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 energy

- Basics (the need for fusion, advantages, nuclear reactions, the Lawson criterion)
- 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: Transport – theoretical basis and phenomenology
- Magnetic Confinement: Heating, burning plasmas, ITER and route to a power plant

B. Industrial applications

- The basics of plasma discharges for applications
- Examples of plasma applications in industry and medicine

C. Plasmas in nature

- Astrophysics and space plasmas
- Solar physics - radiation transport and dynamo
- Joint problems of space and fusion plasmas – Magnetic reconnection and particle acceleration

D. Plasma diagnostics

- Categories of plasma diagnostics

- Measurements of plasma properties, magnetic properties and processes at the plasma-material interface

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 magnetic and inertial confinement fusion
- Describe the main scientific issues in astrophysical plasmas
- Describe the main advantages of plasmas in industrial applications

Teaching methods

Ex cathedra and exercises in class

Assessment methods

oral exam

Resources

Websites

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