Title: Kekulé Superconductivity in Twisted Magic Angle Bilayer Graphene

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Abstract:

Despite its status as a seminal discovery, the precise nature of superconductivity in twisted magic-angle bilayer graphene remains an open question. Motivated by recent scanning tunneling microscopy (STM) experiments reporting Kekul\'e ordering in moiré graphene superconductors, we present a microscopic theory of superconductivity for the twisted bilayer system. We identify the pairing as an intra-valley, finite-momentum pair-density wave (PDW) that intrinsically carries a Kekulé modulation.

In this talk, I will demonstrate how this state captures four salient experimental features: (i) the spontaneous breaking of C_3 rotation symmetry, resulting in nematic order; (ii) triplet pairing; (iii) a quasiparticle density of states that evolves from a V-shaped profile to a fully gapped, U-shaped spectrum as attraction increases; and (iv) systematic behavior in the temperature-dependent zero-bias conductance. We further find that, even with modest interaction strengths, the state approaches a BEC-like phase, consistent with the extremely short coherence lengths observed. Finally, I will discuss the electromagnetic response of this Kekulé PDW state, detailing its specific signatures and implications for identifying this candidate for unconventional superconductivity.