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Quantum Phase Transitions and Adiabatic Control of Ferromagnetic Spin-1 BEC THAI HOANG, MARTIN ANQUEZ, BRYCE ROBBINS, BHARATH MADHUSUDHANA, MATTHEW BOGUSLAWSKI, MICHAEL CHAPMAN, Georgia Inst of Tech — The adiabatic theorem, which states that a quantum system can remain in its instantaneous eigenstate under slow temporal changes to the Hamiltonian, was formulated almost 100 years ago by Born and Fock. This phenomenon relies on the existence of an energy gap between neighboring eigenstates of the quantum system and has proved to be a powerful tool in realizing novel quantum computation algorithms. Furthermore, the energy gap between the ground and first excited state plays a crucial role in understanding the dynamics of quantum phase transitions and the Kibble-Zurek mechanism. A spin-1 Bose-Einstein condensate (BEC) features a well-characterized and controllable Hamiltonian, providing a unique framework for investigating quantum phase transition phenomena. A massive entanglement Dicke state can also be generated by exploiting the nonzero energy gap at the quantum critical point (QCP) and adiabatic quantum phase transition of the ground state (highest eigenstate) in a ferromagnetic (anti-ferromagnetic) condensate. Here, we experimentally investigate the energy gap and adiabaticity in a ferromagnetic BEC and compare our results to quantum simulations.

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