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Hamiltonian simulation for improved state transfer and readout in cavity QED FÉLIX BEAUDOIN, McGill University, ALEXANDRE BLAIS, Université de Sherbrooke, WILLIAM A. COISH, McGill University — Quantum state transfer into a memory, state shuttling over long distances via a quantum bus, and high-fidelity readout are important tasks for quantum technology. Generating the Hamiltonians that realize these tasks is challenging in the presence of realistic couplings to an environment. Here, we use average Hamiltonian theory to design the desired Hamiltonians in cavity QED. In particular, we present a protocol for state transfer between a qubit and a cavity. This approach makes use of a controllable qubit-cavity coupling strength to achieve a high fidelity even in the presence of inhomogeneous broadening that is stronger than the qubit-cavity coupling strength. In addition, we design a time-averaged interaction that allows for an improved quantum nondemolition readout. These ideas can be applied directly to propel novel systems coupling single spins to a microwave cavity into the strong coupling regime [Viennot et al, Science 349, 408 (2015)]. The approach can also be employed to improve quantum operations with spin ensembles.

Felix Beaudoin
McGill University

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