UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

# Monte Carlo Simulation of Radiation Detectors (blended)

**2526-1-F1703Q028**

## Aims

The objective of the course is to learn the up-to-date numeric simulation instruments presently available about the radiation matter interaction and in particular about the operation of gaseous radiation detectors.

## Contents

MC Simulation of radiation detectors

Learning GEANT4

Learning ROOT

Learning Garfield.

## Detailed program

The aim of the course is learning the latest numerical simulation tools currently available about particle-matter interaction and, in particular about the functioning of radiation gaseous detectors. Since this is a work performed mainly on the computer, it lends itself well to a e-learning mode. However, some introductory lectures are foreseen as well as two laboratory sessions in which students will be able to check the operation of the simulated devices and the correspondence between simulation and actual behavior.

The course includes a total of 6 credits distributed between front and Blended-Learning lesson.

The most important aim of the course is learning how to use the simulation platform of particle-matter interaction GEANT4 (http://geant4.cern.ch/). This is a platform developed at CERN available in the public domain and for which on-line interactive instructions, manuals, help desk and everything else needed for the learning remote are already and freely available. Related to the use of GEANT, there will be the learning of the ROOT data analysis program (http://root.cern.ch/), which is also free and accessible on the network. Finally, for the simulation of gas detectors used in the laboratory, it will be also provided the use of a specific simulation program called GARFIELD ().

The purpose of the lectures is to provide students

i) the basic knowledge needed to describe the fundamental physical interactions that occur in radiation gaseous detectors
ii) the basic knowledge necessary to understand the mathematical models used in the numerical simulation of the processes of interaction within a detector
iii) Each student will also be equipped with an operating system located on a virtual machine where GEANT4, ROOT and GARFIELD are already present

The basic knowledge will be further developed in the central part of the course that is about learning of simulation programs.

This phase of the course will be carried out remotely using a specific website where the following items will be made available:

· Virtual machine as described above

· Specific programme of activities and laboratory

· Forum / interactive blog for direct contact between students and between students and teacher

· Specific quiz designed to check the status of advance

· Specific exercises and (on request) their solutions

· Further supplementary teaching material (presentations, documents, etc.)

In the last part of the course, students will have access to a laboratory equipped with a GEM (Gas Electron Multiplier) gas detectors type that is used for the detection of radiation in many physics experiments. Three sessions of four hours each, where it will be possible to compare the results obtained from the simulations and the data measured by the detectors are foreseen.

## Prerequisites

**Physics I and Physics II**

## Teaching form

- Lessons, (face to face)

- Exercises (writing up of simulations codes)

- Blended Learning (remote connection, exercises)

All lesspns will be recorded.

## Textbook and teaching resource

**Geant4 and ROOT manuals**

**G.F. Knoll, Radiation Detection and Measurement

## Semester

Second semester

## Assessment method

**Examination type:**

- Oral

The preparation of a summary on the various exercises proposed during the course is required. The exam starts with a discussion on the elaborate and then continues with more general questions both on the most simulative part (implemented codes) and on the more general one presented at the beginning of the course.

In an eventual Covid-19 emergency period, the oral exams will only be online. They will be carried out using the WebEx platform and on the e-learning page of the course there will be a public link for access to the examination of possible virtual spectators.

The oral exam can be held in English.

**Mark range:**

- Mark in thirtieth 18-30/30

## Office hours

On demand, after sending an e-mail

## Sustainable Development Goals