

Magic Angle Bilayer Graphene - Superconductors, Orbital Magnets, Correlated States and beyond

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Abstract

When twisted close to a magic relative orientation angle near 1 degree, bilayer graphene has flat moire superlattice minibands that have emerged as a rich and highly tunable source of strong correlation physics, notably the appearance of superconductivity close to interaction-induced insulating states. Here we report on the fabrication of bilayer graphene devices with exceptionally uniform twist angles. We show that the reduction in twist angle disorder reveals insulating states at all integer occupancies of the four-fold spin/valley degenerate flat conduction and valence bands, i.e. at moire band filling factors $\nu = 0, +(-) 1, +(-) 2, +(-) 3$, and reveals new superconductivity regions below critical temperatures as high as 3 K close to $\nu = 2$ filling. In addition we find novel orbital magnetic states with non-zero Chern numbers. Our study shows that symmetry-broken states, interaction driven insulators, and superconducting domes are common across the entire moire flat bands, including near charge neutrality. We further will discuss recent experiments including screened interactions, fragile topology and the first applications of this amazing new materials platform.