Mandatory exercise FYSKJM4710 -
Monte Carlo simulations of radiation transport

Use PC located at the EPR lab (room KV 321). Log in as user ”Eirik Malinen”, password ”*EPRlab”. Activate program ”egs_inprz”. Use Excel to evaluate output files (*.egsgph and *.egslst) -> open file, use “fixed width”, select data to be extracted. See also corresponding lecture notes, “Monte_Carlo_07”.

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 beam depth dose

Use parallel beam, radius 1 cm. Medium is water. 60 slabs of thickness 0.2 cm. 1 disc of radius 1 cm. Number of histories: 4000000.

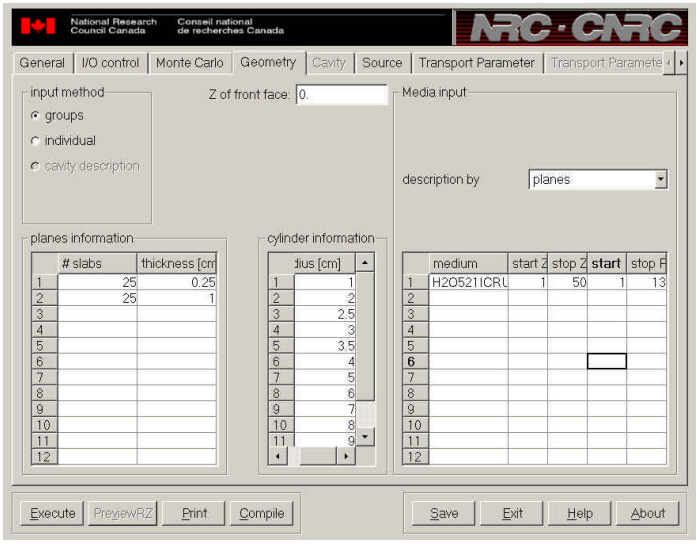
a) 250 keV photons. Plot depth dependence of absorbed dose. If exponential attenuation is assumed, determine “μ".
b) 250 kV spectrum (”250.spectrum”). Plot depth dependence of absorbed dose. Determine “μ”.

Discuss differences between a and b. Compare “μ” for the 250 keV beam to corresponding value found in table in Attix. Why is “μ”(these simulations) < μ(Attix)?

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.

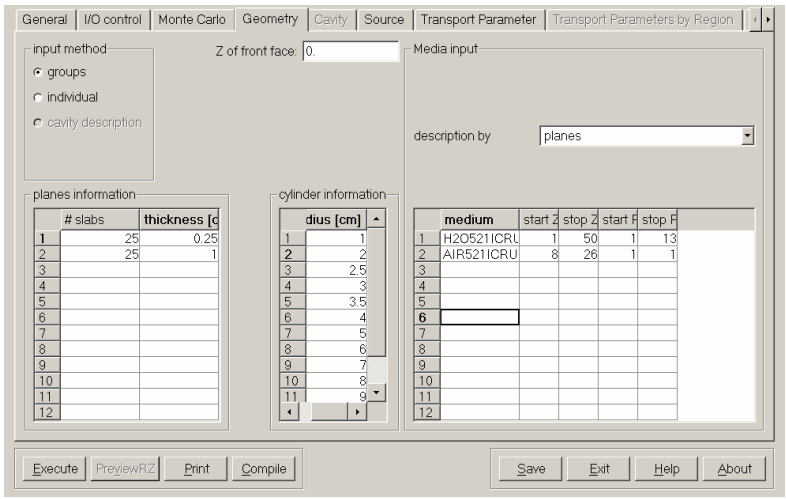
b) 5, 10 and 20 MeV electrons. Use 300000, 2500000 and 2000000 histories, respectively. Extract central, longitudinal dose profile ('depth dose'). Extract lateral dose profile at 2 cm depth.

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. 4000000 histories. Calculate D_{water}/D_{air} (take former from problem 3 above). Compare to CPE-theory, where μ_{en}/ρ found in table from Attix may be used.
b) 10 MeV electrons. 2500000 histories. Calculate D_{water}/D_{air} (take former from problem 3 above). Compare to Bragg-Gray-theory, where S_c/ρ found in table from Attix may be used.

Discuss.