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Quantum criticality in cold atoms KADEN HAZZARD, ERICH MUELLER, Cornell University — We construct a general set of techniques to extract universal quantum critical behavior from cold atoms experiments. Quantum criticality — the finite temperature behavior of systems near quantum phase transitions — is a cornerstone of modern solid state physics, providing examples of non-quasiparticle excitations and interpretations of a wide variety of strongly correlated materials. Since often even the simplest models' behavior is unknown, cold atoms can dramatically improve our understanding. Yet the phenomenology of the quantum critical regime has received little attention, despite the fact that many ongoing experiments are in this regime. We show that quantum critical phenomena are robust in cold atoms: they persist despite the small number of atoms and the inhomogeneity of the harmonic traps. We construct novel analysis methods to observe quantum criticality in these system. We demonstrate the utility of these methods by examining exactly solvable models and quantum Monte Carlo calculations. Additionally, we make first comparisons with experiments. We show that ongoing experiments can immediately impact deep open questions regarding the so-called "O(2) rotor model" at finite chemical potential, and the fermionic Mott insulator/metal crossover.

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