

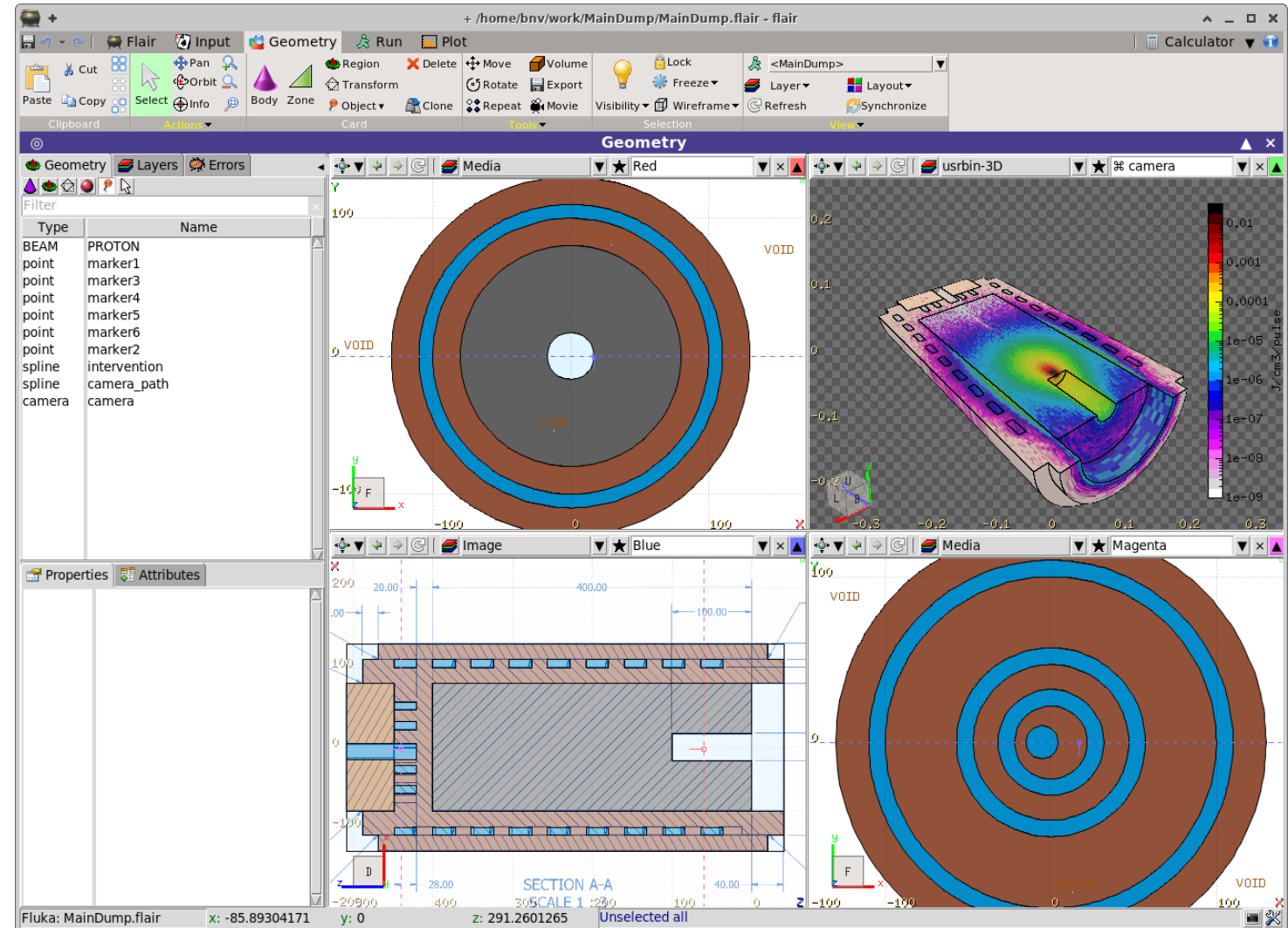


Flair intermediate hands on

Discovering further features in flair

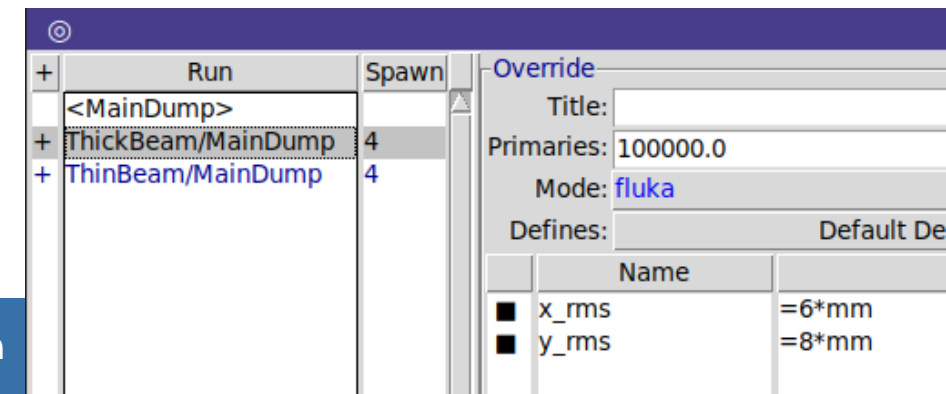
Flair intermediate hands on - aims

- Compare the energy deposition and adiabatic temperature rise for two run scenarios with the CERN LINAC4 main dump
- Geometry editor
 - Learn the use of Layers
 - Discover the 3D capabilities
 - Use a technical drawing in the geometry editor
 - Usrbin layer mapping 2D & 3D with multiple detectors
- Multiple plots with proper normalization



