Entanglement Entropy and Topological Order in Resonating Valence-Bond Quantum Spin Liquids

JULIA WILDEBOER, National High Magnetic Field Laboratory, ALEXANDER SEIDEL, Washington University in St. Louis, ROGER MELKO, University of Waterloo, PI — On the triangular and kagome lattices, short-ranged resonating valence bond (RVB) wave functions can be sampled without the sign problem using a recently-developed Pfaffian Monte Carlo scheme [1]. In this talk [2], we present a study of the Renyi entanglement entropy in these wave functions using a replica-trick method [3]. Using various spatial bipartitions, including the Levin-Wen construction, our finite-size scaled Renyi entropy gives a topological contribution consistent with $\gamma = \ln(2)$, as expected for a gapped $\mathbb{Z}_2$ quantum spin liquid. We prove that the mutual statistics are consistent with the toric code anyon model and rule out any other quasiparticle statistics such as the double semion model.


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