# Exercise: materials

# Exercise objectives

- Declaring & assigning materials
- Defining compound materials
- Setting simple beam parameters
- Running, plotting and interpreting results

# Making gruyère (as a COMPOUND material in FLUKA)

- Swiss gruyère cheese, 100 g (simplified composition):
  - 34.5 g water
  - 28.5 g proteins: $C_3H_7NO_2$
  - 33.4 g lipids: $CH_3(CH_2)_{14}COOH$
  - 1 g Ca
  - 600 mg P
  - 360 mg Na
  - 74 mg K
  - 40 mg Mg

*What is the most convenient way in which to describe these materials?*

- Density $\rho$ = 915.35 kg/m$^3$
- **Note:** Authentic Swiss gruyère does not have holes; it can therefore be considered a homogeneous medium…☺

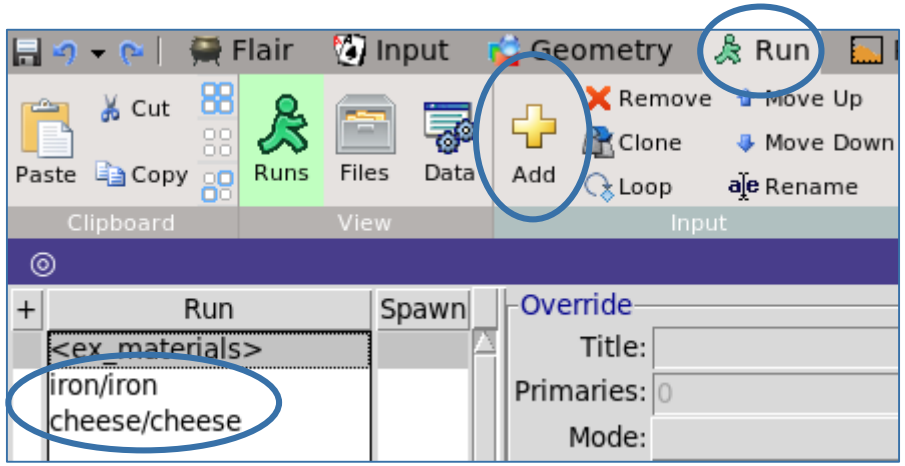
# Geometry, beam parameters and scoring

- Start from the provided input
- Define **GRUYERE** as a compound material
  - **Hint:** first define proteins and lipids as compound materials, then use them to define the gruyère

- A non-divergent 200 MeV proton beam along the z-axis starting from (0,0,-5) is already defined
  - You can confirm this by looking at the **BEAM** and **BEAMPOS** cards
- A scoring card (**USRBIN**) is already included:
  - Proton fluence in an X-Y-Z 3D-mesh encompassing the target

# Run

- Assign the new material **GRUYERE** to region **TARGET**
- Add a new run (“cheese”) and run 5 cycles with $10^4$ primaries each
  - **Note:** check to see that the number of primaries per cycle is set in the **START** card

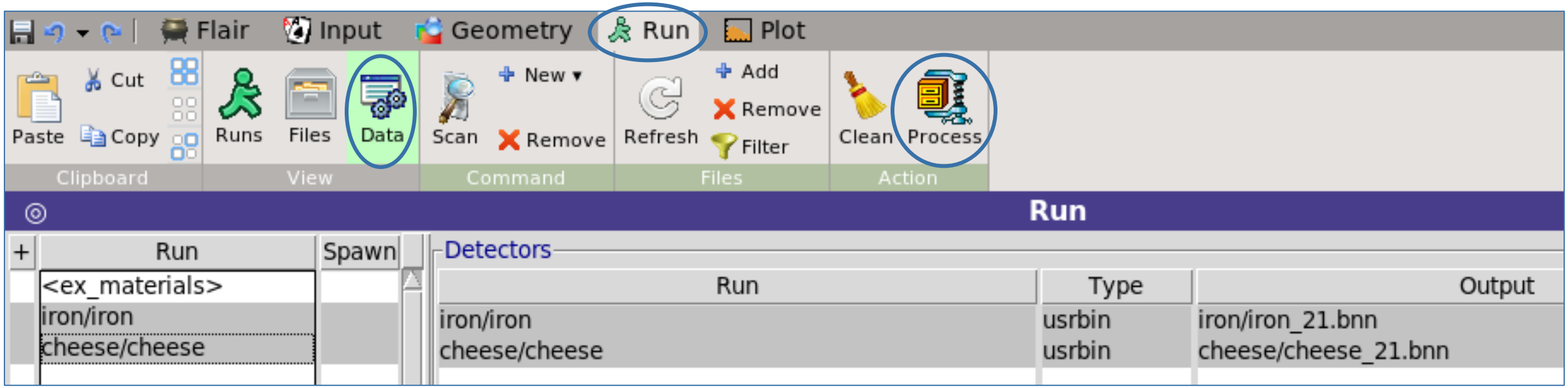



- Then, assign material **IRON** to region **TARGET**, add a new run (“iron”) and run again

- Did you notice a difference in the CPU time per primary for the two cases?

