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The Hyperfine Molecular Hubbard Hamiltonian[1] LINCOLN D. CARR, MICHAEL L. WALL, Colorado School of Mines — An ultracold gas of heteronuclear alkali-metal dimer molecules with hyperfine structure loaded into a one-dimensional optical lattice is investigated. The hyperfine molecular Hubbard Hamiltonian (HMHH), an effective low-energy lattice Hamiltonian, is derived from first principles [1]. The large permanent electric dipole moment of these molecules gives rise to long-range dipole-dipole forces in a dc electric field and allows for transitions between rotational states in an ac microwave field. Additionally, a strong magnetic field can be used to control the hyperfine degrees of freedom independently of the rotational degrees of freedom. By tuning the angle between the dc electric and magnetic fields and the strength of the ac field, it is possible to control the number of internal states involved in the dynamics as well as the degree of correlation between the spatial and internal degrees of freedom. The HMHH's unique features have direct experimental consequences such as quantum dephasing, tunable complexity, and the dependence of the phase diagram on the molecular state.

[1] M. L. Wall and L. D. Carr, Phys. Rev. A **82**, 013611 (2010).

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