Status of the RESPA project

***RE**sidue production in **SPA**llation reactions*

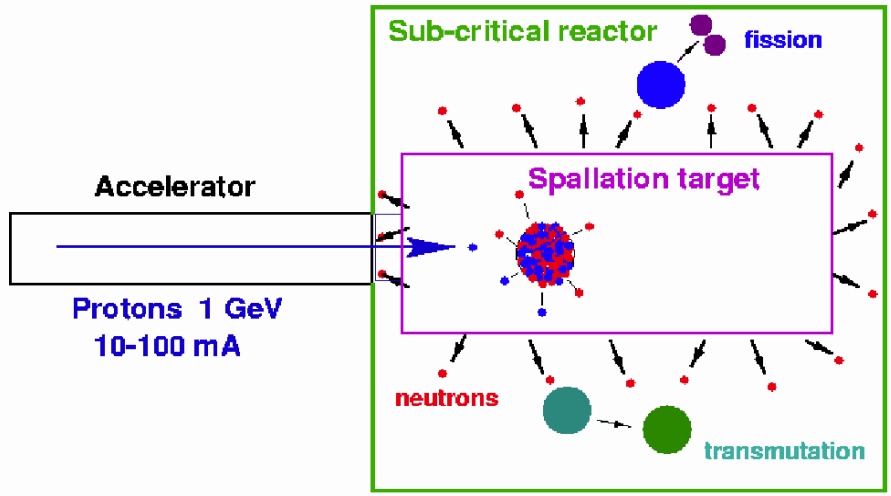
relevant for the incineration of nuclear waste

Spallation studies

- Astrophysics, origin of cosmic rays
- Production of radioactive nuclei
- Intense neutrons sources

  Material physics and biology

  Accelerator Driven Systems



HINDAS

1 A GeV

^{56}Fe, ^{208}Pb, ^{238}U + p, d

C. Canton, T. Enqvist, M. V. Ricciardi,
J. Taieb, M. Bernas, E. Casajeros, J. Pereira

at lower energies

^{56}Fe + p 300, 500, 750, 1500 A MeV

^{208}Pb + p 500 A MeV

C. Canton, L. Audouin, B. Fernandez

Energy dependence of the spallation process

- **Energy loss of the proton beam in the spallation source**
- **Secondary reactions**
- **Projects to demonstrate the components of an ADS**

MUSE → MEGAPIE → MYRRHA → XT-ADS European ADS Demo

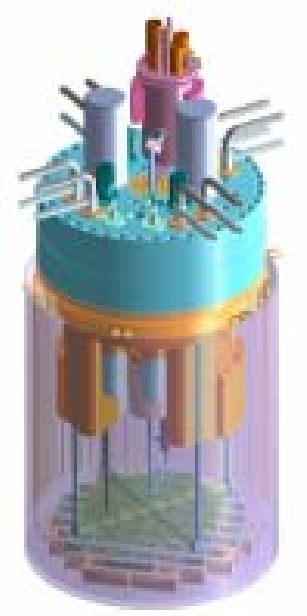
- **MUSE:** Zero power sub-critical core coupled with a D accelerator.
  Objectives: Reactor Physics understanding **(2003)**

- **MEGAPIE:** 1 MW Liq. Pb-Bi target to be installed in PSI, 590 MeV proton.
  Objectives: master the Pb-Bi technology for spallation source **(2006)**

- **MYRRHA:** A multipurpose ADS, 350 MeV proton, Pb-Bi spallation target and subcritical core.
  Objectives: concept design (2004), detailed design (2008), ready **(2014-2016)**

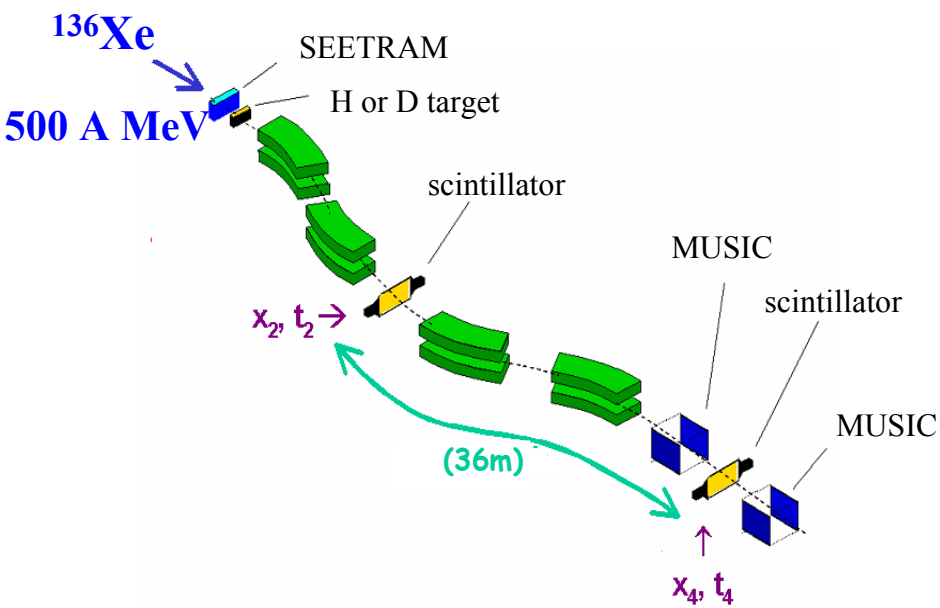
- **European Transmuter demonstrator XADS:**
  30 to 80 MW proton beam, sub-critical core of several 100 MW.
  Objectives: waste transmutation demonstration at semi industrial level **(2020 ?)**

