C2N General Seminar

Friday September 17 - 11h00

"Proximity coupling graphene to a TMD: moiré effects on coupled Fermi seas, and Rydberg excitons as probes for graphene fractional quantum hall states"

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Placing 2D materials in close proximity to each other greatly enriches them, leading to phenomena like interlayer excitons hosting a hole in one layer and an electron in the other layer [1]. Also the superconductivity hosted in twisted bilayer graphene and twisted bilayer WSe2 critically relies on the coupling between the two layers, giving rise to a new system with vastly different properties from its host materials. In this talk, we'll explore structures where the 2D semiconductor MoSe2 is in close proximity to graphene. Using Rydberg excitons in MoSe2 as sensitive probes for the dielectric environment [2], we demonstrate that fractional quantum hall states in graphene can be detected by purely optical means. We further discuss the regime where both graphene and the TMD are doped. We observe a periodic charge transfer between graphene and the TMD as a function of doping which we attribute to the moiré potential arising between the graphene and the hBN substrate. As more and more of 2D materials research is directed to emergent phenomena between different 2D materials, we believe that these results will stimulate important discussions.

References:

1. *Shimazaki, Y., Schwartz, I., Watanabe, K. et al. Strongly correlated electrons and hybrid excitons in a moiré heterostructure. Nature 580, 472–477 (2020)*
2. *Xu, Y., Horn, C., Zhu, J. et al. Creation of moiré bands in a monolayer semiconductor by spatially periodic dielectric screening. Nat. Mater. 20, 645–649 (2021)*