AN IMPROVED AREA-LAW FOR THE GROUND STATES OF 1D GAPPED HAMILTONIANS

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Originating from the works of Bekenstein and Hawking on the entropy of black holes, area laws constitute a central tool for understanding entanglement and locality properties in quantum systems. Essentially, in a system that obeys an area law, the entanglement entropy of a bounded region scales like its boundary area, rather than its volume.

In 2007, in a seminal paper, Hastings proved that all 1D quantum spin systems with a constant spectral gap obey an area law in their ground state. The proof was based on the analytical tool of Lieb-Robinson velocity. A major open problem is whether an area law holds also in 2 or more dimensions.

In this talk I will present a line of research of the past couple of years culminating in an alternative, entirely combinatorial proof for the 1D area law. The proof uses the Chebyshev polynomial to describe the structure of entanglement in the ground state, yielding an exponentially better bound on the entanglement entropy compared to Hastings' bound. Just a slight improvement of our parameters would give a sub-volume law for the 2D case; the combinatorial approach raises hopes that such improvements might be doable.

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