Speaker: Oskar VAFEK (Florida State University, USA)

Title: **Interacting narrow bands of twisted bilayer graphene in magnetic field**

Abstract: In the first part of the talk I will discuss magneto-transport experiments on twisted bilayer graphene at 1.38 degree twist angle, i.e. away from the magic value. Despite the absence of correlated states at B=0, the theoretical explanation of these experiments provides insight into the origin of the Landau level degeneracy near the charge neutrality point and the role of heterostrain[1]. Next, I will discuss the Landau level quantization of the single particle excitations of the correlated insulator states at integer fillings of the narrow bands in the strong coupling limit. This is studied using a novel numerical method based on the projection of the hybrid Wannier states of the narrow bands onto irreducible representations of the magnetic translation group[2], as well as analytically using the topological heavy fermion model[3,4].

Equipped with this understanding, I will present a comprehensive Hatree-Fock study of interacting electrons in finite magnetic field while varying the electron density, twist angle and heterostrain, thus interpolating between the mentioned limits. Within a panoply of correlated Chern phases emerging at a range of twist angles, I will present a unified description for the ubiquitous sequence of states with the Chern number t for $(s,t)=\pm(0,4),\pm(1,3), \pm(2,2)$ and $\pm(3,1)$, interpolating to the filing s in the limit of vanishing B. Correlated Chern insulators at unconventional sequences with $s+t\neq\pm4$ are also found, as well as with fractional s.[5]

[1] Xiaoyu Wang et al. PNAS2023 Vol. 120 No. 34 e2307151120

[2] Xiaoyu Wang and O. Vafek Phys. Rev. B 106, L121111 (2022)

[3] Zhi-Da Song and B.A. Bernevig PRL 129, 047601 (2022)

[4] Keshav Singh et al. arXiv:2305.08171

[5] Xiaoyu Wang and O.Vafek arXiv:2310.15982