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Experimental realisation of quantum networks

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The trapped-ion quantum computer platform benefits from long coherence times [1] and high gate fidelities [2]. Due to the spectral density of motional modes, co-trapping and mutually controlling a large number of ionic qubits in a single trap is technically challenging. Therefore, large-scale trapped-ion quantum computers will require interfaces connecting many individual traps [3-5]. We present a photonic link entangling two Sr-88 ions trapped in physically separate systems with unprecedented fidelity and entangling rate, which renders entanglement distillation viable in future high-fidelity quantum networking applications.

With quantum computers available on a cloud-computing basis, the question of accessibility, privacy and information security arises. Measurement-based blind quantum computing [6] enables remote steering and control of quantum algorithms on a server without disclosing the details of the computation to the provider. We discuss a scheme to implement blind quantum computing experimentally via an optical fibre cable connecting a trapped-ion quantum computer with a client-controlled high-speed polarisation analyser.

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