

Group Theory and Its Application to Raman Spectroscopy

Physics 576B Fall 2022
Instructor: Xiaodong Xu

This course will cover the application of Raman spectroscopy in understanding a wide range of quantum material properties. We will learn the basics of group theory, and how to use group theory to count Raman modes and analyze the Raman optical selection rules based on the symmetry of the system. We will then introduce the application of Raman spectroscopy to understand several material properties, including semiconductors, magnets, superconductors, and charge density waves. Students will have opportunity to form a small group to present the application of Raman in understanding physical properties of their own interest.

Group theory + Application to Raman Analysis (week 1-6)

- Group theory basics (Week 1-3)
- Raman selection rules (Raman Active, Infrared Active, ...) (Week 4-5)
- Modes Assignment (Week 5-6)

Raman Spectroscopy of Quantum Materials (week 7-10, including group presentation)

- Magnetic order (week 7-8)
- Superconductivity (week 8-9)
- CDW (week 9-10)

Textbook:

- (1) Group Theory and Quantum Mechanics by Michael Tinkham;
- (2) Group Theory: Application to the Physics of Condensed Matter by Mildred Dresselhouse, Gene Dresselhaus, and Ado Jorio.