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In-situ study of critical behavior in two-dimensional Bose gases[1]

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High resolution in-situ imaging of ultracold atoms confined in a two dimensional (2D) trap reveals precise information on the in-trap density distribution and density fluctuations. From density measurements we determine the equation of state through the assumption of the local density approximation; fluctuation measurements reflect the density-density correlation in quantum gases and its growth near a continuous phase transition. The in-situ imaging technique opens up exciting opportunities to study critical behavior in the phase transition region in two dimensions, such as the fluctuation region near the Berezinsky-Kosterlitz-Thouless transition and the quantum critical region near the superfluid-Mott insulator phase boundaries of atoms in a 2D square lattice. In this talk, I will present our study on global scale-invariance and universality in weakly interacting 2D Bose gases [1]. Further investigations of 2D gases near a Feshbach resonance and quantum criticality in optical lattices [2] will be discussed.

[1] Chen-Lung Hung, Xibo Zhang, Nathan Gemelke and Cheng Chin, arXiv:1009.0016v2 (to be published in Nature).
[2] Xibo Zhang, Chen-Lung Hung, Shih-Kuang Tung, Nathan Gemelke and Cheng Chin, arXiv:1101.0284v1.

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