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Locally addressable atomic many-body quantum system coupled to a high finesse optical resonator JUSTIN GERBER, EMMA DOWD, JOHANNES ZEIHER, DAN STAMPER-KURN, University of California, Berkeley — The study of many-body quantum systems via weak measurement and at the single atom level will provide a deeper understanding of these systems and provide a basis for novel control techniques. Here we report on the construction of an experimental apparatus in which an atomic many-body system will be strongly coupled to an optical cavity and with which we will be able to locally address the individual components of the many-body system for read out and control. The interaction of atoms with the photonic modes of a high finesse optical cavity allows for the ability to engineer interactions between the atoms as well as the ability to sensitively measure their quantum state. Local addressability will be facilitated by optical potentials imaged onto the atoms through a high-resolution objective transverse to the cavity axis. This apparatus will provide the capability to locally engineer many-body Hamiltonians for quantum simulation, to introduce tunable dissipation into the quantum system and to strongly and weakly measure many-body correlation functions. Weak continuous measurement combined with local dynamical control of the Hamiltonian opens the door to many-body quantum feedback and novel control schemes.

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