Condensed Matter Physics Seminar Series

Renormalization, symmetries, and anomalies: organizing principles for entangled quantum matter

Lei Gioia
CalTech

The renormalization group is one of the pillars of many-body physics, providing the conceptual framework for thinking about the large scale collective behaviour of many small interacting parts. Moreover, one can use the renormalization group to track the symmetries of a problem across the many length scales. In this talk, I will apply this "renormalization group of symmetries" reasoning to explore a myriad of behaviors associated with critical quantum systems (like a metal), which have many low energy degrees of freedom. In particular, I will discuss the Nielsen-Ninomiya aka fermion doubling theorem from this point of view, which forbids the existence of lattice theories with an odd number of stable chiral fermions, and how one may circumvent this no-go theorem. Then, we will explore topological responses of Weyl semimetals that result from "quantum anomalies" associated with chiral fermions. We will demonstrate that their topological responses are observable in the presence of lattice defects such as dislocations. Next, we will show how these observations allow us to derive circuit lower bounds in the context of quantum state preparation.
Finally, we will discuss how the renormalization group of symmetries framework will allow us to explore future directions in the interdisciplinary field of quantum information, quantum computation, and quantum matter.

Friday, May 22nd at 11am
4-330 PAB

Hosted by Yaroslav Tserkovnyak