NEW YORK CITY COLLEGE OF TECHNOLOGY
Physics Department
Center for Theoretical Physics

Emergent Collective Phenomena in Many-Body Systems

Presented by

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Condensed matter physics is the physics of solids and liquids (condensed phases of matter). It is the study of the complex behaviour of a large number of interacting particles such that their collective behaviour gives rise to emergent properties. In this talk, I will discuss some interesting quantum condensed matter systems with their intriguing emergent phenomena arising from complexity.

First, I will revisit Landau's Fermi liquid (FL) theory for normal metals, and thereby outline the properties of the non-Fermi liquid (NFL) metals (also called "strange" metals) which cannot be described within the Landau framework. I will outline a framework to extract the low-energy physics of such systems in a controlled approximation, using the tool of dimensional regularization.

Second, I will focus on Sachdev-Ye-Kitaev (SYK) models, which are toy-models of exactly soluble NFLs. I will consider a model with SYK fermions coupled to non-interacting lead fermions, which can be realized in a graphene flake connected to external leads. I will discuss the characteristics of the system after a sudden quench, where a thermal state is reached rapidly via collapse-revival oscillations of the quasiparticle residue of the lead fermions. across the NFL-FL transition, leads to multiple pre-thermal regimes and much slower thermalization.