Flair intermediate hands on– 2 beam size scenarios

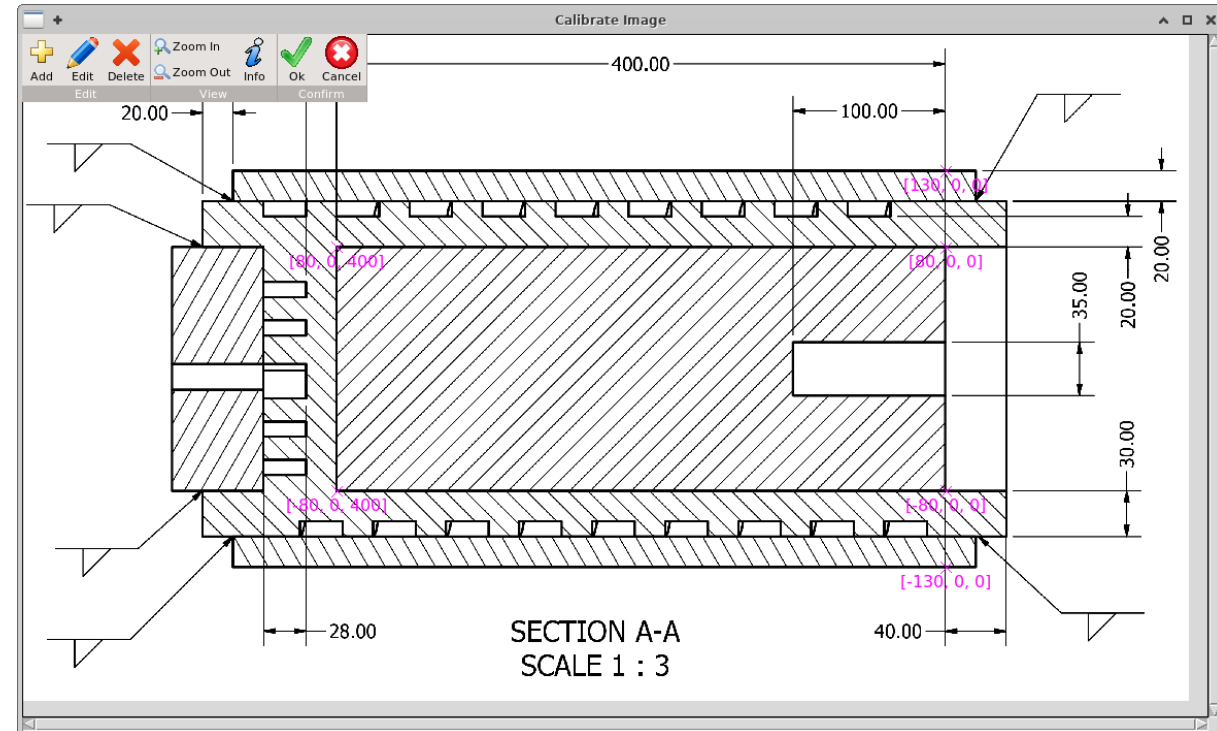
1. Download the [MainDump.flair](#) project as well the auxiliary file [Main_Dump.png](#) (and optionally the pdf document)
2. Inspect the input, it describes the CERN LINAC4 main dump.
 - In the [project notes](#) you have the beam description
 - The dump is made from a graphite core inside an iron jacket with a spiral water coil
 - There are a few predefined USRBIN detectors:
 - 21 energy deposition coarse and fine mesh
 - 22 dose equivalent everywhere
3. Create two `#define` variables in the input to hold the x&y beam rms (e.g. `x_rms` and `y_rms`)
 - modify the `BEAM` card to `Gaussian` with a `FWHM` as a function of the x&y beam rms variables
4. In the `Run`→`Run` tab create two runs
 - i. `ThickBeam/MainDump` and set the x&y rms to correspond to the small beam size 3 x 6 mm RMS
 - ii. `ThinBeam/MainDump` and set the x&y rms to the big beam size 6 x 8 mm RMS
5. Override the number of primaries to 100'000
6. Spawn both runs to 4 cpus for 5 cycles
7. Perform the runs



