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Quantifying the sensitivity to errors in analog quantum simulation[1] PABLO POGGI, University of New Mexico, NATHAN LYSNE, KEVIN KUPER, University of Arizona, IVAN DEUTSCH, University of New Mexico, POUL JESSEN, University of Arizona — Quantum simulators are widely seen as one of the most promising near-term applications of quantum technologies. However, it remains unclear to what extent a noisy device can output reliable results in the presence of unavoidable imperfections. Here we propose a framework to characterize the performance of quantum simulators by linking the robustness of measured quantum expectation values to the spectral properties of the output observable, which in turn can be associated with its macroscopic or microscopic character. We show that, under general assumptions and on average over all states, imperfect devices are able to reproduce the dynamics of macroscopic observables accurately, while the relative error in the expectation value of microscopic observables is much larger on average. We experimentally demonstrate the universality of these features in a state-of-the-art quantum simulator and show that the predicted behavior is generic for a highly accurate device, without assuming any detailed knowledge about the nature of the imperfections.

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