

Geant4 at IST

Applications in Brachytherapy

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Monte Carlo Techniques in Medical Physics (1)

- **1970s** A number of Monte Carlo codes were written for application to medical physics, mainly radiotherapy physics.
(ETRAN, EGS, MCNP, MORSE)
- **1976** Raeside “*Monte Carlo principles and applications*”
(*Phys. Med. Biol.*)

Monte Carlo Techniques in Medical Physics (2)

- Nuclear Medicine
- X-ray Diagnostic
- *Radiotherapy Physics* ←
- *Dosimetry* ←
- Radiation Protection

Radiotherapy

It is a kind of therapy with which we want to deliver to the tumour (target) a high radiation dose while sparing surrounding healthy tissues.

Radiotherapy at IST

Facilities for radiotherapy installed in our Institute:

- Three LINACs (5 X-ray beams, 10 e⁻ beams)
- A Brachytherapy unit

Brachytherapy

- Method of treatment in which sealed radioactive sources are used to deliver radiation at a short distance

Afterloading unit



Catheter along which the source moves

Monte Carlo Techniques in Radiotherapy

•Dose calculation

- ◆ Computation of dose deposition kernels for treatment planning dose calculation algorithms based on convolution/superposition methods
- ◆ Separation of primary, first scatter and multiple scatter components for complex dose deposition models
- ◆ Computation of other model-dependent parameters
- ◆ Accurate computation of dose deposition in high gradient regions

• Verification of experimental calibration procedures

GEANT4 at IST

- Test of electromagnetic processes for photons in the energy range characteristic of brachytherapy applications
- Simulation of isodose distribution around a brachytherapy source
- Comparison with analytical calculations by the treatment planning system (*Plato*)
- Comparison with our own measurements