

PHYS-424

Plasma physics III

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Cursus	Sem.	Type
Energy minor	E	Opt.
Ing.-phys	MA2, MA4	Opt.
Physicien	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Oral
Workload	120h
Weeks	14
Hours	4 weekly
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

This course completes the knowledge in plasma physics that students have acquired in the previous two courses, with a discussion of different applications, in the fields of controlled fusion and magnetic confinement, astrophysical and space plasmas, and societal and industrial applications.

Content**A. Fusion**

- Basics (the need for fusion, advantages, nuclear reactions, the Lawson criterion)
- Design of a fusion reactor; Inertial confinement: physics issues and the reactor concept
- Magnetic Confinement: MHD reminder, tokamak and other options (stellarator)
- Magnetic Confinement: tokamak equilibrium, instabilities and operational limits
- Magnetic Confinement: Heating and Current drive
- Magnetic Confinement: Transport – theoretical basis and phenomenology
- Magnetic Confinement: Burning plasmas, ITER and the reactor (safety, Tritium,...)

B. Plasma applications

- The basics of plasma discharges for applications
- Examples of plasma applications

C. Plasmas in nature (3 lessons - Dr. Ivo Furno)

- Plasma astrophysics
- Space plasmas
- Joint problems of space and fusion plasmas – Magnetic reconnection and particle acceleration

Learning Prerequisites**Recommended courses**

Electrodynamics, Plasma physics I and II

Learning Outcomes

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

- Design the main elements of a magnetic confinement system
- Describe various applications of plasma physics
- Identify the main components and physics issues of a magnetic fusion reactor
- Describe the main scientific issues in space and astrophysical plasmas

- Describe the main scientific issues in plasma applications

Teaching methods

Ex cathedra and exercises in class

Assessment methods

oral exam

Resources

Websites

- <https://crppwww.epfl.ch/physplas3/>