

DAMOP08-2008-020078

Abstract for an Invited Paper
for the DAMOP08 Meeting of
the American Physical Society

Cavity QED with a Bose-Einstein condensate

FERDINAND BRENNECKE, Institute for Quantum Electronics, ETH

Cavity quantum electrodynamics (cavity QED) deals with the interaction of matter with the radiation field inside a resonator. In the regime of strong coupling a single atom–photon system coherently evolves over dynamically relevant timescales before the interaction with the environment leads to decohering processes. By strongly coupling a Bose-Einstein condensate (BEC) to the quantized field of a high-finesse optical cavity, we experimentally enter a new regime of cavity QED where all atoms couple identically and highly controlled to the cavity field. The collective nature of the internal state dynamics of this coupled BEC–cavity system is verified in the energy spectrum for a single excitation shared between BEC and cavity. In the far dispersive regime, the simultaneous coupling of all atoms to a single radiation mode gives rise to a highly nonlinear feedback mechanism between atomic motion and cavity field. We continuously monitor the coherent evolution of the driven system and find a degenerate matterwave to be requisite for the observed behavior. Besides its decisive relevance to the field of quantum information processing, the presented system offers a variety of interesting phenomena expected in the field of quantum gases within a quantum optical lattice.