

PHYS-440

**Particle detection**

Haefeli Guido

Cursus	Sem.	Type
Ing.-phys	MA1, MA3	Opt.
Physicien	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Lecture	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Summary**

The course will cover the physics of particle detectors. It will introduce the experimental techniques used in nuclear and particle physics. The lecture includes the interaction of particles with matter, scintillators, gas detectors, silicon detectors, detectors for particle ID and photo-detectors.

**Content**

**Interaction of particles in matter:** ionization (Bethe-Bloch formula), interaction of electrons and photons (electromagnetic showers, radiation length and critical energy).

**General characteristics of detectors:** linearity, efficiency, resolution and Fano factor.

Gas detectors: ionization, proportional and Geiger-Muller counters, multiwire proportional, drift and time-projection chambers, micro-pattern gas detectors.

**Semiconductor detectors:** pn junction, silicon and germanium diode detectors, silicon microstrip and pixel detectors.

**Scintillators:** organic and inorganic scintillators, wavelength shifters and light guides.

**Photodetectors:** photomultipliers, photodiodes and other alternatives.

**Applications:** momentum measurement in magnetic fields, calorimetry, particle identification.

**Learning Prerequisites****Recommended courses**

Elementary particle I, knowledge in nuclear and particle physics

**Learning Outcomes**

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

- Categorize processes
- Describe energy deposit processes
- Quantify available signal

**Transversal skills**

- Communicate effectively with professionals from other disciplines.

**Teaching methods**

Slides, blackboard and exercises in class

**Assessment methods**

Semester work report evaluation 2/3 and presentation 1/3

**Supervision**

Office hours	No
Assistants	No
Forum	No
Others	During exercises and at office if required

**Resources****Bibliography**

K.Kleinknecht: Detectors for Particle Radiation, Cambridge

W.R.Leo: Techniques for Nuclear and Particle Physics Experiments, Springer

**Moodle Link**

- <https://go.epfl.ch/PHYS-440>