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Collision Microscope to Study Many-Body Quantum Entanglement CRAIG PRICE, QI LIU, NATHAN GEMELKE, Pennsylvania State University — Quantum entanglement over long length scales is present in both quantum critical and quantum ordered many-body systems and can often be used as a fingerprint for underlying dynamics or ground-state structure. Limited quantum measurement and thermal back-action via controlled collisions of cold atoms and subsequent optical detection can be used to probe long-range entanglement. Entanglement Entropy has recently arisen as a quantitative vehicle to describe entanglement in thermodynamic systems, and its scaling with area can reveal detailed character of the system. We present progress in constructing an apparatus to experimentally extract Entanglement Entropy through pair-wise entanglement of cold fermionic potassium and bosonic cesium gases. The measurement will be made by translating localized probe atoms through a portion of a strongly entangled sample, then recording the heating effect of back-action after optical detection of probe atoms. To do so, precise independent control over the atoms will be maintained in a bichromatic lattice[1] formed with a monolithic, common-mode optical setup imbedded in a quantum gas microscope. Other applications are discussed, including cooling of a Mott-Insulator and study of non-equilibrium quantum systems.

[1]Rev Sci Inst 81,013109 (2010).

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