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Probing many-body localization with semi-classical phase-space methods[1] OSCAR L. ACEVEDO, ARGHAVAN SAFAVI-NAINI, JOHANNES SCHACHENMAYER, JILA, NIST, and University of Colorado, Boulder, RAHUL NANDKISHORE, Department of Physics, University of Colorado, Boulder, ANA MARIA REY, JILA, NIST, and University of Colorado, Boulder — The Discrete Truncated Wigner Approximation (DTWA) has been proven to successfully predict several aspects of many-body quantum dynamics. This approach is based on an exact phase-space representation of the initial state of a discrete quantum system, and estimates the time evolution by classical mean field equations. In this work, we show that these methods are suitable for exploring Many-Body Localization (MBL) in disordered and interacting spin 1/2 arrays. By taking as benchmark case a 1D Heisenberg model, we show that DTWA is able to reproduce dynamical signatures of the MBL phase such as long-time persistence of initial state information and logarithmic growth of entanglement, even though a pure mean field analysis would lead to no dynamics at all. Our approximate results are able to characterize the thermal phase and many aspects of the MBL phase, especially in the large disorder limit. Our observations indicate potential exciting opportunities for the use of phase-space methods to study MBL in regimes where efficient exact solutions are not available, such as systems with long range interactions in higher dimensions. Those systems are in the reach of current cold atom experiments.

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