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Amplitude Excitations in a Symmetry-Breaking Quantum Phase Transition MATTHEW BOGUSLAWSKI, BHARATH H M, MARYROSE BARRIOS, MICHAEL CHAPMAN, Georgia Inst of Tech — Quantum phase transitions (QPT) can be characterized using a local order parameter. In a symmetry-breaking phase transition, this order parameter spontaneously breaks one or more of the symmetries of the Hamiltonian while crossing the quantum critical point (QCP). A spin-1 Bose Einstein condensate, in a single spatial mode, undergoes a QPT when the applied magnetic field is quenched through a critical value. The transverse spin component is an order parameter characterizing this QPT. It shares a U(1)SO(2) symmetry with the Hamiltonian, but one of these two symmetries is broken when the system is quenched through the QCP. As a result, two massless, coupled phonon-magnon modes are present along with a single massive, or Higgs-like mode which has the form of amplitude excitations of the order parameter. Here, we experimentally characterize this phase transition and the resulting amplitude excitations by inducing coherent oscillation in the spin population [1]. We further use the amplitude oscillations to measure the energy gap between the ground state and the first excited state for different phases of the QPT. At the QCP, finite size effects lead to a non-zero gap, and our measurements are consistent with this prediction.
1. T. M. Hoang et al, PNAS, 113, 34, 2016

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