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The Molecular Hubbard Hamiltonian: Field Regimes and Molecular Species ERMAN BEKAROGLU, MICHAEL WALL, KENJI MAEDA, LINCOLN CARR, Colorado School of Mines — The molecular Hubbard Hamiltonian (MHH) naturally arises for ultracold polar alkali dimer molecules in optical lattices. We show that, unlike ultracold atoms, different molecules display different many-body phases due to intrinsic variances in molecular structure. We also demonstrate a wide variety of experimental controls on molecules via external fields, including applied static electric and magnetic fields, an AC microwave field, and the polarization and strength of optical lattice beams. We provide explicit numerical calculations of the parameters of the MHH, including tunneling and direct and exchange dipole-dipole interaction energies, for the molecules 6 Li133 Cs, 23Na40 K, 87 Rb133 Cs, 40 K87 Rb, and 6 Li23 Na in weak and strong applied electric fields. As case studies of many-body physics, we use infinite-size matrix product state (iMPS) methods to explore the quantum phase transitions from the superfluid phase to half-filled and third-filled crystalline phases in one dimension.

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