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Who is the Lord of the Rings in the Zeeman-spin-orbit Saga: Majorana, Dirac or Lifshitz?¹ CARLOS SA DE MELO, KANGJUN SEO, LI HAN, Georgia Institute of Technology — Zeeman, spin-orbit fields and interactions can be tuned in the context of ultra-cold atoms and allow for the visitation of several different phases. For systems with zero Zeeman field, the evolution from BCS to BEC superfluidity in the presence of spin-orbit effects is only a crossover [1]. In contrast, for finite Zeeman fields, spin-orbit coupling induces a triplet component in the order parameter that produces nodes in the quasiparticle excitation spectrum leading to bulk topological phase transitions of the Lifshitz type [2]. A fully gapped phase also exists, where a crossover from indirect to direct gap occurs. For spin-orbit couplings with equal Rashba and Dresselhaus strengths the nodal quasi-particles are Dirac fermions that live at and in the vicinity of rings of nodes. Transitions from and to nodal phases can occur via the emergence of zero-mode Majorana fermions at phase boundaries, where rings of nodes of Dirac fermions annihilate [3]. Lastly, we characterize different phases via spectroscopic and thermodynamic properties and conclude that Lifshitz is the “Lord of the Rings.”

[1] Li Han, C. A. R. Sa de Melo, arXiv:1106.3613v1.

[2] Kangjun Seo, Li Han and C. A. R. Sa de Melo, arXiv:1108.4068v2.

[3] Kangjun Seo, Li Han and C. A. R. Sa de Melo, arXiv:1110.6364v1.

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Prefer Oral Session
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