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Realistic parameter regimes for a single sequential quantum repeater node KENNETH GOODENOUGH, FILIP ROZPEDEK, JEREMY RIBEIRO, VALENTINA CAPRARA VIVOLI, QuTech, Delft University of Technology, ANDREAS REISERER, Max Planck Institute of Quantum Optics, DAVID ELKOUSS, STEPHANIE WEHNER, QuTech, Delft University of Technology, QUTECH TEAM, MAX PLANCK INSTITUTE OF QUANTUM OPTICS TEAM
— The goal of a quantum repeater is to be able to communicate more efficiently than it is possible without a quantum repeater. In particular, it is natural to compare the rate at which one can generate secret key with an implementation of a quantum repeater and the theoretical maximum rate without one. By modeling such a repeater implementation, it is possible to find parameter regimes where repeaters would give a benefit over direct communication. Here, we model a specific, but general, setup for a repeater which can be implemented using, for example, nitrogen-vacancy centers. Furthermore, we also introduce three new tools to assess the performance of repeaters. The first of these tools is a series of benchmarks based on finite-energy considerations and to what one considers as losses in the setup. The second tool is the introduction of a cut-off, which reduces the effect of decoherence in systems such as nitrogen-vacancy centers by implementing a maximum on the allowed storage time. Finally, we analyze the repeater setup when advantage distillation is used, which is a more advanced type of classical post-processing. Using these tools, we find realistic parameters for which it is possible to beat the mentioned benchmarks, guiding the way towards implementing quantum repeaters.

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