

Abstract Submitted
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Calculation of Entanglement Entropy in Fermion Lattices

MICHELLE STORMS, Ohio Wesleyan University, RAJIV SINGH, University of California, Davis — We study bipartite entanglement entropies of the ground and excited states of model fermion systems, where a staggered potential, μ_s , induces a gap in the spectrum. Ground state entanglement entropies satisfy the “area law,” and the “area law coefficient” is found to diverge as a logarithm of the staggered potential, when the system has an extended Fermi surface at $\mu_s = 0$. On the square-lattice, we show that the coefficient of the logarithmic divergence depends on the Fermi surface geometry and its orientation with respect to the real-space interface between subsystems, and is related to the Widom conjecture as enunciated by Gioev and Klich (Phys. Rev. Lett. 96, 100503 (2006)). For point Fermi surfaces in two-dimension, the “area-law” coefficient stays finite as $\mu_s \rightarrow 0$. The von Neumann entanglement entropy associated with the excited states follows a “volume law” and allows us to calculate an entropy density function $s_V(e)$, which is substantially different from the thermodynamic entropy density function $s_T(e)$, when the lattice is bipartitioned into two equal subsystems but approaches the thermodynamic entropy density as the fraction of sites integrated out of the larger subsystem approaches unity.

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