Correlations and topology in buckled graphene superlattices

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Electronic correlations stemming from nearly flat bands in van der Waals materials have demonstrated to be a powerful playground to engineer artificial quantum matter. Here we show that spontaneously buckled graphene can yield a correlated state, emerging from an elastic pseudo Landau level. Our results build on top of recent experimental findings reporting that, when placed on top of hBN or $NbSe_2$ substrates, wrinkled graphene sheets relax forming a periodic, longrange buckling pattern. The high density of states at the lowest pseudo Landau level leads to the formation of a periodically modulated ferrimagnetic groundstate, which can be controlled by the application of external electric fields [1]. We also demonstrate the emergence of valley topology driven by competing electronic correlations in buckled graphene superlattices [2]. We show, both by means of atomistic models and a lowenergy description, that the existence of longrange electronic correlations leads to a competition between magnetic and charge density wave instabilities. Interestingly, we find that the emergent charge density wave has a topologically nontrivial electronic structure, leading to a coexistent quantum valley Hall insulating state. In a similar fashion, the magnetic phase realizes a spinpolarized quantum valleyHall insulating state. Our results indicate that periodically strained graphene is a versatile platform to explore topological and correlated.

References

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