



Seminar

Helicity-resolved Raman spectroscopy of chiral materials



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Venue: Room w563, Physics building, Peking University

地点: 北京大学物理楼, 西563会议室

Abstract

Chirality is geometric property according to which an object is mirror-asymmetric irrespective of orientation. Chiral mediums rotate the polarization of propagating electromagnetic waves. They may exhibit chiral optical response, spin-momentum locking, to name a few remarkable properties.

We investigate an example of chiral medium, – layered material 1T-TaS₂, – which hosts a series of charge-density-wave (CDW) transitions: an Incommensurate Charge Density Wave below 550 K, followed by a nearly commensurate CDW at 350 K; it then undergoes a metal-insulator transition below 180 K that induces the formation of a commensurate CDW lattice. The states below 350 K are chiral with a composite domain structure; they are believed to preserve inversion yet omit mirror symmetries. Still, the physical consequences of the chiral order, e.g., in electronic structures and the optical properties, are yet to be explored.

We apply rare methodology, – the helicity-resolved Raman spectroscopy (HRRS), – to identify the symmetry and dynamics of the electronic excitations and the lattice modes across the chirality induced phase transitions. Although circular dichroism has not been observed in 1T-TaS₂ due to the preserved inversion symmetry, we demonstrate novel property of chirality-dependent Raman response to circularly polarized light. The analyses of the HRRS data reveals the composite structure of the chiral CDW states and is an example of a mechanism enabling generation of chiral electronic structures with anomalous Raman responses. Using this example of 1T-TaS₂ system, theoretical aspects of light interaction with the chiral medium will be discussed.

About the speaker

Girsh Blumberg is a world expert in Raman scattering with research interests in spectroscopic instrumentation, general optical spectroscopy in solids. He is well known for his contribution to electronic Raman scattering studies in strongly correlated electron systems, superconductors and quantum spin systems. Girsh Blumberg received the MS Cum Laude in Theoretical Physics and Physics Education from Tartu University in 1981. He received his Ph.D. in Physics and Mathematics from Estonian Academy of Sciences in 1987. Since 1981 he was Research/Senior Research Associate at the Institute of Chemical Physics and Biophysics, Estonian Academy of Sciences. Starting from 1992 visiting Assistant Professor at the University of Illinois at Urbana-Champaign, and at the NSF Science and Technology Center for Superconductivity before joining Bell Labs in 1998 as the Member of Technical Staff. Professor Blumberg joined the faculty at Rutgers in 2008.