PHYS-419 **Solid state physics III**

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Cursus	Sem.	Type
Ing.-phys	MA1, MA3	Opt.
Physicien	MA1, MA3	Opt.
Quantum Science and Engineering	MA1, MA3	Opt.

Contact language	English
Credits	6
Session	Winter
Semester	Fall
Exam	Oral
Workload	180h
Weeks	14
Hours	**5 weekly**
Lecture	3 weekly
Exercises	2 weekly
Number of positions	

Summary

The aim of this course is to provide an introduction to the theory of a few remarkable phenomena of modern condensed matter physics ranging from the quantum Hall effects to superconductivity.

Content

Magnetism of insulators

- Review of band theory
- Mott insulators and Hubbard model
- Heisenberg model
- Spin-wave theory of ferromagnets and antiferromagnets

Orbital magnetism of metals and semiconductors

- Landau levels
- De Haas-Van Alphen and Shubnikov-de Haas oscillations
- 2D electron gas: Integer and fractional Quantum Hall effects

Theory of superconductivity

- Electron-phonon interaction
- BCS theory
- Landau-Ginsburg theory
- Flux quantization and Josephson effect

Learning Prerequisites

Recommended courses

Good grasp of quantum mechanics and solid state physics say at the level of *"Lectures on quantum mechanics"* by Gordon Baym and *"Solid state physics"* by Ashcroft and Mermin

Learning Outcomes

By the end of the course, the student must be able to:

- Explore the quantum properties of solids and synthetic many body systems

Transversal skills

- Access and evaluate appropriate sources of information.
- Continue to work through difficulties or initial failure to find optimal solutions.

Teaching methods

Ex cathedra. Exercises in class

Assessment methods

oral exam

Resources

Bibliography

Lecture notes

Prerequisite for

Solid state physics IV