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A dysprosium quantum gas microscope

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We present the progress towards constructing of a dipolar quantum gas microscope using dysprosium atoms. This new apparatus combines the single-site resolution of a quantum gas microscope with the long-range and anisotropic interactions found in dipolar quantum gases, allowing for detailed studies of strongly correlated quantum phases. We plan to do this using dysprosium atoms trapped in an ultraviolet optical lattice with a lattice spacing of 180 nm. Combined with the long-range dipole interaction, the short lattice spacing will significantly increase the nearest-neighbor interaction strength to be on the order of 200 Hz (10 nK). This will allow us to enter the regime of strongly interacting dipolar Bose- and Fermi-Hubbard physics where even next-nearest-neighbor interactions could become visible. We will combine this lattice setup with a spin- and energy resolved super-resolution imaging technique. Our new dipolar quantum gas microscope as a quantum simulator will enable the investigation of a wide variety of problems ranging from quantum magnetism and lattice spin models to topological matter.

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