Flat Band Superconductivity and Quantum Geometry in 2D Moiré Materials

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In a flat band system, the charge carriers' energy-momentum relation is very weakly dispersive. The resultant large density of states and the dominance of Coulomb potential energy relative to the kinetic energy favor the formation of strongly correlated electron states, such as ferromagnetism, nematicity, and superconductivity. The advent of two-dimensional (2D) materials and their heterostructures has ushered in a new era for exploring, tuning and engineering of flat band system. Here I will begin with an overview of the state-of-art of superconductivity in moiré materials, following by presenting our recent works in twisted bilayer graphene, including experimental demonstration of the resolution of the paradox of slow Fermi velocity by quantum geometry, and our recent observation of correlated insulating states at fractional fillings in large angle twisted bilayer graphene.