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Detecting, mapping, and manipulating a ferro-rotational order in solids

Abstract: Multipolar orders are key in addressing many outstanding questions in a wealth of quantum materials. Yet, their coupling to conventional linear probes is very weak, prohibiting the comprehensive understanding and efficient controlling of them. As the lowest rank multipolar order, the ferro-rotational order, schematically featured as a head-to-tail loop arrangement of electric dipole moments and mathematically described by the antisymmetric components of the electric quadrupolar tensor, was theoretically suggested to be widely present, but has been experimentally detected only very recently with nonlinear optics. In this talk, we will exploit the electric quadrupolar contribution to the second harmonic generation (SHG) to couple with this spatial-inversion and time-reversal symmetric ferro-rotational order. We will examine its symmetry properties with the rotational anisotropy (RA) measurements scheme of SHG, map its domain structures and domain boundaries with optical diffraction limited RA-SHG, and finally manipulate it and track its evolution on an ultrafast time scale with time-resolved RA-SHG.

Short Bio: Dr. Liuyan Zhao received her PhD in physics from Columbia University in 2013 and her postdoctoral training at California Institute of Technology in 2013–2016, before joining the University of Michigan in 2017. Her current research interest at Michigan focuses on studying electronic and magnetic phases in 2D and 3D quantum materials, using linear and nonlinear, static and ultrafast, elastic and inelastic optical spectroscopy and microscopy techniques. Her selected awards include NSF CAREER, AFOSR YIP, Bryan R. Coles Prize, and Alfred P. Sloan Research Fellowship.