Abstract template for “Workshop on Twistronics and Moiré Materials”

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The discovery of superconducting and correlated insulating behaviour in twisted bilayer graphene (TBG) has shaken up the field of two-dimensional (2D) materials, reinvigorating the study of graphene-based systems. We demonstrate that one-dimensional moiré patterns, analogous to those found in twisted bilayer graphene, can arise in collapsed chiral carbon nanotubes (CNT) [1]. Performing a detailed study of the electronic structure of all types of chiral nanotubes, previously collapsed via molecular dynamics and validated against ab-initio modelling, we find that magic angle physics occurs in all families of collapsed carbon nanotubes [2]. Velocity reduction, flat bands, and localization in AA regions with diminishing moiré angle are revealed. Remarkably, all kinds of nanotubes behave the same with respect to magic angle tuning, showing a monotonic behaviour that gives rise to magic angles in full agreement with those of TBG.
Superconductivity in TBG was an unexpected phenomenon, so the quest for other systems which could be the 1D analogues of TBG is of great importance to elucidate the nature of superconductivity found therein. Moreover, nontrivial topological phases have been found in the magic angle regime and are closely related to flat bands. Therefore, chiral collapsed carbon nanotubes stand out as promising candidates to explore topology and superconductivity in low dimensions, emerging as the one-dimensional analogues of twisted bilayer graphene.

[1] O. Arroyo-Gascón, R. Fernández-Perea, E. Suárez Morell, C. Cabrillo, L. Chico, Nano Letters **20**, 7588 (2020).
[2] O. Arroyo-Gascón, R. Fernández-Perea, E. Suárez Morell, C. Cabrillo, L. Chico, Carbon **205**, 394 (2023).