# Mandatory exercise FYSKJM4710 -
# Monte Carlo simulations of radiation transport

Activate program ”egs_inprz”. Use Excel to evaluate output files (*.egsgph and *.egslst) -> open file in excel, use “fixed width”, select data to be extracted.

**1. ’Watch’ electron and photon interactions**

Use parallel beam, radius 3 cm. Medium is water. 1 slab of thickness 10 cm and radius 10 cm. 10 histories. IWATCH=graph. Extract the path of primary particles only. Plot trajectory in yz-plane.

a) 0.1 MeV photons.
b) 5 MeV electrons.

Discuss differences between electrons and photons.

IWATCH=off in the following. Normalize all plots to maximum value.

2. **Narrow photon beam attenuation**

Simulate narrow beam attenuation. Use parallel beam, radius 1 cm. Use copper as absorber. At 1 m from the absorber, place a water filled detector with 0.5 cm radius. Use air in between. Vary the thickness of copper.

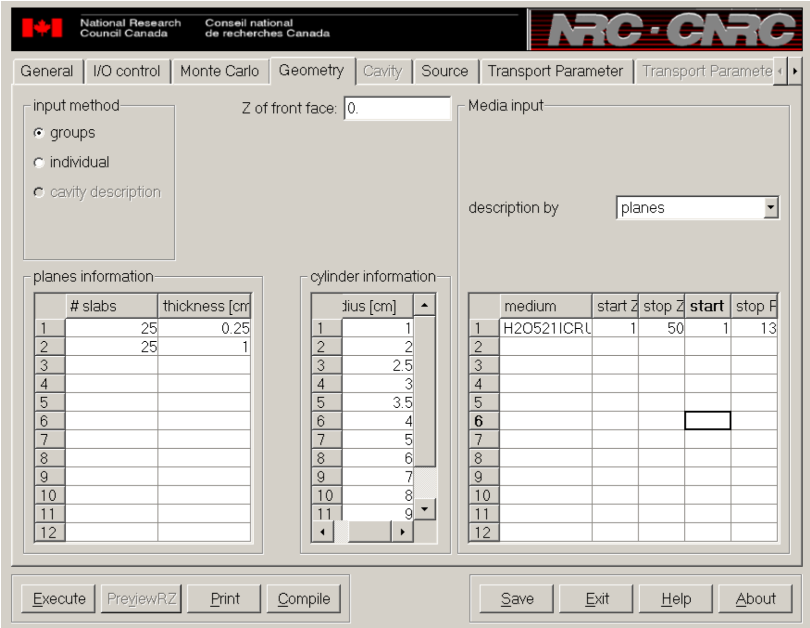
a) 250 keV monoenergetic photons. Plot dose in the detector as a function of copper thickness (semilogarithmic). Determine HVL and $\mu$ from the slope. Use tables in Attix to find the equivalent photon energy.
b) 250 kV spectrum (”250.spectrum”). Plot dose in the detector as a function of copper thickness Determine HVL and $\mu$ from the slope. Use tables in Attix to find the equivalent photon energy.

Discuss differences between a and b.

## 3. Longitudinal and lateral dose deposition characteristics

Use parallel beam, radius 3 cm. Medium is water.

Geometry (continue list with radius 10 and 15 cm):




a) 0.1, 1 and 10 MeV photons. Use 5000000, 4000000 and 3000000 histories, respectively. Extract central, longitudinal dose profile ('depth dose'). Extract lateral dose profile at 5 cm depth.

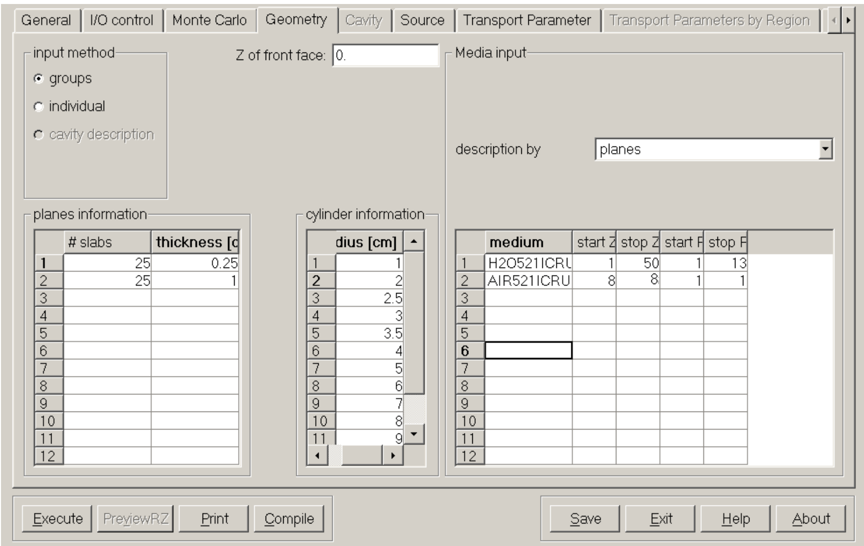
b) 5, 10 and 20 MeV electrons. Use 2000000, 1500000 and 1000000 histories, respectively. Extract central, longitudinal dose profile ('depth dose'). Extract lateral dose profile at 2 cm depth.

Discuss differences between the dose deposition characteristics of photons and electrons. Discuss the dependence of photon or electron energy on the dose deposition characteristics.

## 4. Air cavity

Place an air cavity in the central part of the phantom at 2 cm depth. Calculate the dose to the air cavity.

Geometry the same as above, except air cavity:



a) 1 MeV photons. 10000000 histories. Calculate $D_{water}/D_{air}$ (take former from problem 3 above). Compare to CPE-theory, where tables from Attix may be used.

b) 10 MeV electrons. 1500000 histories. Calculate $D_{water}/D_{air}$ (take former from problem 3 above). Compare to Bragg-Gray-theory, where tables from Attix may be used.

Discuss.

## 5. Own simulation

Simulate a problem of relevance for the course!