Noise resilient quantum interface based on QND interaction

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We propose a quantum interface protocol based on two quantum-non-demolition interactions (QND) arranged either in sequence or in parallel. Since the QND coupling arises naturally in interactions between light and a macroscopic ensemble of atoms, or between light and a micro-mechanical oscillator, the proposed interface is capable of transferring a state of light onto the matter systems. The transfer itself is perfect and deterministic for any quantum state, for arbitrarily small interaction strengths, and for arbitrarily large noise of the target system. It requires a all-optical pre-processing, requiring a coupling stronger than that between the light and the matter, and a displacement feed-forward correction of the matter system. We also suggest a probabilistic version of the interface, which eliminates the need for the feed-forward correction at a cost of reduced success rate. An application of the interface can be found in construction a quantum memory, or in the state preparation for quantum sensing.

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