Disorder in twisted multilayer graphene: Quasicrystals and Superperiodicities

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The stacking of 2D materials can dramatically modify the properties of those. One of the most spectacular cases is the new physics related with the stacking twist angle. That is the case of the twisted multilayer graphene, where highly correlated physics have been observed at a wide range of systems with different number of layers and twst-angle. Yet this exhotic physics is only observed at ultra-clean samples and ultra-low temperatures.
In this talk we will review the effects of disorder in twisted multilayers focusing on special angles such as the magic-angle (~1.05º) and the quasicrystalline (~30º). For that we will present exotic results attached to disorder as the disorder induced dellocalization mechanism for the flat-band in magic angle twisted bilayer graphene(MATBLG)[1] and its dissapearence when combined with a quasicrystall twisted bilayer graphene (QCTBLG)[2]. We will also cover the effects this disorder have in correlations and wave-function properties.

References

[1] PA Guerrero, VH Nguyen, JM Romeral, AW Cummings, JC Charlier, S Roche, arXiv:2401.08265.
[2] PA Guerrero, VH Nguyen, AW Cummings, JC Charlier, S Roche, arXiv:2502.17069

Figures

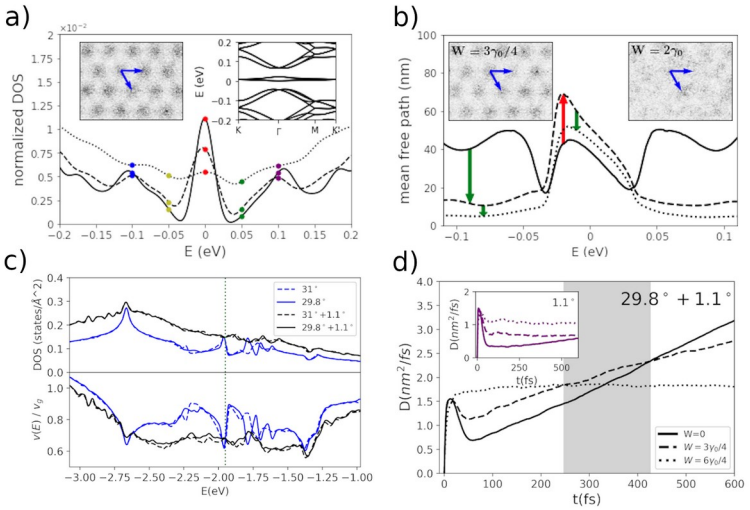

Figure 1: a) Density of states of MATBLG for increasing disorder (solid → dashed → dotted). The left and right insets show the localization pattern and band structure of the clean system, respectively. **b)** Mean free path of electrons for increasing disorder strength (solid → dashed → dotted). An increase in disorder initially leads to an increase in the mean free path in the flat bands, with the usual trend recovered once its contribution dominates the Moiré potential. Insets show local densities of states for intermediate (left) and strong (right) disorder. **c)** Density of states of MATBLG and QCTBLG approximant compared to a trilayer composed by the two respective angles **d)** Diffudivity against time for the previously mentioned trilayer system and a MATBLG (in the inset), we can see the aforementioned dellocalization mechanism spoiled.