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**Entanglement entropy of fermionic quadratic band touching model**[1] XIAO CHEN, GIL YOUNG CHO, EDUARDO FRADKIN, University of Illinois at Urbana Champaign — The entanglement entropy has been proven to be a useful tool to diagnose and characterize strongly correlated systems such as topologically ordered phases and some critical points. Motivated by the successes, we study the entanglement entropy (EE) of a fermionic quadratic band touching model in $(2+1)$ dimension. This is a fermionic "spinor" model with a finite DOS at k=0 and infinitesimal instabilities. The calculation on two-point correlation functions shows that a Dirac fermion model and the quadratic band touching model both have the asymptotically identical behavior in the long distance limit. This implies that EE for the quadratic band touching model also has an area law as the Dirac fermion. This is in contradiction with the expectation that dense fermi systems with a finite DOS should exhibit $L \log L$ violations to the area law of entanglement entropy (L is the length of the boundary of the sub-region) by analogy with the Fermi surface. We performed numerical calculations of entanglement entropies on a torus of the lattice models for the quadratic band touching point and the Dirac fermion to confirm this. The numerical calculation shows that EE for both cases satisfy the area law. We further verify this result by the analytic calculation on the torus geometry.

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