



# Exercise 1: Energy Deposition

FLUKA Advanced 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:  $\sigma_x = \sigma_y = 1\text{mm}$ , with no divergence;

- Dump: copper cylinder:

- ◆ 5 cm radius; 5 cm length;

NB: range of protons@200MeV in Cu:  $\sim 4.3$  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 stepping and maximum radius, in order to compare results:

$$\Delta r_1 = 5\sigma;$$

$$\Delta r_2 = 1\sigma;$$

$$\Delta r_3 = 0.1\sigma;$$

$$R_{1,\max} = 5.0\text{cm};$$

$$R_{2,\max} = 1.0\text{cm};$$

$$R_{3,\max} = 0.1\text{cm};$$

- 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:  $\sigma_x = \sigma_y = 1\text{mm}$ , 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?