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### Observation

**of Coherence between Superfluid Spheres with Quantum Monte Carlo Simulation** YASUYUKI KATO, NAOKI KAWASHIMA, Institute for Solid State Physics, University of Tokyo — We execute quantum Monte Carlo simulation based on the directed-loop algorithm (DLA) for the Bose-Hubbard model with an external harmonic field, which is effective for modeling a cold atomic Bose gas trapped in an optical lattice. While the general idea of DLA has very broad applicability, its straight forward application to boson systems is not efficient. To simulate large systems efficiently, we modified the DLA. [1,2] We treat a system consisting of  $1.8 \times 10^5$  particles in a  $64^3$  lattice and observe a four-tiered large “wedding-cake” structure in Ref. [2]. These numbers are comparable to those in the pioneering experimental work by Greiner *et al.* We focus on cases of the two-tiered wedding-cake systems, which have two superfluid spherical regions separated by Mott insulator region at low temperature. We show an evidence of the coherence between the two superfluid spheres. [1]. Y. Kato, T. Suzuki, and N. Kawashima: Phys. Rev. E 75, 066703 (2007) [2]. Y. Kato and N. Kawashima unpublished

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