Simulation of NIT activation

FLUKA simulation performed on request of the Radioprotection Service of CNAO

(they use the same MC as standard reference)

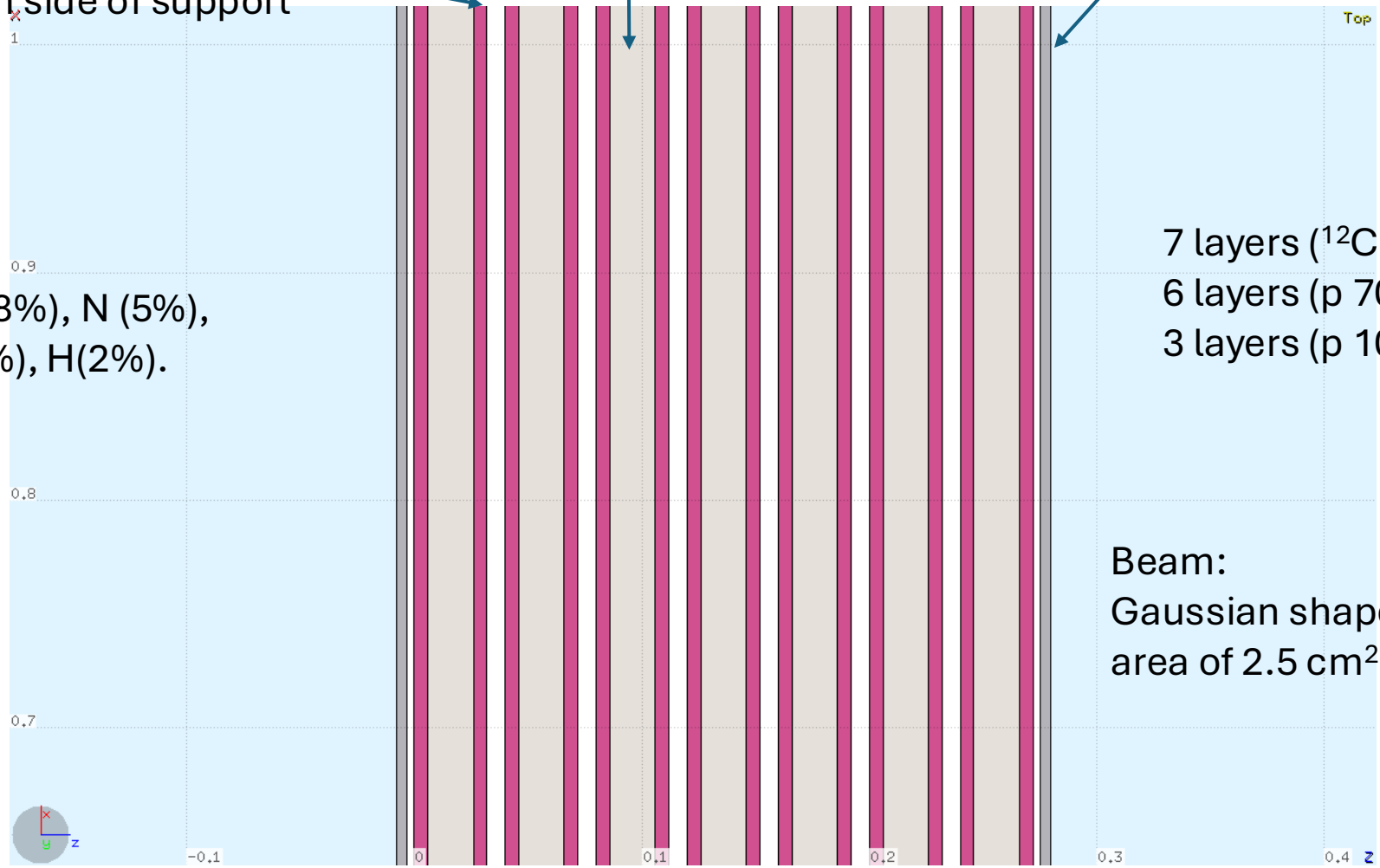
First preliminary results

Geometries

Polystyrene support (200 micron)

Emulsion Gel (50 micron)
On both side of support

Aluminum envelope



Emulsion Gel:
Ag (39%), Br (28%), N (5%),
C (13%), O(12%), H(2%).

