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Eigenstate spectroscopy with cold ion quantum simulation[1]
JAMES FREERICKS, BRYCE YOSHIMURA, Georgetown University, WES CAMPBELL, UCLA — As the number of ions employed in quantum simulations grows, the minimal excitation gaps shrink, as does the decoherence time, making it more and more difficult to run a simulation that will adiabatically prepare a non-trivial ground state. This is especially true for systems that are frustrated and have a large number of low lying eigenstates. But this creates a new opportunity for simulation, as it allows one to populate the excited states due to diabatic effects and then perform spectroscopy on them to determine the energy levels of the low-lying excited states. In this talk, we describe the ideas behind excited state spectroscopy and we show examples drawn from the transverse-field Ising model, where one can perform an analysis for large systems when the interactions do not decay with distance, or for smaller systems when one takes into account realistic parameters from experiments. We discuss the role of symmetry and how to optimize the spectroscopy measurements by performing conventional simulations of this model. The parameters we optimize with respect to include the time dependence of the transverse field, and the expectation value that is employed for the spectroscopy measurement. We discuss the prospects for experiments to use these techniques in the near future.

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