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Thermalization Processes in Quantum Mechanics VAN NGO, STEPHAN HAAS, University of Southern California — In quantum mechanics, the emergence of thermalization processes from unitary evolution has remained one of the greatest challenges. The two outstanding theories of this issue by Srednicki and Tasaki cannot address the concepts of temperature, heat, and work. Here, we present a theory using multiple quenches to examine the thermalization processes to advance thermodynamics concepts. To perform multiple quenches, one can vary one single control parameter (λ) in a series of time evolutions, which create a set of density operators. The average of these density operators results into a diagonal operator with probability distribution function that can describe the emerging ensembles. Measuring probability distribution functions of key physical observables, temperature, equal to the derivative of energy with respect to entropy, can be easily measured. Therefore, simulations via multiple quenches can mimic dynamics in open quantum systems with much cheaper computational cost. They allow (1) tuning of temperature and entropy via λ, (2) measuring work distribution functions from distributions of a reaction coordinate, and (3) computing free-energy changes via Jarzynski's Equality. We hope that this approach can provide a new foundation and open up new directions for studying control of quantum systems.

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