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Entanglement entropy scaling of composite Fermi liquids, Bose metals, and non-Fermi liquids on the lattice RYAN V. MISHMASH, OLEXEI I. MOTRUNICH, Caltech — Quantum phases characterized by surfaces of gapless excitations in momentum space are known to violate the otherwise ubiquitous boundary law of entanglement entropy in the form of a multiplicative log correction: $S \sim L^{d-1} \log L$. Using variational Monte Carlo, we calculate the second Rényi entropy for a model wavefunction of the $\nu = 1/2$ composite Fermi liquid (CFL) state defined on the two-dimensional triangular lattice. By carefully studying the scaling of the total Rényi entropy and, crucially, its contributions from the modulus and sign of the wavefunction on various finite-size geometries, we argue that the prefactor of the leading $L \log L$ term is equivalent to that in the analogous free fermion wavefunction. We thus conclude that the "Widom formula" likely holds even in this non-Fermi liquid CFL state. Furthermore, we calculate and analyze the entanglement entropy scaling of various other U(1) Bose metal and non-Fermi liquid states built from fermionic slave particles with Fermi surfaces. Overall, our results further elucidate—and place on a more quantitative footing—the relationship between nontrivial wavefunction sign structure and $S \sim L \log L$ entanglement scaling in such highly entangled gapless phases.

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