

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

**Electron-Photon Transport Modeling  
with PENELOPE-2018**

**Physics, Code Structure and Operation**

**11-15 July, 2022**

**Universitat de Barcelona  
Facultat de Física  
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, 2020, 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 (now including radioactive sources) in material structures described by the quadric geometry tool PENGEOM. The exercises will be performed with a new graphical user interface that largely simplifies the operation of the code. Practical sessions will deal with

- 1) the installation of required software (Fortran compiler, gnuplot) and the simulation 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. Software installation
- P1.3. Generation of material data files (MATERIAL)
- P1.4. Visualization of macroscopic parameters (TABLES)
- P1.5. 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. Graphical-user interface
- P3.5. Examples in the distribution package
- P3.6. Designing the simulation of your application

## Teachers of the Training Course / Tutorial

Francesc Salvat, Randy Schwarz

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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](mailto:reserves_penyafort@ub.edu)
- University Residence Yugo Aleu. Universitat de Barcelona  
Restricted to University activities. For reservations, send them an e-mail indicating that the sender is going to attend the “Electron-Photon Transport Modeling with PENELOPE-2019” course.  
<https://www.ub.edu/allotjament/en>  
e-mail: [aleu@yugo.com](mailto:aleu@yugo.com)
- 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](mailto:torregirona@resa.es)

Prices are in the range 50-75 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/>