Polystyrene:
C_8H_8

7 layers (^{12}C @ 200 and 400 MeV/u)
6 layers (p 70 and 200 MeV)
3 layers (p 10 and 30 MeV)

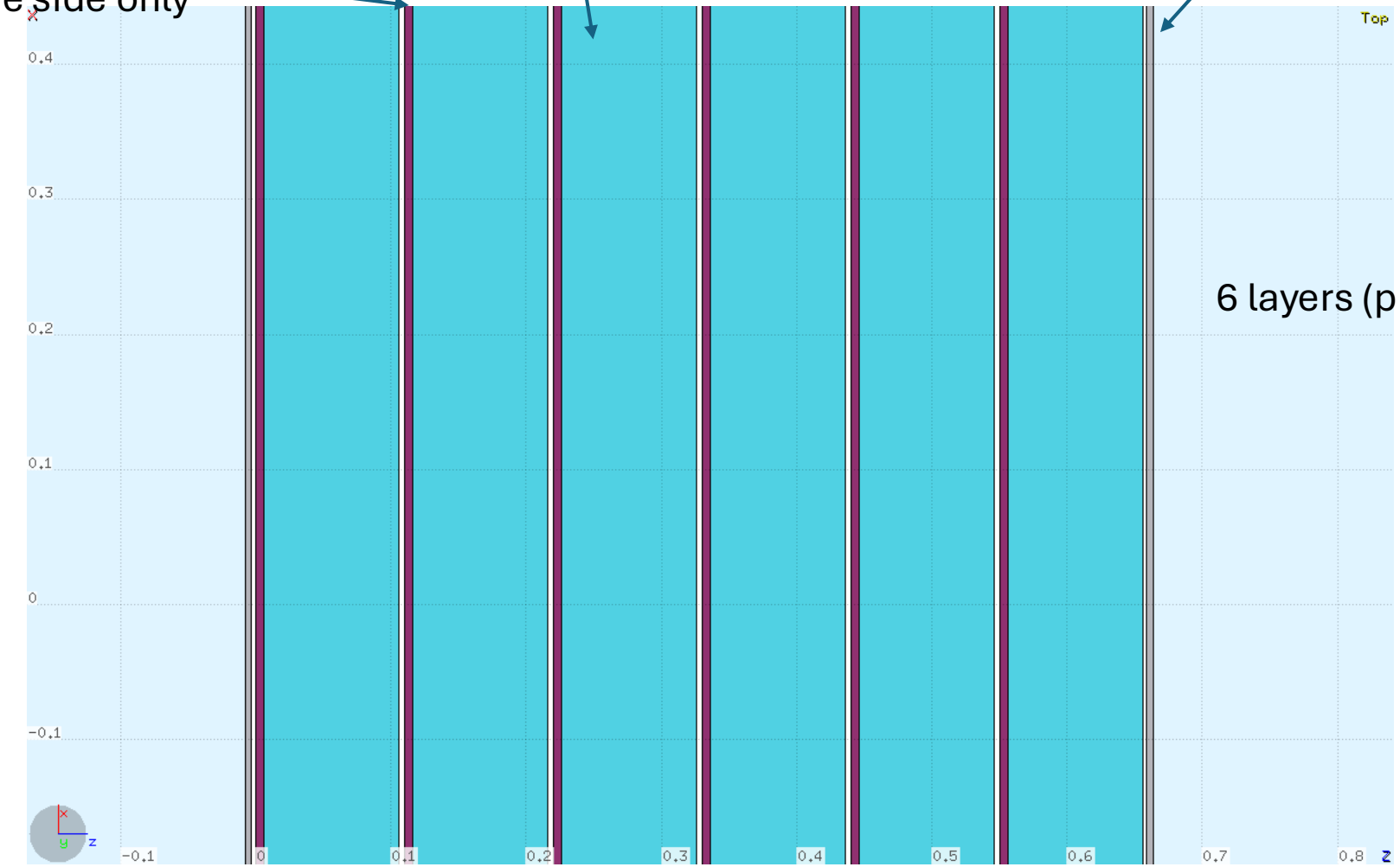
Beam:
Gaussian shape with FWHM
area of 2.5 cm^2

Geometries

Emulsion Gel
On one side only

Glass support (1 mm)

