CC-04-01

Resource efficient fault-tolerant one-way quantum repeater with code concatenation

Johannes Borregaard

QuTech, Delft University of Technology

Abstract

One-way quantum repeaters where loss and operational errors are counteracted by quantum error correcting codes can ensure fast and reliable qubit transmissions in quantum networks. It is crucial that the requirements of such repeaters such as the number of spin-photon interfaces per repeater station, the gate error rates, and loss rates within a repeater node are reduced to allow for near-future implementations. In this talk, I will discuss a recent proposal of a one-way quantum repeater that targets the general asymmetry between loss- and operational error rates in a communication channel in a resource efficient manner using code concatenation. Specifically, we consider a tree-cluster code as an outer loss-tolerant code concatenated with an inner 5-qubit code for protection against Pauli errors. Adopting flag based stabilizer measurements, we show that intercontinental distances of up to 10,000 km can be bridged with a minimal resource overhead by interspersing repeater stations that operates differently at the two codes. Our work demonstrates how tailored error correcting codes can significantly lower the experimental requirements for long-distance quantum communication.