Exercise: Energy Deposition and thresholds

Advanced FLUKA Course 2019

Exercise Edep-Thresholds

- 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 Edep-thresholds (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):

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

    $R_{1,max}$=5.0cm; $R_{2,max}$=1.0cm; $R_{3,max}$=0.1cm;
  - 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*?

Exercise Edep- thresholds (III)

- Note that option NEW-DEFAULT sets, among the others, δ ray production threshold to 1MeV, as the e^+e^- transport threshold unless modified using EMFCUT. Particles transport threshold is 10MeV.
- Are these settings adequate to describe our study case?

  Try to play with tresholds (using DELTARAY, EMFCUT) to see how this influences the simulated data.

  Is it necessary to change the proton transport threshold?

  (look at https://physics.nist.gov/cgi-bin/Star/ap_table.pl)

- Is the USRBIN mesh adequate? Compare with the e range in copper.

Exercise Edep- thresholds (IV)

- Finaly note that, plotting with flair the energy deposition density AVERAGED over the transverse plane (1D projection), the normalization of the curve (in GeV/cm3) depends on the area of the considered transverse section. Wider meshes, lower the average, but the product average*area (GeV/cm) remains the same.