Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Protocols for a quantum network based on single photons SUSANNE BLUM, Theoretical Physics, Saarland University, Germany, CHRISTOPHER O'BRIEN, Department of Physics and Astronomy, Texas A& M University, DANIEL REICH, Theoretical Physics III, University of Kassel, Germany, NIKOLAI LAUK, Physics Department, University of Kaiserslautern, Germany, CHRISTIANE KOCH, Theoretical Physics III, University of Kassel, Germany, MICHAEL FLEISCHHAUER , Physics Department, University of Kaiserslautern, Germany, GIOVANNA MORIGI, Theoretical Physics, Saarland University, Germany — Two protocols for interfacing single optical photons with individual qubits are theoretically discussed. The first is a protocol which allows one to interface a single optical photon with a superconducting qubit. It makes use of a a spin ensemble, where the individual emitters possess both an optical and a magnetic dipole transition. Reversible frequency conversion is realized by combining optical photon storage, for instance by means of EIT, with the controlled switching on and off the coupling of the magnetic dipole transition with a microwave cavity, which in turn couples to a superconducting qubit. We test various strategies and compare their efficiencies in terms of robustness and transfer time. The second protocol aims at achieving perfect absorption of a photon by a single trapped atom, or solid-state emitter, by means of optimal control theory. We make use of the Krotov algorithm for the purpose of identifying pulses driving the atom, that maximize the efficiency and fidelity of absorption in the setup of [Reiser et al., Nature **508**, 237 (2014)]. These protocols contribute to the development of a toolbox for quantum networks using hybrid platforms.

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Date submitted: 13 Nov 2014 Electronic form version 1.4