A New Set Up for Dysprosium Bose-Einstein Condensation

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The study of dipolar systems in a quantum degenerate state represents a field of general interest so far only barely experimentally explored. Dipolar interaction has been predicted to give rise to a wealth of peculiar quantum phenomena and exotic quantum phases, encompassing supersolids, quasi-crystals, frustated crystals and self-assembeld structures. These phenomena are due to the combination of the long-ranged and anisotropic nature of such interaction.

Ultracold atomic gases in optical lattices are emerging as quantum simulators of complex phenomena thanks to their high degree of tunability and control of the parameters. Notably the possibility of engineering with light defect-free lattices for atomic gases allows to investigate paradigmatic phenomena related to condensed matter physics in different dimensionalities.

We are running an experiment for the production of quantum degenerate gases of Dysprosium (Dy) atoms to load an optical lattice. Contrary to alkali atoms, usually employed in cold atoms experiments, Dysprosium has a huge magnetic dipole moment, 10 Bohr magnetons, the largest among all elements. For this reason, besides interacting via van der Waals interaction, which has substantially a contact nature, Dy atoms also interact via dipole-dipole magnetic interaction. At present an atomic beam emitted from an effusive oven is slowed by means of a laser beam emitting at 421 nm in a Zeeman slower. The slowed atoms are catched in a magneto-optical trap, working on the narrow atomic transition at 626 nm, and subsequently transferred in far-detuned optical traps working at 1064 nm. Here, evaporative cooling is performed allowing to reach the Bose-Einstein condesation of the ^{162}Dy isotope. Actual work is devoted to the study of the Feshbach spectrum and to the tensor polarizability of the excited state of ^{162}Dy.

This experiment is a joint effort of teams from the Pisa section of the INO-CNR and groups working at LENS, from the Physics Department of the University of Florence and from the INO-CNR section.