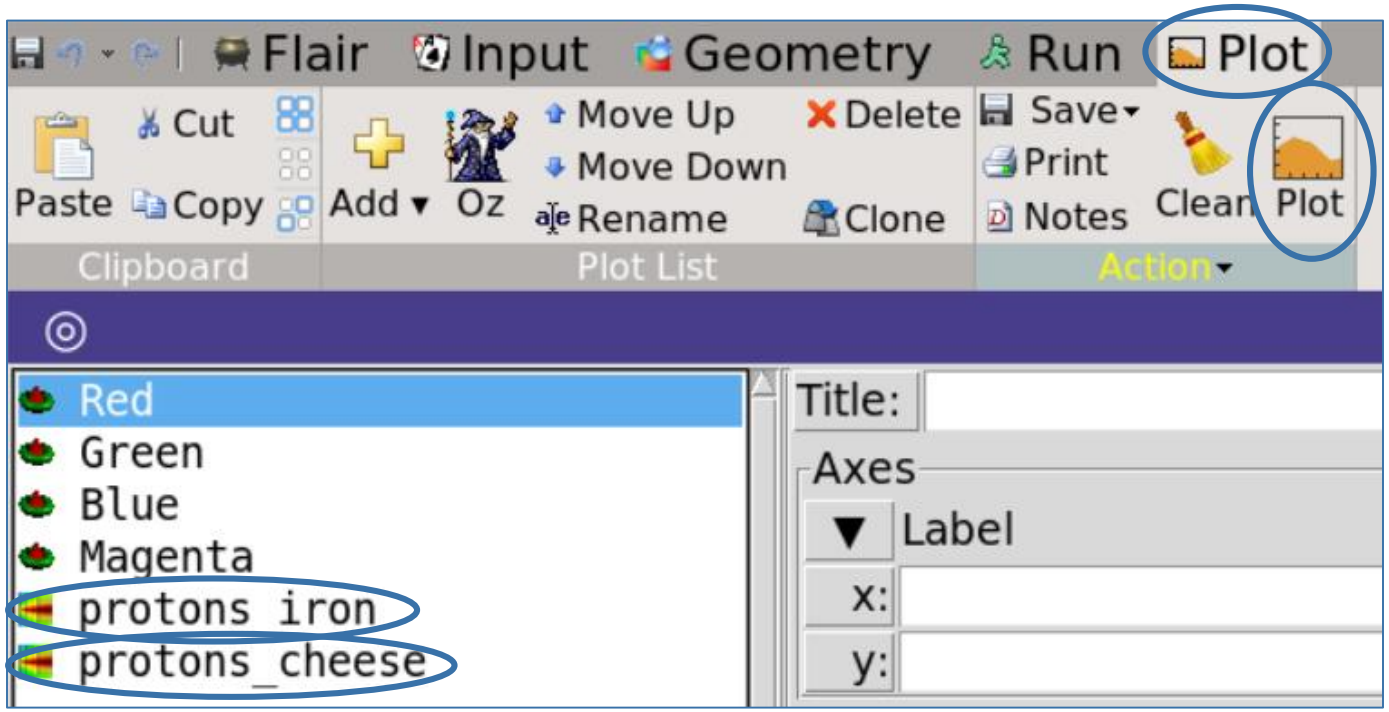
# Process the results

- After running, process the results (in the Run tab, go to Data, select both runs and click Process)



