

PHYS-423

**Plasma physics II**

Theiler Christian Gabriel

Cursus	Sem.	Type
Energy minor	H	Opt.
Ing.-phys	MA1, MA3	Opt.
Physicien	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Oral
Workload	120h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Courses	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Summary**

Following an introduction of the main plasma properties, the fundamental concepts of the fluid and kinetic theory of plasmas are introduced. Applications concerning laboratory, space, and astrophysical plasmas are discussed throughout the course.

**Content****I Collisional and relaxation phenomena**

- Inelastic collisions: ionization and recombination, degree of ionization
- Elastic collisions: Coulomb collisions
- Isotropisation and thermalisation
- Plasma resistivity and the runaway regime

**II Transport in plasmas**

- Random walk and diffusion
- Ambipolar and cross-field diffusion
- Energy and particle confinement

**III Waves in cold magnetized plasma**

- Dielectric tensor
- Resonances and cut-offs
- Parallel and perpendicular propagation

**IV Wave-particle interaction and kinetic description of waves in hot un-magnetized plasmas**

- The Vlasov-Maxwell model
- Resonant wave-particle interaction and Landau damping
- Stability criteria and streaming instabilities
- Langmuir and ion-acoustic waves and instabilities

**V Waves in hot magnetized plasmas****VI Examples of nonlinear effects****Learning Prerequisites****Recommended courses**

Electrodynamics, Plasma Physics I

**Learning Outcomes**

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

- Manipulate the fundamental elements of the plasma fluid and kinetic theory

**Teaching methods**

Ex cathedra and exercises in class

**Assessment methods**

oral exam