Abstract Submitted
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Topological 'Luttinger' invariants protected by crystal symmetry in semimetals[1] S.A. PARAMESWARAN, University of California, Irvine — Luttinger's theorem is a fundamental result in the theory of interacting Fermi systems: it states that the volume inside the Fermi surface is left invariant by interactions, if the number of particles is held fixed. Although this is traditionally justified using perturbation theory, it can be viewed as arising from a momentum balance argument that examines the response of the ground state to the insertion of a single flux quantum [M. Oshikawa, *Phys. Rev. Lett.* **84**, 3370 (2000)]. This reveals that the Fermi sea volume is a topologically protected quantity. Extending this approach, I show that spinless or spin-rotation-preserving fermionic systems in non-symmorphic crystals possess generalized topological 'Luttinger invariants' that can be nonzero even in cases where the Fermi sea volume vanishes. A nonzero Luttinger invariant then forces energy bands to touch, leading to semimetals whose gaplessness is rooted in topology; opening a gap without symmetry breaking automatically triggers fractionalization. The existence of these invariants is linked to the inability of non-symmorphic crystals to host band insulating ground states except at special fillings. I exemplify the use of these new invariants by showing that they distinguish various classes of semimetals.

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