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Symmetry, maximally localized Wannier states, and low energy model for the twisted bilayer graphene narrow bands

I will discuss how to build symmetry adapted exponentially localized Wannier states, as well as the low energy tight binding model for the four narrow bands of the twisted bilayer graphene. Because the total Chern index of the four bands vanishes, there is no a'priori obstruction to building exponentially localized Wannier functions when the narrow bands are separated from the rest of the bands by energy gaps. However, similar to the case of 2D topological insulators with Z2 index, some of the emergent (approximate) symmetries cannot be represented locally.

Our construction is for a commensurate twist angle, near the `magic' value. On each layer and sublattice, every Wannier state has three peaks near the triangular moire lattice sites. However, each Wannier state is localized and centered around a site of the honeycomb lattice that is dual to the triangular moire lattice. The corresponding tight binding model provides a starting point for studying the correlated many-body phases.