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 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, 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](https://www.penyafort.ub.edu)
  e-mail: 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](https://www.ub.edu/allotjament/en)
  e-mail: aleu@yugo.com

- The hall of residence of the Universitat Politècnica de Catalunya
  University Residence Hall Torre Girona
  e-mail: 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/](http://www.barcelona.cat/en/)