UCLouvain

lphys2235

2025

Advance detection and simulation method in HEP experiments

The version you're consulting is not final. This course description may change. The final version will be published on 1st June.

5.00 credits	25.0 h + 5.0 h	Q2

Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	LPHYS2102: Ionizing Radiation Detection and Nuclear Instrumentation
Main themes	Advanced (astro-)particle detectors – Experiment design in (astro-)particle physics – Triggering, data acquisition and computing systems. Simulation tools: GEANT4.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 **Contribution of the teaching unit to the learning outcomes of the programme (PHYS2M and PHYS2M1)** 1.3,1.4,1.5, 1.6, 2.2, 2.3, 2.4, 2.5, 5.1, 5.3, 6.1,6.2,6.3,6.4,7.1,7.3 , 8.1,8.2 **Specific learning outcomes of the teaching unit** 2 1. Explain and discuss in detail the advanced experimental techniques of complex systems used in HEP experiments: detection techniques in (astro-)particle physics ; simulation ; trigger, data acquisition and computing systems; 2. Explain and discuss advanced nuclear electronics techniques 3. Conceive a detector setup for basic fundamental physics measurements. 4. Setup and carry out a small-scale experiment. 5. Develop a software project within an existing framework aiming at simulating an experimental setup in which particles propagate through matter.
Content	1. Signal Formation: General case. 2. Tracking detectors a. Large area counters: hodoscopes b. Magnetic spectrometers: Magnets, resolution. c. Gas position detectors: MWPC, Drift detectors, Jet Chambers, TPCs, RPCs. d. Solid state position detectors: silicon detectors, scintillation fiber detectors. e. LAr TPCs. Double phase TPCs. 3. Calorimetry a. Electromagnetic calorimeters b. Hadronic calorimeters c. Low temperature calorimeters. Bolometers 4. Particle identification a. Muon detectors b. Cerenkov detectors: threshold, differential, RICH. c. TRD detectors. d. Time of flight. e. dE/dx 5. Complex detector study: (Journal club like approach) a. Collider: CMS, DELPHI b. Fixed target: NA62 c. Astroparticle: AMS-02, Auger, IceCube 6. Auxiliary systems a. Low and High Voltage systems b. Gas systems c. Cooling systems d. Mechanical supports e. Cabling

	8. Trigger and Data Acquisition Systems 9. Simulation of particle propagation in matter
Bibliography	1. Kolanowski, Wermes, “Particle Detectors” Oxford 2. McGregor, Shultis, “Radiation Detection: Concepts, Methods and Devices” CRC 3. C. Grupen, B. Schwartz, “Particle Detectors” (2nd edition) 4. R. Fernow, “Introduction to Experimental Particle Physics” 5. S. Tavernier, “Experimental Techniques in Nuclear and Particle Physics”
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [60] in Physics	PHYS2M1	5		🔍
Master [120] in Physics	PHYS2M	5		🔍