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Nonlinear Damping in a Strongly-Driven Two Dimensional Bose Gas in a Box. MACIEJ GALKA, PANAGIOTIS CHRISTODOULOU, NISHANT DOGRA, JULIAN SCHMITT, ZORAN HADZIBABIC, University of Cambridge — Ultracold atoms constitute a powerful platform to study non-equilibrium phenomena by providing a tractable testbed for microscopic models of the emergent complex macroscopic behavior. In this light, we aim at investigating the response of a quantum many-body system that is driven further and further away from its equilibrium state. Our experiment is based on an interaction-tunable 2D Bose gas confined in a box trap, in which we excite the lowest-lying long wavelength sound mode by shaking with a magnetic field gradient. Within the linear perturbation regime, this zero-temperature excitation is expected to be undamped due to a gapped energy spectrum and the absence of a (thermal) bath. On increasing the shaking amplitude, we however observe a finite damping rate of this mode, which is solely attributed to its nonlinear coupling to higher excited phonon states arising from inter-particle interactions. We find a power-law decay of the quality factor Q of the sound mode as a function of the driving strength. We further discover a universal behavior of Q as we vary the interaction strength. Our observations establish a connection between the weakly driven regime of linear excitations and the highly non-equilibrium turbulent state obtained by strongly driving the system.

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