Basic/Essential Course Information	
Course title	LABORATORY OF PARTICLE DETECTORS
Degree Course title	Physics
ECTS	6
Compulsory attendance	Yes
Course teaching language	ENGLISH

Teacher	Francesco Loparco	francesco.loparco@uniba.it

ECTS Details	Disciplinary area/broad field:	SSD	ECTS
	Characterizing	FIS/01	6

Time management and teaching activity type	Period	Year	lesson type
	1st semester	1st	Lessons (32h) Laboratory (30h)

Time management	Total hours	in-class/in-lab study hours	out-of-class study hours
	62	62	88

Course calendar	Starting date	Ending date
	September 2020	December 2020

Syllabus	
Prerequisites	Basic knowledge of detector physics.
Expected learning outcomes (according to Dublin Descriptors)	**Knowledge and understanding of:** • *Principles of operation of the most commonly used detectors in high-energy particle physics.* **Applying knowledge and understanding:** • *Ability to perform simple experiments with detectors and to analyse the data collected.* **Making judgements:** • *Ability to understand the precision of a measurement, depending on the available instrumentation.* **Transferable Communication skills:** • *communication skills in English;* • *coding skills related to data processing and analysis;* • *skills in the presentation of experimental results using appropriate scientific language;* • *ability to work in a group, and to be inserted quickly and effectively in the workplace* **Lifelong learning skills:** • *ability to learn and to transfer experimental procedures;* • *knowledge of basic data analysis techniques.*

Course contents summary	Interactions of particles with matter. Principles of operation of the most common detectors. Laboratory experiences with high-energy particle detectors.
detailed syllabus	**Gaseous detectors:** interactions of charged particles, X-rays and gamma rays with gases. Motion of electrons and ions in the gases: drift and diffusion. Ionization chambers. Proportional counters. Drift chambers. Streamer counters. Geiger-Muller counters. Resistive plate chambers. **Cherenkov detectors.** The Cherenkov effect. Particle identification with Cherenkov detectors. Threshold Cherenkov counters. DISC. RICH. **Semiconductor detectors.** The p-n junction as a particle detector. Motion of electrons and holes in silicon. Signal formation in silicon detectors. The Schockley-Ramo's theorem and its application to silicon detectors. Silicon strip and pixel detectors. Silicon photomultipliers. **Electromagnetic calorimeters.** Interactions of high-energy gamma-rays, electrons and positrons with matter. Radiation length. Electromagnetic showers. Homogeneous and sampling electromagnetic calorimeters. Gamma-ray spectroscopy with scintillators. **Hadron calorimeters.** Hadronic interactions. Interaction length. Hadronic showers. Hadronic calorimeters. Compensation. **Transition radiation detectors.** Transition radiation. Regular and irregular radiators. Operation and performance of conventional transition radiation detectors. Innovative transition radiation detectors. **Laboratory experiences:** 1. Characterization of a NaI scintillator and measurement of the spectra of radio-active sources; 2. Study of the response of a Pb-glass calorimeter to cosmic rays; 3. Characterization of a silicon photomultiplier.
Books	G. Knoll, "Radiation Detection and Measurement", Wiley
Notes	Scientific articles and reports published on international peer reviewed journals; slides shown during the course
Teaching methods	Lectures; laboratory experience under the supervision of a teacher.
Assessment % of final mark	Laboratory Reports (50%), Oral exam (50%)
Evaluation criteria	The student • **knows** the mechanisms of interactions of particles and radiation with matter and the physical quantities relevant for each kind of interaction; • **knows how to evaluate** the amounts of energy deposited by particles in layers of different materials; • **knows** the principles of operation of the various detectors; • **knows how to derive** the models which describe the performance of the various detectors; • **knows how to operate** a detector; • **knows how to calibrate** a detector; • **knows how to analyse the data** of a measurement in a proper way; • **knows how to write** a laboratory report; • **knows how to present** the results of an experiment in written and oral forms;

Other	