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Spin dynamics and Kondo physics in optical tweezers YIHENG LIN, BRIAN J. LESTER, MARK O. BROWN, ADAM M. KAUFMAN[1], JUNLING LONG, RANDALL J. BALL, LEONID ISAEV, MICHAEL L. WALL, ANA MARIA REY, CINDY A. REGAL, JILA, National Institute of Standards and Technology and University of Colorado; Department of Physics, University of Colorado — We propose to use optical tweezers as a toolset for direct observation of the interplay between quantum statistics, kinetic energy and interactions, and thus implement minimum instances of the Kondo lattice model in systems with few bosonic rubidium atoms. By taking advantage of strong local exchange interactions, our ability to tune the spin-dependent potential shifts between the two wells and complete control over spin and motional degrees of freedom, we design an adiabatic tunneling scheme that efficiently creates a spin-singlet state in one well starting from two initially separated atoms (one atom per tweezer) in opposite spin state. For three atoms in a double-well, two localized in the lowest vibrational mode of each tweezer and one atom in an excited delocalized state, we plan to use similar techniques and observe resonant transfer of two-atom singlet-triplet states between the wells in the regime when the exchange coupling exceeds the mobile atom hopping. Moreover, we argue that such three-atom double-tweezers could potentially be used for quantum computation by encoding logical qubits in collective spin and motional degrees of freedom.

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