MAR07-2006-002969

Abstract for an Invited Paper
for the MAR07 Meeting of
the American Physical Society

Universal contributions to entanglement entropy at critical points in two spatial dimensions[1]

JOEL MOORE, UC Berkeley and Lawrence Berkeley National Laboratory

The entanglement entropy of a pure quantum state of a bipartite system $A \cup B$ is defined as the von Neumann entropy of the reduced density matrix obtained by tracing over one of the two parts. Critical ground states of local Hamiltonians in one dimension have entanglement that diverges logarithmically in the subsystem size, with a universal coefficient that for conformally invariant critical points is related to the central charge of the conformal field theory. We find the entanglement entropy for a standard class of $z = 2$ quantum critical points in two spatial dimensions with scale invariant ground state wave functions: in addition to a nonuniversal "area law" contribution proportional to the size of the AB boundary, there is generically a universal logarithmically divergent correction. This logarithmic term is completely determined by the geometry of the partition into subsystems and the central charge of the field theory that describes the equal-time correlations of the critical wavefunction. Taken together with results on entanglement entropy in gapped, topologically ordered phases, these results indicate that even when the "area law" correctly predicts the leading behavior of entanglement, universal subleading terms can reflect important properties of a quantum many-body system.

[1]This work was in collaboration with Eduardo Fradkin. The author was supported by NSF DMR-0238760.