Nonlinear Optics Driven Phase Transition in Ferroics

Jian Zhou*[1]

[1] *School of Materials Science and Engineering, Xi'an Jiaotong University, Xi'an, Shaanxi 710049, P.R. China*

Physical orders have been serving as the heart of condensed matter physics research and various applications. Toggling different order parameters via contactless light field is attracting tremendous attention, which is invasive and is less-susceptible to lattice damage. In this talk, we try to discuss the relationship between nonlinear optical response and ferroic orders in magnetic material systems (1) Through establishing nonlinear optical torque on spin polarization, we develop a perturbation theory to show how circularly and linearly polarized light to reorient spin polarization in ferromagnetic (FM) materials. We use a FM material that favors in-plane spin polarization, and show that a light-induced spin torque can drive it along the out-of-plane direction, under an ultrafast kinetics. (2) Furthermore, we extend such a scheme to reorient the Néel vector of collinear antiferromagnetic (AFM) systems, and explore the differences in symmetry between AFM systems and altermagnetic (AM) materials. Through scrutinizing different symmetries, we suggest that linearly polarized light could switch the Néel vector in AFMs, but it produces spin canting in general AMs, giving contrasting spintronics behaviors.