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First-order phase transition in the bosonic Kondo-Hubbard model MICHAEL FOSS-FEIG, ANA MARIA REY, University of Colorado, NIST, and JILA — Recent experimental progress in populating the excited bands of an optical lattice gives rise to the exciting possibility of simulating multi-band condensed matter Hamiltonians. The Kondo lattice model (KLM), in which tightly bound electrons act as spinful scattering centers for electrons in a conduction band, is a typical example of the type of model one would like to simulate. In the KLM, the orbital (band) degree of freedom gives rise to a complex phase diagram, which includes magnetically ordered states, a heavy Fermi liquid, and unconventional superconductors [1]. Here we consider a version of the KLM first proposed in [2], in which the electrons are replaced by spin-$\frac{1}{2}$ bosons, which in turn are realized physically by bosonic alkali atoms in an optical lattice. As we demonstrate, the interplay between spin, charge, and orbital degrees of freedom can drive the Mott insulator to superfluid transition to be first order, without explicit breaking of SU(2) symmetry. The observability of such behavior in the context of current experiments will also be discussed.

[1] H. Tsunetsugu, M. Sigrist, and K. Ueda, Rev. Mod. Phys. 69, 809 (1997).
[2] L. Duan, Europhys. Lett. 67, 721 (2004).

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