Exercise: Biasing

Advanced FLUKA Course 2019

Goal and setup

- Goal:
  - Use of importance bias
  - Use of interaction length bias
  -
- Setup : basic data already provided: ex_bias_skeleton.inp
- Iron Shielding around a Tungsten target irradiated by an electron beam
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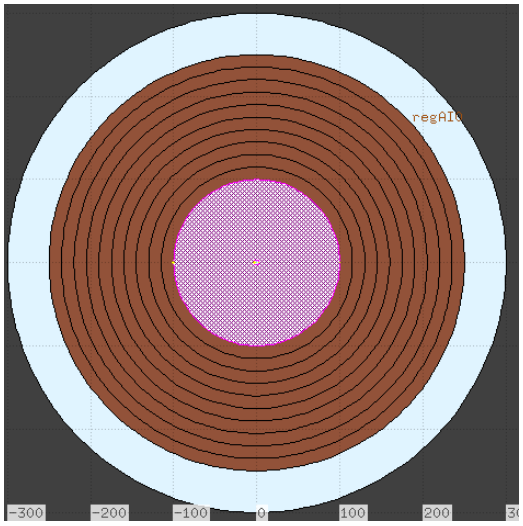
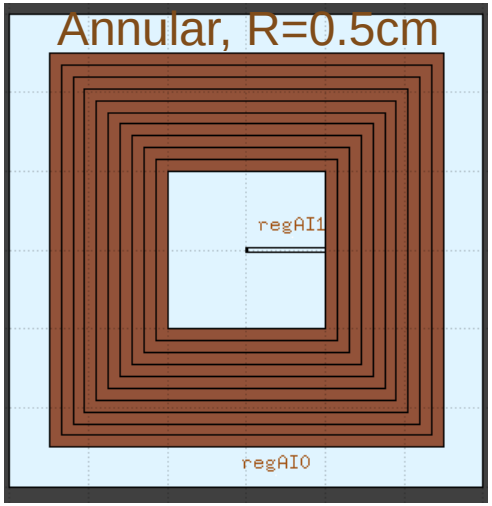


X-Y view

Target :R=3cm
H=.35cm
Starting (0,0,0)

IRON
From R=100
To R=250
From Z=+-100
To Z=+-250
10 Layers
Air around the target

Beam: 40 MeV electrons
Annular, R=0.5cm



Y-Z view

Setup -II

- The input skeleton contains the possibility to switch to a Concrete shielding, expanding its dimensions.
- It contains the outer limits of the shielding, does not contain the segmentation
- It also contains part of the scoring, in parametric form because of the above.
- Note: we are using pure iron here, which is not a fully realistic option: will discuss this in the lecture/exercise on materials.

ToDo

- Add segmentation of the shielding in the geometry
- Add photonuclear interaction bias (LAM-BIAS) in the target, knowing that your colleague already run the simulation and found that the probability to get a photon interaction in the target is few /1000
- Add importance bias in the shielding layers, for all particles,
- knowing that the same colleague found an attenuation factor for dose of the order of 1/500. (use round factors). Start splitting in the second shielding layer.
- OPTION (since contains topics treated in the scoring lecture):
- Add additional scoring: USRBIN with neutron fluence everywhere (same dimensions as as e+-gamma)
- Add same USRBIN for ambient dose equivalent (H*10), using AUXSCORE with AMB74
- Add USRBIN ambient dose equivalent scoring for the “frontal part of the shielding only
- OTHERWISE: add (or #include) cards from more_scoring_cards.inp

Runs

- ...run...3 cycles should be enough
- If it is early: run without the biasing cards, changing the number of primaries to 75000.
- See if you get neutrons and dose outside of the shielding

- OPTION:
- Change the shielding to Concrete (: see next slide) . Use of different importances for different particles. See the different behavior with respect to neutron and electromagnetic attenuation.

Runs: OPTION

- Change the shielding to Concrete.
- Since Concrete is not a good material for electron/photon shielding, increase its thickness by a factor 1.333333333333
- To do it easily: add expansion of the bodies of the shielding with
  - #ifdef ConcrShield
  - $Start_expansion 1.333333333333
  - #endif
- (and similar with $End_expansion at the end of the shielding layers)
- Concrete will be more effective than Iron for neutrons, less effective for e.m. showers ==> differentiate bias
- Attenuation factor for neutrons becomes huge. One needs a weight increase by 9E6, → need to start from a value <1 to avoid integer overflow (remember: what counts is the RATIO of importances)
- ==> set initially importance 1.E-4 for all regions, all particles
- ==> set importances from 1E-4 to 2.0 in the shield, all particles
- ==> set importances from 1E4 to 900 in the shield for NEUTRONS
- Hint to write less: use the fact that last card supersedes previous one