UCLouvain

lphys2233a

2019

Experimental methods in particle physics : Introduction and use of GEANT

In view of the health context linked to the spread of the coronavirus, the methods of organisation and evaluation of the learning units could be adapted in different situations; these possible new methods have been - or will be - communicated by the teachers to the students.

4 credits	22.5 h + 7.5 h	Q2

Teacher(s)	Bruno Giacomo ;Cortina Gil Eduardo ;Delaere Christophe ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	Advanced particle detectors ' Particle physics experiment design ' Triggering, data acquisition and computing systems ' Data reconstruction algorithms ' Advanced statistics ' Software tools for simulation in particle physics.
Aims	*The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Evaluation of reports written by the students on projects concerning either the simulation of the particle propagation in matter or real systems for particle detection in a laboratory or a statistical analysis of data resulting from an experiment in physics. Evaluation of an oral interrogation on the projects and the subjects treated in the teaching unit.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** 1. Theory classes and exercises. - Lectures in auditorium. - Resolution of problems . 2. Laboratory sessions (7.5h). Mandatory presence at the following laboratories : • Large-area cosmic ray detector ; • Silicon sensors characterization ; • Construction of an RPC detector. Writing of a report on a laboratory of the student's choice. 3. Personal software project and report writing
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. 6. Auxiliary systems. a. Low and high voltage systems. b. Gas systems. c. Cooling systems. d. Mechanical supports. e. Cabling. 7. Nuclear electronics. 8. Trigger and data acquisition systems. 9. Offline data processing systems. 10. Event reconstruction algorithms. a. Tracking, b. Vertexing. c. Clustering. d. Jets 11. Calibration and alignment techniques. 12. Statistical methods of data analysis. 13. Simulation of particle propagation in matter. 14. Projects concerning either the simulation of particle propagation in matter or real particle detection systems in the laboratory or a statistical analysis of data from a physics experiment.
Bibliography	C. Grupen, B. Schwartz, “Particle Detectors” (2nd edition). D. Green, “The Physics of Particle Detectors”. R. Fernow, “Introduction to Experimental Particle Physics”. C. Leroy, P.G. Rancoita, “Principles of Radiation Interaction in Matter and Detection”. S. Tavernier, “Experimental Techniques in Nuclear and Particle Physics”. G. Cowan, “Statistical Data Analysis”, Oxford Science Publications.
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Master [120] in Physics	PHYS2M	4		🔍