

**Modules:**

physics700 **Elective Advanced Lectures**  
 physics710 **Experimental Physics**  
 physics720 **Applied Physics**  
 physics730 **Theoretical Physics**

**Course:**

## Fundamentals of Molecular Symmetry (E/A/T)

**Course No.:**

Category	Type	Language	Teaching hours	CP	Semester
Elective	Lecture	English	2	4	ST

**Requirements:****Preparation:**

Basic knowledge of quantum mechanics

**Form of Testing and Examination:**

Oral Examination

**Length of Course:**

1 semester

**Aims of the Course:**

Understanding the fundamental concepts of representation theory and its application to describe the symmetry of molecules

**Contents of the Course:**

The lecture introduces to group theory with special emphasis on representations and their use to describe the symmetry of molecules in high-resolution spectroscopy and in molecular physics generally. The theory is accompanied by a series of "prototypical" examples. Topics covered are

- symmetry in general and symmetry of a molecule.
- groups and point groups.
- irreducible representations, characters.
- vanishing integral rule
- the Complete Nuclear Permutation-Inversion (CNPI) group.
- the Molecular Symmetry (MS) group).
- the molecular point group.
- classification of molecular states: electronic, vibrational, rotational, and nuclear spin states
- nuclear spin statistical weights
- hyperfine structure
- non-rigid molecules (inversion, internal rotation)

**Recommended Literature:**

Jensen: Script (text of powerpoint presentation files; available during the course)  
 P. Jensen and P. R. Bunker: The Symmetry of Molecules, in: "Encyclopedia of Chemical Physics and Physical Chemistry" (J. H. Moore and N. D. Spencer, Eds.), IOP Publishing, Bristol, 2001.  
 P. R. Bunker and Per Jensen: "Molecular Symmetry and Spectroscopy, 2nd Edition," NRC Research Press, Ottawa, 1998 (ISBN 0-660-17519-3).  
 P. R. Bunker and P. Jensen: "Fundamentals of Molecular Symmetry", IOP Publishing, Bristol, 2004 (ISBN 0-7503-0941-5).