Aluminum envelope

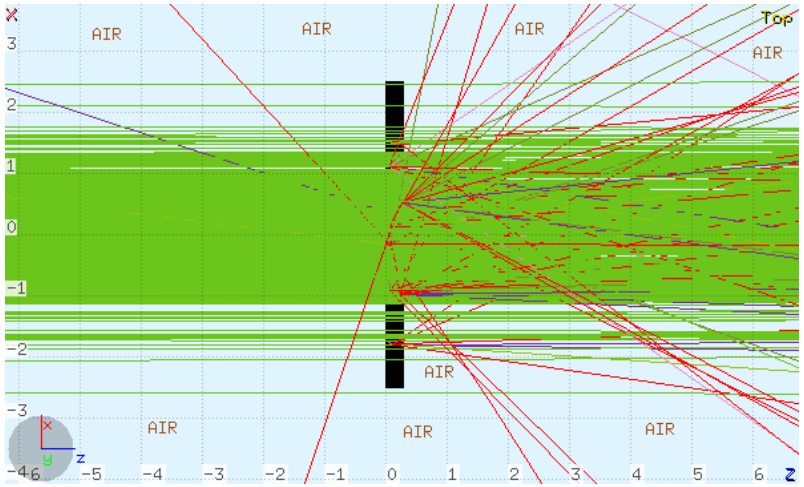


6 layers (p 70 and 200 MeV)

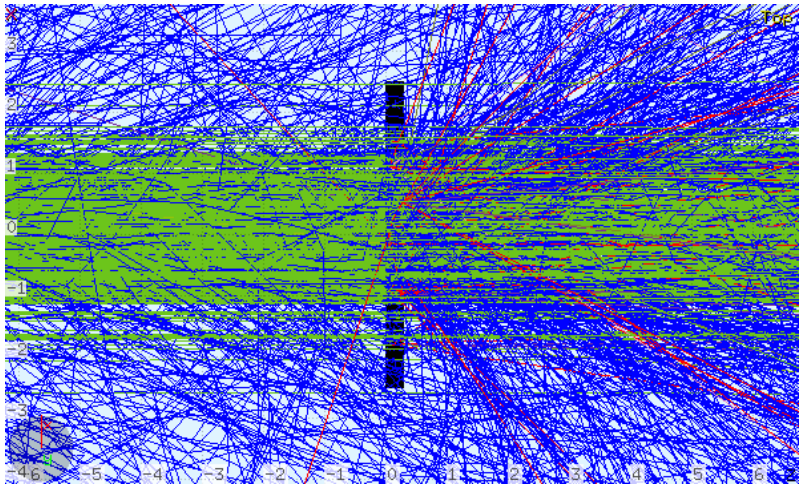
Glass:

SiO_2 71 %
K_2O 15.4 %
CaO 9 %
MgO 3 %
Al_2O_3 1.5 %
Fe_2O_3 0.1 %

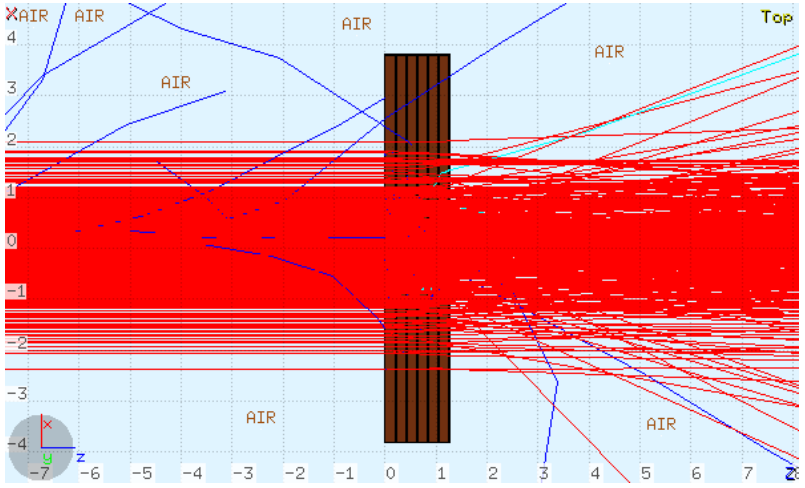
^{12}C 200 MeV/u (no electrons shown)



