Indicazioni per l’esame

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Exam

Different MC codes seen:

- FLUKA
- Geant4
- Geant4-DNA
- FRED
- EGS-nrc

Exam consists of making a small and simple MC simulation project, with one of the codes FLUKA, GEANT, GEANT-DNA or EGS-nrc.

- run a simulation (see next slides)
- identify what is the primary particle source, the geometry, physics, scoring, etc
- try to make at least 1 analysis plot (or more), analysis code of choice (e.g. python, root)
- make the code available to others (Baltig or google drive)
- during oral exam (in presence at INFN Pisa): explain your project clearly (about 30 minutes)

Exam

- Fino ad ora circa 2*8=16 ore di lezioni
- Progetto da fare in 8 ore massimo

May 2026

04 May Aafke Christine Kraan, "Indicazioni per progetto finale"

April 2026

16 Apr Mariagrazia Celentano, "Simulazioni MC con ERG-nrc: pratica"

March 2026

27 Mar Serena Fattori, "Geant4-DNA: toolkit for radiation biophysics & radiobiology"

20 Mar Pablo Cirrone, "Codice Monte Carlo Geant 4: esercizi"

16 Mar Alberto Taffelli, "FRED: A Simple and Fast Monte Carlo Tool for Proton Therapy Applications"

06 Mar Pablo Cirrone, "Codice Monte Carlo Geant 4: teoria"

February 2026

27 Feb Aafke Christine Kraan, Giuseppe Battistoni, Silvia Muraro, "Codice Monte Carlo FLUKA: esercizi"

20 Feb Aafke Christine Kraan, "Codice Monte Carlo FLUKA: teoria"

13 Feb Aafke Christine Kraan, "Introduzione al corso Tecniche Monte Carlo per la radioterapia"

FLUKA

Example:

- Create a 200 MeV proton beam with a 5 mm beam width
  - Plot the longitudinal dose profile (Bragg peak)
  - Plot the lateral dose profile at a certain depth
- Same, but with a 200 MeV/u Helium beam
- Same, but with a 200 MeV/u Carbon beam
- Same, but with a 200 MeV/u Neon beam
- Same, but with a 200 MeV/u Oxygen beam
- Plot them into a single plot

Hint: start with exercise 1 which we saw during the lecture.

GEANT4

Example:

- Create a 200 MeV proton beam
  - Plot the longitudinal dose profile (Bragg peak)
  - Plot the lateral dose profile
- Same, but with a 200 MeV/u Helium beam
- Same, but with a 200 MeV/u Carbon beam
- Same, but with a 200 MeV/u Neon beam
- Same, but with a 200 MeV/u Oxygen beam
- Plot them into a single plot

Hint: start with example/extended/medical/radiobiology ‘ which we saw during the lecture.

Geant-dna

- Try to run and visualize the output one of the examples in examples/extended/medical
  - Example:
    - Try examples/extended/medical/microdosimetry to draw the path of a charged particle in water
    - Change the particle type, look at the differences

EGS-nrc

EGSnrc

- Create a LINAC beam simulation using LINAC example (tutor app online geometry or BEAMnrc EX16MVp example) or custom LINAC
- Use the phase-space to irradiate a water phantom or a patient CT (tutor app or DOSXYZnrc)
  - Water phantom -> generate PDD using custom code (python, c++,....)
    Use different energies or jaws apertures to plot the differences
  - Patient -> generate DVH on PTV (VICTORIA online +python code or 3DSlicer with Radiotherapy module) and generate dose statistics on OARs
    Hint: if more beams are needed to cover the target (3D-CRT treatment) you will sum the dose maps which will be created using the same reference system.
    Try to use the whole CT as simulation volume to have a perfect match with the dose map

Hint: phase-space of at least 1e8 primaries is needed. Is better to use all the particles in the phase-space for the water phantom/patient phantom but is ok to have 1e7 particles for that