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Relaxation dynamics of the one-dimensional Bose gas via the coordinate Bethe ansatz MATTHEW DAVIS, JAN ZILL, TOD WRIGHT, KAREN KHERUNTSYAN, School of Mathematics and Physics, The University of Queensland, Brisbane QLD 4072, Australia, THOMAS GASENZER, Institut für Theoretische Physik, Universität Heidelberg, Philosophenweg 16, 69120 Heidelberg, Germany
— Recently there has been significant progress in understanding the nature of relaxation in closed quantum systems following a disturbance. Many of the theoretical results have been obtained through the study of models that can be mapped to non-interacting systems, or via approximate numerical methods. We instead utilise the symbolic evaluation of matrix elements between the coordinate Bethe-ansatz eigenstates of the Lieb-Liniger model to simulate quenches of the one-dimensional Bose gas for up to $N = 5$ particles. We consider a range of scenarios, including quenches of the interaction strength to both repulsive and attractive values, and the application of momentum kicks in analogy to the quantum Newton's cradle experiment of Kinoshita *et al.*, Nature **440**, 900 (2006). Our approach allows us to compare the time-evolving nonequilibrium correlation functions to their diagonal-ensemble (infinite-time-average) values. We find evidence of relaxation to the diagonal ensemble following a quench to repulsive interactions, and most of our results for relaxed-state correlations agree with recent generalized thermodynamic Bethe-ansatz calculations. However, our results for local third-order correlations differ markedly from the predictions of these generalized ensembles.

Matthew Davis
School of Mathematics and Physics, The University of Queensland,
Brisbane QLD 4072, Australia

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