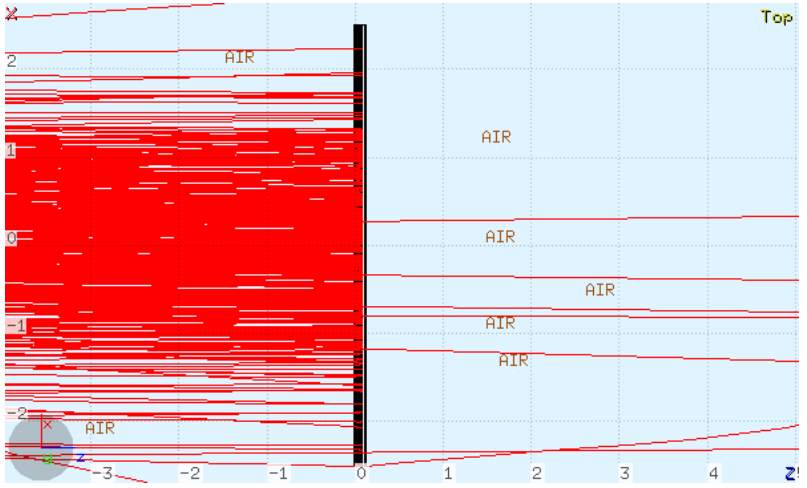
^{12}C 200 MeV/u (with electrons)



