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How the scaling behavior changes near the quantum phase transition point? HAO LEE, SHIANG FANG, DAW-WEI WANG, Physics Department and Frontier Research Center on Fundamental and Applied Sciences of Matter, National Tsing-Hua University, Hsinchu, Taiwan — With unbiased quantum Monte Carlo simulation (worm algorithm), we investigate off-diagonal long-ranged correlation and density-density correlation in two-dimensional Bose-Hubbard model. For a finite size system, we show how the Bose-Einstein condensate and the off-diagonal long-range order can appear before the presence of superfluidity in higher temperature, and demonstrate the difference of the definition of Tc for various model independent methods. Furthermore, we systematically explore the critical behaviors such as the decaying behavior of the single-particle correlation function near the classical (BKT) and quantum phase transition point. We define the regime when the critical behavior works and observe how this regime changes when the critical temperature approaches zero near the quantum critical point (SF-Mott). Our results show the higher order behavior beyond the universal scaling regime, and provides a lot of insight to future experiments on critical behavior near various quantum phase transition.

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