Abstract Submitted
for the DAMOP11 Meeting of
The American Physical Society

Emulating Quantum Magnetism and t–J Models in Systems of Ultracold Polar Molecules S.R. MANMANA, JILA (CU and NIST), and Dep. of Physics, U Colorado, Boulder, CO 80309, A.V. GORSHKOV, IQI, Caltech, Pasadena, CA 91125, E. DEMLER, M.D. LUKIN, Physics Dep., Harvard Univ., Cambridge, Massachusetts 02138, A.M. REY, JILA (CU and NIST), and Dep. of Physics, U Colorado, Boulder, CO 80309 — In contrast to atomic systems, strong electric dipole-dipole interactions in systems of ultracold polar molecules open the way to directly emulate spin Hamiltonians at temperatures of the order of nK, realizable in current experiments. At unit filling of the lattice, this leads to $S = 1/2$ XXZ-type of Hamiltonians, while below unit filling a highly tunable generalization of the $t - J$ model is obtained which we refer to as the $t - J - V - W$ model. In addition to the long-range dipolar interactions of XXZ type (J_z and $J_\perp$) present at unit filling, density-density interactions V and a novel density-spin interaction W are obtained. These interaction terms can all be tuned independently of the tunneling t in magnitude as well as in sign. The 'spin' degrees of freedom are realized by addressing two rotational degrees of freedom of the molecules, while the interactions are controlled by applying static electric and continuous-wave microwave fields. Using the Density Matrix Renormalization Group method (DMRG) we obtain the phase diagram for the experimentally relevant case $J_z = V = W = 0$ in 1D and find that superconductivity is enhanced compared to the usual $t - J$ model.

S.R. Manmana
JILA (CU and NIST), and Dep. of Physics, U Colorado, Boulder, CO 80309

Date submitted: 04 Feb 2011 Electronic form version 1.4