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Many-body spin systems with ultracold polar KRb molecules JACOB COVEY, BRYCE GADWAY, BO YAN, STEVEN MOSES, DEBORAH JIN, JUN YE, JILA/University of Colorado-Boulder, JILA KRB TEAM — Long-range dipolar interactions are expected to facilitate understanding of strongly correlated many-body quantum systems such as quantum magnetism. We have used dipolar interactions of polar molecules pinned in a three-dimensional optical lattice to realize a lattice spin model where spin is encoded in rotational states of molecules that are prepared and probed by microwaves. The many-body dipolar interactions are apparent in the evolution of the spin coherence, which shows oscillations in addition to an overall decay of the coherence. The frequency of these oscillations depends on the strength of the dipolar interaction, which we can vary, and agrees quantitatively with a dipolar spin-exchange model. However, the absence of an external electric field precludes the study of the full spin-1/2 Hamiltonian that includes the Ising interaction. We are now building a novel apparatus that will allow us to reach large electric fields with full tunability of the relative strength of the Ising and exchange terms. Moreover, we anticipate imaging our sample with a high-NA microscope objective, allowing microscopic studies of a many-body spin system of polar molecules.

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