Contribution ID: **5** Type: **not specified**

Kinetic theory of Fermi-boson systems

Thursday, 27 June 2024 15:45 (15 minutes)

In this work, we explore the dynamics of coupled quantum systems comprising both fermionic and bosonic particles, focusing on their collective behaviors and emergent phenomena in graphene. Conventional research frequently isolates a main species and examines its characteristics either independently of or in equilibrium with nearby species. Here we diverge by studying mixed systems with complex interactions between bosons and fermions, with particular emphasis on bosonic charge density oscillations, called plasmons. We use a kinetic theory framework that quantizes both bosonic and fermionic particles, in contrast to traditional methods that treat fields classically. By incorporating non linear effective forces to couple and correlate the various species, we are able to provide a more thorough understanding of their dynamics. With this kinetic approach we will uncover new modes and instabilities within the plasma dynamics, offering insights into the complex behaviors underpinning coupled fermi-boson systems.

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