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Relaxation Dynamics and Pre-thermalization in an Isolated Quantum System[1] MAXIMILIAN KUHNERT, MICHAEL GRING, TIM LANGEN, Vienna Center for Quantum Science and Technology, Atominstitut, TU Wien, 1020 Vienna, Austria, TAKUYA KITAGAWA, Harvard-MIT Center for Ultracold Atoms, Department of Physics, Harvard University, Cambridge, Massachusetts 02138, USA, BERNHARD RAUER, IGOR MAZETS, DAVID A. SMITH, Vienna Center for Quantum Science and Technology, Atominstitut, TU Wien, 1020 Vienna, Austria, EUGENE DEMLER, Harvard-MIT Center for Ultracold Atoms, Department of Physics, Harvard University, Cambridge, Massachusetts 02138, USA, JOERG SCHMIEDMAYER, Vienna Center for Quantum Science and Technology, Atominstitut, TU Wien, 1020 Vienna, Austria — Understanding relaxation processes is an important unsolved problem in many areas of physics. This fact is exacerbated by the scarcity of experimental tools for characterizing complex transient states. We employ measurements of full quantum mechanical probability distributions of matter-wave interference to study the relaxation dynamics of a coherently split one-dimensional Bose gas and obtain unprecedented information about the dynamical states of the system. Following an initial rapid evolution, the full distributions reveal the approach towards a thermal-like steady state which exhibits an effective temperature eight times lower than the initial equilibrium temperature of the system as well as a strong memory of the initial state prepared by the splitting process. We associate this thermal-like state with pre-thermalization.

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