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Quantum double-exchange physics with ultracold atoms and synthetic gauge potentials[1] JOHANNES SCHACHENMAYER, LEONID ISAEV, ANA MARIA REY, JILA, NIST and Dept. of Physics, University of Colorado Boulder — We study an interplay between local spin exchange and Néel antiferromagnetism in a two-band optical lattice. The lowest narrow band is half-filled and implements the magnetic background, while a higher band contains mobile atoms. When the local spins are locked in a Néel state, the motion of itinerant atoms is hindered by exchange energy barriers and the system is a flat-band insulator. As we show, this picture breaks down when exchange interaction between local and mobile spins is comparable to an energy scale of the Néel state. In this regime, formation of singlets between local and itinerant spins gives rise to a metallic phase of mobile atoms dressed by the spin fluctuations. This state is characterized by coupled spin-charge excitations whose spin is transverse to the Néel vector. Our predictions can be realized with ultracold alkaline-earth fermionic atoms coupled to a laser-induced staggered magnetic field, which stabilizes the Néel order and controls the amount of quantum fluctuations of local spins. By tuning the strength of this laser coupling relative to the exchange interaction, one can either adiabatically drive the crossover between the flat-band insulator and correlated metal phases, or explore non-equilibrium spin-charge dynamics in quench experiments.

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