Quantum Networks of the First Kind

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Quantum networks are tailor-made large-scale quantum systems with applications ranging from quantum computation to communication. Elementary networks with limited capabilities have been demonstrated, but realizing a scalable architecture with distributed quantum memories is a challenge. Against this backdrop, the seminar introduces a unique set of network protocols, all based on quantum non-demolition light-matter interaction in cavity quantum electrodynamics. They can track photonic qubits, distribute heralded entanglement, implement quantum logic, generate flying cat states on demand, teleport qubits without ex-ante entanglement, and detect Bell states of distant material qubits in a non-destructive way. The protocols are mutually compatible and can be combined in a useful quantum network.