Mandatory exercise FYSKJM4710 -
Monte Carlo simulations of radiation transport

Use PC located at the EPR lab (room KV 321). Activate program ”egs_inprz”. Use Excel to evaluate output files (*.egsgph and *.egslst) -> open file, 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.

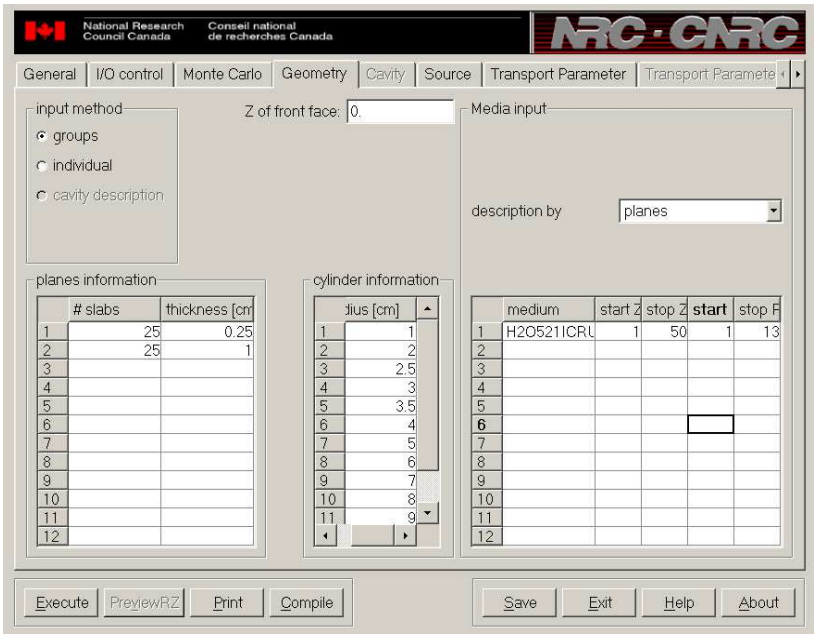
a) 250 keV monoenergetic photons. Plot dose in the detector as a function of copper thickness (semilogarithmic). Determine HVL and μ from the slope. Use tables in Attix to find the equivalent photon energy.
b) 250 kV spectrum (”250.spectrum”). Plot dose in the detector as a function of copper thickness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

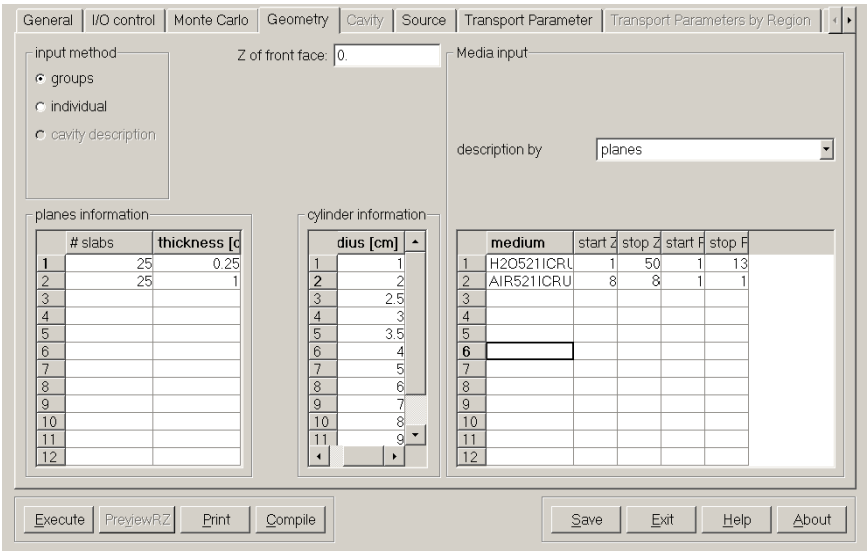
b) 5, 10 and 20 MeV electrons. Use 2000000, 1500000 and 1000000 histories, respectively. Extract central, longitudinal dose profile (’depth dose’). Extract lateral dose profile at 2 cm depth.

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!