Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Searching new topological superfluids and phase transitions with spin-orbit coupled fermions in an optical lattice[1] YU YIXIANG, FADI SUN, JINWU YE, Mississippi State Univ, NINGFANG SONG, Beihang University — We study the global phase diagram of attractively interacting fermions hopping in a square lattice with any linear combinations of Rashba or Dresselhaus spin-orbit coupling (SOC) in a normal Zeeman field. Here, we focus on half filling case. We find there are 3 phases Band insulator, Superfluid (SF) and Topological SF with C=2. The TSF happens in small Zeeman fields and very weak interactions which is the experimentally most easily accessible regimes and has also the smallest heating effects. The transition from the BI to the SF is a first order one due to the multi-minima structure of the energy landscape. There is a topological phase transition from the SF to the TSF at the low critical field h_{c1}, then another one from the TSF to the BI at the upper critical field h_{c2}. We derive effective actions to describe the two topological phase transitions, then study the edge modes and the Majorana zero modes inside a vortex core of the C=2 TSF near both h_{c1}and h_{c2}. We map out the local Berry Curvature distribution near both h_{c1}and h_{c2}. We find a topological tri-critical point along h_{c1}and conjecture that any topological transitions can only be odd order. We also study some bulk-Berry curvature-edge-vortex correspondences.

[1]We thank W. M. Liu for encouragements and acknowledge AFOSR FA9550-16-1-0412 for supports.

Yu Yixiang
Mississippi State Univ

Date submitted: 11 Nov 2016 Electronic form version 1.4