Energy dependence of the spallation process



^{136}Xe+p	at 1 A GeV	Paolo's Thesis
^{136}Xe+p,d	at 500 A MeV	Lydie, in progress
^{136}Xe+p	at 200 A MeV	Orsay, in progress

Experimental setup @ FRS



mass identification:

$$\frac{A}{Z} = \frac{e}{u}\frac{B\rho}{\beta\gamma c}$$

positions in scintillators

dE ionisation chamber

ToF

$\beta\cdot\gamma/\Delta\beta\cdot\gamma \approx 400$

$A/\Delta A \approx 400$

$Z/\Delta Z \approx 200$

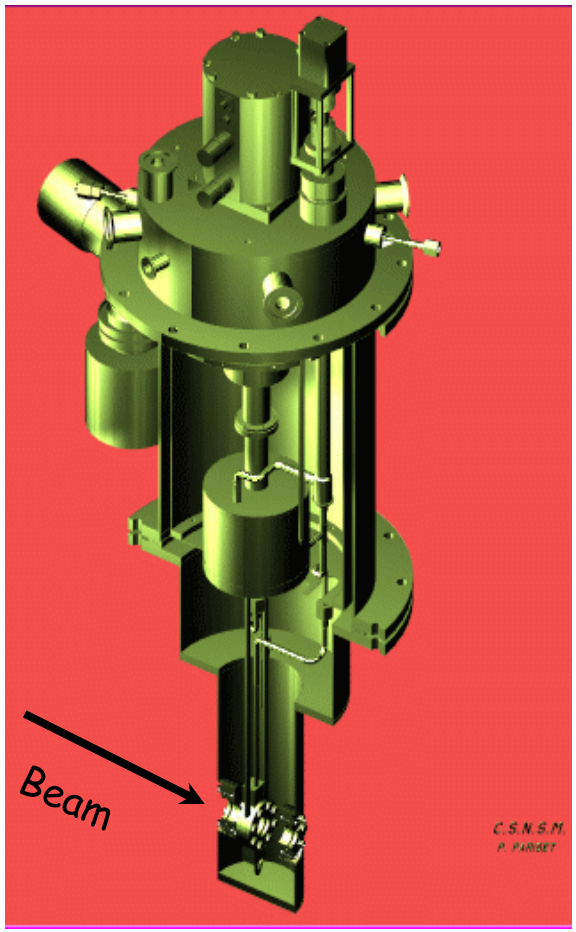
When the charge and the mass are identified (A, Z integers)

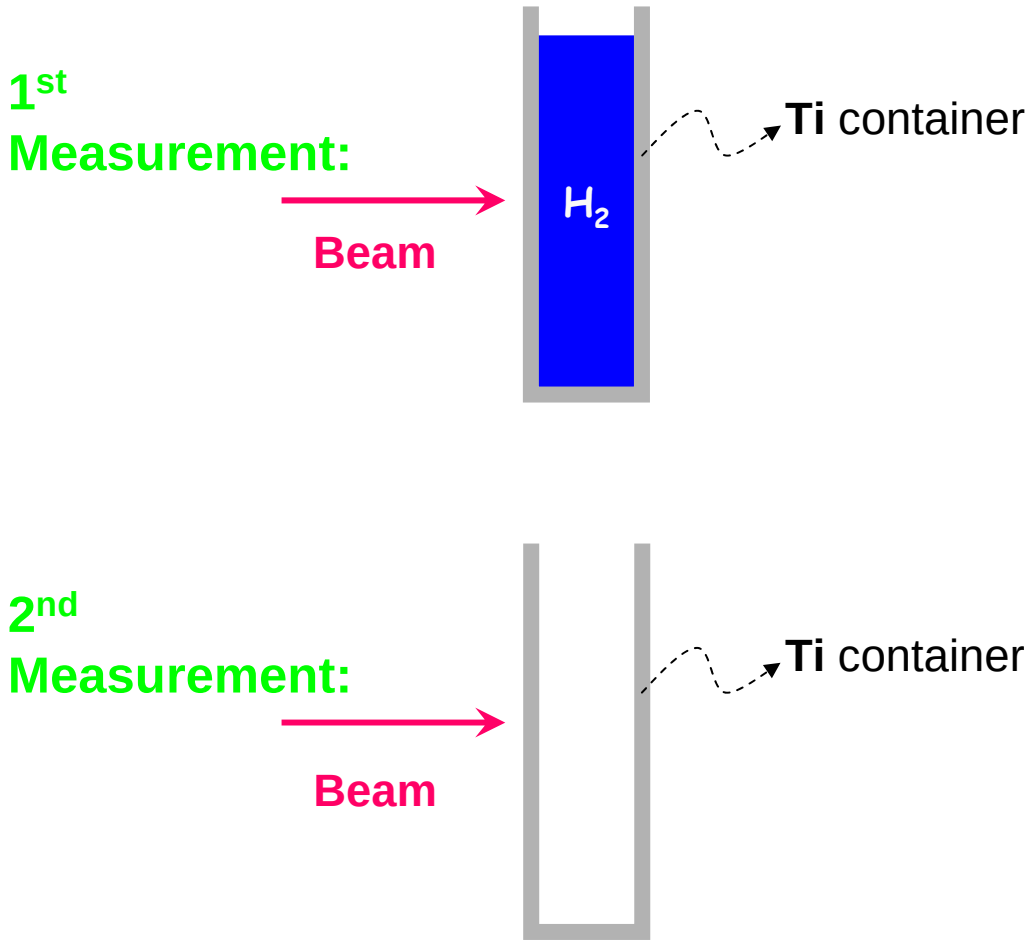
the velocity is calculated from $B\rho$ => precised determination !

