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Entangling transportable neutral atoms via local spin-exchange ADAM KAUFMAN, BRIAN LESTER, University of Colorado at Boulder, JILA, NICLAS LUICK, University of Hamburg, CINDY REGAL, University of Colorado at Boulder, JILA — Building on our recent work preparing indistinguishable atoms and performing an atomic Hong-Ou-Mandel experiment [1], we now use these techniques to create controlled spin-entanglement between two neutral atoms. We demonstrate the full toolset for using local spin-exchange to create non-local entanglement. Starting with two spatially separated atoms, we controllably apply a tunnel-coupling to load the atoms into the same optical tweezer but in distinct motional states. By initially preparing the atoms in opposing spin-states, contact interactions between the atoms, along with their quantum statistics, yield entangling spin-swapping dynamics. We experimentally verify that upon separating the atoms subsequent to these dynamics, the entanglement achieved prior is retained. We will also present our recent realization of deterministic loading of 87Rb atoms into an optical tweezer via the techniques developed in Ref. [2]; we achieve fast loading with up to 91% probability. In combination, these techniques demonstrate a novel platform using mobile optical tweezers for loading uniform atom arrays for quantum-information applications.

[1] Kaufman et al., Two-particle quantum interference in tunnel-coupled optical tweezers, Science **345**, 306-309 (2014)
[2] Grünzweig et al., Near-deterministic preparation of a single atom in an optical microtrap, Nature Phy. **6**, 951-954 (2010)

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