“The Monte Carlo Method in Radiation Transport"

Lessons’ time and date:

Tuesday: 14:00-16:00
Thursday: 14:00-16:00

Course syllabus

Fundamentals of the Monte Carlo method. Elements of probability theory. Sampling methods by use of cumulative probability functions. Particle transport models. Main interaction process of charged and neutral particles in matter. Algorithms for photon transport simulation. Algorithms for electron transport simulation. Estimation of uncertainties during Monte Carlo simulations. Variance reduction techniques. Application of the Monte Carlo method in specific problems.

Objective.

To know the fundamentals of the Monte Carlo method for the simulation of radiation transport through matter.

Program

- A short history of the Monte Carlo method for stochastic process simulations. Pseudo-random number generators.
- Elements of probability theory. Construction of cumulative probability functions from interaction cross sections. Direct and indirect sampling method of stochastic variables.
- Photon interaction processes in matter. Mean free path and interface crossing.
- Charged particle interaction processes in matter. Class I and II transport algorithms. History condensation. Even-by-event transport. Interface crossing.
- Uncertainty estimation in Monte Carlo simulations. History-by history and batch methods.
- Variance reduction techniques.
- Applications.

Bibliography

Basic reference:

· Fundamentals of the Monte Carlo method for neutral and charged particle transport. Alex Bielajew. Universidad de Michigan, 2000.

Complementary references:

· Monte Carlo calculation of the penetration and diffusion of fast charged particles. M J Berger. Academic Press: New York, 1963. Editors M. R. B. Alder, S. Fernbach

· PENELOPE, a code system for Monte Carlo simulation of electron and photon

transport. F. Salvat and J. Sempau and J. M. Fernandez-Varea. Universitat de Barcelona, 2006
· Monte Carlo Transport of Electrons and Photons. Editors T.M. Jenkins, W.R. Nelson, A. Rindi, A.E. Nahum, and D.W.O. Rogers. Plenum Press, New York, 1989.

Evaluation

Two written examinations (60%) and a computational project (40%).