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Non-equilibrium quench dynamics and observation of Townes solitons in two-dimensional Bose gases[1] CHENG-AN CHEN, SAMBIT BANERJEE, CHEN-LUNG HUNG, Purdue University — We experimentally study non-equilibrium dynamics of two-dimensional atomic Bose gases confined in a box potential [2]. When the atomic interaction is quenched from repulsive to attractive values, we observe the manifestation of modulational instability that, instead of causing collapse, fragments a large two-dimensional superfluid into multiple wave packets universally around a threshold atom number, leading to the formation of unstable Townes solitons. Our density measurements in space and time domain reveal detailed information about this process, from the hyperbolic growth of density waves, the formation of solitons, to the subsequent collision and collapse dynamics, demonstrating multiple universal behaviors in an attractive many-body system in association with the formation of a quasi-stationary state. In a second quench experiment, we analyze the generation and distribution of entangled phonon pairs in the early-time evolution of the modulational instability by monitoring the time evolution of the density-density correlation and the static structure factor.

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[2]Cheng-An Chen and Chen-Lung Hung, **arXiv:** 1907.12550 (2019)

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