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WORKSHOP ON QUANTUM INFORMATION IN QUANTUM MANY-BODY PHYSICS
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Entanglement entropy in exotic phases of quantum matter

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The scaling of entanglement entropy in quantum many-body wavefunctions is expected to be a fruitful resource for identifying exotic quantum phases and phase transitions in condensed matter systems. In one-dimensional systems, entanglement entropy has been studied extensively through the density matrix renormalization group. However, until the recent development of estimators for Renyi entropy in quantum Monte Carlo (QMC), we have been in the dark about even the simplest scaling in two-dimensional systems. After reviewing some results for Renyi entropy scaling in typical two-dimensional wavefunctions, I will demonstrate how an exotic gapped Z2 spin liquid phase can be identified in a non-trivial Bose-Hubbard model through it's topological entanglement entropy. Such calculations pave the way for future work on identifying exotic phases and phase transitions in a variety of systems amenable to large-scale study by QMC in two dimensions and higher.

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