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Spin-1 degenerate Fermi gases with 2D spin-orbit coupling JUNPENG HOU, TIAN-SHENG ZENG, HAIPING HU, CHUANWEI ZHANG, University of Texas at Dallas — Recent researches reveal many interesting phenomena on the topological properties of matters, for instance, triply-degenerate points (TPD), high-order band touching (HoBT) and multi-Weyl fermions. However, those fascinating phenomenons usually rely on extra degree of freedom and requires certain lattice symmetry, making them difficult to realize in experiments. In this work, we present an unified approach towards those fascinating topological features through a pristine generalization of Rashba spin-orbit coupling (SOC) to spin-1 degenerate Fermi gases. Remarkably, we identify exotic band touching types, including a single Dirac point, TPD and HoBT through the tuning of linear and quadratic Zeeman fields. We further consider the SU(3) Fermi-Hubbard interaction effects. We show that (i) for attractive interactions, the system hosts a topological *s*-wave superfluid with a large Chern number in 2D, and multiple-Weyl nodes in 3D, and (ii) for repulsive interactions, the system hosts an interaction-driven quantum anomalous Hall phase with a quadratic band touching. Our work shows that the spin degree of freedom itself is sufficient to induce intriguing topological properties, and provides a guideline towards the observability and understanding of 2D SO coupled large spin system.

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