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Non-equilibrium States of Coupled Cavity Arrays

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Abstract:

Arrays of coupled cavities, supporting modes of electromagnetic radiation, coupled to atoms or artificial atoms, provide a flexible platform to realise controllable quantum lattice problems. In particular, microwave cavities coupled to superconducting qubits[1] provide a promising realisation of such arrays. However, real experiments face dephasing and losses, and real cavities will have disorder due to imperfections in fabrication, and so it is important to determine what engineered states can exist in the presence of these effects.

Losses require compensating pumping, and I will discuss two forms of pumping; coherent pumping[2] (yielding a symmetry-broken Hamiltonian with no possible phase transitions), and discuss the effects of disorder in this case[3]. I will also discuss parametric pumping[4], leading to a transverse-field Ising model. I will show how, at mean-field level, losses lead to a new non-trivial phase diagram, and how beyond mean-field, fluctuations destroy long range order but the residual short-range order reflects that arising in mean-field theory.

[1] A. Houck, H. Tureci and J. Koch, Nature Physics 8 292 (2012)
[2] F. Nissen et al, Phys. Rev. Lett. 108 233603 (2012)
[3] G. Kuliatis et al, Phys. Rev. A 87 013840 (2013)
[4] C. Joshi et al, Phys. Rev. A, 88 063835 (2013)