



Exercise: Importance biasing

FLUKA Beginner's Course

Exercise: Importance biasing

Aim of the exercise:

- 1- Discover biasing power
- 2- Experience region importance
- 3- Use of cylindrical mesh USRBIN
- 4- Plot USRBIN in the Geometry Editor

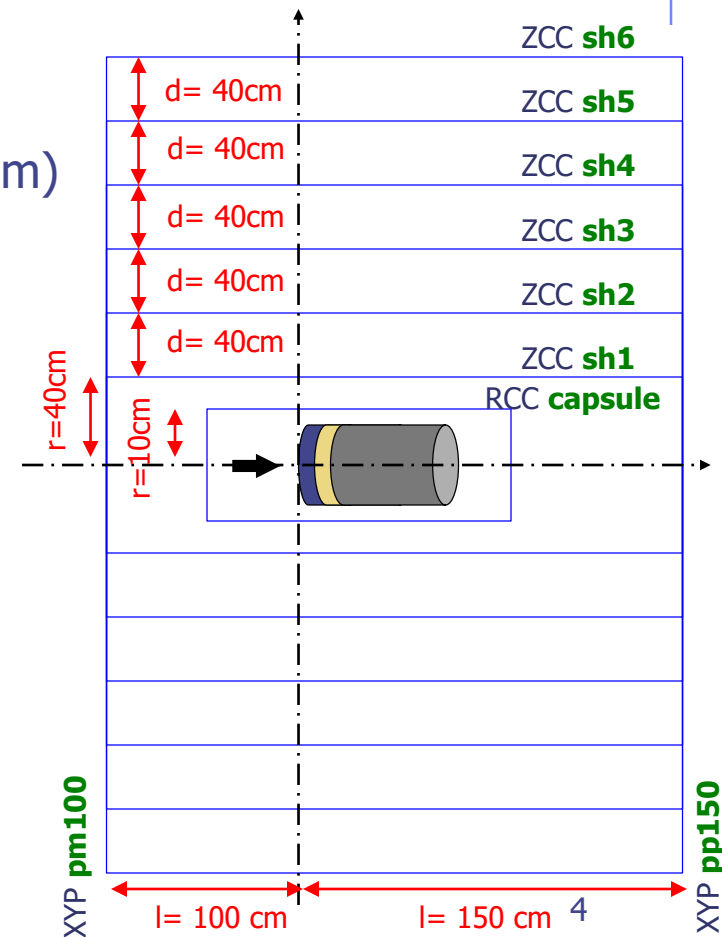
Exercise: Importance biasing

- ❑ Start from the solution of `ex_Geometry1`:
`mkdir ex_Biasing`
`cp ex_Geometry1/ex_Geometry1_final.inp ex_Biasing/ex_Biasing.inp`
`cd ex_Biasing`
`flair ex_Biasing.inp` (and immediately save flair project)
- ❑ Proton beam with:
 - ❑ 3.5 GeV Gaussian energy profile, 0.8 GeV FWHM
 - ❑ Gaussian divergence 1.7 mrad FWHM
 - ❑ Origin at (0,0,-0.1) cm
- ❑ Target materials: water, aluminum, lead
- ❑ In the next slide we enclose the target in a cylindrical capsule filled with CO₂ and arrange coaxial cylindrical layers of concrete surrounding the capsule, acting as shielding material

