Dipolar Chromium BECs and magnetism

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Abstract:

Bose-Einstein condensates (BECs) made of 52Cr atoms reveal new phenomena, due to relatively strong dipole-dipole interactions. In this talk, I will focus on the effect of dipolar interactions on the properties of multi-component (spinor) Cr condensates. The atoms can be seen as quantum magnets interacting through dipole-dipole interactions, and the system is therefore a natural playground to revisit magnetism.
One important consequence is that due to its anisotropy, the dipole interaction introduces magnetization-changing collisions, which frees the magnetization of the gas. We have thus observed a demagnetization of the BEC when the magnetic field is quenched below a critical value Bc corresponding to a phase transition between a ferromagnetic and a nonpolarized ground state. We have also studied the thermodynamic properties of spinor Cr atoms, and we have observed that above Bc, the ferromagnetic nature of BECs leads to the spontaneous magnetization of the cloud when BEC is reached.
I will also describe experiments studying the magnetic properties of dipolar Cr atoms loaded in a 3D optical lattice. This system offers a realization of quantum magnetism and has important similarities with the Heisenberg model of magnetism. I will present experiments studying spin dynamics in this regime.