Role of interlayer interactions in stacked 2D crystals

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Interlayer interactions in stacked 2D crystals are one of key ingredients in exhibiting their qualitative different physical properties. For example, a well-known 2D quantum spin Hall insulating transition metal dichalcogenide can show either topological Weyl metallic phase or trivial one depending on a minute stacking order difference. Recent advances in fabricating stacked 2D crystals enable us to perform controlled studies on interesting electronic, magnetic and topological properties in low dimensional heterostructures.

In this talk, I will first discuss interplay between interlayer interactions and electronic properties in graphene bilayer systems. And I will also briefly discuss a possible modification in its phonon spectrum. Regarding on electronic properties, I will show that the system has a quasicrystalline order through a perfect incommensurate interlayer interaction when two graphene rotate 30 degrees with respect to each other and shows localized 12-fold resonant states with fractal scaling. In addition to existing 2D materials, if time allowed, I will also introduce a new computational scheme to search a new family of 2D crystals that will expand both material and property spaces of layered crystals.