p 70 MeV, Glass support

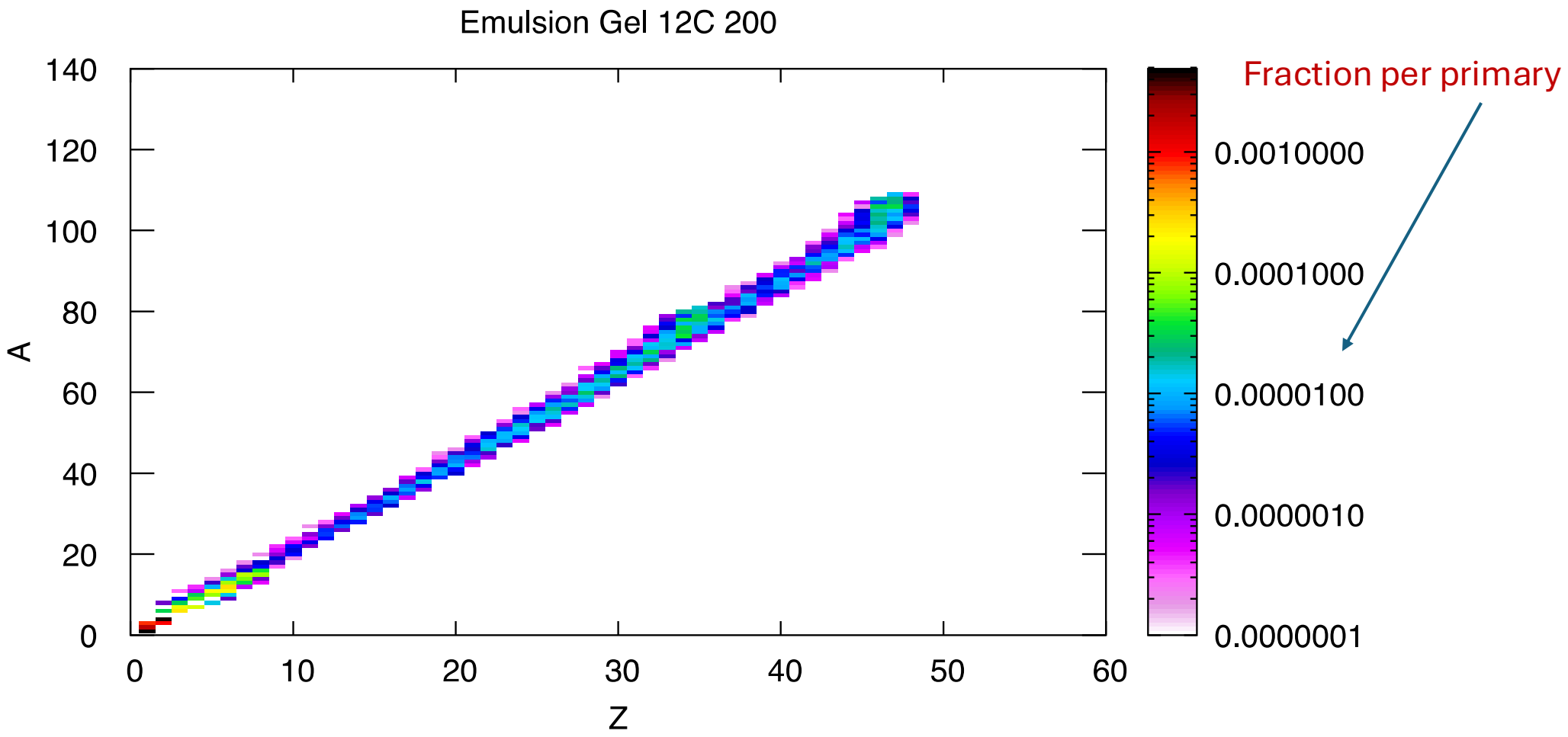


p 10 MeV, Polystyrene support



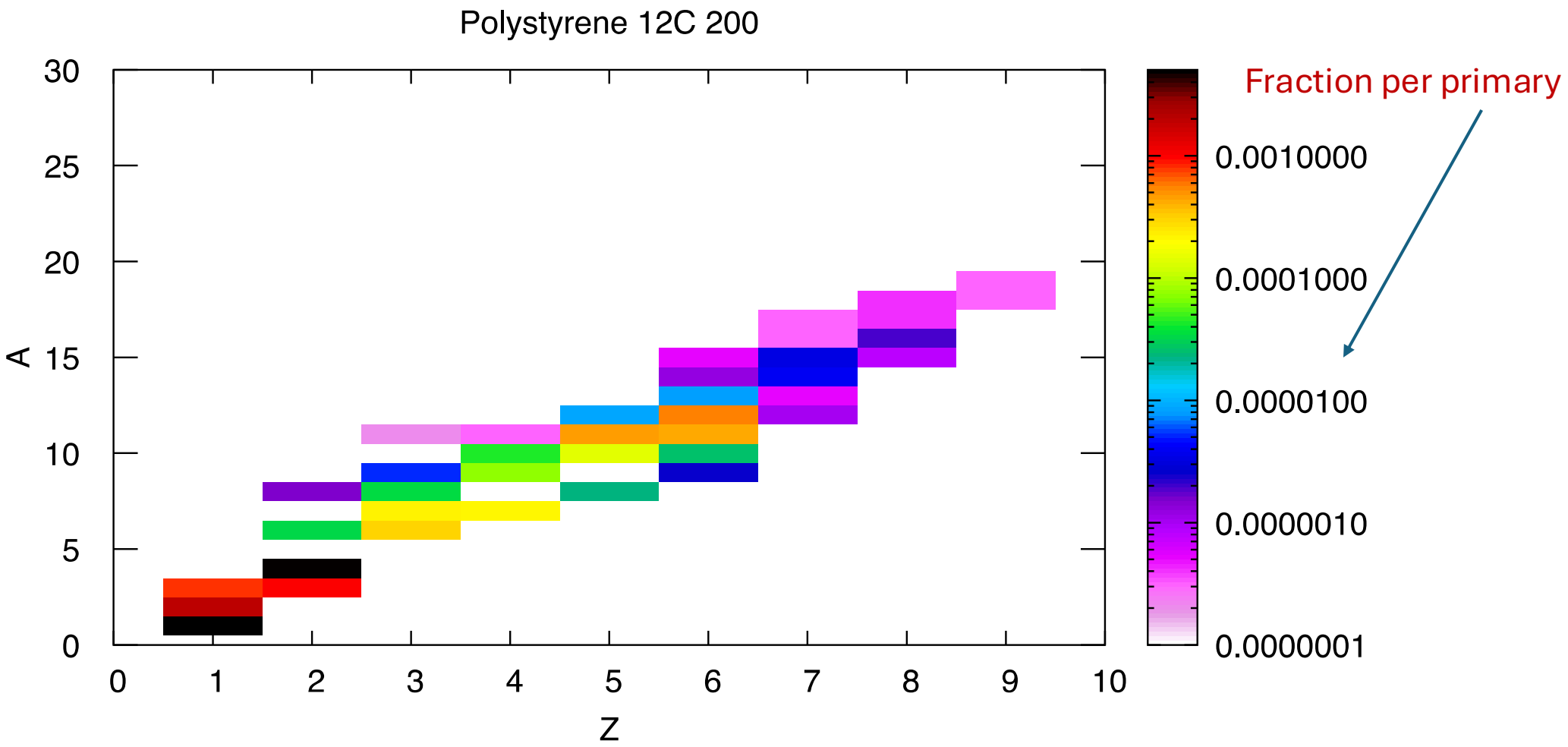
Examples of results

A vs Z of Residual Nuclei in **Emulsion