# Plot the results

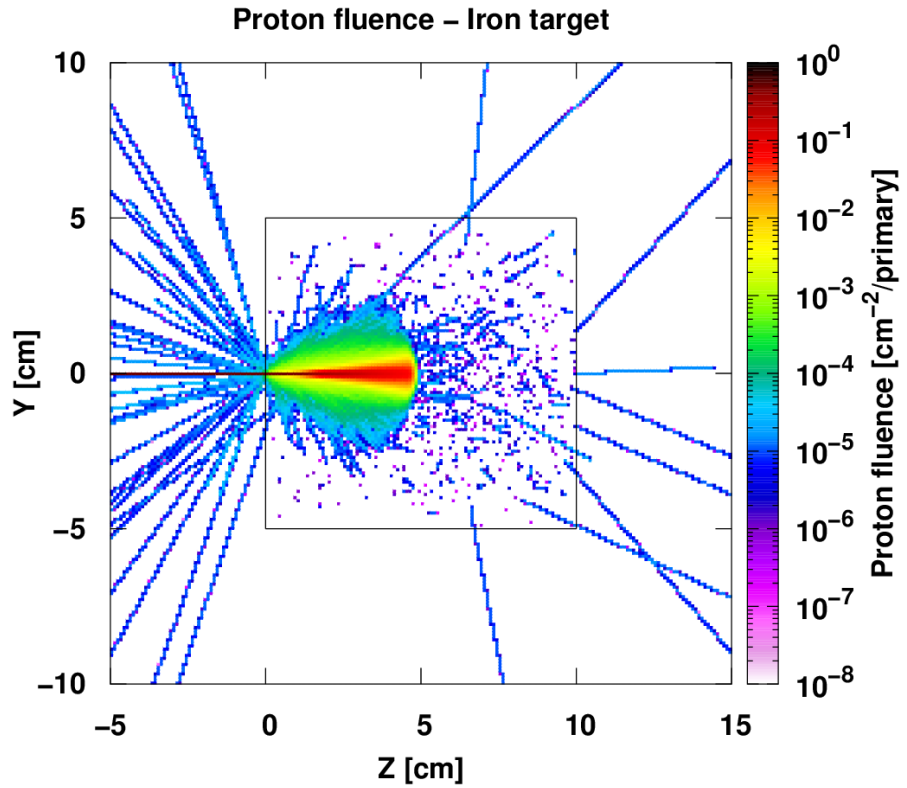
- After processing the results, go to the Plot tab and plot each result in turn by selecting the corresponding scoring (shown in the lower left) and clicking Plot

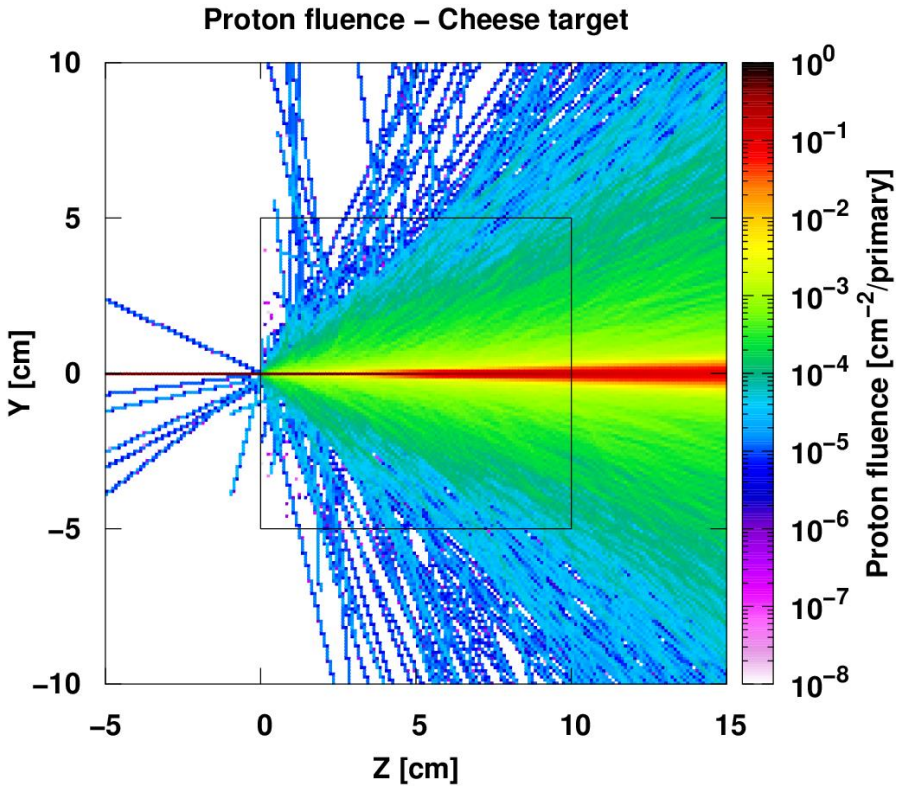



- **Note:** if you did not name the runs “iron” and “cheese”, then you will need to change the Binning Detector file in order to produce the plots

# Interpreting the results and getting additional information

- Observe the plotted results for the two cases. Which material would be a better beam dump? Can you explain the difference in CPU time between the two cases?



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