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Ground-state bistability of cold atoms in a cavity

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We experimentally demonstrate an optical bistability between two hyperfine ground states of trapped, cold atoms, using a single mode of an optical resonator in the collective strong coupling regime. Whereas in the familiar case, the bistable region is created through atomic saturation, we report an effect between states of high quantum purity, which is essential for future information storage. The source of nonlinearity is a cavity-assisted pumping between ground states of the atoms and the stability depends on the intensity of two driving lasers. We interpret the phenomenon in terms of the recent paradigm of first-order, driven-dissipative phase transitions, where the transmitted and driving fields are understood as the order and control parameters, respectively. A semiclassical mean-field theory is invoked to describe the nontrivial two-dimensional phase diagram arising from the competition of the two drive. The saturation-induced bistability is recovered for infinite drive in one of the controls. The order of the transition is confirmed experimentally by hysteresis in the order parameter when either of the two control parameters is swept repeatedly across the bistability region. [1]

[1] B. Gábor, D. Nagy, A. Dombi, T. W. Clark, F. I. B. Williams, K. V. Adwaith, A. Vukics, and P. Domokos Phys. Rev. A 107, 023713

Abstract category

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