

**OECD/NEA Data Bank
Training Course / Workshop on**

**Electron-Photon Transport Modeling
with PENELOPE-2023**

Physics, Code Structure and Operation

8-12 July, 2024

**Universitat de Barcelona
Facultat de Fisica
Diagonal 645
08028 Barcelona
Spain**

Scope and Objectives

This course is addressed to researchers in Radiation Physics and its applications. The main objective is to provide the participants with a detailed description of the new, 2023, version of PENELOPE, with an ample perspective on Monte Carlo methods for simulation of electron/photon transport. The course will consist of theoretical lectures and hands-on sessions. Basic aspects of Monte Carlo sampling methods and scoring, physical interaction models, constructive quadric geometry, and transport schemes for charged particles will be introduced in the theoretical lectures. Benchmark comparisons with experiments will also be presented to illustrate the capabilities and reliability of the code.

Hands-on sessions will be based on the generic main program PENMAIN, which operates with a variety of radiation sources (including radioactive sources) in material structures described by the quadric geometry tool PENGEOM. The exercises will be performed with the Windows graphical user interface PenGUIn that largely simplifies the operation of the code. Participants are expected to run their own Windows laptops. Practical sessions will deal with

- 1) the installation of required programs and tools (GUIs),
- 2) the use of PENMAIN for the set of examples provided in the distribution package,
- 3) the design of simulations of other experimental arrangements (geometry, radiation source, simulation parameters).

As in previous editions, the duration of the course is four and a half days. To allow closer practical tuition, the number of participants is limited to a maximum of 15.

SYLLABUS (T, theory; P, practical):

T1. Monte Carlo simulation. Basic concepts

- T1.1. Random sampling methods
- T1.2. Monte Carlo integration. Statistical uncertainties
- T1.3. Simulation of radiation transport. Scoring
- T1.4. Concepts in variance reduction

T2. Physics of photon interactions

- T2.1. Rayleigh scattering
- T2.2. Photoelectric effect
- T2.3. Compton scattering
- T2.4. Pair production
- T2.5. Scattering of polarised photons

T3. Physics of electron/positron interactions

- T3.1. Elastic scattering
- T3.2. Inelastic scattering
- T3.3. Bremsstrahlung emission
- T3.4. Positron annihilation

T4. Electron/positron transport mechanics

- T4.1. Multiple elastic scattering
- T4.2. Energy-loss straggling
- T4.3. Condensed and mixed simulation schemes
- T4.4. The random hinge method
- T4.5. Simulation parameters: accuracy vs. simulation speed
- T4.6. Transport in electromagnetic fields

T5. Geometry

- T5.1. Quadric surfaces
- T5.2. Constructive quadric geometry
- T5.3. The PENGEOM geometry package
- T5.4. Geometry editor/viewer/debugger PenGeomJar

P1. The PENELOPE code system

- P1.1. Structure of the simulation package
- P1.2. Generation of material data files (MATERIAL)
- P1.3. Visualization of macroscopic parameters (TABLES)
- P1.4. Visualization of electron-photon showers (SHOWER)

P3. Practical simulations with PENMAIN

- P3.1. Structure of the input file: source definition, simulation parameters
- P3.2. Scoring: impact detectors, angular detectors, energy-deposition detectors
- P3.3. The graphical-user interface (PenGUIn)
- P3.5. Examples in the distribution package
- P3.6. Designing the simulation of your application

Teachers of the Training Course / Tutorial

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Course registration

Accommodation

The best options for accommodation near the Faculty of Physics are

- The hall of residence of the Universitat de Barcelona
Col·legi Major Penyafort-Montserrat
<https://www.penyafort.ub.edu>
e-mail: reserves_penyafort@ub.edu
- The hall of residence of the Universitat Politècnica de Catalunya
University Residence Hall Torre Girona
<http://www.resainn.com/accommodation/barcelona/torre-girona-residence-hall/>
e-mail: torregirona@resa.es

Prices are in the range 60-75 euros/night (single room). These residences are at walking distances from the Faculty of Physics. RESA has another residence at Diagonal Mar Campus, across the city; the trip by metro takes about 50 minutes. Reservation of accommodation must be arranged by the participants; availability of rooms at the university residences cannot be guaranteed.

Further information on accommodation can be found at <http://www.barcelona.cat/en/>