$$\beta\gamma = \frac{e}{c \cdot u} \cdot \frac{A}{Z} \cdot B\rho$$

$\beta\cdot\gamma/\Delta\beta\cdot\gamma = B\rho/\Delta B\rho \approx 2000$

Liquid ^1H and ^2H targets





CEA/DSM/DAPNIA/STCM

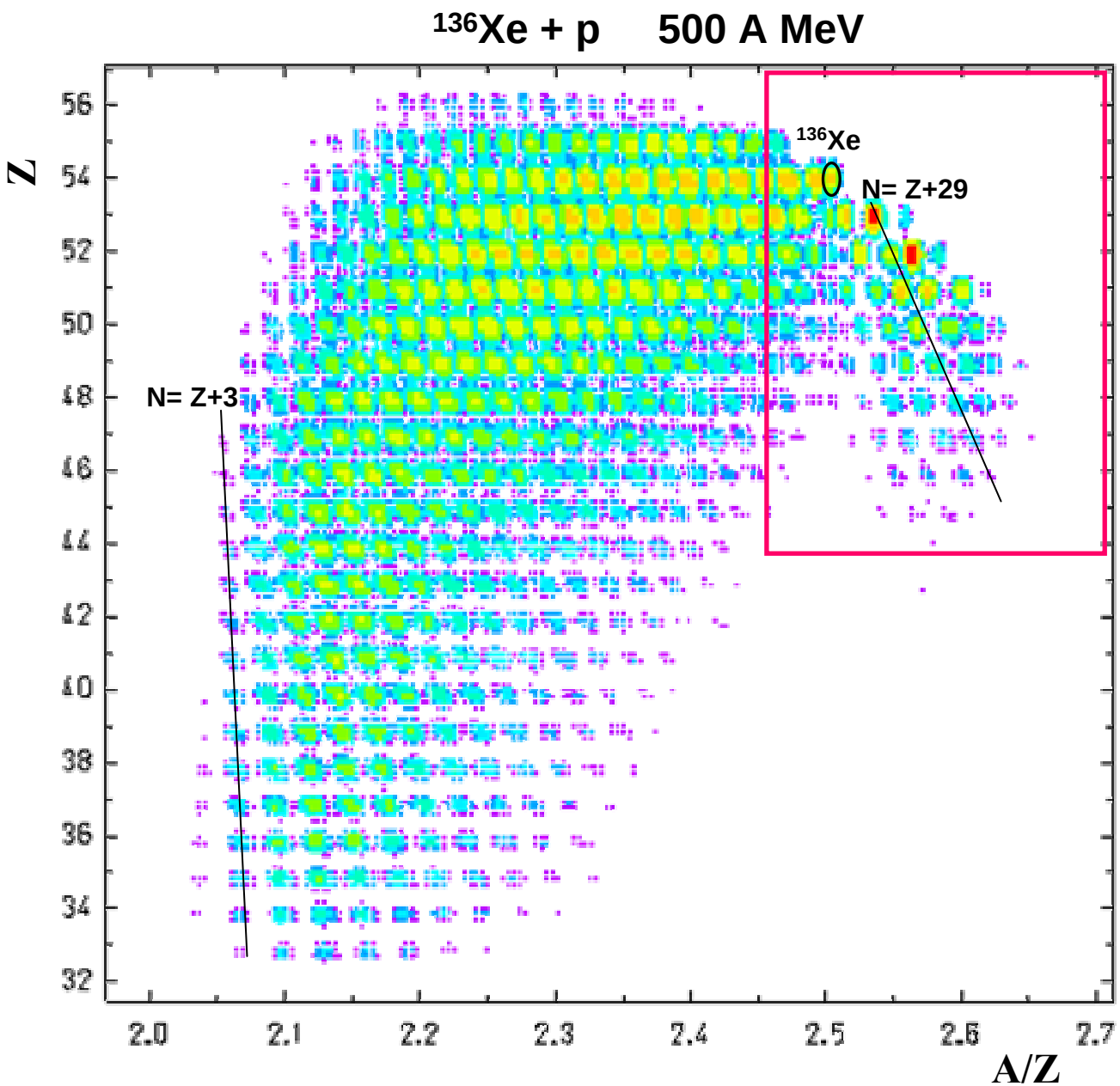
Ph. Chesny et al., GSI scientific report 1996

Analysis Status

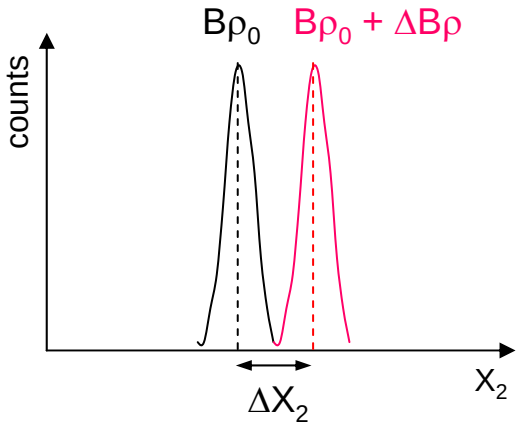
136Xe + p 500 A MeV	Velocity distributions in progress
136Xe + dummy 500 A MeV	Fragments identification done

