Unveiling the metallic phases of twisted transition metal dichalcogenides

Presenter:
Augusto Ghiotto
(Physics, Columbia University)

Authors:
Augusto Ghiotto
(Physics, Columbia University)

En-Min Shih
(Physics, Columbia University)

Giancarlo S. S. Pereira
(Physics, Columbia University)

Lei Wang
(Physics, Nanjing University)

Lede Xian
(Physics, Max Planck Institute)

Daniel Rhodes
(Physics, University of Wisconsin - Madison)

Cheng Tan
(Mechanical Engineering, Columbia University)

Dante Kennes
(Physics, Freie Universitat Berlin)

Martin Claassen
(Physics, University of Pennsilvania)

Yusong Bai
(Chemistry, Columbia University)

Bumho Kim
(Mechanical Engineering, Columbia University)

Kenji Watanabe
(NIMS - Japan)

Takashi Taniguchi
(NIMS - Japan)

Xiaoyang Zhu
(Chemistry, Columbia University)

James Hone
(Mechanical Engineering, Columbia University)

Angel Rubio
(Physics, Max Planck Institute)

Cory Dean
(Physics, Columbia University)

Abhay Narayan
(Physics, Columbia University)

Emergent quantum phases driven by electronic interactions can manifest in materials with narrowly dispersing, i.e. “flat", energy bands. One such system is twisted bilayer tungsten diselenide (tWSe2), a semiconducting transition metal dichalcogenide (TMD). Unlike twisted bilayer graphene where the flat band appears only within a narrow range around a “magic angle", we have observed correlated insulating states over a continuum of angles, spanning 4° to 5.1°. Metal-insulator transitions can be driven in this system both by doping as well as by vertical electric field. We find that immediately adjacent to the metal-insulator transition lies a region of T-linear resistivity that extends down to the lowest temperature of our measurement (200 mK). Further away from the metal-insulator boundary, the low temperature resistance recovers a Fermi-liquid quadratic dependence on temperature. This T-linear resistivity becomes sub-linear at temperatures of 30-60 K, and eventually gives rise to a temperature-independent saturated resistance at high temperature. Magnetoresistance measurements at low magnetic fields show a B-linear dependence, with a slope that is maximized where the T-linear behavior is observed in the phase diagram.