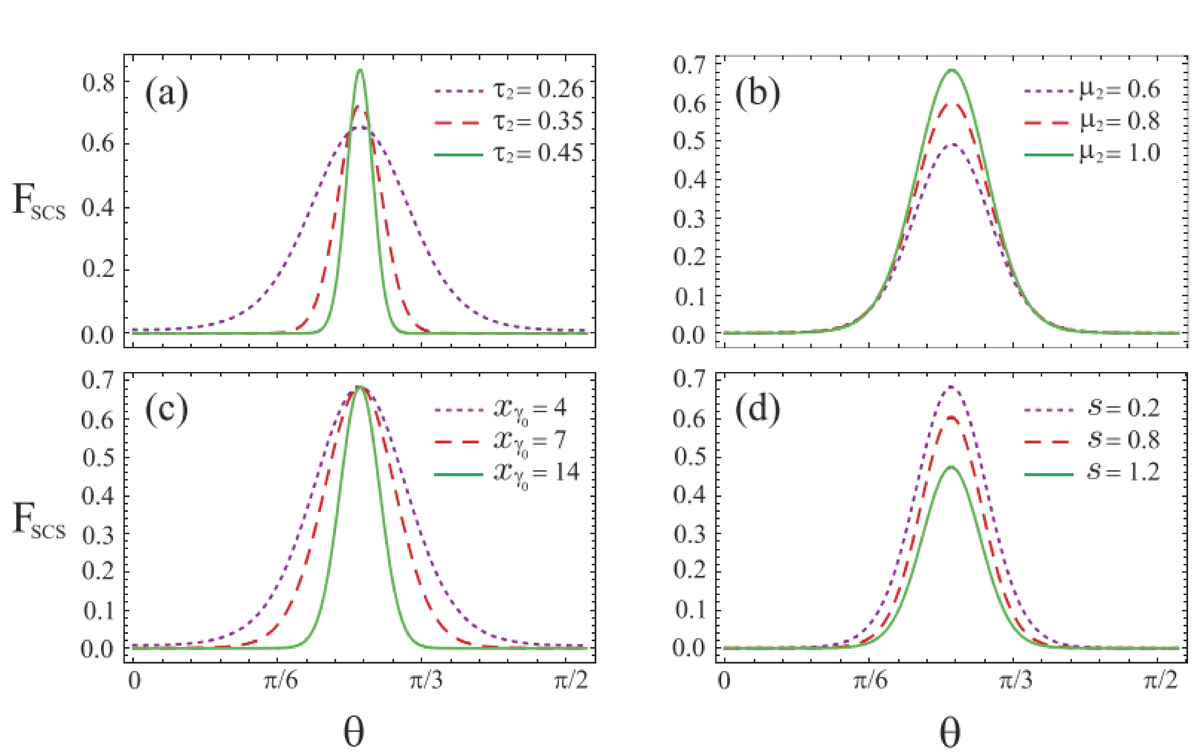

FIG. 2: The fidelity F_{SCS} of the teleported squeezed coherent state is plotted versus angle θ of the BS_1 with various parameters of the system. (a) $\mu_1 = \mu_2 = 1$, $\tau_1 = 0.1$, $x_{\gamma_o} = p_{\gamma_o} = 7$, and $s = 0.2$. (b) $\tau_1 = 0.1$, $\tau_2 = 0.3$, $x_{\gamma_o} = p_{\gamma_o} = 7$, and $s = 0.2$. (c) $\mu_1 = \mu_2 = 1$, $\tau_1 = 0.1$, $\tau_2 = 0.3$, $p_{\gamma_o} = 7$, and $s = 0.2$. (d) $\mu_1 = \mu_2 = 1$, $\tau_1 = 0.1$, $\tau_2 = 0.3$, and $x_{\gamma_o} = p_{\gamma_o} = 7$.

Conclusions

- It is easy to teleport an unknown quantum state with maximal pure input states.
- To obtain easier teleportation, one must have minimized the squeezing parameter of the state which is being teleported.
- Continuous variable quantum teleportation in terms of the non-classicality and purity of the input states may play pivotal role for the practical realization of quantum communication and computation [2].

Reference

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2. N. Gisin, G. Ribordy, W. Tittel, and H. Zbinden, Rev. Mod. Phys. **74**, 145 (2002).

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Further information

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