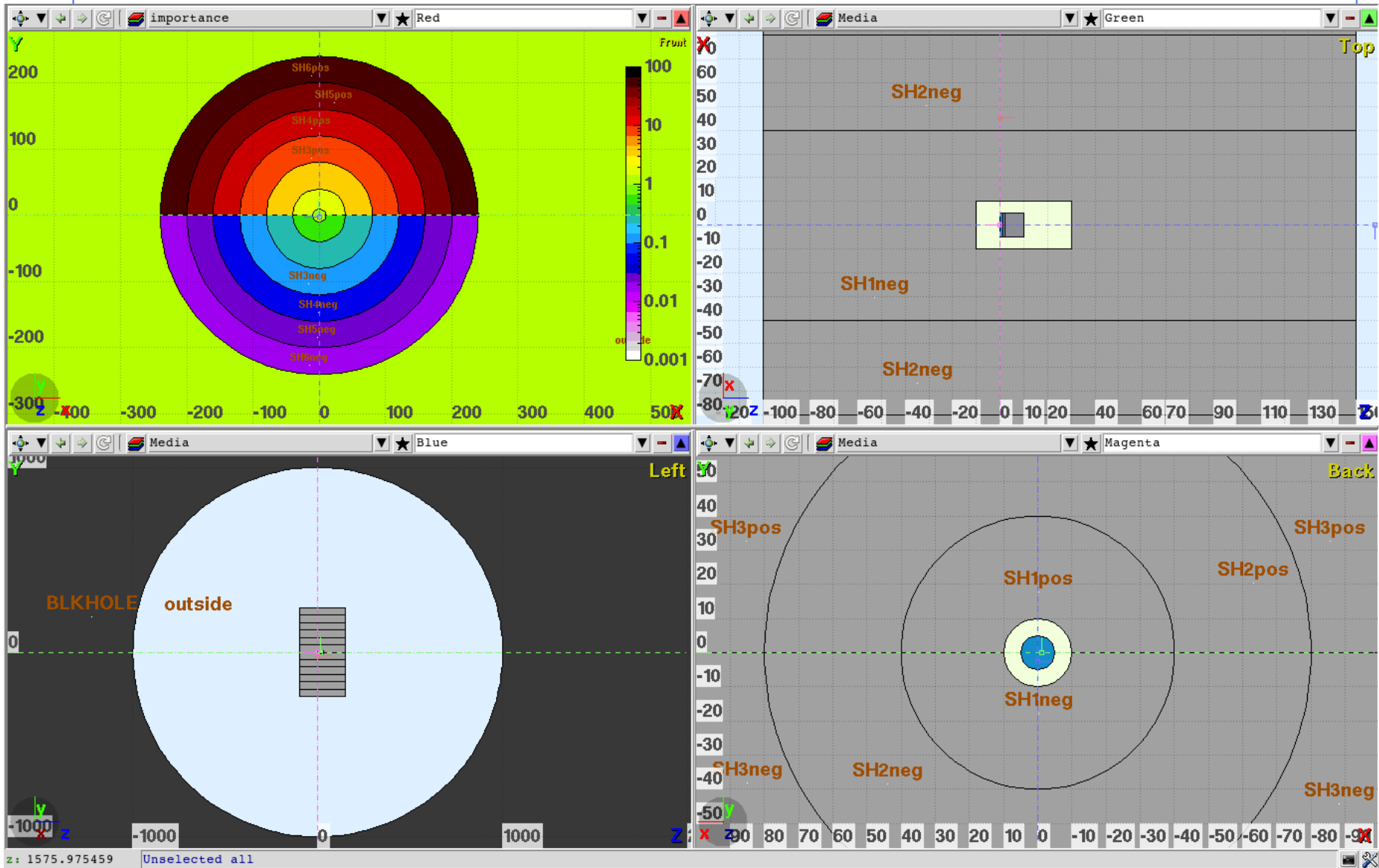
Exercise: Importance biasing

- Geometry modifications:
create a coaxial shielding and split vertically the geometry in two ($y > 0$ and $y < 0$)
- E.g.:
 - Add 1 RCC surrounding the target
 - ($R=10\text{cm}$; $Z_{\text{min}}=-10\text{cm}$; $Z_{\text{max}}=30\text{cm}$)
 - Add 6 ZCC (radius = $n \times 40\text{cm}$)
 - Add 2 XYP planes
 - ($z=-100\text{cm}$ and $z=150\text{cm}$)
 - Add 1 XZP plane ($y=0$)
- Define a region for each shielding "shell"

NOTE: a subdirectory geometry/ is available with the completed geometry in case this takes too long



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Materials

- ❑ Shielding will be made of concrete
- ❑ Concrete is not a FLUKA predefined material
- ❑ It has to be defined

Concrete: (mass fraction)