136Xe + d 500 A MeV	Fragments identification in progress
136Xe + dummy 500 A MeV Second measurement	Fragments identification in progress

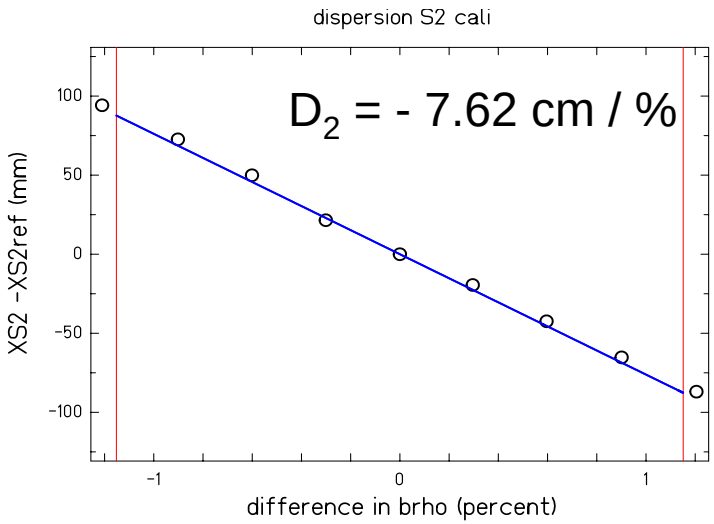
Identification pattern

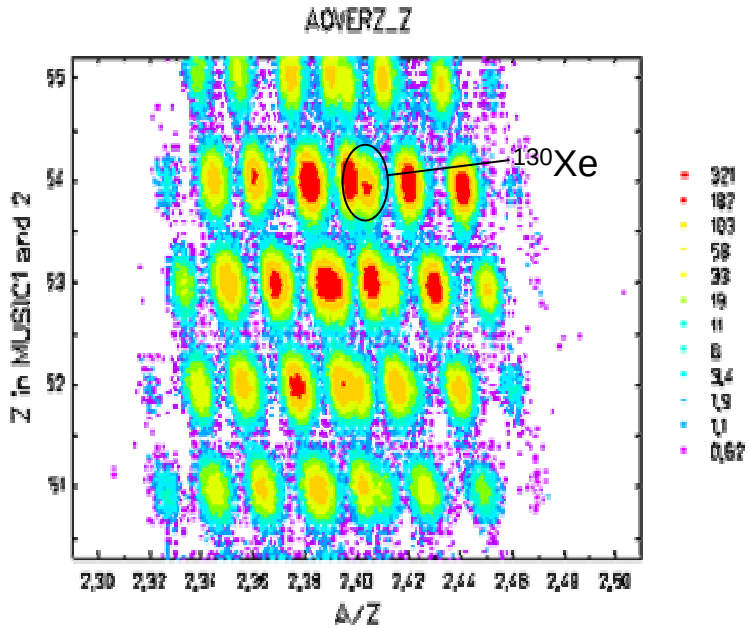


Dispersion at S2 method 1

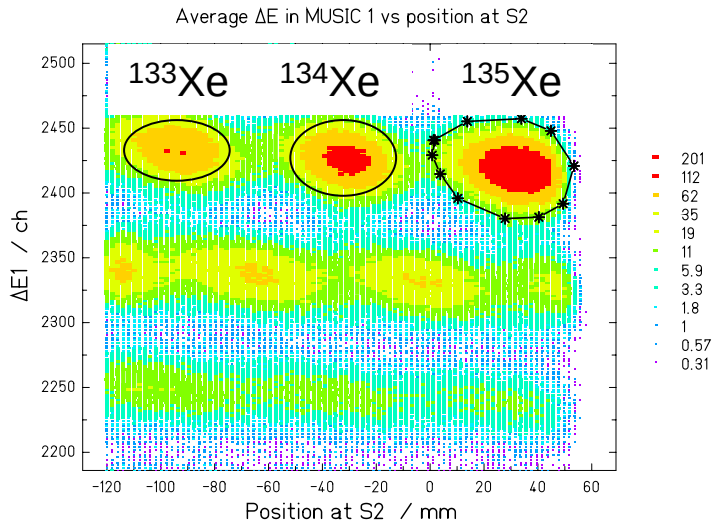


