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Area laws and topological order in a many-body localized state
BELA BAUER, Microsoft Station Q, CHETAN NAYAK, Microsoft Station Q & UC Santa Barbara — The question whether Anderson insulators can persist to finite-strength interactions - a scenario dubbed many-body localization - has recently received a great deal of interest. In this talk, I will discuss our recent work on defining such a many-body localized phase and exploring it through its entanglement properties. We formulate a precise sense in which a many-body localized system can be connected adiabatically to an Anderson insulator. The most striking consequence of our definition is an area law for the entanglement entropy of highly excited states in such a system. We present the results of numerical calculations for a one-dimensional system of spinless fermions, which are consistent with an area law and, by implication, many-body localization for weak enough interactions and strong disorder. Furthermore, we discuss the implications that many-body localization may have for topological phases and self-correcting quantum memories. We find that there are scenarios in which many-body localization can help to stabilize topological order at non-zero energy density, and we propose potentially useful criteria to confirm these scenarios.

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