

State learning from qubit pairs or trios or ...

Berge Englert

School of Physics, Beijing Institute of Technology, China
Department of Physics, National University of Singapore, Singapore

A source emits qubits in two pure states at random — that is, the next qubit is of either kind, and we also do not know with which frequency each kind occurs. A tomographically complete measurement on the arriving qubits will not tell us the two states or their frequencies, unless we have additional information. As shown in [1], if the qubits are paired up with partners in the same state, we can infer the states and their frequencies. I'll review this matter and explain how one can learn three states from trios, four states from quartets, and so forth.

Two ongoing experiments realize this situation, one in Beijing and the other in Toronto. I'll report on the progress of both experiments.

As a possible application of such a communication channel, I'll describe a quantum key distribution scheme inspired by the B91 protocol.

- [1] P. Agarwal, N. Ali, C. Polvara, M.-I. Trappe, B.-G. Englert, and M. Hillery, *State learning from pairs of states*, Phys. Rev. A **111**, 062428 (2025); e-print arXiv:2409:11120 [quant-ph].