Ultracold dysprosium gases: A complex system from radiative trapping to many-body physics

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Atomic dysprosium features a complex electronic structure, which leads to several interesting properties in the context of atomic physics: a large electronic angular momentum, a large magnetic moment, many narrow optical transitions. Those characteristics imply specific physical behaviors, from the radiative cooling and trapping to the design of novel schemes for quantum many-body physics.

We will first present a detailed study of the magneto-optical trapping (MOT) of ultracold dysprosium [1]. We will show that the MOT can be operated in several regimes, with either all or a single Zeeman components involved. Due to the weak radiative forces obtained with a narrow optical transition, gravity plays an major role, and tends to polarize the atomic sample. We will also discuss light-induced inelastic collisions.

The second part of the talk will address the prospects of our experiment, which aims at realizing topological superfluids with ultracold dysprosium. We will show that the structure of optical transitions is well suited for realizing light-induced gauge fields, the basic ingredient for realizing a topological superfluid. We will also present several schemes to reveal the presence of Majorana fermions at the edges of the topological superfluid.

[1] D. Dreon, L. A. Sidorenkov, C. Bouazza, W. Maineult, J. Dalibard, S. Nascimbene, Optical cooling and trapping highly magnetic atoms: The benefits of a spontaneous spin polarization, arXiv:1610.02284 (2016)