2D Degenerate Fermi Gas of Polar Molecules in a Single Layer

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Ultracold polar molecules offer an ideal platform for exploring spin-motion models [1, 2, 3], such as the generalized t-J model, with well-developed tools for controlling their rich internal structure and their strong, long-range dipole-dipole interactions. To observe novel phases and dynamics predicted by these models, a low entropy sample of molecules confined to two dimensions (2D) is essential, as such geometries allow full control over the anisotropic dipolar interactions. Building on our previous work of loading and selecting molecules in individual layers of 2D optical traps [4] and electric field assisted evaporative cooling [5], we now report recent progress toward realizing a deeply degenerate 2D gas of KRb molecules. Using an optical lattice of variable spacing, we compress a mixture of K and Rb atoms from 3D into a quasi-2D configuration. We subsequently create a quasi-2D sample of 20,000 ground-state KRb molecules at a temperature below the Fermi temperature. Further transverse confinement is achieved by transferring the atomic mixture to a fixed-spacing lattice, where dipolar evaporation is initiated to evaporate KRb molecules into the deeply degenerate regime under applied DC electric fields [5]. This work sets the stage for studying novel many-body dynamics with polar molecules in 2D.

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