Topological Fermiology of Gate-Tunable Rashba Electron Gases in Few-Layer Black Arsenic

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The Onsager-Lifshitz rule lays the foundations of understanding Landau quantizations and topological matters by correlating the Fermi-surface (FS) extrema to the frequencies of magnetic quantum oscillations. By introducing first-order quantum phase corrections as topological invariants, recent symmetry-analysis based theoretical works have reinvigorated this semiclassical approach as a versatile quantum probe for unfolding the FS topology along with the geometry information, i.e. topological Fermiology [1, 2]. In this talk, we demonstrate the comprehensive topo-Fermiology of high mobility Rashba 2D electron gases with ultra gate-tunability of spin-orbit coupling parameters in few-layer black arsenic [3]. The remarkable consistencies with the key theoretical predictions of period doubling in quantum oscillations, gate-tunable aperiodic beating patterns, and the symmetry enforced Landau level crossing phenomena controlled by the competition between Rashba coupling and the Zeeman interaction, which ultimately manifests as all odd-filling factor integer quantum Hall effect with superb sensitivity to quantum phases, establish topo-Fermiology as an indispensable methodology for studying topological quantum matters [4].

References

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