



New topological gapless particles in cold atom systems

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Recently, condensed matter systems have proven to be a powerful platform to study low energy gapless particles by using momentum space band structures to simulate the three-dimensional energy-momentum relation of relativistic particles and beyond. One celebrated example is the zero-dimensional Weyl point, a touching point between two bands, viewed as a magnetic monopole in momentum space. These points have been long sought after in particle physics but only recently experimentally observed in condensed matter materials. Apart from those fundamental particles endorsed by laws of particle physics, new species can exist in condensed matter systems such as structured (type-II) Weyl fermions, which have attracted tremendous interest in various fields. In this talk, I will discuss our first discovery of structured (type-II) Weyl fermions in quasiparticle spectra of spin-orbit coupled Fermi superfluids. Another example of gapless particles is the one-dimensional Weyl nodal ring, which has a quantized Berry phase but does not possess a nonzero quantized Chern number. I will present our recent study of Weyl exceptional rings that exhibit both a nonzero quantized Berry phase and Chern number in a dissipative ultracold atomic gas.

References:

1. Y. Xu, F. Zhang, and C. Zhang, Phys. Rev. Lett. 115, 265304 (2015)
2. A. A. Soluyanov, et. al., Nature, 527, 495 (2015)
3. Y. Xu and L.-M. Duan, Phys. Rev. A 94, 053619 (2016)
4. Y. Xu, S.-T. Wang, and L.-M. Duan, Phys. Rev. Lett. 118, 045701 (2017)

Yong Xu received his B.S. degree from Lanzhou University in 2005 and PhD degree from Institute of Physics, Chinese Academy of Science in 2013. During his PhD training, he spent two years from 2010 to 2012 at ICQM as a visiting graduate student. Currently, he is a research fellow at the University of Michigan, Ann Arbor. His research interests broadly encompass the theory of ultra-cold atomic gases and topological condensed matter physics. He has published 20 papers including 6 Physical Review Letters and 1 Nature Communications.