Strongly interacting topological quantum matter

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Systems of strongly interacting fermions or bosons can give rise to novel topological phases of matter that are absent in non-interacting systems. Topological insulators, as well as Dirac and Weyl semimetals, are now well-understood. This is primarily because band theory facilitates the determination of their topological invariants, thus offering a complete characterization of their electronic and photonic properties.

However, when it comes to interacting topological quantum matter, our understanding of their fundamental properties remains limited, with a few exceptions like the experimentally realized fractional quantum Hall effect. There exists the potential for discovering new phases born from the intricate relationship between strong interactions and topology.

The primary objective of this project is to introduce, develop, and employ contemporary concepts and cutting-edge methods to elucidate and define these intriguing systems. From a physics standpoint, we aim to explore novel physical phenomena, such as the topological properties of Weyl Mott insulators, flat band systems with strong interactions, laser-induced superconductivity, or the topology associated with quantum spin liquids.

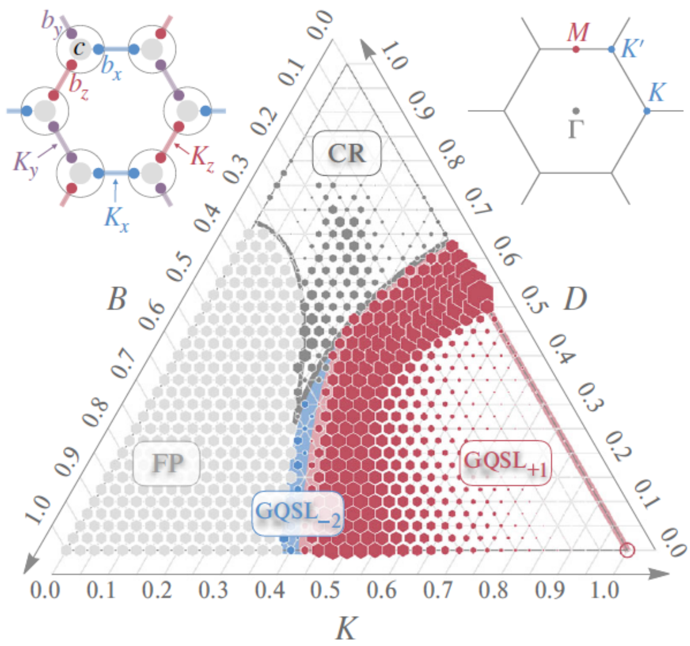

***Figure**: Phase diagram of Kitaev model with Dzyaloshinskii-Moriya (DM) interaction under magnetic field. An intermediate phase GQSL-2 (blue region) arises between the Kitaev spin liquid, GQSL+1 B (red colored region) at small DM and the fully polarized (FP) phase.*