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Demonstration of the Kibble-Zurek mechanism in a non-equilibrium phase transition YOGESH S PATIL, HIL F H CHEUNG, ADITYA G DATE, MUKUND VENGALATTORE, Cornell University — We describe the experimental realization of a driven-dissipative phase transition (DPT) in a mechanical parametric amplifier and demonstrate key signatures of a critical point in the system, where the susceptibilities and relaxation time scales diverge and coincide with the spontaneous breaking of symmetry and the emergence of macroscopic order. While these observations are reminiscent of equilibrium phase transitions, it is presently an open question whether such DPTs are amenable to the conventional Landau-Ginsburg-Wilson paradigm that relies on concepts of scale invariance and universality – Indeed, recent theoretical work has predicted that DPTs can exhibit phenomenology that departs from these conventional paradigms [1]. By quenching the system past the critical point, we measure the dynamics of the emergent ordered phase and its departure from adiabaticity, and find that our measurements are in excellent agreement with the Kibble-Zurek hypothesis. In addition to validating the KZ mechanism in a DPT for the first time, we also uniquely show that the measured critical exponents accurately reflect the interplay between the intrinsic coherent dynamics and the environmental correlations, with a clear departure from mean field exponents in the case of non-Markovian system-bath interactions. We also discuss how the techniques of reservoir engineering and the imposition of artificial environmental correlations can result in the stabilization of novel many-body quantum phases and exotic non-equilibrium states of matter. [1] L. M. Sieberer et al., Phys. Rev. Lett. 110, 195301

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