PHYS-445 **Nuclear fusion and plasma physics**

Fasoli Ambrogio

| Cursus | Sem. | Type |
|---|---|---|
| Auditeurs en ligne | H | Opt. |
| Energy Science and Technology | MA1, MA3 | Opt. |
| Ing.-phys | MA1, MA3 | Opt. |
| Nuclear engineering | MA1 | Opt. |
| Physicien | MA1, MA3 | Opt. |

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|---|---|
| Language of teaching | English |
| Credits | 4 |
| Session | Winter |
| Semester | Fall |
| Exam | Oral |
| Workload | 120h |
| Weeks | 14 |
| **Hours** | **4 weekly** |
| Courses | 2 weekly |
| Exercises | 2 weekly |
| **Number of positions** | |


## Summary

The goal of the course is to provide the physics and technology basis for controlled fusion research, from the main elements of plasma physics to the reactor concepts.


## Content

1) Basics of thermonuclear fusion
2) The plasma state and its collective effects
3) Charged particle motion and collisional effects
4) Fluid description of a plasma
5) Plasma equilibrium and stability
6) Magnetic confinement: Tokamak and Stellarator
7) Waves in plasma
8) Wave-particle interactions
9) Heating and non inductive current drive by radio frequency waves
10) Heating and non inductive current drive by neutral particle beams
11) Material science and technology: Low and high Temperature superconductor - Properties of material under irradiation
12) Some nuclear aspects of a fusion reactor: Tritium production
13) Licensing a fusion reactor: safety, nuclear waste
14) Inertial confinement

## Learning Prerequisites

### Recommended courses

Basicknowledge of electricity and magnetism, and of simple concepts of fluids

## Learning Outcomes

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

- Identify the main physics challenges on the way to fusion
- Design the main elements of a fusion reactor
- Identify the main technological challenges of fusion

## Teaching methods

Ex cathedra and in-class exercises

## Assessment methods

oral examen (100%)

## Resources

### Websites

- https://spcnet.epfl.ch/nuclfus/

### Moodle Link

- https://go.epfl.ch/PHYS-445