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/