

# Quantum diffusion in sheared bilayer graphene

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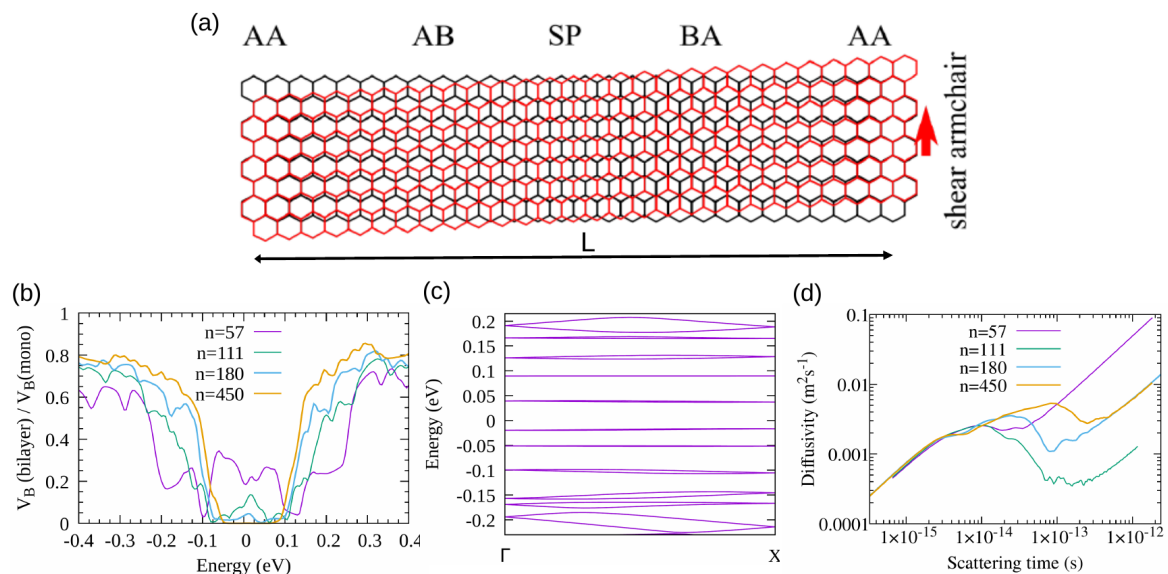
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The identification of correlated insulators and superconductivity in magic-angle twisted bilayer graphene (MATBG) has sparked significant interest in its electronic properties [1]. When examining the MATBG moiré patterns along the line with alternating regions of AA, AB, and BA, we observe striking similarities to those found in a 1D moiré of a sheared bilayer graphene, where one layer is laterally displaced. That may lead to a localization of the electronic states [2,3]. In this study, we investigate numerically [4,5] the electronic and quantum transport properties in sheared bilayer graphene, focusing on how the shear and the associated moiré length scale affect these properties. We show in particular that increasing the superlattice size ( $L$ ) induces a strong reduction of the semiclassical (Boltzmann) velocity over an energy window of about 0.2 eV, and that the quantum diffusion – studied as a function of  $L$  and energy – exhibits clear signatures of moiré-induced localization in this 1D moiré system.

## References

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- [2] J. González, *Phys. Rev. B*, 94 (2016) 165401,
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## Figures



**Figure 1:** (a) Sheared Bilayer Graphene structure of supercell size  $L = na$  (along the 1D moiré direction), where  $a$  is the lattice parameter of graphene. (b) The normalized Boltzmann velocity along the 1D moiré direction ( $x$ -direction) as function of energy for  $n = 59, 111, 180, 450$ . (c) Band energies in the  $\Gamma X$  direction of the 1<sup>st</sup> Brillouin zone for  $n = 111$ , and (d) Diffusivity as function of scattering time for energy  $E = -0.05$  eV and different  $n$  values.