Rabi oscillations of a Bose-Einstein condensate in the optical domain

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Abstract

Two-electron atoms, such as Ytterbium, feature ultranarrow optical transitions that are nowadays largely exploited in metrology laboratories to build optical clocks. These transitions, nearly free of spontaneous emission, are not only interesting for metrological applications, but also provide a good tool to investigate many-body physics with atomic quantum gases, and therefore offer new instruments for quantum simulation and quantum information. In our experiment, we wish to exploit a protocol that requires the coherent coupling of these two electronic states to realize artificial magnetic fields in an optical lattice [1,2].

In this talk I will show the coherent driving of Rabi oscillations on an optical clock transition in a 174-Yb Bose Einsten Condensate (BEC) loaded in an optical dipole trap. Dynamics are strongly influenced by the effects of interactions in our system. I will show that the decoherence of these oscillations is due both to the asymmetric elastic [3,4] and inelastic interactions and the movement of atoms in the trap. In particular, we can show the transition between a regime in which the coupling leads to Rabi oscillations when the driving strength is important with respect to the inelastic losses, to a quasi-exponential decay in the opposite case. This transition is reminiscent of the textbook problem of a discrete level coupled to a continuum: in the case of a broad continuum the evolution leads to an irreversible Weisskopf-Wigner decay and if the continuum is so narrow that can be approximated by a discrete state, reversible Rabi oscillations are observed.

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