UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Nuclear and Subnuclear Physics Laboratory

2122-3-E3001Q065

Aims

Education to the use of nuclear instruments and methods with applications in particle physics, in environmental analysis and medical diagnostics.

Contents

- Introduction to the base principles for ionizing radiation detection

- Practical experiences with alpha radiation detectors for spectroscopic and radiation-matter interaction measurements

- Practical experiences with gamma radiation detectors for spectroscopic or PET-like measurements, analysis of radiatio-matter interaction or of Compton effect

- Practical experiences with organic scintillators for detection and characterization of cosmic rays

- Practical experiences with inorganic scintillators coupled to SiPM detectors for gamma radiation and cosmic rays detection

Detailed program

Introduction to particle detection: particle sources, dosimetry, particle-matter interaction base principles, base principles of more standard particle detectors and signal processing, data acquisition and data analysis.

Practical experiences on Alpha, beta and gamma spectroscopy: optimization, calibration and characterization of solid state detectors; measurements of activities; measurements of the range-energy curve and of the specific ionization of alpha particles;

Measurements of gamma rays absorption and released energy, angle and time correlations in nuclear decays, Compton effect, and measures with PET-like apparatus.

Characterization of cosmic rays at ground: time of flight, speed and lifetime of muons using plastic scintillators and coincidence/anticoincidence/veto techniques.

Gamma and cosmic rays measurement with inorganic scintillating crystals coupled do SiPM detectors: characterization and comprehension of the specific properties of SiPM detectors, optimization of working points and parameters for data acquisition, gamma spectroscopy measurements comparing the performances of scintillating crystals made of different compounds.

Prerequisites

None

Teaching form

- **Frontal introductory lessons**: 12 hours organized in 2 hours lessons, given for all the students at the beginning of the first semester. They are fundamental to acquire the basics about the to the topics that will be developed during the practical experiences in the laboratory

- **Practical part:** 84 hours organized in 2 mornings of 4 hours each at week, to be attended at choice between first or second semester (until filling of the available places). Groups composed of 2 or 3 students are assigned one single practical experience among those available, to be developed during the whole duration of the laboratory. The indication of the semester preference will be expressed by a questionary that will be published on the elearning page after advising all the registered students via forum email.

Textbook and teaching resource

- Handouts about the introductory lessons

- Reference book: G.F.Knoll, “Radiation Detection and Measurement”

- Practical guides for each experience

- Instrumental manuals

- Gamma/beta and alpha radiation tables

- Reports from previous years' students about the practical experiences

Semester

Frontal introductive lessons given collectively for all the students attending the course at the beginning of the first

semester.

Practice at student's choice to be attended during the first or the second semester until saturation of availability.

Assessment method

- Direct interaction with students in the laboratory

- Final detailed report including data analysis about the practical experience done during the laboratory, to be given to the teacher at least one week before the oral examination

- Oral examination concerning the presented final report and the general topics about particle detection faced up both during the introductory lessons and during the practical work.

Office hours

Everyday, after checking via email the teacher availability