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2D twistronics

The wide family of 2D materials (2DMs) includes metals, semiconductors, superconductors, dielectrics, ferroics and more, each displaying novel phenomena due to the qualitatively different nature of interactions in 2D. However, the real delight is in the ability to combine different 2D materials into atomically defined heterostructures by simply stacking layers, engineering interactions between them. From this a new parameter space arises, the twist angle between neighbouring layers. Changing the twist angle can be used to tune interlayer interactions. This is exemplified by 'magic-angle'twisted graphene, engineering strongly correlated behaviour through moire interactions, an effect also used to trap ordered arrays of excitons in transition metal dichalcogenide (TMDC) heterobilayers. moire effects conventionally require a moire wavelength much longer than the atomic scale. But for larger lattice mismatch, Umklapp processes can result in unexpected electronic structure changes. Here, I will present our recent studies of electronic structure measurements of twisted 2DMs, including twisted graphenes and TMDCs, illustrating the effects of these twist-angle dependent inter-layer interactions.

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