Gel** for the case of **^{12}C at 200 MeV/u**



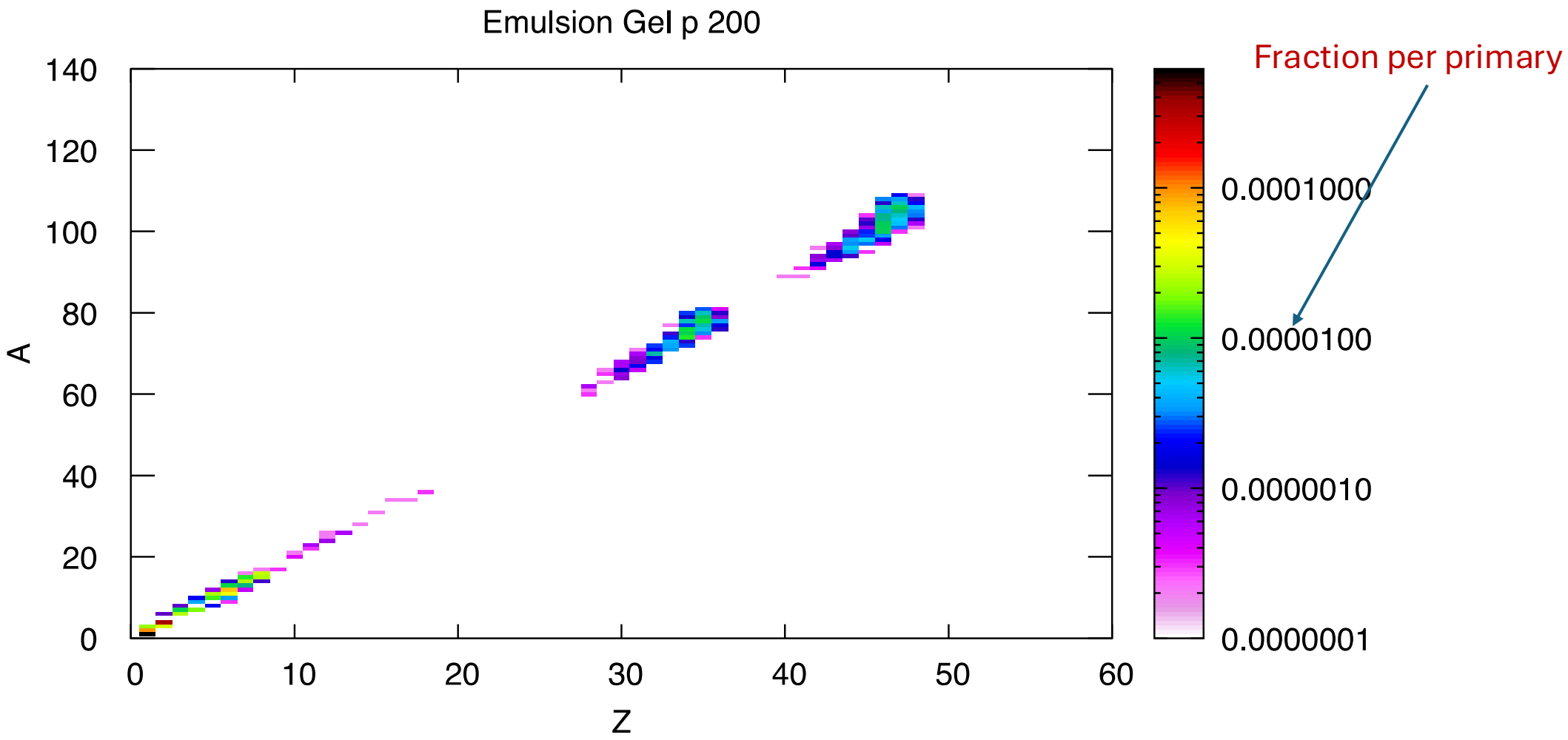
Examples of results

A vs Z of Residual Nuclei in **Polystyrene** for the case of **^{12}C at 200 MeV/u**



