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Quantum Phase Transition in a Cold Atomic Spin-Boson Mixture

PETER P. ORTH, IVAN STANIC, KARYN LE HUR, Yale University — We theoretically implement a spin array in a tunable bosonic environment using cold bosonic atoms with two (hyperfine) ground states, trapped by different potentials [1]. The first specie lies in a deep optical lattice with tightly confining wells and forms a spin array; spin-up/down corresponds to occupation by one/no atom at each site. The second specie forms a superfluid reservoir. Different species are coupled coherently via laser transitions and collisions. Whereas the laser coupling mimics a transverse field for the spins, the coupling to the reservoir phonons (sound modes) induces a ferromagnetic (Ising) coupling as well as dissipation. This results in a peculiar ferro-paramagnetic quantum phase transition where the effect of dissipation can be studied in a controllable manner.

[1] Peter P. Orth, Ivan Stanic, and Karyn Le Hur, arXiv:0711.2309 [cond-mat.other].

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