$$\Delta X_2 = D_2 \frac{\Delta B\rho}{B\rho_0}$$





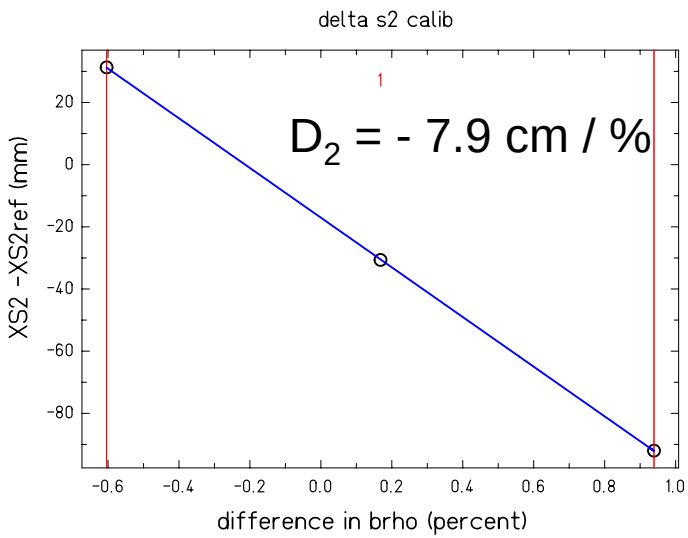
Dispersion at S2 method 2

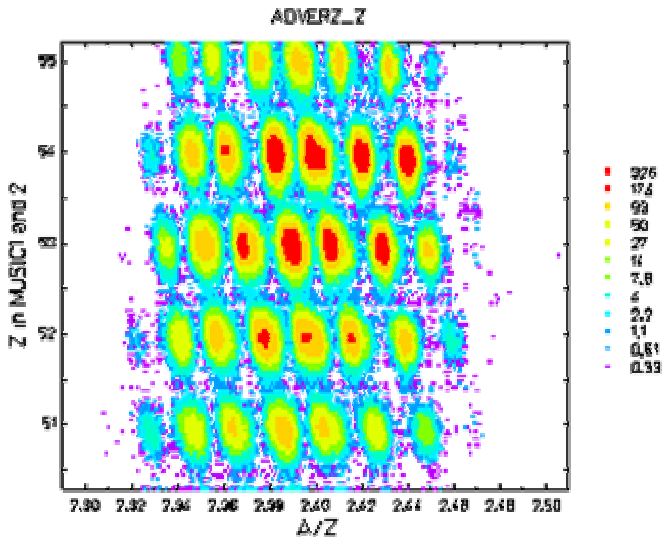


For $B\rho_0$ $X_2 = 0$

For each nuclei, X_2 is known

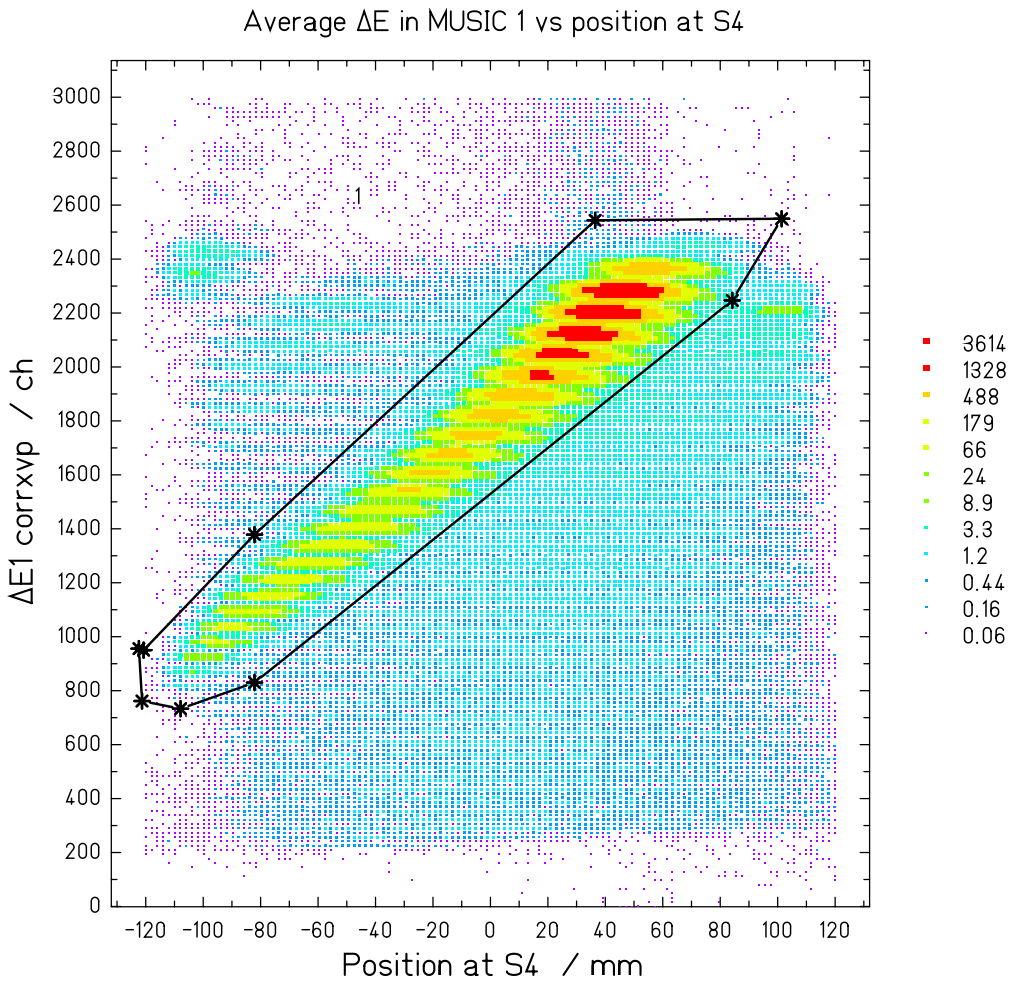
but $B\rho$ needs to be calculated (AMADEUS)





