Electronic contribution to the Raman spectrum of twisted bilayer graphene.

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The interest in the physics of twisted bilayer graphene (tBLG) has been redoubled following the recent discovery in this material of a superconducting phase [1]. In this system, the coupling between the two graphene monolayers hybridizes Dirac states, resulting in a reduction of the Fermi velocity and the formation of van Hove singularities (VHSs). The position of these VHSs is closely connected to the twist angle, drifting towards the neutrality point as the angle becomes smaller. For a twist angle around 1.1°, the first bands below and above the neutrality point become flat [2], and electron-electron interaction takes over, leading to the appearance of strongly correlated phenomena.

Here, we use the continuum model, we study theoretically the electronic contributions to the Raman spectrum of twisted bilayer graphene for twist angles close to the magic angle. We show that non-resonant excitations of electron-hole pairs between the first minibands above and below the neutrality point lead to a peak, the position of which is determined by the twist angle. We estimate the quantum efficiency of this Raman feature as $\sim 10^{-13}$, about two orders of magnitude less than the intensity of the G peak [3]. Because of its electronic origin, the new peak provides direct information about the flatness of the first minibands in tBLG.

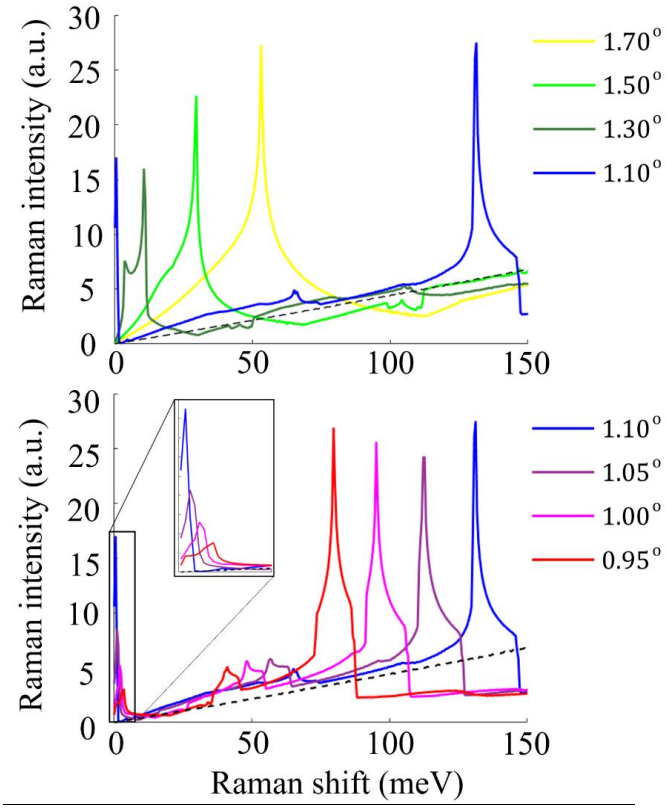

Figure 1: Simulated electronic contribution to the Raman spectrum of twisted bilayer graphene for different twist angles above (top) and below (bottom) the magic angle. For comparison, the dashed black line represents the electronic contribution of two uncoupled layers of graphene.

References

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