Flair intermediate hands on– Image calibration

While the run is going on profit to create a new layer with the technical drawing

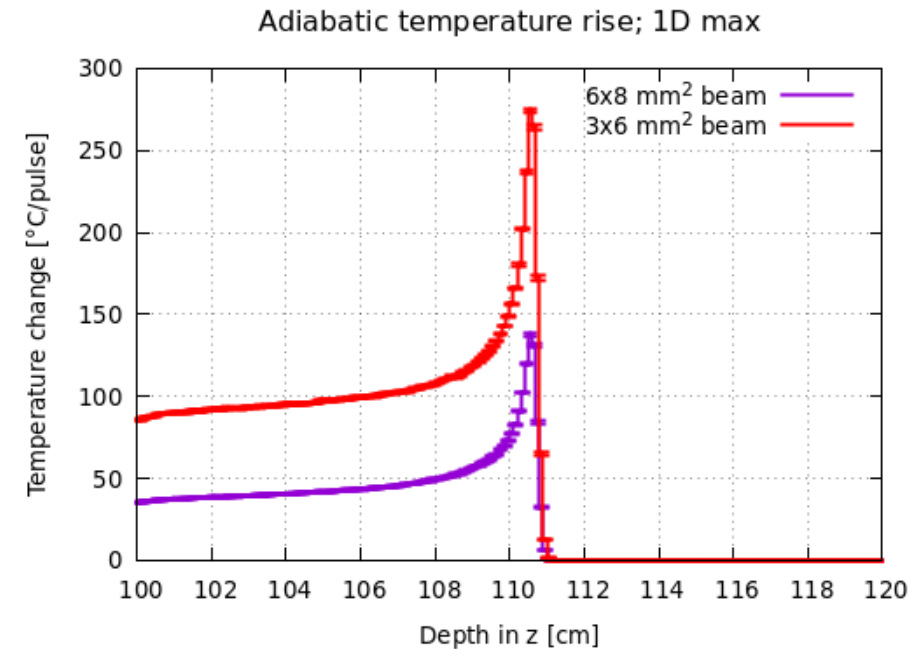
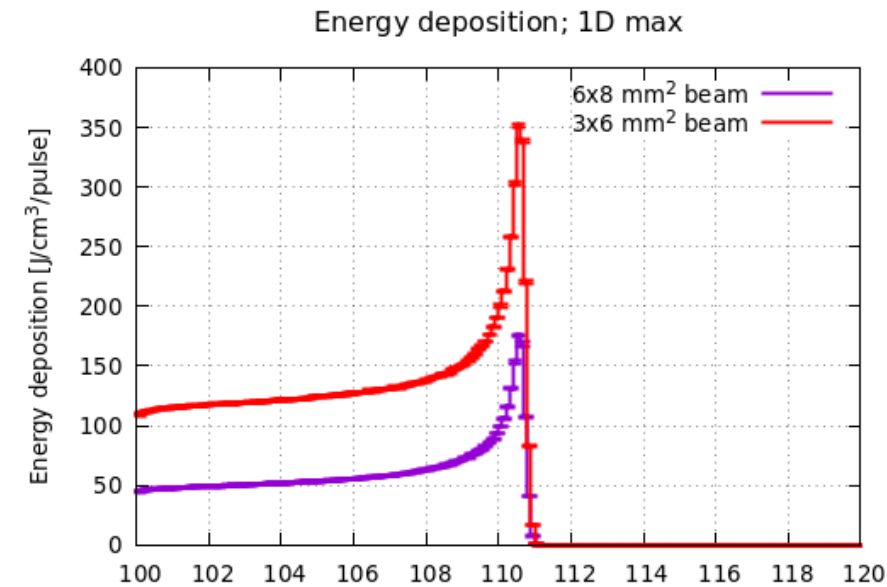
1. Go to the **Geometry** editor
2. Select the **layers** tab
3. Add a new layer name it as “**Image**”
4. Insert the “**Image**” option in the new layer
5. Load the “**Main_Dump.png**” file
6. Calibrate the image with the coordinates of at least 4 points (objects: points may be of help)
7. Adjust the **transparency** and the **background** color
8. Tick the “**prompt draw**”
9. Go in one of the viewports e.g. **Blue** and select the **Image** layer
10. Check if everything looks ok



