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Exploring quantum criticality based on ultracold atoms in optical lattices XIBO ZHANG, CHEN-LUNG HUNG, LI-CHUNG HA, University of Chicago, NATHAN GEMELKE, The Pennsylvania State University, SHIH-KUANG TUNG, CHENG CHIN, University of Chicago — Critical behavior developed near a quantum phase transition offers exciting opportunities to explore the universality of strongly-correlated systems near the ground state. Cold atoms in optical lattices, in particular, represent a paradigmatic system, for which the quantum phase transition between the superfluid and Mott insulator states can be externally induced by tuning the microscopic parameters. Based on in situ density measurements, quantum criticality of cesium atoms in a two-dimensional lattice can be probed by testing critical scaling of thermodynamic observables and by extracting transport properties in the quantum critical regime. Here we present experimental progress on quantum critical scaling [1]. The thermodynamic measurement suggests that the equation of state near the critical point follows the predicted scaling law at low temperatures, and that there exists an upper limit of the temperature for which the quantum critical behavior persists.

[1] X. Zhang, C.-L. Hung, S.-K. Tung, N. Gemelke, and C. Chin, arXiv:1101.0284v1.

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