# Beyond Twistronics: An Alternative Quantum Simulator for Condensed Matter Physics

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Abstract: Twisted heterostructures have been proposed to act as a quantum simulator for condensed matter physics. In this talk, I will show an alternative route towards generating flat bands using a superlattice potential and argue its capability for being an alternative quantum simulator. Particularly, I will show that bilayer graphene in the presence of a 2D superlattice potential provides a highly tunable setup that can realize a variety of flat band phenomena. We focus on two regimes: (i) topological flat bands with non-zero Chern numbers, C, including bands with higher Chern numbers $|C| > 1$; and (ii) an unprecedented phase consisting of a stack of nearly flat bands with $C = 0$. For realistic values of the potential and superlattice periodicity, this stack can span nearly 100 meV, encompassing nearly all of the low-energy spectrum. I will show in the topological regime, the topological flat band has a favorable band geometry for realizing a fractional Chern insulator (FCI) and use exact diagonalization to show that the FCI is in fact the ground state at 1/3 filling. I will then present results on generalizing this approach to multilayer graphene. Our results provide a realistic guide for future experiments to realize a new platform for flat band phenomena.