Flair intermediate hands on– Plots

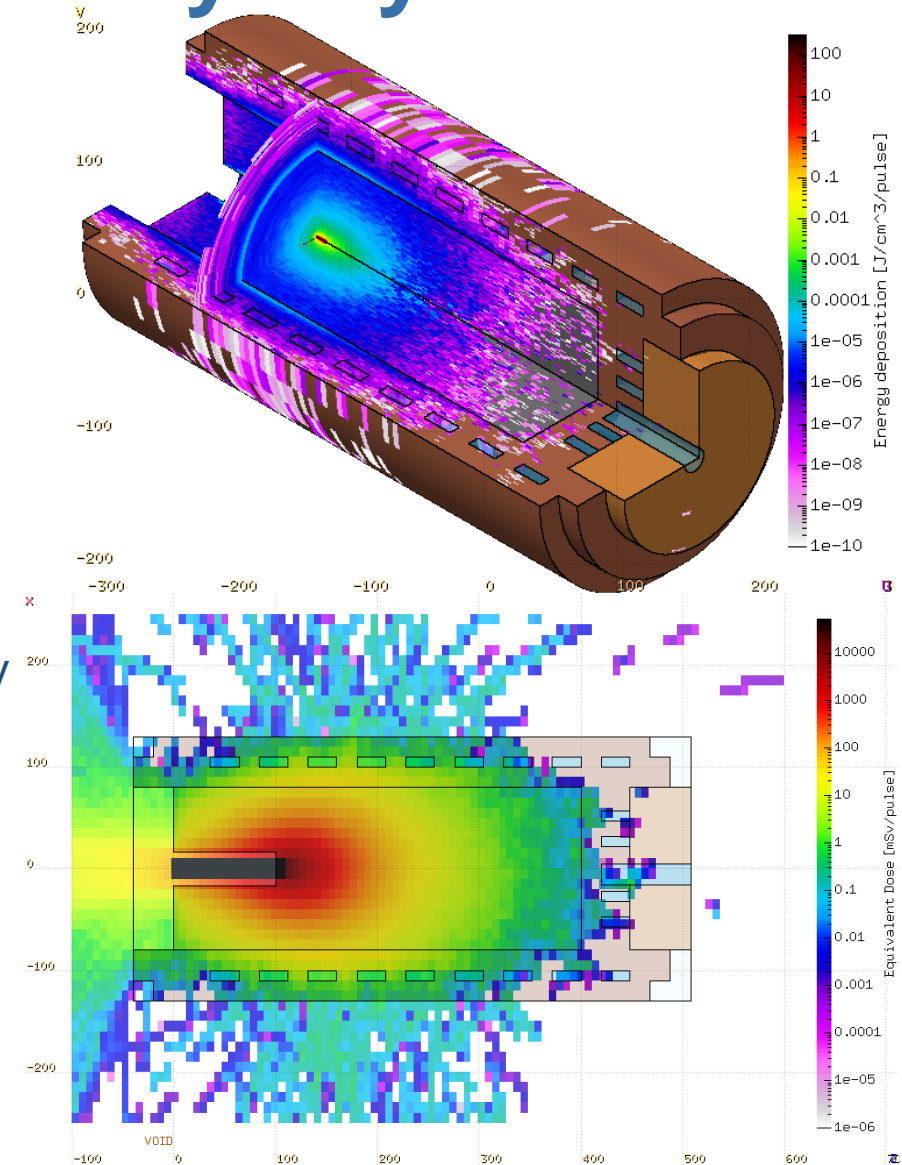
When the runs have finished

- process the detectors in the Run→Data
- In the Plot tab create few plots
 1. **ThinBeam_1Dmax_fine** : USRBIN 1D Maximum trace plot of the energy deposition with the energy fine mesh detector 21 for the thin beam run. Take a look to the gnuplot commands used by clicking the output symbol (black terminal).
 2. **ThickBeam_1Dmax_fine** : same as above for the thick beam run.
 3. **Energy**: Usr-1D plot where you load the **ThinBeam_1Dmax_fin** and **ThickBeam_1Dmax_fine** as detectors. Use the proper normalization to convert the simulated result from $\text{GeV}/\text{cm}^3/\text{p} \rightarrow \text{J}/\text{cm}^3/\text{pulse}$ (the calculator tab may be of help)
 4. **Temperature**: Usr-1D plot with the adiabatic temperature rise in the graphite core for both scenarios. Specific heat of graphite $C_p=699 \text{ J}/\text{kg}/\text{C}$



Flair intermediate hands on – Geometry Layers

- Create two additional layers in the geometry editor
 1. 3D with the usrbins of the energy deposition using both 21(energy) meshes for the thin-scenario (Coarse and Fine)
You need to add the following options:
 - i. 3D – clip by the clipping plane (or RCC) to see inside the target. Try also to project a body (option below clipping)
 - ii. Usrbins with the thin beam 21 energyC
 - iii. Usrbins2 with the thin beam scenario 21 energyF
 - iv. Use the proper normalization to convert from $\text{GeV}/\text{cm}^3/\text{primary}$ $\rightarrow \text{J}/\text{cm}^3/\text{pulse}$
 2. 2D usrbins with the 22 (eq.dose) mesh for the min-scenario
Normalize from pSv/p $\rightarrow \text{mSv}/\text{pulse}$
- Create some nice pictures to be exported from the geometry tab to the project notes.

