# Atomic-scale structure and electronic properties of twisted double bilayer graphene: topological edge states and broken symmetries

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Van der Waals materials stacked with an interlayer twist are an excellent platform towards achieving gate-tunable correlated phenomena linked to the formation of flat bands. We demonstrate the formation of correlated phases in twisted double bilayer graphene (tDBG) in two regimes of twist angle: minimally twisted (<0.1°) and 1.1°. Tiny-angle tDBG host large regions of uniform rhombohedral graphene where scanning tunneling spectroscopy reveals a sharp flat band of 3-5 meV half-width. We demonstrate that, when this flat band straddles the Fermi level, a correlated many-body gap emerges. Moreover, we show that ABCA graphene hosts surface topological edge states at natural interfaces with ABAB graphene. Scanning tunneling microscopy on tDBG at higher twist (~1.1°) reveals the presence of van Hove singularities on all inequivalent moiré sites. Tuning carrier density and displacement field reveals long-range broken $C_3$ symmetry that emerge when the Fermi level is at the electronic flat bands. We demonstrate that the $C_3$ symmetry breaking is a manifestation of an interaction-driven electronic nematic phase, which emerges even away from integer fillings. The nematic instability is an emergent phenomenon at the scale of the moiré lattice, pointing to its universal character.