Lecture Course given within the International Max Planck Research School "Complex Surfaces in Materials Science"

## "Group theory - an introductory course with applications in molecular and solid state physics"

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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. Starting from a basic assignment of the irreducible representations of atomic orbitals, we will discuss symmetryinduced lowering of electronic degeneracies. The classification of molecular vibrations is used as a simple example for the application of group representations. Other applications are molecular orbitals as well as 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.

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

Date: Thursdays 10 - 12, Seminarraum T3, Fachbereich Physik der FU Berlin, Arnimallee 14(U-Bahn "Dahlem Dorf" (U3)).

Start: 18.October 2007