Experimental Realization of Continuous-Variable Quantum Error Correction Codes

Lassen, Mikael Østergaard; Madsen, Lars Skovgaard; Andersen, Ulrik Lund

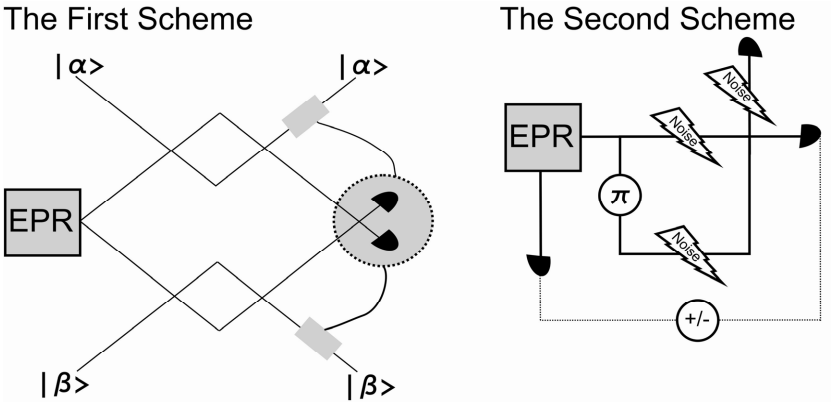
Publication date:
2011

Document Version
Publisher's PDF, also known as Version of record

Experimental Realization of Continuous-Variable Quantum Error Correction Codes

Mikael Lassen, Lars Skovgaard Madsen and Ulrik L. Andersen
Department of Physics, Technical University of Denmark, Building 309, 2800 Lyngby, Denmark

Quantum information processing relies on the robust and faithful transmission, storage and manipulation of quantum information. However, since different decoherent processes are inherent to any realistic implementation, the future of quantum information systems strongly relies on the ability to detect and perform error code correction and noise filtration. We present two different schemes to eliminate erasure errors and channel excess noise in continuous-variable quantum channels.



The first code we present is for eliminating erasure errors in quantum channels [1]. The scheme encodes two coherent states (the quantum information) into a bi-party entangled state, and the resulting 4-mode code is conveyed through 4 independent channels that randomly erases the signal. The scheme relies on the fact that one can correct the losses provided that one can monitor the occurrence of erasures.

The second code has the ability to eliminate channel excess noise. This scheme conveys the quantum information (coherent, squeezed states or the distribution of entangled states) through 2 independent channels (for example two polarization modes) with correlated noise and with the quantum information being prepared so that it is anti-correlated in the two modes. Note that this kind of excess noise is found in optical fibers. After transmission the two modes are overlapped on a beam-splitter and the quantum information and channel excess noise can be separated.

[1] M.Lassen *et al.,* Nature Photonics **4**, 700–705 (2010)