Universal Dynamics of a Turbulent Superfluid Bose Gas

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We study the emergence of universal scaling in the time-evolving momentum distribution of a harmonically trapped three-dimensional Bose-Einstein condensate, parametrically driven to a turbulent state. We demonstrate that the out-of-equilibrium dynamics post-excitation is described by a single function due to nearby non-thermal fixed points. The observed behavior connects the dynamics of a quantum turbulent state to several far-from-equilibrium phenomena. We present a controllable protocol to explore universality in such systems, obtaining scaling exponents that can serve as reference for future theoretical investigations. Our experimental results thus offer a promising route to investigate the complex dynamics of the quantum turbulent regime under a novel perspective.