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Quantum Magnetism with Polar Alkali Dimers ALEXEY GORSHKOV, California Insitute of Technology, SALVATORE MANMANA, JUN YE, University of Colorado, Boulder, EUGENE DEMLER, MIKHAIL LUKIN, Harvard University, ANA MARIA REY, University of Colorado, Boulder — We show that ultracold polar alkali dimers in optical lattices can be used to realize a highly tunable generalization of the $t-J$ model, which we refer to as the $t-J-V-W$ model. The model features long-range dipolar interactions of XXZ type (J_z and $J_\perp$) and of density-density type (V), as well as a novel density-spin interaction W. The interaction terms can all be controlled in both magnitude and sign independently of each other and of the tunneling t. The "spin" is encoded in the rotational degree of freedom of the molecules, while the interactions are controlled by applied static electric and continuous-wave microwave fields. Furthermore, we show that nuclear spins of the molecules can be used to implement an additional, orbital, degree of freedom that is coupled to the original rotational degree of freedom in a tunable way. We expect the competition between the different types of interaction to stabilize exotic phases. In particular, we carry out a Density Matrix Renormalization Group calculation to study the phase diagram in 1D for the special experimentally relevant case $J_z = V = W = 0$ and find that superconductivity is enhanced relative to the usual $t-J$ model.

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