

CMD2020GEFES mini-colloquium

Flat Band Moirés

Leni Bascones, Dmitri Efetov, Johannes Lischner

The recent discovery of superconductivity emerging from correlated insulating states in twisted bilayer graphene has shaken up the condensed matter community. The narrow bands formed for twist angles close to the so-called magic angle are believed to be behind these properties as they make the system strongly responsive to interactions. The small mismatch between the two layers created by the twist angle produces a moiré pattern with unit cells containing several thousand atoms.

Moiré systems displaying flat bands have emerged as a novel platform to study correlated electron physics. Moiré patterns with narrow bands are not restricted to twisted bilayer graphene and similar insulating and superconducting states have been found in other systems, such as trilayer graphene on hBN, twisted double bilayer graphene or twisted heterostructures based on transition metal dichalcogenides.

The resemblance of the phase diagrams of these systems to those found in many unconventional superconductors, including high- T_c cuprates, suggests that similar physics could be at play. The large doping levels induced with gate voltages and the variety of systems open many new possibilities to explore and tune different correlated states, including states with non-trivial topological properties or nematicity. This new area of condensed matter physics brings together researchers working on graphene and other 2D systems, electronic correlations and topology, experimentalists and theorists.

The symposium will cover both experimental and theoretical aspects of flat band moirés: synthesis, transport, spectroscopy, modeling and simulation. It will mostly focus on the correlated and superconducting states but properties of the metallic phases will also be discussed.

Wednesday, 02 September 2020

Zoom host: Maria José Claderón.

9:30-10:10 *Correlated, insulating and superconducting States in twisted bilayer graphene Below the Magic Angle.* **Jeanie Lau (invited).**

10:10-10:30 *Flat band moires and superconductivity in twisted bilayer graphene.* **Tero Heikkilä**, T. Peltonen, A. Julku, R. Ojajärvi, L. Long, P. Törmä.

10:30-10:50 *Band structure and insulating states driven by the Coulomb interactions in twisted bilayer graphene.* **Tommaso Cea**, F. Guinea.

10:50-11:10 *Interactions in magic-angle twisted bilayer graphene.* **María José Calderón**, E. Bascones.

11:10-11:30 *Evidence of weakly dispersive bands in twisted bilayer graphene from nano-ARPES.* **Simone Lisi**, X. Lu, T. Benschop, T. A. de Jong, P. Stepanov, J. R. Duran, Fl. Margot, I. Cucchi, E. Cappelli, A. Hunter, A. Tamai, V. Kandyba, A. Giampietri, A. Barinov, Johannes Jobst, Vincent Stalman, M. Leeuwenhoek, K. Watanabe, T. Taniguchi, L. Rademaker, S. J. van der Molen, M. Allan, D. K. Efetov, F. Baumberger.

11:30-11:50 *Marginal Fermi liquid in twisted bilayer graphene* **José González**, T. Stauber.

11:50-12:10 *Incommensurability induced sub-ballistic states in twisted bilayer graphene.* **Miguel de Jesús Mestre Gonçalves**, H. Z. Olyaei, B. Amorim, R. Mondaini, P. Ribeiro, E. V. Castro.

12:10-12:30 *Strain induced excitonic instability in twisted bilayer graphene.* **Héctor Ochoa.**

Special sessions Wednesday Afternoon.

Zoom host: Maria José Claderón.

Posters

1. *Electronic compressibility of Magic Angle Twisted Bilayer Graphene.* **Alejandro Jimeno**, F. Guinea.

2. *Normal and Andreev transport in Magic Angle Graphene Junctions.* **Miguel Alvarado Herrero**, A. Levy-Yeyati.

3. *Valley spirals in magnetically encapsulated twisted bilayer graphene.* **Tobías Wolf**, O. Zilberberg, G. Blatter, J. L. Lado.

