Exercise 1: Energy Deposition

Advanced FLUKA Course

Exercise 1a

- Study case

  Beam dump of a proton-therapy facility

- Goal

  Evaluate the peak and total energy deposition on the dump

- Ingredients
  - Beam settings:
    - 200 MeV protons;
    - Gaussian beam: $\sigma_x = \sigma_y = 1mm$, with no divergence;
  - Dump: copper cylinder:
    - 5 cm radius; 5 cm length;

NB: range of protons@200MeV in Cu: ~4.3 cm

(from: http://physics.nist.gov/PhysRefData/Star/Text/PSTAR.html)

Exercise 1a (II)

- Instructions:
  - Choose option NEW-DEFA in the **DEFAULTS** card;
  - Set three *cylindrical* **USRBIN** detectors, with different radial step and maximum radius, in order to compare results (Δz=1mm in all cases):

    $\Delta r_1 = 5\sigma$; $\Delta r_2 = 1\sigma$; $\Delta r_3 = 0.1\sigma$;

    $R_{1,max} = 5.0$cm; $R_{2,max} = 1.0$cm; $R_{3,max} = 0.1$cm;
  - In Flair, plot results as longitudinal distributions:
    - ‘Type: 1D Max’ for the peak energy deposition;
    - ‘Type: 1D Projection’ for the total energy deposition (i.e. *averaged* over the transverse dimension of the scoring mesh);
  - Which plot will show a proper *Bragg Peak*?
  - How do results change when option PRECISIO is chosen in the **DEFAULTS** card?

Exercise 1b

- Study case

  Beam dump of a multi-GeV proton accelerator

- Goal

  Evaluate the peak and total energy deposition on the dump, and their dependence on the beam dimensions;

- Ingredients
  - Beam settings:
    - 20 GeV protons (x100 wrt previous exercise)
    - Gaussian beam: $\sigma_x = \sigma_y$ = 1mm, with no divergence (*basic* case);
  - Dump: copper cylinder:
    - 5 cm radius; 25 cm length (x5 wrt previous exercise);

NB: inelastic scattering length of protons@20GeV: 14.6cm;

Radiation length: 1.4cm;

Exercise 1b (II)

- Instructions:
  - Choose the proper option in the **DEFAULTS** card;
  - Set one *cylindrical* **USRBIN** detector, based on the outcome of the previous exercise;
  - Activate Leading Particle Biasing (through **EMF-BIAS** card);
  - In Flair, plot results as longitudinal distributions (see previous exercise);
  - Increase the beam spot size of the *basic* case by a factor 2 and 8: how do results change? Is there a linear scaling among the simulated cases?
  - Is it a good dump?

Optional:

- Which particles are carrying most of the escaping energy?