



10. Curricular Unit

Advanced Physics Topics 1

Module

Group Theory and Applications to Condensed Matter Physics

Type

Tutorial: Reading and Study assignment

Contact hours

18

Professor/Researcher in charge

Joaquim Agostinho Moreira , U. Porto

Summary of Contents

Representations theory and basic theorems. Character of a representation and basis functions. Direct product and its representations. Application to selection rules and splitting of atomic levels in a crystal field.

Space groups in real space and in the reciprocal space. Symmetry of the k vectors and the group of the wave vector. Representations of a space group. Little group and stars. Factor group analysis and the Γ point. Points for $k \neq 0$. Compatibility relations.

Applications to lattice vibrations and electronic energy levels. Energy band models based on symmetry. Spin-orbit coupling in solids and double groups and application to energy bands with spin.

Time reversal symmetry. The Magnetic Groups and their Corepresentations. Properties of the magnetic point groups.

References

Group Theory. M. S. Dresselhaus, G. Dresselhaus, and A. Jorio. Springer. 2008

The Mathematical Theory of Symmetry in Solids. Representation Theory for Point Groups and Space Groups. C. Bradley and A. Cracknell. Oxford Classic Texts in the Physical Sciences. 2010.

J. L. Ribeiro. Phys. Rev. B 76, 144417 (2007).

J. L. Ribeiro and L. G. Vieira. Phys. Rev. B 82, 064410 (2010)

I. Urcelay-Olabarria, J. M. Perez-Mato, J. L. Ribeiro, J. L. García-Muñoz, E. Ressouche, V. Skumryev, and A. A. Mukhin. Phys. Rev. B 87, 014419 (2013).

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