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Quantum Entanglement and the Topological Order of Fractional Hall States[1]

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Fractional quantum Hall states or, more generally, topological phases of matter defy Landau classification based on order parameter and broken symmetry. Instead they have been characterized by their topological order. Quantum information concepts, such as quantum entanglement, appear to provide the most efficient method of detecting topological order solely from the knowledge of the ground state wave function. This talk will focus on real-space bi-partitioning of quantum Hall states and will present both exact diagonalization and quantum Monte Carlo studies of topological entanglement entropy in various geometries. Results on the torus for non-contractible cuts are quite rich and, through the use of minimum entropy states, yield the modular S-matrix and hence uniquely determine the topological order, as shown in recent literature. Concrete examples of minimum entropy states from known quantum Hall wave functions and their corresponding quantum numbers, used in exact diagonalizations, will be given.

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