

**Dirac meets flat band:  
Interplay of local moments and quantum geometry in  
correlated graphene heterostructures**

Niklas Witt<sup>1</sup>, Siheon Ryee<sup>2</sup>, Lennart Klebl<sup>3</sup>, Jennifer Cano<sup>4,5</sup>,  
Giorgio Sangiovanni<sup>3</sup>, and Tim Wehling<sup>6,7</sup>

<sup>1</sup>*Faculty of Physics, Bielefeld University*

<sup>2</sup>*Department of Physics, Pusan National University*

<sup>3</sup>*Institute for Theoretical Physics and Astrophysics and Würzburg-Dresden Cluster of  
Excellence ctd.qmat, University of Würzburg*

<sup>4</sup>*Department of Physics and Astronomy, Stony Brook University*

<sup>5</sup>*Center for Computational Quantum Physics, Flatiron Institute*

<sup>6</sup>*I. Institute of Theoretical Physics, University of Hamburg*

<sup>7</sup>*The Hamburg Centre for Ultrafast Imaging (CUI:AIM)*

Graphene-based multilayer systems serve as versatile platforms for exploring the interplay between electron correlation and topology, thanks to distinctive low-energy bands marked by significant quantum metric and Berry curvature from graphene's Dirac bands. Here, we investigate Mott physics and local spin moments in Dirac bands hybridized with a flat band of localized orbitals in functionalized graphene [1]. Via hybridization control, a topological transition is realized between two symmetry-distinct site-selective Mott states featuring local moments in different Wyckoff positions, with a geometrically enforced metallic state emerging in between. We find that this geometrically controlled real-space switching of local moments and associated metal-insulator physics may be realized through proximity coupling of epitaxial graphene on SiC(0001) with group IV intercalants [1,2,3], where the Mott state faces geometrical obstruction in the large hybridization limit. Our results show that chemically functionalized graphene provides a correlated electron platform, very similar to the topological heavy fermions in graphene moiré systems [4,5] but at significantly enhanced characteristic energy scales.

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[4] J. Herzog-Arbeitmann et al., arXiv:2404.07253