Chirality-Induced Phenomena in Chiral Crystals: Magnetic Soliton Lattice and Chiral Phonon

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Chirality is a common feature in nature, observed from elementary particles to macroscopic crystals, where mirror-reflection symmetry is broken. This absence leads to polarization/spin-dependent behaviors in particles like electrons, photons, magnons, and phonons, illustrating how chirality impacts physical processes.

In this seminar, I'll discuss recent progress in understanding the magnetic, electronic, spintronic, and phononic properties of chiral crystals[1-4]. I'll focus on explaining how chirality-induced interactions, like the mono-axial Dzyaloshinskii-Moriya interaction (DMI), influence physical responses.

A notable example is the emergence of a chiral spin soliton lattice (CSL) in chiral helimagnets[5]. CSLs have unique properties, affecting magnetic transport and contributing to new magnetic phases[1,3,4]. They also serve as platforms for studying exotic quantum phenomena, making them valuable for research and potential applications in spintronics and magnetic data storage.

Additionally, I'll explore the connection between lattice-vibration/phonon behavior and chirality. Recent experiments using Raman scattering [6] in chiral crystals have revealed insights into the relationship between *crystal chirality* and *phonon angular momentum*[7,8]. I'll define chiral phonons and show how their pseudo-angular momentum relates to photon spin in Raman scattering. This investigation will enhance our understanding of how chirality influences the vibrational properties of materials and could lead to new applications in the future.

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