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Multiplexed Photonic Qubit Memory with Individual Atoms in an Optical Cavity STEFAN LANGENFELD, OLIVIER MORIN, MATTHIAS KOERBER, GERHARD REMPE, Max Planck Institute of Quantum Optics — A future quantum internet is likely to rely on multi-purpose nodes that can store, route and compute on photonic qubits. To this end, one needs to combine a light-matter qubit interface for communication with a multi-qubit register for computation. After recently demonstrating a qubit memory featuring a coherence time compatible with global scale communication [1], we now implement multi-qubit memory capabilities in a setup which has already been shown to support elementary computations [2]. Our system consists of two Rb87 atoms trapped in a high-finesse optical resonator. We use an atom-selective single-photon stimulated Raman adiabatic passage (STIRAP) to store and retrieve photonic qubits [3]. I will discuss how we achieve close to negligible cross-talk between the atoms, maintain a high efficiency and near-unity fidelity with a coherence time approaching 1ms. These results promote individually addressable neutral atoms in optical cavities to a scalable architecture and make them a prime candidate for realizing quantum network nodes. [1] M. Körber et al., Nat. Photonics 12, 18-21 (2018). [2] S. Welte et al., Phys. Rev. X 8, 011018 (2018). [3] O. Morin et al., Phys. Rev. Lett. 123, 133602 (2019).

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