Charge states

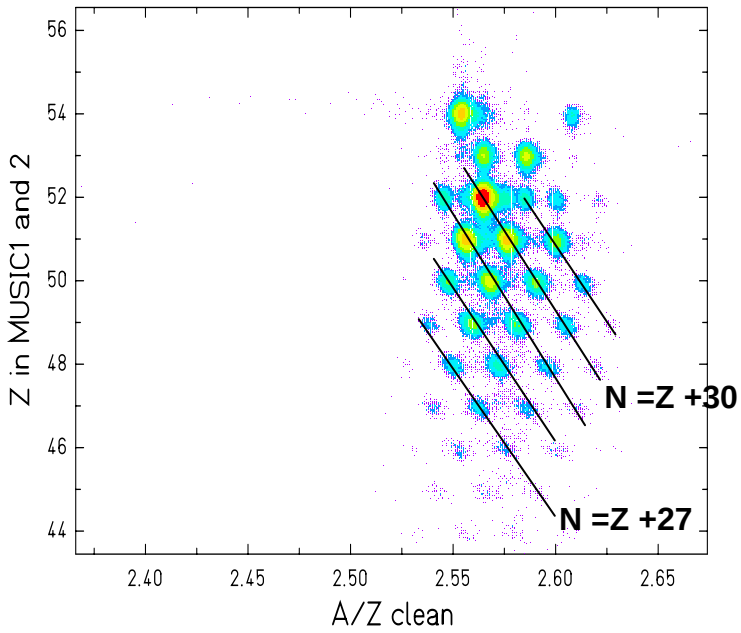
Same problems for all the settings with Bρ > Bρ of the beam ...

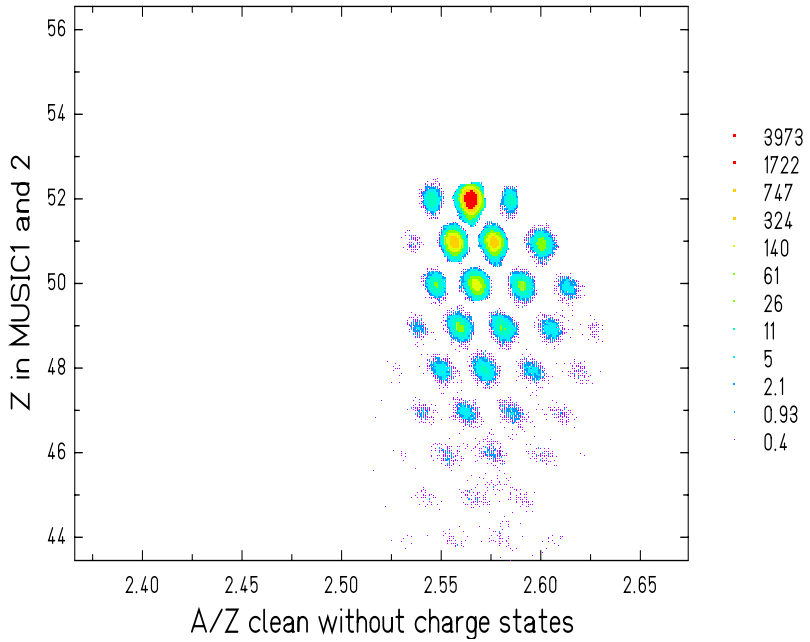


Charge states

Same problems for all the settings with Bρ > Bρ of the beam ...

