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Entanglement Entropy in Heisenberg Ladders with Valence Bond QMC ANN KALLIN, Waterloo, IVÁN GONZÁLEZ, CESGA, MATTHEW HASTINGS, Station Q, ROGER MELKO, Waterloo — Entanglement has arisen as a new paradigm for the study of correlations in condensed matter systems. Traditionally entanglement is measured through the von Neumann entanglement entropy (vNEE). Unfortunately, calculating vNEE requires access to the wavefunction of the system, which is not available in quantum Monte Carlo (QMC). Recently a new quantity has been proposed, the valence bond entanglement entropy (VBEE), which is easily calculated using QMC in the valence bond basis and seems to share many characteristics with the vNEE [1,2].

I will discuss our recent paper in which we directly compare the VBEE and the vNEE on Heisenberg ladders using QMC to calculate VBEE and density matrix renormalization group (DMRG) simulations to calculate vNEE. We find in some cases, the VBEE is greater than the vNEE, while in other cases VB EE is less than the vNEE. Hence the VBEE cannot provide a bound for the vNEE. We confirm the previous result [1,2] that the VB EE gives a logarithmic correction to the area law in the 2D limit of the Néel ground state, however results from DMRG show the vNEE in this system obeys the area law without correction. We relate the VBEE to the bond-length distribution in the QMC.

[1] F. Alet, et. al., Phys. Rev. Lett. 99, 117204 (2007).
[2] R. W. Chhajlany, et. al., Phys. Rev. Lett. 99, 167204 (2007).

Ann Kallin
Waterloo

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