Investigating Orbitronics and Spin Dynamics with Magneto-Optics

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TUESDAY, March 3rd @ 2:00 pm in BRK 1001
Coffee and snacks served before seminar
also on MS Teams

Abstract: Spin currents and Berry curvature from the spin-orbit coupling have emerged over the past ~15 years as a scientific frontier of condensed matter physics, and also provide possible routes for substantially enhanced energy efficiency of magnetoelectric memories. These lie at the heart of the fields of spintronics and topological materials. More recently, the concept of orbital current, namely the flow of orbital angular momentum, has given rise to a new concept of orbitronics. In this talk, I will discuss magneto-optic experiments investigating orbitronics in transition metals and spin dynamics in 2D material heterostructures. For the former, we use magneto-optics to directly detect the orbital accumulation associated with the orbital Hall effect [1,2], whose predictions date back to the mid 2000s. For the latter, we use time-resolved magneto-optics to investigate the mechanisms for optical excitation of spin dynamics in 2D heterostructures.

[1] Y.-G. Choi, D. Jo, K.-H. Ko, D. Go, K.-H. Kim, H. G. Park, C. Kim, B.-C. Min, G.-M. Choi, and H.-W. Lee, Observation of the orbital Hall effect in a light metal Ti, Nature 619, 52 (2023).

[2] I. Lyalin, S. Alikhah, M. Berritta, P. M. Oppeneer, and R. K. Kawakami, Magneto-Optical Detection of the Orbital Hall Effect in Chromium, Phys. Rev. Lett. 131, 156702 (2023).

Bio: I've been fascinated by spin and magnetism beginning with my early studies on ferromagnetic metal and semiconductor heterostructures grown by MBE. The advent of 2D materials opens up great new possibilities for spintronics, valleytronics, and novel magnetic and topological phenomena. Our team has worked hard to develop a unique laboratory with advanced MBE, device, optics, and spin-polarized STM capabilities to create materials and devices with atomic-scale precision and to explore their properties by transport and microscopies with high spatial and temporal resolution. Our latest effort is developing time-resolved ARPES as part of the Ohio State NeXUS facility, and I am especially proud of our group's new magnetic materials grown by MBE.

Host: Tiancong Zhu, Physics Dept. | Email: zhu1242@purdue.edu