run 490 $^{124.5}$Cd

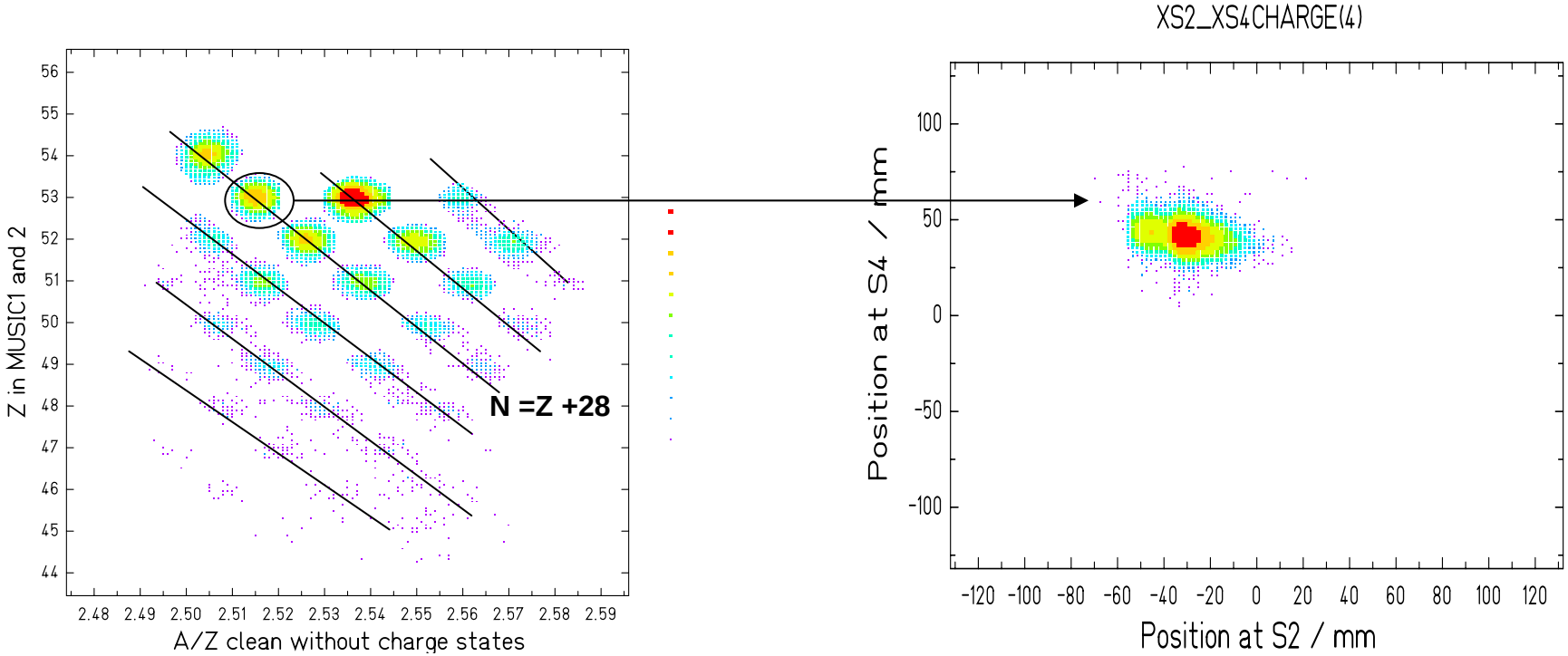




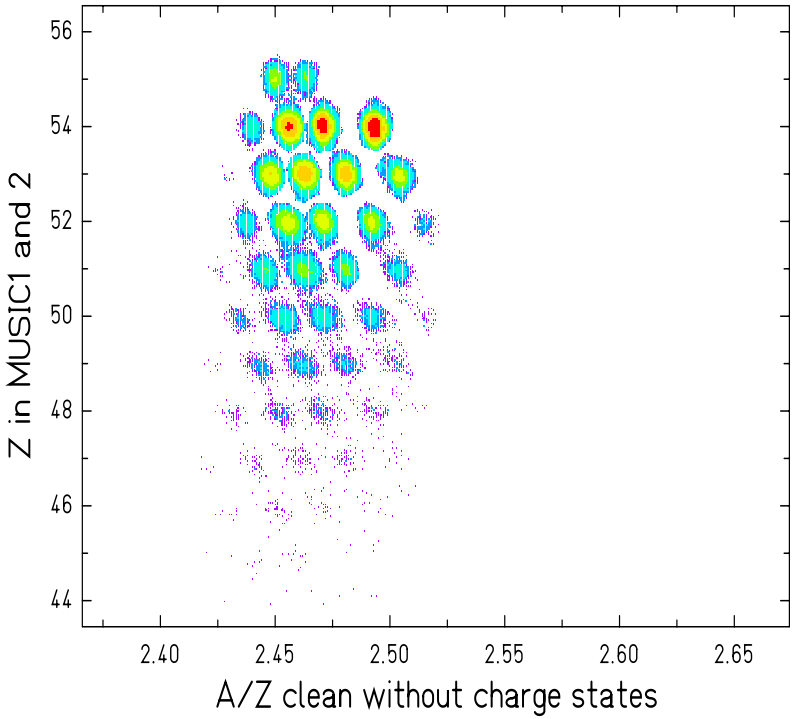
Solution: contours on the blob, look position at S2 and check with Lieschen

