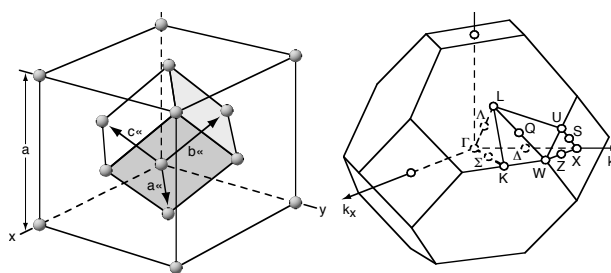
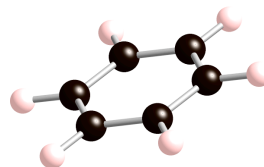


## "Introduction to Group Theory with Applications in Molecular and Solid State Physics"

Prof. Karsten Horn

Symmetry considerations are useful when dealing with problems in many fields of physics; they often lead to selection rules and other criteria, which remove the need for numerical calculations or at least greatly simplify them. This lecture course deals with symmetry elements and point groups, introduces group representations and discusses the most important properties of irreducible representations and their characters. Group theory is of particular importance in the quantum-mechanical treatment of molecular orbitals. From a basic assignment of the irreducible representations of atomic orbitals, we will discuss, among other things, symmetry-induced lowering of electronic degeneracies. The classification of molecular vibrations is used as a simple example for the application of group representations. Other applications include phonon and electron bands in solids. Since this is a lecture course for experimentalists, there will be few mathematical proofs; emphasis is put on the use of character tables and correlation tables, using many examples. Having attended the lecture course you should be able to solve, without recourse to calculations, problems such as finding out whether a particular electronic band in a solid will have to split by symmetry in different parts of the Brillouin zone, or why the interaction between specific atomic orbitals in a molecule is forbidden. We will also discuss spontaneous symmetry lowering such as the Jahn-Teller effect.



*Example of "objects" with a number of symmetry elements. The lecture course will deal, among other things, with point groups of such objects and the classification of wave functions, in terms of irreducible representations.*

**This lecture course is aimed at** students in the Hauptstudium as well as Diplomanden and Doktoranden, who are involved in an experimental Diplomarbeit or Ph.D. thesis; this of course includes students in the IMPRS "Complex Surfaces in Materials Science".

**Requirements:** Basic quantum mechanics; basic solid state physics.

**Literature :** There are many good textbooks for this important field. I will follow, for the most part, the excellent book by M. Tinkham, "Group Theory and Quantum Mechanics", McGraw-Hill 1964, and the classic book by E. Wigner, "Gruppentheorie...", Vieweg 1931, (Vieweg Reprint 1977); both are available in the FB-Bibliothek. Another book with more applications is the one by G. Burns, "Introduction to Group Theory with Applications".

**Date:** Thursday 10<sup>00</sup> - 11<sup>30</sup>, Fachbereichs-Sitzungssaal, Fachbereich Physik der FU  
 Arnimallee 14 (U-Bahn "Dahlem Dorf" (U3).

**Start:** April 14, 2005