The vanishing Fermi velocity in Periodically Strained Graphene

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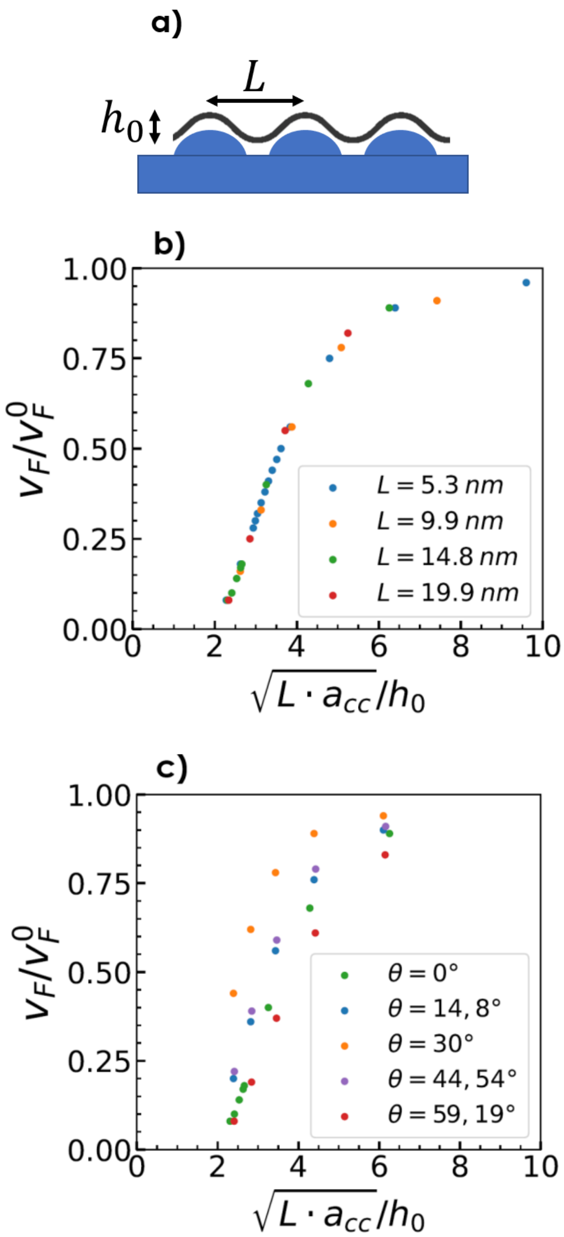
In recent years, intense research has been made in band structure engineering of two-dimensional systems. Most notably Flat bands were obtained in Twisted Bilayer Graphene (TBG) and shown to exhibit superconductivity and various strongly correlated phases [1]. An alternative route to realizing similar flat bands involves inducing a triangular superlattice of Periodic Strain on monolayer Graphene (PSG) by a corrugated substrate (Fig.a). It can be shown that the height modulation h_0 and the superlattice periodicity L serves as tuning parameters for controlling band flattening and the Fermi velocity v_F near the Dirac cones [2, 3].
In this poster, we will show, by using tight-binding calculations, that not only does v_F decrease as h_0 increases [4] but eventually v_F vanishes at a finite value of h_0 for any given superlattice size L (Fig.b). Remarkably, this property is universal for any size L, regardless of whether C_2 symmetry is broken —leading to bandgaps— or whether in-plane graphene bond relaxation is taken into account. Furthermore, a similar behaviour is observed (Fig.c) when the periodic strain superlattice is rotated with respect to graphene atomic lattice. These predictions may help the design of experimental devices.

References

[1] Cao *et al.*, Nature, 556 (2018) 43-50
[2] Mao *et al.*, Nature, 7820 (2020) 215-220
[3] Yuan *et al.*, Phys. Rev. B, 24 (2024) 245408
[4] S. P. Milovanović *et al.*, Phys. Rev. B, 24 (2020) 245427

Figures



Figures: a) Model schematic of PSG **b)** v_F versus order parameter for different lattice pitch **c)** and for different lattice orientation at L = *14,8 ± 0,2 nm*.