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### Seeing and Steering Spins in Quantum Materials: From Atomically Thin Magnets to Spin-Based Technologies

Modern electronics has transformed society by controlling the motion of electric charge. Quantum materials invite a broader question: what new functions become possible when we can also control the spin of the electron, its interaction with light, and collective magnetic excitations such as magnons? These quantum degrees of freedom offer promising pathways toward energy-efficient memory, spin-based logic, quantum sensing, and hybrid platforms that convert information between electronic, optical, and magnetic forms. Yet many of the most interesting effects are subtle, fast, and confined to materials only a few atomic layers thick, where conventional measurement techniques often reach their limits. In this talk, I will describe how van der Waals materials, which can be stacked layer by layer like “quantum Lego,” allow us to design new magnetic and spintronic systems from the bottom up. I will highlight experiments that optically inject spins across MoS<sub>2</sub>/graphene interfaces, image spin-valley dynamics in monolayer semiconductors, and use ultrasensitive Sagnac interferometry and X-ray magnetic microscopy to detect spin-orbit torques and nanoscale magnetic textures. I will also discuss recent work using spin-filter tunneling to electrically detect and tune antiferromagnetic resonance in bilayer CrSBr, opening a new route to probing magnetic dynamics in atomically thin insulating magnets. Together, these studies illustrate how precision measurements of quantum materials can uncover hidden magnetic order, reveal new spin dynamics, and guide the design of future technologies based on spins, photons, and magnons.

#### Bio-sketch

Kelly is a Gabilan Assistant Professor of Physics and Astronomy, Chemistry, Chemical Engineering and Materials Science at the University of Southern California (USC) since 2023. She was previously a Presidential Postdoctoral Fellow and Honorary Kavli Fellow at Cornell University studying spin torque dynamics in van der Waals magnets from 2019 to 2022. She received her PhD in physics at the Ohio State University studying information transduction between spintronic, photonic, and magnetic states in two-dimensional hybrid systems in 2019. She obtained undergraduate degree in physics at the Hong Kong University of Science and Technology in 2012.

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13:00 CET

Seminar room EG 136, Bldg. 900 (MPSD)