Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

The Detection of Massive Goldenstone (Higgs) Mode in Two-Dimensional Ultra-cold Atomic Lattice Systems KUN CHEN, University of Massachusetts, Amherst; University of Science and Technology of China, LONGXIANG LIU, University of Science and Technology of China, YOUJIN DENG, University of Science and Technology of China; University of Massachusetts, Amherst;, MANUEL ENDRES, Harvard University; California Institute of Technology, LODE POLLET, Ludwig Maximilian University of Munich, NIKOLAY PROKOF'EV, University of Massachusetts, Amherst;Russian Research Center Kurchatov Institute — We discuss how to reveal the massive Goldstone mode, often referred to as the Higgs amplitude mode, near the Superfluid-to-Insulator quantum critical point (QCP) in a system of two-dimensional ultra-cold bosonic atoms in optical lattices. The spectral function of the amplitude response is obtained by analytic continuation of the kinetic energy correlation function calculated by Monte Carlo methods. Our results enable a direct comparison with the recent experiment [M. Endres, T. Fukuhara, D. Pekker, M. Cheneau, P. Schauß, C. Gross, E. Demler, S. Kuhr, and I. Bloch, Nature **487**, 454-458 (2012)], and demonstrate a good agreement for temperature shifts induced by lattice modulation. Based on our numerical analysis, we formulate the necessary conditions in terms of homogeneity, detuning from the QCP and temperature in order to reveal the massive Goldstone resonance peak in spectral functions experimentally. We also propose to apply a local modulation at the trap center to overcome the inhomogeneous broadening caused by the parabolic trap confinement.

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Date submitted: 06 Nov 2015 Electronic form version 1.4