Center for Artificial Low D Electronic Systems

2022 IBS-CALDES Seminar

- ✓ **Date & Time** 9:00AM, March 21st (Mon), 2022
- ✓ **Zoom ID: 993 9887 5694 / PW: 013949**
- ✓ **Speaker & Title**

09:00AM~ Prof. Ilija Zeljkovic (Boston College)

Nanoscale imaging of symmetry-broken electronic phases in kagome metals AV3Sb5

10:10AM~ Prof. Kin Fai Mak (Cornell Univ.)

Kane-Mele-Hubbard physics in semiconductor moiré materials

Organized by Prof. Gil Young Cho (gilyoungcho@postech.ac.kr, 054-279-2097)
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- **09:00AM~**

Nanoscale imaging of symmetry-broken electronic phases in kagome metals AV3Sb5

Ilija Zeljkovic
Department of Physics, Boston College

The kagome lattice of transition metal atoms provides an exciting platform to study the interplay of electronic correlations and band topology. AV3Sb5 (A=K, Rb, Cs) is a recently discovered class of kagome metals that does not exhibit resolvable magnetic order, and yet, surprisingly, shows a large anomalous Hall response and superconductivity. In this talk, I will discuss our experiments on AV3Sb5 materials using low-temperature spectroscopic imaging scanning tunneling microscopy. In CsV3Sb5, we discover a cascade of different symmetry-broken electronic states as a function of temperature [1]. At a temperature far above the superconducting transition Tc ~ 2.5 K, we reveal a tri-directional charge order with a 2a0 period that breaks the translation symmetry of the lattice. As the system is cooled down towards Tc, we observe an additional breaking of the six-fold rotation symmetry, which persists through the superconducting transition. This rotation symmetry breaking is observed as the emergence of an additional 4a0 unidirectional charge order and strongly anisotropic scattering attributed to the orbital-selective renormalization of the Vanadium kagome bands. I will conclude by discussing the symmetry of the 2a0 CDW state in KV3Sb5 and its response to externally applied magnetic field [2]. Our experiments reveal a complex landscape of electronic states that can co-exist on a kagome lattice, and provide intriguing parallels to high-Tc superconductors and twisted bilayer graphene.

[1] Zhao, … Zeljkovic. Nature 599, 216–221 (2021)
[2] Li, … , Zeljkovic. Nature Physics (2022)

- **10:10AM~**

Kane-Mele-Hubbard physics in semiconductor moiré materials

Kin Fai Mak
Department of Physics, School of Applied and Engineering Physics,
Kavli Institute at Cornell

Semiconductor moiré materials provide a physical realization of the Kane-Mele-Hubbard model for studies of the combined effects of non-trivial band topology and strong electronic correlations. In this talk, I will discuss the rich electronic phase diagram of the Kane-Mele-Hubbard model realized in AB-stacked MoTe2/WSe2 moiré bilayers.

In particular, I will discuss the emergence of the quantum spin Hall and the quantum anomalous Hall effects, the realization of the Haldane model, the nature of the Chern insulators, and, if time permits, a metamagnetic quantum phase transition between different intervalley coherent states.