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Measuring Entanglement at a Quantum Critical Point with Numerical Linked Cluster Expansion ANN B. KALLIN, University of Waterloo, KATHARINE HYATT, University of California, Santa Barbara, RAJIV R. P. SINGH, University of California, Davis, ROGER G. MELKO, University of Waterloo — We develop a method to calculate the bipartite entanglement entropy of quantum lattice models in the thermodynamic limit, using a Numerical Linked Cluster Expansion (NLCE) involving only rectangular clusters. The NLCE is based on exact diagonalization of all N x M rectangular clusters at the interface between entangled subsystems A and B. We show that the method can be used to obtain the Renyi entanglement entropy of the two-dimensional transverse field Ising model, for arbitrary real Renyi index. Furthermore, extrapolating these results as a function of the order of the calculation, one can obtain subleading universal pieces of the entanglement entropy at a quantum critical point. These results are compared with series expansions, quantum Monte Carlo simulations and field theories, where available, and they demonstrate the utility of the NLCE in obtaining accurate results for the universal properties of this critical point for von Neumann and non-integer Renyi entropies.

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