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Exploring Few- and Many-Body Dipolar Quantum Phenomena with Ultracold Erbium Atoms

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Given their strong magnetic moment and exotic electronic configuration, rare-earth atoms disclose a plethora of intriguing phenomena in ultracold quantum physics with dipole-dipole interaction. Here, we report on the first degenerate Fermi gas of erbium atoms, based on direct cooling of identical fermions via dipolar collisions. We reveal universal scattering laws between identical dipolar fermions close to zero temperature, and we demonstrate the long-standing prediction of a deformed Fermi surface in dipolar gas. Finally, we present the first experimental study of an extended Bose-Hubbard model using bosonic Er atoms in a three-dimensional optical lattice and we report on the first observation of nearest-neighbor interactions.