Einblicke in die Forschungsarbeit

FORSCHUNGSARBEIT

„Optimal Measurement-Disturbance Tradeoff“

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Optimal Measurement-Disturbance Tradeoff

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Based on the theoretical work [1] from Hashagen together with her former thesis advisor Prof. Dr. Michael Wolf, this collaboration aimed at validating a tight bound for the tradeoff relation between the measurement induced disturbance and the thereby gained information in quantum theory [2].

[1] Ann. Henri Poincaré (2018), 1-40.

[2] arXiv:1808.07882

Optimal Measurement-Disturbance Tradeoff

One of the characteristic features of quantum mechanics is that every measurement that extracts information about a general quantum system necessarily causes an unavoidable disturbance to the state of this system. A plethora of different approaches has been developed to characterize and optimize this tradeoff for particular measurement scenarios. Yet, the framework of quantum instruments not only allows to investigate the optimal tradeoff, but furthermore to derive and identify the general, optimal procedures themselves.

In our collaboration, we focus on binary measurements on qubits as commonly used in communication and computation protocols. We demonstrate theoretically and in an experiment that the optimal universal asymmetric quantum cloner, albeit ideal for cloning, can be outperformed with high significance by the optimal procedures derived with the quantum instrument framework.

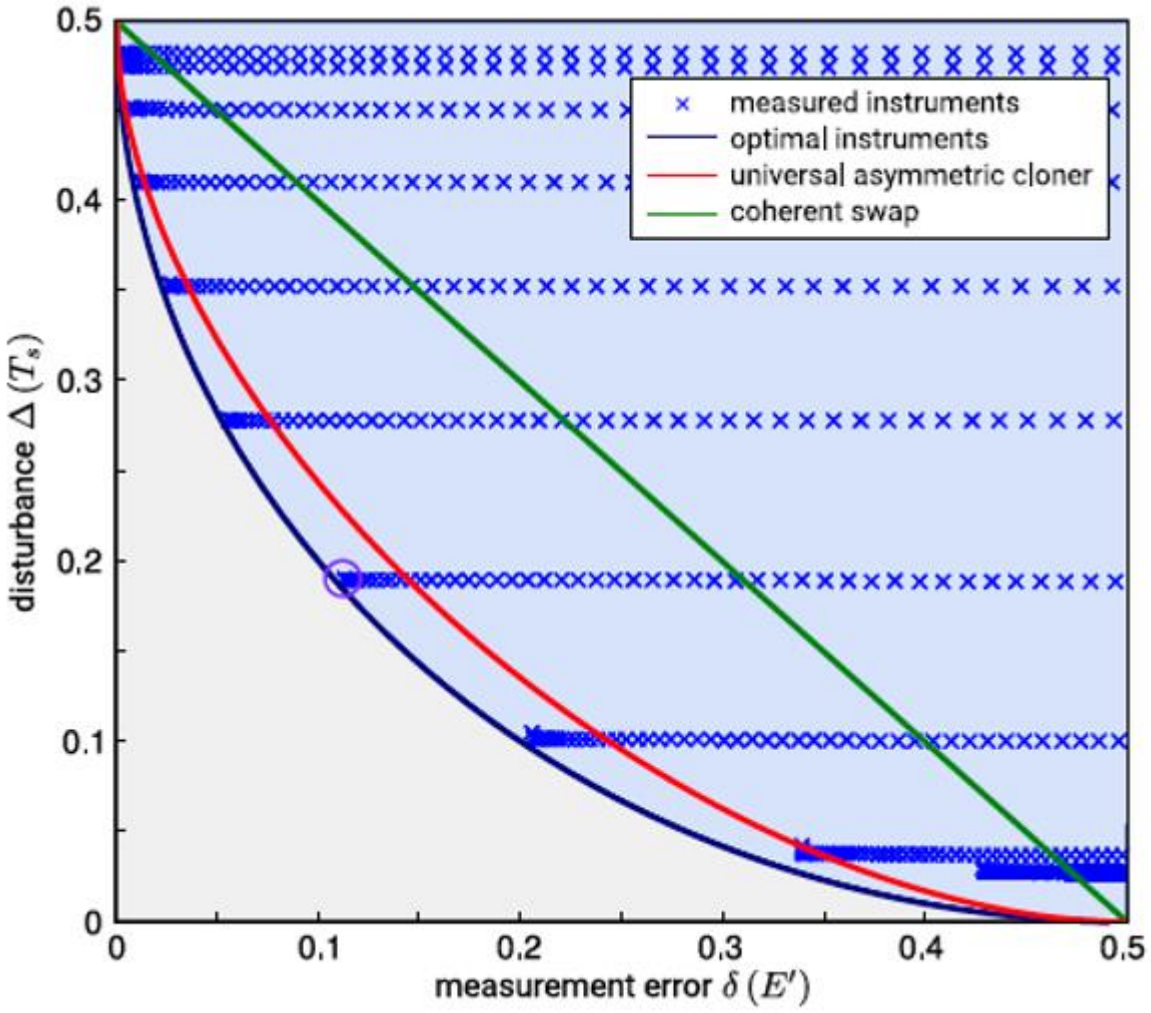

FIG. 1. The optimal quantum instruments in terms of measurement error and disturbance clearly outperform the optimal asymmetric cloner (red curve) and the coherent swap operation (green line). Our measurements (blue crosses) come close tot he theoretical curve (blue curve).