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Detecting the BCS pairing amplitude via a sudden lattice ramp in a honeycomb lattice[1] EITE TIESINGA, Joint Quantum Institute, MARLON NUSKE, NIST and University of Hamburg, LUDWIG MATHEY, University of Hamburg — We determine the exact time evolution of an initial Bardeen-Cooper-Schrieffer (BCS) state of ultra-cold atoms in a hexagonal optical lattice. The dynamical evolution is triggered by ramping the lattice potential up, such that the interaction strength U_f is much larger than the hopping amplitude J_f. The quench initiates collective oscillations with frequency $|U_f|/(2\pi)$ in the momentum occupation numbers and imprints an oscillating phase with the same frequency on the order parameter Δ. The latter is not reproduced by treating the time evolution in mean-field theory. The momentum density-density or noise correlation functions oscillate at frequency $|U_f|/(2\pi)$ as well as its second harmonic. For a very deep lattice, with negligible tunneling energy, the oscillations of momentum occupation numbers are undamped. Non-zero tunneling after the quench leads to dephasing of the different momentum modes and a subsequent damping of the oscillations. This occurs even for a finite-temperature initial BCS state, but not for a non-interacting Fermi gas. We therefore propose to use this dephasing to detect a BCS state. Finally, we predict that the noise correlation functions in a honeycomb lattice will develop strong anti-correlations near the Dirac point.

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