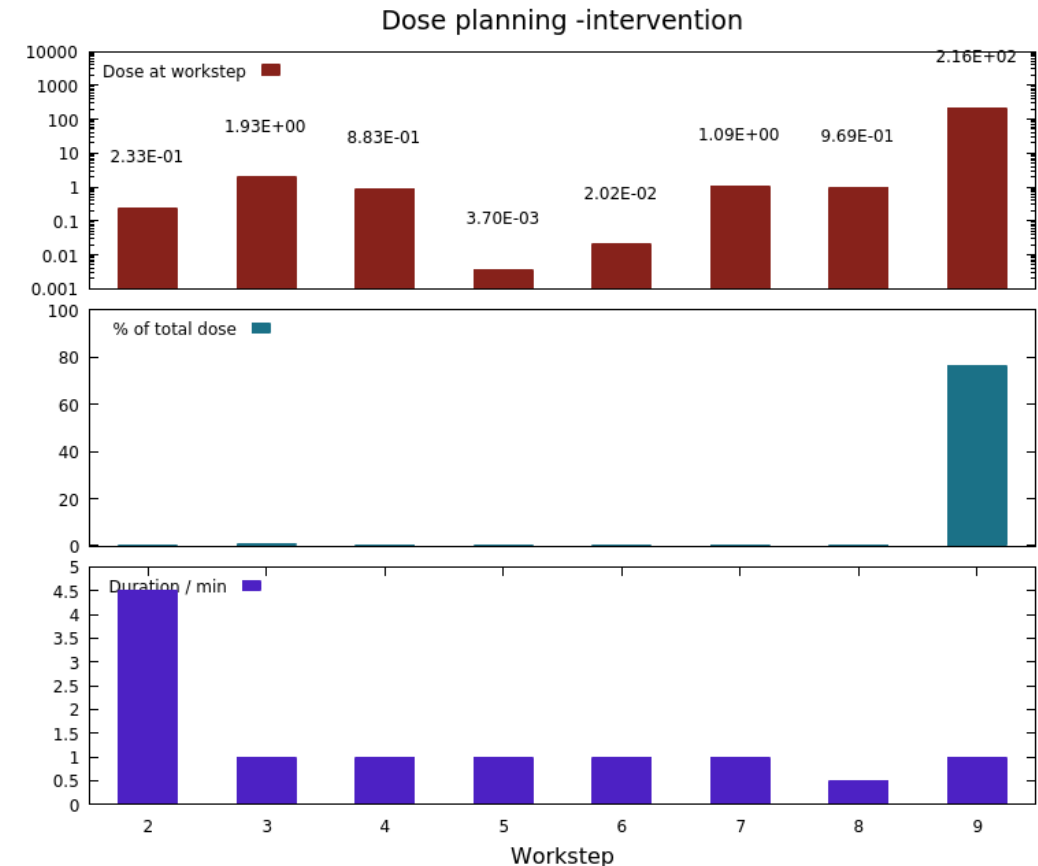




Flair intermediate hands on – Planner (optional)

Using the 2D eq dose layer perform an intervention planning scenario

1. Create a spline path along the Z-X projection around the target
2. Use at least 6 nodes
3. The path can be either closed or open
4. In the Input editor adjust the node time.
Default value is seconds but you can use minutes, if you provide 60 as scaling factor
5. In the geometry editor open the planner tool
 - i. Select the viewport with the 2D usrbn
 - ii. Select the spline path
 - iii. Set time scaling to 60 if you have used minutes in the time nodes
 - iv. Provide a file name e.g. “planner.dat”
6. Calculate
7. In a terminal open gnuplot and type
 - `$ gnuplot`
 - `gnuplot> load “planner.dat”`



Flair intermediate hands on – Movie (optional)

Using the 3D energy deposition layer perform a movie around the target
... follow the lectures backup slides for instructions...

