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BCS-BEC Crossover and topological phase transition in Fermi Gases driven by Spin-Orbit Coupling and Zeeman field[1] YI-XIANG YU, JINWU YE, Mississippi State University, WUMING LIU, Chinese Academy of Sciences — In this work, we investigate 3D and 2D Fermi gases with uniaxial, Rashba-type and isotropic spin-orbit coupling (SOC). By calculating the chemical potentials and cooper-pair sizes, we find that the increasing Rashba and isotropic SOC can drive a crossover from BCS side to BEC side, while uniaxial SOC will not affect the properties of the many-body system. According to recent experiments, we also consider both a zeeman field and SOC simultaneously appearing in a 3D and 2D Fermi gas. We find the zeeman field can drive the system from the normal state to the topological superfluid states in Rashba SOC case. In 3D Rashba case, there are two topological superfluid phases which have different number of Weyl Fermions. At the same time, our results also show that the zeeman field can drive a converse crossover from BEC side to BCS side.

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