Chez Pierre

Presents ...

Monday, May 8th, 2023

12:00pm noon- 1:00 pm

Duboc Room 4-331

Chez Pierre Seminar

Zhiqiang Mao, Pennsylvania State University

"Spin-valley locking, bulk quantum Hall effect and nonlinear Hall effect in anoncentrosymmetric Dirac material".

Spin-valley locking in the band structure of monolayers of MoS_2 and other group-VI transition metal dichalcogenides (TMDCs) has attracted enormous interest, since it offers potential for valleytronic and optoelectronic applications. Such an exotic electronic state has sparsely been seen in bulk materials. In this talk, I will show a bulk spin-valley locked electronic state in a 3D non-centrosymmetric Dirac material $BaMnSb_2$ [1]. Such a state is revealed by comprehensive studies using first principles calculations, tight-binding and effective model analyses, angle-resolved photoemission spectroscopy measurements. Moreover, this material also exhibits a stacked quantum Hall effect (QHE). The spin-valley degeneracy extracted from the QHE is close to 2. This result, together with the Landau level spin splitting, further confirms the spin-valley locking picture in $BaMnSb_2$. Recently, we also found such a spin-valley locked state leads to a bulk intrinsic nonlinear Hall effect at room temperature, which is characterized by alternating current driven second-harmonic and rectified Hall voltage response under time-reversal symmetry conditions [2]. These findings broaden the coupled spin and valley physics in 2D systems into a 3D system. Additionally, I will also report on a colossal nonreciprocal Hall effect caused by an extrinsic nonlinear Hall effect in a trivial metal.

References:

[1] Liu et al., Nature Communications 12, 4062(2021).

[2] Min et al., Nature Communications 14, 364(2023).