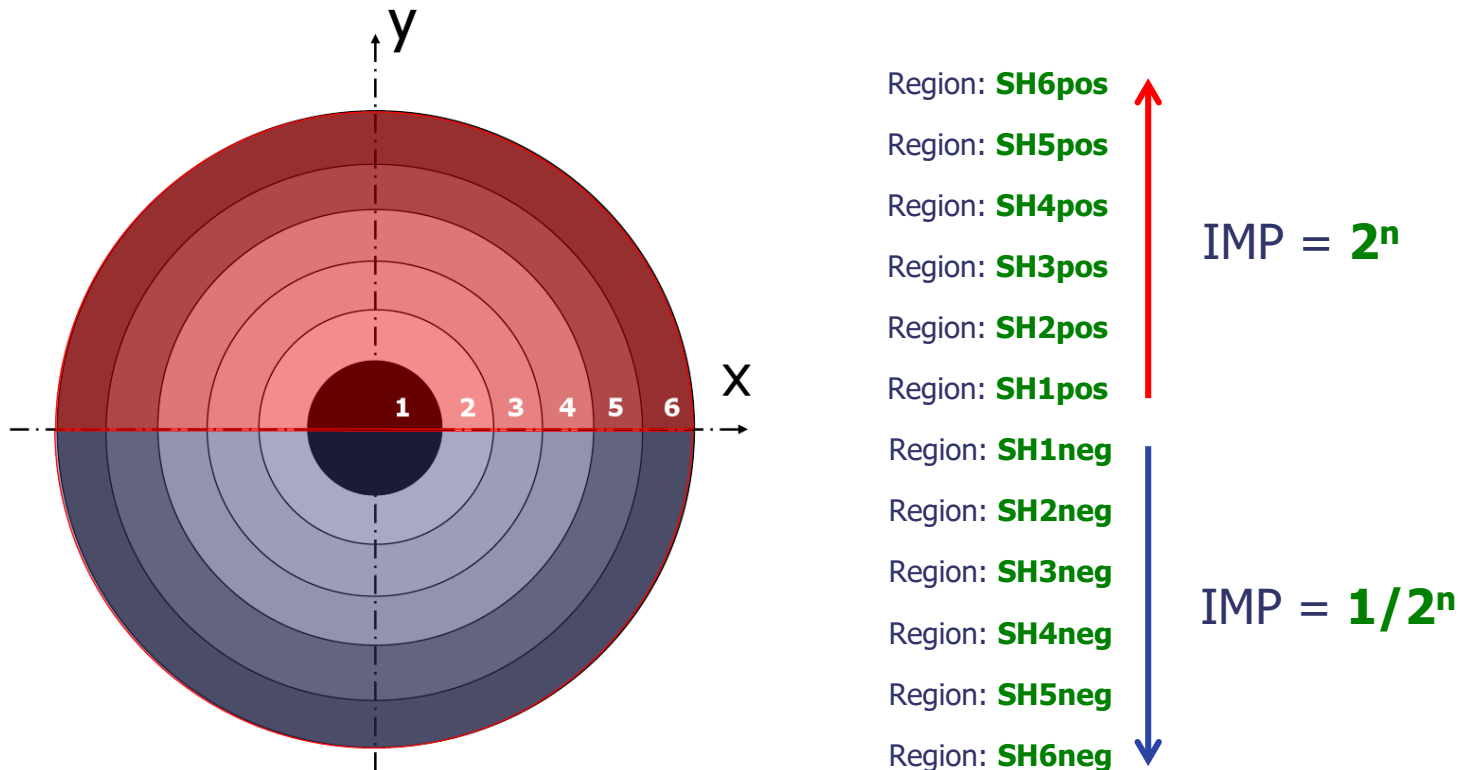
Hydrogen	0.01	Aluminum	0.034
Carbon	0.001	Silicon	0.337
Oxygen	0.529	Potassium	0.013
Sodium	0.016	Calcium	0.044
Magnesium	0.002	Iron	0.014

Density: 2.3g/cm³

- ❑ Assign it to all the shielding regions
- ❑ Surround the whole shielding with air

