Abstract for an Invited Paper

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Cavity Quantum Electrodynamics: A Universal Quantum Optics Toolbox

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Electromagnetic resonators provide unparalleled capabilities in controlling the interaction between light and matter. The recently developed techniques for trapping and cooling atoms between closely spaced mirrors now open up new experimental avenues for genuine quantum-mechanical experiments. Particularly exciting possibilities concern long-distance quantum networking and scalable quantum computation. Recent achievements like the nondestructive detection of an optical photon [1], the realization of a quantum gate between a single atom and a single photon [2], and the heralded and efficient conversion of a flying qubit into a stationary qubit [3] are past highlights. The longstanding dream of a quantum gate between individually addressable photonic qubits might become reality in the future. The talk will summarize recent experiments and give an outlook onto future directions.