PHYS-424 **Plasma II**

Ball Justin

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

Language of teaching	English
Credits	6
Session	Summer
Semester	Spring
Exam	Oral
Workload	180h
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 magnetic confinement and controlled fusion, astrophysical and space plasmas, and societal and industrial applications.

Content

A. Fusion energy

- Basics (nuclear reactions, the Lawson criterion)
- Magnetic Confinement: MHD model
- 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 industrial applications
- Examples of plasma applications in industry and medicine

C. Plasmas in nature

- Astrophysics and space plasmas
- Solar physics - radiation transport and dynamo
- 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

PHYS-324 Classical electrodynamics, PHYS-325 Introduction to plasma physics and PHYS-423 Plasma I.

Learning Outcomes

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

- Describe various applications of plasma physics
- Identify the main components and physics issues of magnetic confinement fusion
- Describe the main scientific issues in astrophysical plasmas
- Describe the main advantages of plasmas in industrial applications
- Describe the physics basis of key plasma diagnostics
- Work out / Determine when plasma effects are important

Teaching methods

Ex cathedra and exercises in class

Assessment methods

oral exam

Resources

Moodle Link

- https://go.epfl.ch/PHYS-424