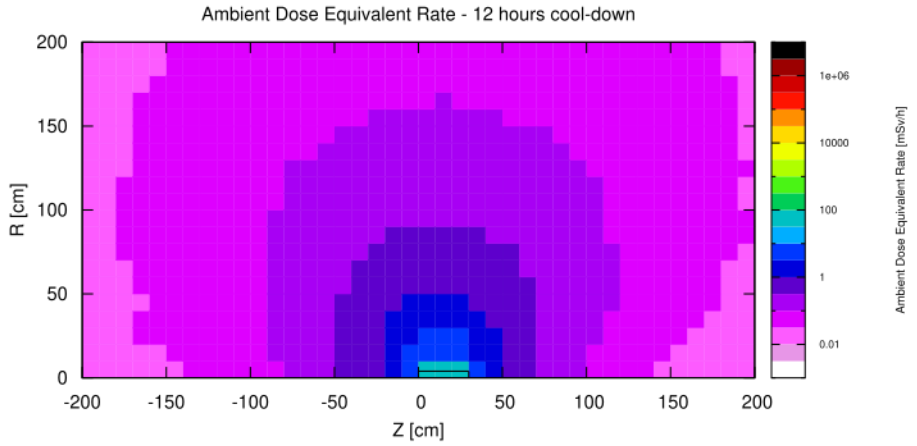
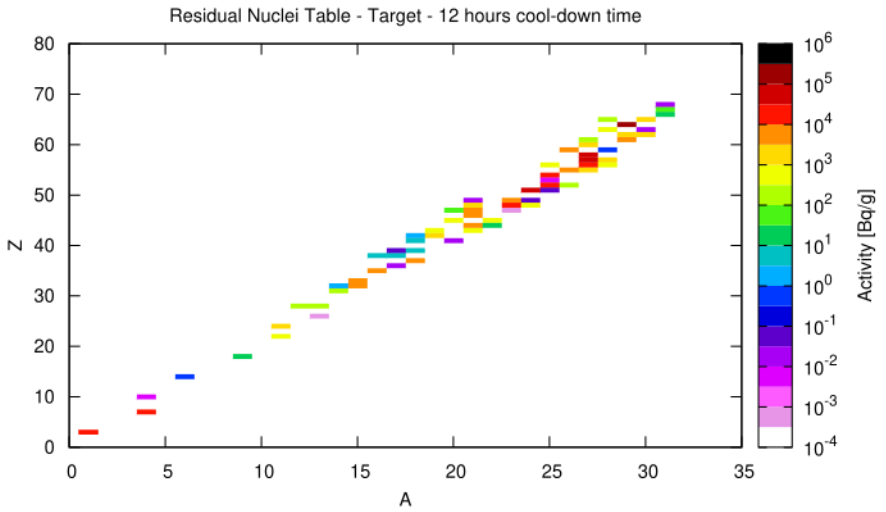
RP specific quantities exercise

Activation exercise

Study of 4 RP (Radiation protection) related quantities for proton beam on a copper target:

- Prompt ambient dose equivalent rate
- Residual ambient dose equivalent rate
- Production Yields of residual nuclei
- Activity after 12 hours of cool-down





Activation exercise - Starting point

What is already contained in input file:

- Relevant `PHYSICS` cards
- Geometry
- Scoring for prompt ambient dose equivalent (in 2 meshes)
- Scoring for Nuclei Production Yield tables [#nuclei/g/primary] for the target
- Plots (without normalization)

Activation exercise – To be done

Preparation of the input file

- Add a **RADDECAY** card that:
  - Use defaults for residual transport (PRECISION: 100 keV for photons and electrons)
  - Switch off EMF for the prompt transport (prompt cut)
    - Check this point if your simulations runs slow!
  - Decay cut = 10.0 (no modification of PRECISION settings)
- Define the irradiation profile:
  - 180 days of irradiation, with 10^{10} primaries per second
- Define a cooling time:
  - 12 hour after the end of irradiation

Activation exercise

Preparation of the input file

Task 1: Ambient dose equivalent rate maps

- Add one **USRBIN** for the cool-down time
- USRBIN should have the same R-Φ-Z as the prompt USRBIN in the file **PrDR-rz**
  - 20 radial bins, up to R=200 cm
  - 1 angular bin
  - 40 longitudinal bins in the range -200 cm ≤ Z ≤ 200 cm
  - Why is this a good choice?
- Associate the new USRBIN to the cool-down time (**DCYSCORE**)

Activation exercise

Preparation of the input file

Task 2: Residual nuclei tables [Bq/g] for the target

- Add **RESNUCLE** for the targetB Region
- Do not forget to include the mass normalization [Vol field]

  [you should enter the mass in g; density of copper= 8.96 g/cm^3]
- Hint: See **RESNUCLE** scoring for Production Yields
- Associate the new RESNUCLE to the cool-down time (**DCYSCORE**)

Activation exercise

Compile a new executable

- In the Flair “compile tab”, use ldpmqmd to create a new executable (e.g. **`flukaexe`**)
- This is necessary to use DPMJET as the beam is made of high energy protons
- Do not forget to select the new executable in the “run tab”

Running the input file

- Use spawns and cycles to run a total of 100000 primaries
- Do not forget to merge the results

Activation exercise

Plotting results

- In flair Plot tab
  - 4 plots already exist in the flair file
  - Link the plots to the processed output files
  - Add the proper normalization for ambient dose equivalent rates to [mSv/h]
    - Irradiation profile already contains beam intensity, but prompt scoring is per primary
  - Create all 4 plots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Activation exercise - Solutions