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Probing non-equilibrium dynamics with homogeneous two-dimensional atomic quantum gases[1] CHENG-AN CHEN, CHEN-LUNG HUNG, Purdue University — Probing non-equilibrium dynamics in a trapped, inhomogeneous atomic quantum gas can be a challenging task because coexisting mass transport and spreading of quantum correlations often make the problem intractable. By removing density inhomogeneity in an atomic quantum gas and employing local control of chemical potential as well as interaction parameters, it is possible to perform quasi-particle control, initiate and probe collective quantum dynamics without or with a controlled mass flow. We report progress toward quasi-particle control and non-equilibrium dynamics study in a homogeneous two-dimensional quantum gas. We initiate the experiment by loading ultracold cesium atoms into a quasi two-dimensional (2D) box trap formed by an all blue-detuned optical potential. We employ the control of quasi-particles, or more precisely phonons, in a 2D superfluid by spatiotemporal modulation of the atomic interaction, via an optical Feshbach addressing technique. We discuss our scheme of engineering phonon transport, manipulating a phononic band gap crystal in a quantum gas, as well as phonon-pair generation and entanglement detection.

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