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The Hyperfine Molecular Hubbard Hamiltonian[1] LINCOLN D. CARR, MICHAEL L. WALL, Colorado School of Mines — Recently, ultracold diatomic heteronuclear polar molecules were cooled to near quantum degeneracy [1]. We study the many body physics of such systems in optical lattices [1,2] in the presence of strong electric and magnetic fields. The molecules interact via an electric dipole-dipole interaction. Our main model is the Hyperfine Molecular Hubbard Hamiltonian, a generalization of Hubbard Hamiltonians for lattice physics which includes the internal degrees of freedom of molecules and external DC magnetic and electric and AC electric driving fields. Our main numerical method is time-evolving block decimation, which treats entangled quantum dynamics. We consider both fermionic and bosonic molecules. Our choice of a strong electric field plus a strong magnetic field prevents chemical reactions, thereby stabilizing the molecular ensemble. We find that tuning the electric AC driving field plus the angle between the DC electric and magnetic fields allows us to progressively include more molecular degrees of freedom, from spatial to rotational to nuclear hyperfine.

[1] L. D. Carr, David DeMille, Roman V. Krems, and Jun Ye, New J. Phys. v. 11, p. 055049 (2009).
[2] M. L. Wall and L. D. Carr, New J. Phys. v. 11, p. 055027 (2009).

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