Towards a Quantum Network

A quantum network allows for communication between separate quantum processors to perform clustered computation and could eventually lead to the development of a quantum internet. The backbone of quantum computing is the superconducting quantum circuit (SQC), but these qubits are stationary and a “flying” qubit is needed for networking. I will discuss how to convert between the microwave frequency qubits of SQC and telecom wavelength photons with a high fidelity, such that the photons can be used to transfer entanglement to distant quantum computers. My scheme involves using a modified optical quantum memory protocol to faithfully store a telecom photon in an erbium doped crystal. Then the collective spin resonance created in the memory can be made to couple through a microwave cavity to the SQC. Reversing this process couples the SQC excitation into a telecom photon. Developing such a quantum transducer is the missing piece to the development of high fidelity quantum networks.