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Cold atoms and the 2D Bose-Hubbard model

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Cold atoms in optical lattices provide new avenues for studying iconic condensed matter problems. Using an initially Bose condensed sample of ^{87}Rb atoms, we implement the 2D Bose-Hubbard model (one intense lattice beam partitions the system into an ensemble of 2D systems; the remaining 2D lattice potential determines the constants in the Bose-Hubbard model). This model has a superfluid-insulator transition, and this work focuses on the insulating phase. We carefully control the lattice lattice parameters, the loading procedure, and the total atom number and we measure momentum distributions which agree quantitatively with the predictions of theory (for a homogenous system). In our images, we also measure correlations in the atom-shot noise which given information regarding the spatial extend of the system. The correlation signal changes as expected as the insulating region develops.