

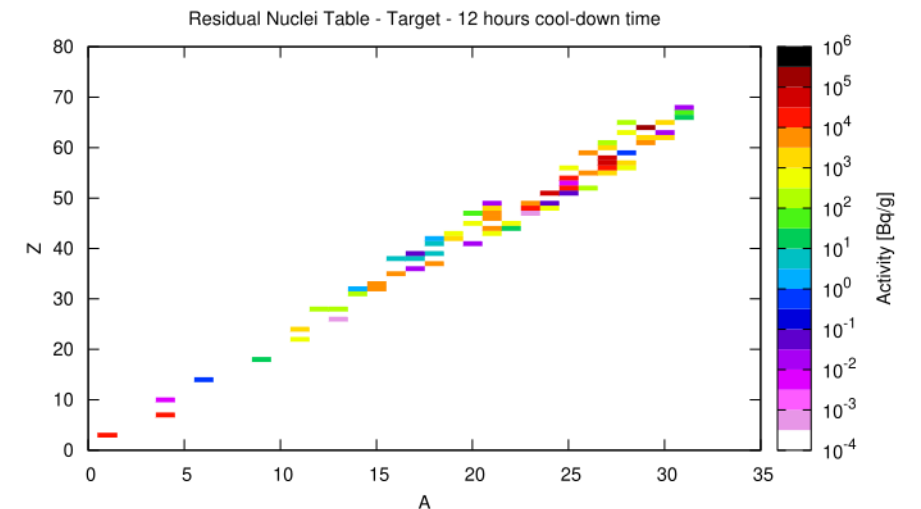
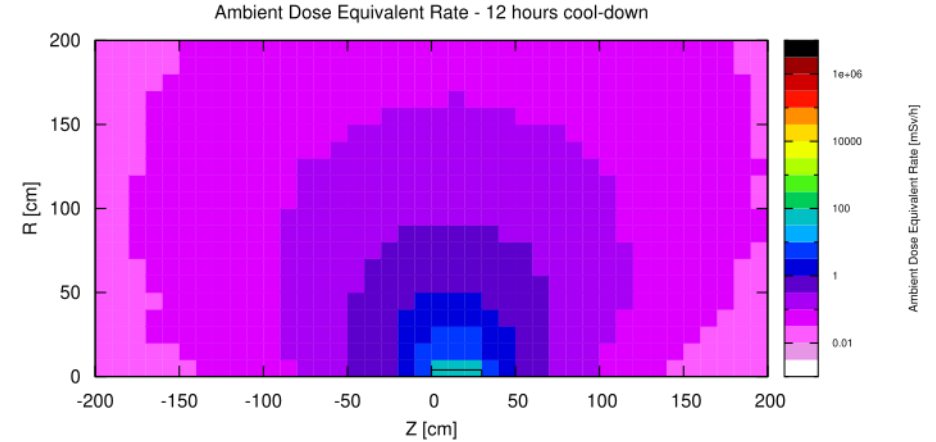


RP specific quantities exercise

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)
- 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 (this makes the evaluation of the prompt ambient dose unreliable -> should be lifted)
 - Check this point if your simulations runs slow!
- 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 $-200 \text{ cm} \leq Z \leq 200 \text{ cm}$
 - 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: Nuclei Production Yield tables [#nuclei/g/primary] 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/cm³]

Activation exercise

Preparation of the input file

Task 3: 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/cm³]
- 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



Activation exercise - Solutions

