A quantum network of room temperature quantum memories

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Progressing quantum technologies to room temperature operation is key to unlock the potential and economic viability of many-device quantum networks. Along these lines, warm atomic ensembles are a viable alternative to cold atoms setups or cryogenically cooled condensed matter systems.

Here we report our progress towards building a prototypical quantum network, containing several high duty cycle room-temperature quantum memories interconnected using high rate entanglement sources. We have already demonstrated important capabilities such as, (i) portable warm 87 Rb atomic vapor quantum memories operating in a ultralow-noise regime of operation with qubit storage fidelities > 98% [1], (ii) memory-built-in photon-shaping techniques necessary to interface several quantum memories efficiently [2] and (iii) a functional elementary quantum network combining random polarization qubits, a free-space quantum communication channel, an ultra-low noise quantum memory and a qubit decoder, already capable of performing the BB84 quantum cryptography protocol with small quantum bit error rates [3].

Furthermore, we have finished the implementation of a cryptographic network containing two quantum memories, receiving, storing and transforming randomly polarized photons, aimed to realize the memory-assisted measurement device independent QKD protocol [4]. Recently we have also finished the expansion of this elementary network by adding two more quantum memories and two SPDC-based polarization entanglement sources tuned to rubidium transitions. This body of works suggest that an elementary quantum repeater node using polarization entanglement swapping mediated by room temperature quantum memories is already within experimental reach.

References

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