PHYS4801 Seminar: Abstract and outline

Group 18: Quantum Hall Effect

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Abstract:

Quantum Hall Effect (QHE), the quantized version of Hall effect observed in 2-D electron systems under low temperature and strong magnetic field, marked the turning point of condensed matter physics. That electron resistance can be defined in terms of fundamental constants in irregular samples. Different theories and experimental measurements in multiple fields were motivated by QHE in the past 40 years. We will begin with some background story, followed by introducing the principles of QHE and edge state, focusing on the experimental observations with implications, and finally the outlook on this topic.

Outline:

1) Background
    a) Classical hall effect
    b) From Classical to Quantum
    c) 2-D Electron Gas
    d) Discovery of Quantum hall effect (QHE)
2) The various QHEs
    a) **Integer** Quantum Hall Effect (With mentions on Fractional and Anomalous QHE)
    b) Edge state
3) Experimental Observation of QHEs
    a) Quantized resistance and small uncertainty
    b) Edge state experiment: Stanene as both topological superconductor and insulator
4) Implications
    a) Significance
        i) Fine-structure constant in particle physics
        ii) Revealing the “Quantumness” of nature
    b) Branching with other fields of physics
5) Outlook
    a) Modeling in many-particle system (Quasiparticles in quantum entanglement and information processing)
    b) Topological insulators/ superconductors