UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Geant4

2526-113R047

Title

Geant4 for research applications

Teacher(s)

Gabriele Croci

Language

English

Short description

Description

The course introduces the advanced use of the Geant4 Monte Carlo simulation framework for research applications in particle physics, applied physics, and radiation detector studies. The aim is not to provide a simple software introduction, but to develop operational and methodological skills for designing, evaluating, and optimizing realistic simulations used in scientific research.

Particular attention is devoted to the choice of interaction models and to variance reduction techniques (biasing) for

the efficient simulation of rare events.

The course is suitable for PhD students with heterogeneous backgrounds and does not require prior experience with Geant4. However, a basic familiarity with the topic is helpful for understanding the course material.

Main contents

Geant4 architecture: Run, Event, Track, Step
Physics Lists and interaction models
Realistic geometries and detector modelling
Biasing and variance reduction techniques
Data output and analysis with ROOT

Teaching approach

The course combines short lectures with practical demonstrations and guided exercises based on realistic case studies. Students will work on complete simulations (based on Geant4 examples), modifying geometry, physics configuration, and statistical sampling strategies.

Requirements

Basic knowledge of C/C++
Fundamental concepts of radiation–matter interaction (recommended)
Familiarity with Monte Carlo methods (recommended)
Basic experience with Geant4 (recommended)

CFU / Hours

8 hours

Teaching period

September - October 2026

Sustainable Development Goals

AFFORDABLE AND CLEAN ENERGY