PHYS-400

Selected topics in nuclear and particle physics

Blanc Frédéric

Cursus	Sem.	Type
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**
Lecture	2 weekly
Exercises	2 weekly
Number of positions	

Summary

This course presents the physical principles and the recent research developments on three topics of particle and nuclear physics: the physics of neutrinos, dark matter, and plasmas of quarks and gluons. An emphasis is given on experimental aspects in these three fields.

Content

Neutrino physics:

- Neutrino mass measurements, beta and double-beta decay experiments.
- Neutrino mass generation mechanism, Majorana and Dirac particles.
- Neutrino oscillations, MNS matrix.
- Cosmic neutrinos : origin, energy spectrum and detection.

Dark matter:

- Evidence for dark matter from astronomical and cosmological data.
- Relic particles of the "Big bang". Candidates for dark matter, and link with particle physics beyond the Standard Model.
- Direct and indirect searches for dark matter.

Quark gluon plasma (QGP):

- Plasma of quarks and gluons: properties, plasma signatures, production in the collisions of heavy ions.

Learning Prerequisites

Required courses

Nuclear and particle physics I and II (PHYS-311, PHYS-312)

Recommended courses

Quantum physics I and II (PHYS-313, PHYS-314), Particle physics I (PHYS-415)

Learning Outcomes

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

- Interpret fundamental results in neutrino, dark matter, and quark and gluon plasma physics
- Identify the physical observables in these three fields of research
- Discuss the experimental principles in these fields
- Assess / Evaluate the experimental methods and results presented in scientific publications
- Estimate the experimental sensitivity of experiments

Teaching methods

Ex cathedra and exercises in the classroom

Assessment methods

oral exam (100%)

Supervision

Office hours	No
Assistants	Yes
Forum	No

Resources

Moodle Link

- https://moodle.epfl.ch/course/view.php?id=2861