

# Moiré fractals in Twistronics

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ABSTRACT Twisted bilayer graphene (TBLG) [1] subject to a sequence of commensurate external periodic potentials reveals the formation of moiré fractals [2] that share striking similarities with the central place theory (CPT) of economic geography, thus uncovering a remarkable connection between twistronics and the geometry of economic zones. Using various super-moiré structures we explain how such fractals can emerge in various Van der Waals heterostructures consists of twisted layers. The moiré fractals arise from the self-similarity of the hierarchy of Brillouin zones (BZ) so formed, forming a nested subband structure within the bandwidth of the original moiré bands. The fractal generators for TBLG under these external potentials are derived and we explore their impact on the hierarchy of the BZ edges. Furthermore, we uncover parallels between the modification of the BZ hierarchy and magnetic BZ formation in the Hofstadter butterfly, allowing us to construct an incommensurability measure for moiré fractals as a function of the twist angle. The resulting band structure hierarchy bolsters correlation effects, pushing more bands within the same energy window for both commensurate and incommensurate TBLG.

- [1] Deepanshu Aggarwal, Rohit Narula and Sankalpa Ghosh, A primer on twistronics: a massless Dirac fermion's journey to moiré patterns and flat bands in twisted bilayer graphene, *J. Phys.: Condens. Matter* **35**, 143001 (2023).
- [2] Deepanshu Aggarwal, Rohit Narula and Sankalpa Ghosh, Moiré fractals in twisted graphene layers: <https://arxiv.org/abs/2306.04580>.