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Incompressible Quantum Glass State of Bosons in Two Dimensions[1] WENAN GUO, YANCHENG WANG, Department of Physics, Beijing Normal University, ANDERS SANDVIK, Department of Physics, Boston University — We study the quantum glass state intervening between the conventional superfluid and Mott-insulator states of lattice bosons with random potentials at average filling $\rho = 1$. Its properties at temperature $T = 0$ are controlled by rare large regions of superfluid surrounded by Mott insulator. These regions make the state gapless although it is insulating. Contrary to the commonly accepted theory of this state in two dimensions, we show here that a vanishing gap does not necessarily imply nonzero compressibility. Using quantum Monte Carlo simulations of the Bose-Hubbard model and a percolation theory, we show that the compressibility κ follows the form $\kappa \sim \exp(-b/T^{\alpha})$ with $\alpha < 1$. In addition, the dynamic exponent of the superfluid-quantum glass transition is found to be smaller than 2. The system is, thus, incompressible at $T = 0$ and should be classified as a Mott glass.

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