4. *Conductivity of twisted bilayer graphene nanotubes with disorder.* **Héctor Sainz Cruz**, T. Cea, F. Guinea.

5. *Spin polarization in Twisted Transition Metal Dichalcogenides.* **Ignacio Vicent**, J. A. Silva-Guillén, F. Guinea.

Thursday, 03 September 2020

Zoom host: Maria José Claderón.

9:30-10:10 *Moiré physics and symmetry breaking in magnetically encapsulated van der Waals structures.* **José Lado (invited).**

10:10-10:30 *Twist angle homogeneity in twisted bilayer graphene devices studied with STM.* **Tjerk Benschop**, T. A. de Jong, V. Stalman, M. Leeuwenhoek, P. Stepanov, X. Lu, S. J. van der Molen, D. K. Efetov, M. P. Allan.

10:30-10:50 *Chirality in twisted bilayer graphene.* **Tobias Stauber**, J. González, G. Gómez-Santos.

10:50-11:10 *Topological excitons and bosonic fractional quantum Hall liquids in twisted bilayer graphene.* **Yves Kwan**, Y. Hu, S. H. Simon, and S. A. Parameswaran.

11:10-11:30 *Topological flat bands and correlated states in twisted monolayer-bilayer graphene.* **Louk Rademaker**, I. Protopopov, D. Abanin.

11:30-11:50 *Double superlattices and supercurrent measurements in graphene/hBN superlattices.* **Peter Makk**, D. Indolese, L. Wang, S. Zihlmann, R. Delangrange, A. Baumgartner and Ch. Schönberger.

11:50-12:10 *Atomic scale structure and broken symmetries in twisted double bilayer graphene.* **Carmen Rubio Verdú**, S. Turkel, L. Song, L. Klebl, D. M. Kennes, L. Xian, H. Ochoa, K. Watanabe, T. Taniguchi, Á. Rubio, A. N. Pasupathy.

12:10-12:30 *Floquet engineering of twisted double bilayer graphene.* **Martín Rodríguez Vega**, M. Vogl, G.A. Fiete.

Friday, 04 September 2020

Zoom host: Maria José Claderón.

9:30-10:10 *Correlated electrons in a moiré superlattice probed with optical spectroscopy.* Yuya Shimazaki (invited), I. Schwartz, K. Watanabe, T. Taniguchi, M. Kroner, A. Imamoglu.

10:10-10:30 *Flatbands in twisted transition metal dichalcogenides.* José Ángel Silva Guillén, Z. Zhan, Y. Zhang, G. Yu, F. Guinea, S. Yuan.

10:30-10:50 *Flatbands in transition metal dichalcogenides –when and why do we have them.* Priya Mahadevan, S. Patra, P. Kumari.

10:50-11:10 *Twisted nano-optics: Manipulating light at the Nanoscale with Twisted Polaritonics Slabs.* Jiahua Duan, N. Capote-Robayna, J. Taboada-Gutiérrez, G. Álvarez-Pérez, I. Prieto, J. Martín-Sánchez, A. Y. Nikitin, P. Alonso-González.

11:10-11:30 *Simulating twistrionics with ultra-cold atoms.* Alejandro González Tudela, J.I. Cirac.

11:30-11:50 *Dirac node engineering and flat bands in doped Dirac materials.* Anna Pertsova, S P. Johnson, D. Arovas, A. V. Balatsky.



European Physical Society
Condensed Matter Division



División de Física de
la Materia Condensada



Real
Sociedad
Española de
Física

11:50-12:10 *Domain walls in twisted bilayer graphene*. Glenn Wagner, Y. Kwan, N. Chakraborty, S. Simon, S. Parameswaran

12:10-12:30 *Deconfinement of Mott Localized Electrons into Topological and Spin-Orbit Coupled Dirac Fermions*. José Pizarro, S. Adler, K. Zantout, T. Mertz, P. Barone, R. Valenti, G. Sangiovanni, T.O. Wehling.