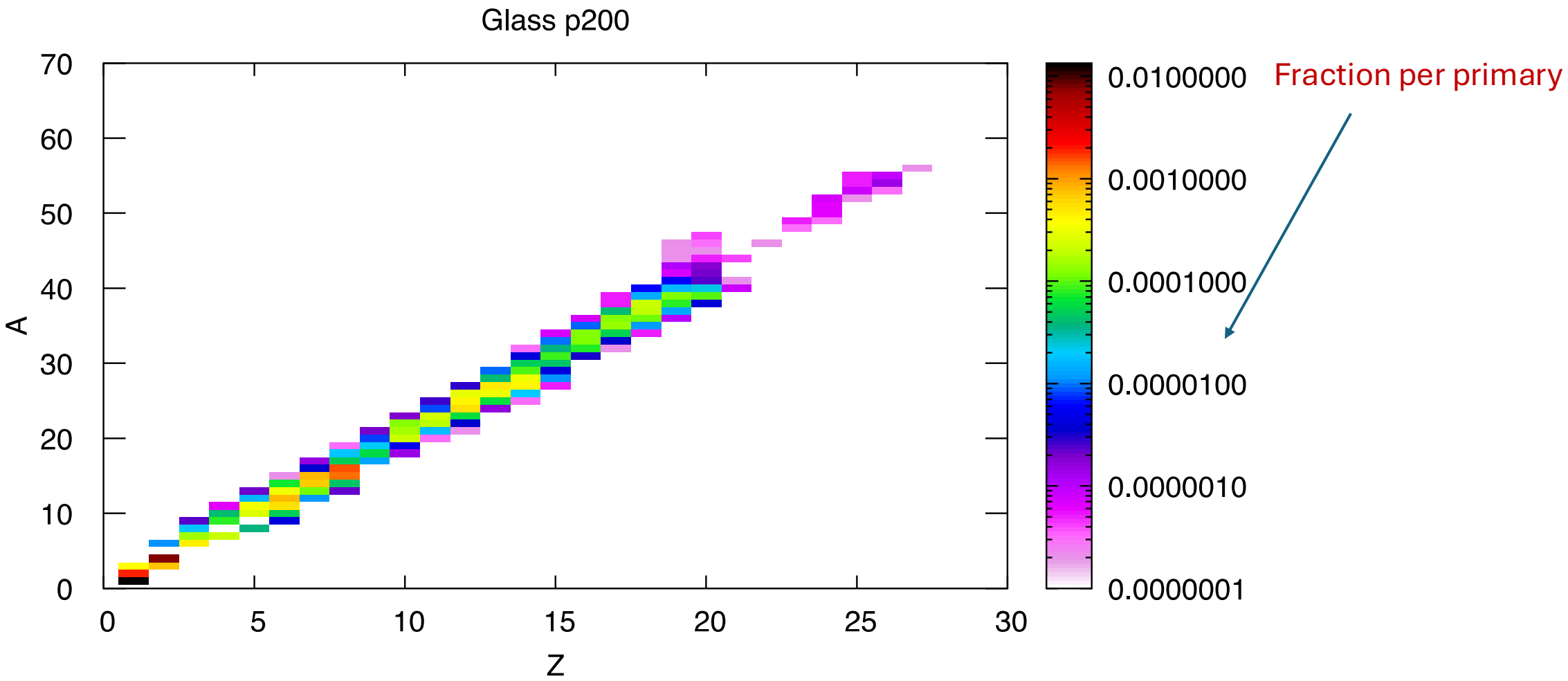
Examples of results

A vs Z of Residual Nuclei in **Emulsion Gel** for the case of **p at 200 MeV**



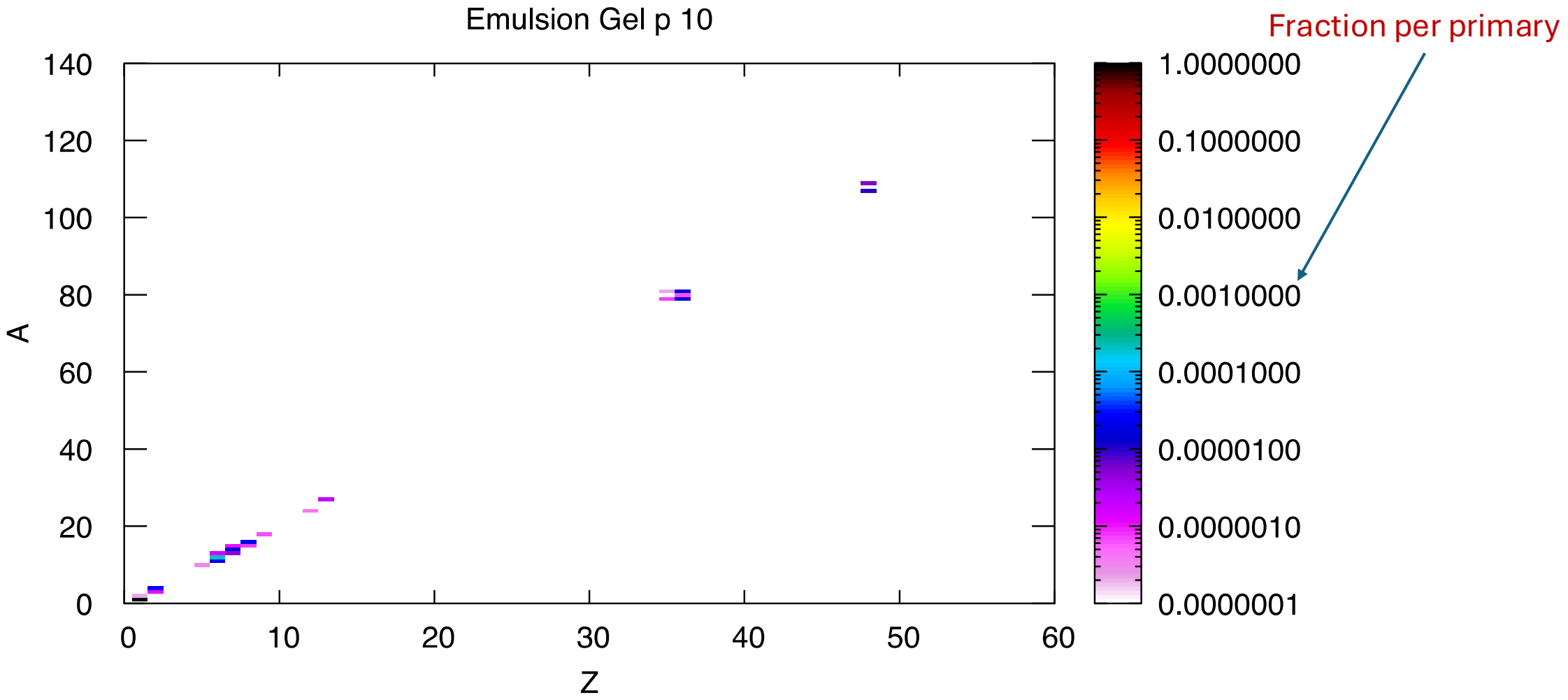
Examples of results

A vs Z of Residual Nuclei in **Glass** for the case of **p at 200 MeV**



Examples of results

A vs Z of Residual Nuclei in **Emulsion Gel** for the case of **p at 10 MeV**



Comment:

From the point of view of Radioprotection rules, the high Z radionuclides are those which are considered problematic

Apparently, we predict a production of high-Z isotopes with an abundance, at maximum, of a few 10^{-5} per primary, and the plan is to integrate 2 – 3 millions of primary for each NIT pack

Maybe those radionuclides could be also hard to be detected with the spectrometer they have in CNAO

However,…

…first response from Radioprotection Service

12 Nov 16:33:

“The center prescriptions do not allow the removal from CNAO of radionuclides with Z higher than that of Gallium (Z=31).

Unfortunately, already for protons at 10 MeV and carbon at 200 MeV/u there is the generation of radionuclides in the gel which we are not authorized to move away from the center.”

Waiting for the final word from the Radioprotection Responsible