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Thermalization in the Quantum Ising Model – Approximations, Limits, and Beyond[1] LINCOLN D. CARR, DANIEL JASCHKE, Colorado School of Mines, INES DE VEGA, Ludwig-Maximilians-University Munich — We present quantitative predictions for quantum simulator experiments on Ising models from trapped ions to Rydberg chains and show how the environment can be used to control thermalization and thus decoherence times with global, local, and endcap reservoirs. We find (i) local reservoirs enable more rapid thermalization in comparison to a global one; (ii) the thermalization timescale depends strongly on the position in the Ising phase diagram; and (iii) for a global reservoir larger system sizes show a significant slow down in the thermalization process. We find it is necessary to treat the full multi-channel Lindblad master equation rather than the commonly used single-channel local Lindblad approximation to make accurate predictions on a classical computer. This reduces the number of qubits one can practically classical simulate by a factor of 4, in turn showing quantum advantage at a factor of 4 smaller qubit number for open quantum systems as opposed to closed ones. Thus our results encourage open quantum system exploration in noisy intermediate-scale quantum (NISQ) technologies.

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