Exercise: Importance biasing

- ❑ Enclose biasing within a " `#if BIASFLAG` " statement
- ❑ First, set the importance to 1, for all regions and particles
- ❑ Then set importance only for low energy neutrons and hadrons & muons
 - For regions having $y > 0$ set importance to 2^n ($n = \# \text{layer}$)
 - For regions having $y < 0$ set importance to $1/2^n$ ($n = \# \text{layer}$)



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How to display region importance in the Geometry Editor

The screenshot shows the Geometry Editor interface for a file named '+ ex_Biasing.flair - flair'. The main window displays a circular region with concentric rings, each labeled with a region name: SH6pos, SH4pos, SH3pos, SH3neg, SH4neg, SH5neg, and SH6neg. The regions are color-coded according to their importance, with a color scale on the right ranging from 0.001 (purple) to 100 (red). The top toolbar includes various tools like Cut, Copy, Paste, Select, Pan, Orbit, Info, Body Zone, Object, Clone, Region, Delete, Lock, Wireframe, Selection, and View. The 'Importance' tab is selected in the top right, and the 'Red' color is chosen for the visualization. The left sidebar shows the 'Geometry' panel with the 'Importance' option selected, and the 'Show' panel with 'Vertices' checked and 'Color' set to 'Importance-N'. The bottom status bar shows the current coordinates: x: 262.0741383, y: -211.9348432, z: 0, and the status 'Unselected all'.

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Scoring

- ❑ Add one region independent scoring for neutrons (USRBIN)
 - To span over the whole geometry
 - To have sufficient bins
 - To have cylindrical coordinates [i.e. **R-Phi-Z**]
 - Unformatted output on unit 54

Run

- ❑ 2 separate runs, w/ and w/o biasing (do not overwrite results)
- ❑ 5 cycles, 1000 primaries each

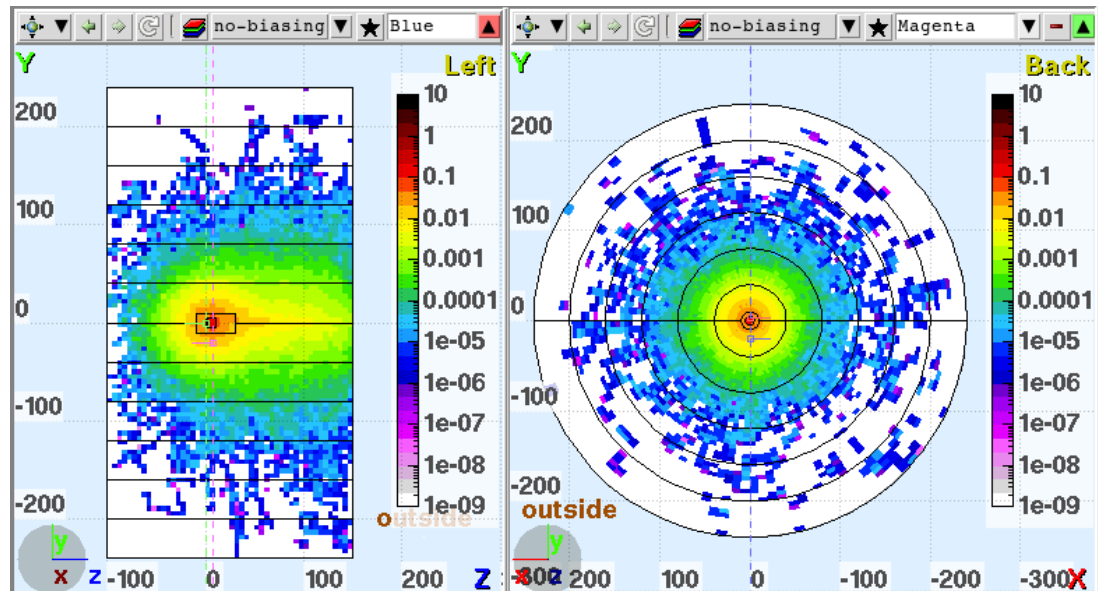
Plot

- ❑ USRBIN results in Flair
- ❑ Region importance in the Geometry Editor
- ❑ USRBIN results in the Geometry Editor

Exercise: Importance biasing - Results

**Without
Biasing**

Neutron fluence
[n/cm² primary]



**With
Region
Importance
Biasing**

