## Dynamical phenomena in interacting atomic gases coupled to optical cavities

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The realization and control of non-trivial quantum phases by the coupling of quantum light and matter is currently of great interest. We investigate the coupling of atoms confined to optical lattices to a cavity field which leads to an effective long-range interaction between the atoms. We determine the coupled state of the cavity and the atoms beyond the typically employed mean field approach. We show that strong deviations from the predictions of the mean-field theory arise. We discuss both the steady states and also the dynamics of the coupled atom-cavity systems.