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Bloch electron on Moire superlattice: from superconductivity to non-coplanar spin systems

Tuesday 2 December 2025 10:00 (1 hour)

Moiré superlattices in van der Waals heterostructures provide an exceptionally versatile platform in which electronic, orbital, and spin degrees of freedom can be engineered at the mesoscopic scale. By twisting or lattice-mismatching atomically thin layers, one can create flat or quasi-flat bands with strongly enhanced interaction effects, driving a rich assortment of correlated phases ranging from unconventional superconductivity and correlated insulators to topological states. In this talk, I will first discuss how moiré band engineering controls superconductivity, for example, through bandwidth tuning, valley and spin degeneracies, and quantum geometry of the Bloch wavefunctions. I will then turn to moiré platforms that stabilize non-coplanar spin textures, including chiral magnets and skyrmion orders emerging from frustrated exchange coupling encoded in the moiré pattern. In such systems, Berry curvature and scalar spin chirality can induce large anomalous and topological Hall responses, and potentially intertwine with superconductivity in the same moiré environment.

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