Strong coupling theory for the Jaynes-Cummings-Hubbard model

Gianni Blatter
nstitute for Theoretical Physics, ETH Zurich, 8093 Zurich, Switzerland

We present an analytic strong-coupling approach to the phase diagram and elementary excitations of the Jaynes-Cummings-Hubbard model (JCHM) describing a superuid-insulator transition of polaritons in an array of coupled QED cavities. In the Mott phase, we nd four modes corresponding to particle/hole excitations with lower and upper polaritons, respectively. Simple formulas are derived for the dispersion relations, spectral weights, and e?ective masses within a strong-coupling random-phase approximation (RPA). The phase boundary is calculated beyond RPA by including the leading correction due to quantum uctuations. In two dimensions, our results agree well with recent Monte-Carlo calculations. In three dimensions, where numerical data is currently not available, we present a quantitatively accurate calculation of the quantum phase diagram.

Referenz: S. Schmidt and G. Blatter, Phys. Rev. Lett. 103, 086403 (2009)