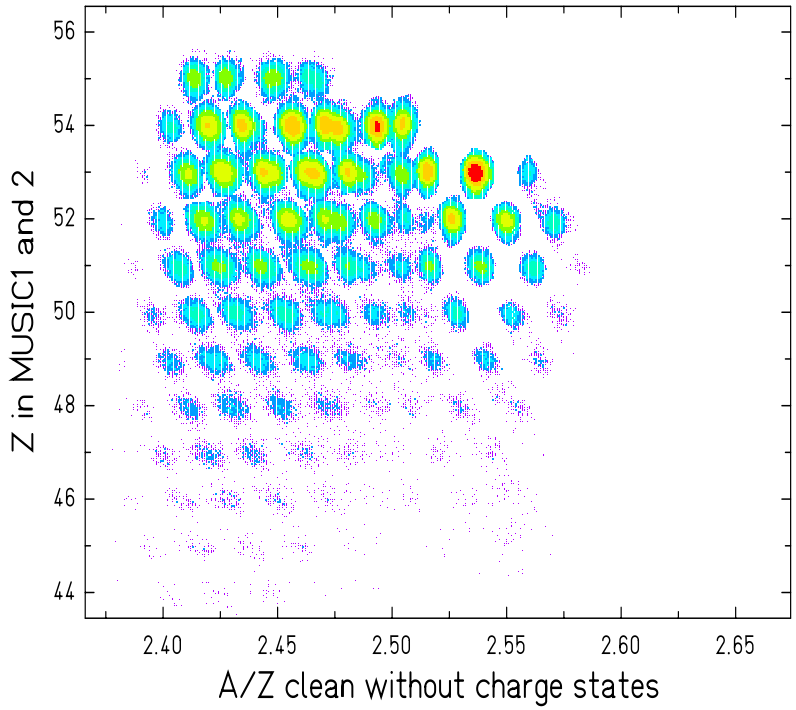
Charge states

run 493 $^{122.2}$Cd



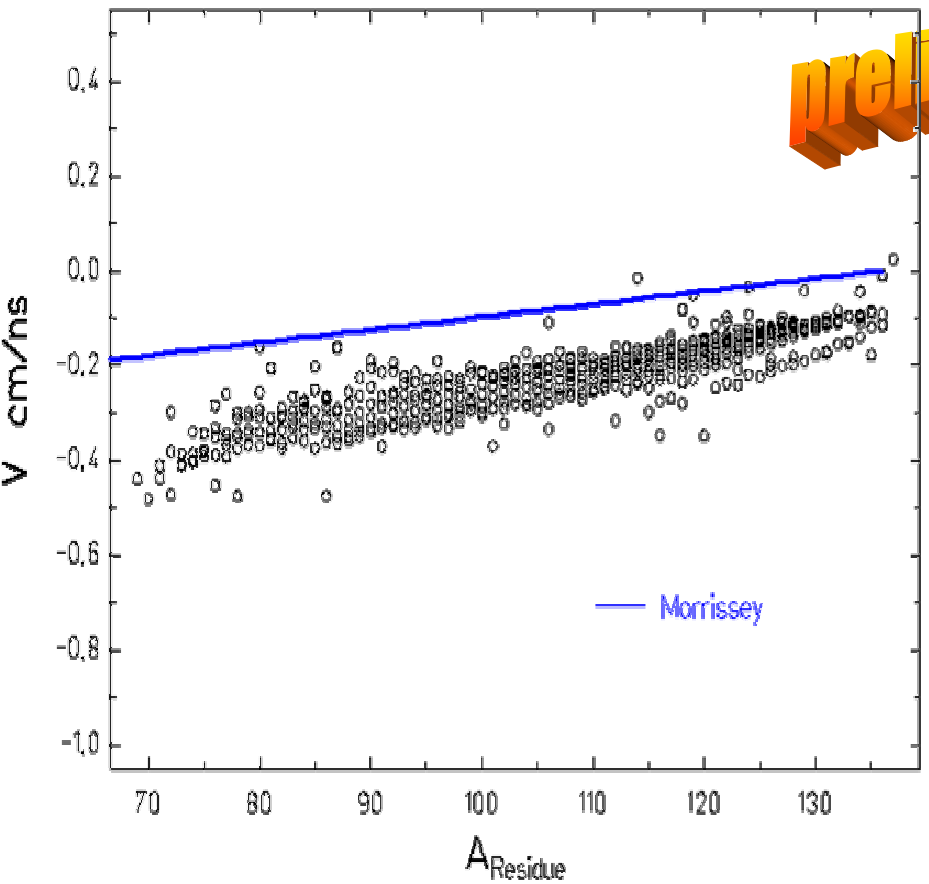
Setting close to the beam



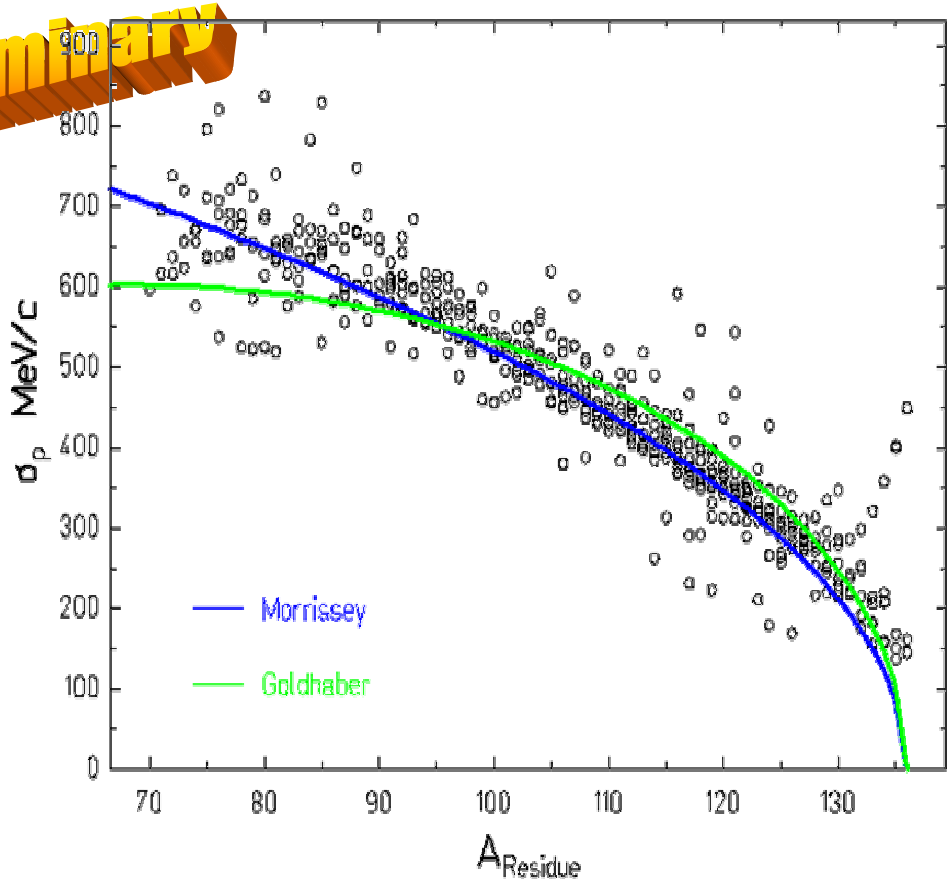


Velocity distributions: ^{136}Xe + p 500 A MeV

Mean values of the velocity distribution



Widths of the momentum distribution



$$v_{II} = \frac{8\,\Delta A}{A_p\,.u}\left(\frac{\gamma+1}{\beta\gamma}\right)_{proj} c$$

$$\sigma_p^2 = \frac{150^2}{3}\,\Delta A$$

$$\sigma_p^2 = \sigma_0^2\,\frac{A_R\,.\,\Delta A}{A_p - 1}$$

In progress

^{136}Xe + p 500 A MeV

- Charge states
- Transmission correction for velocity distributions
- Look carefully all velocity spectra
  shift to solve ...

^{136}Xe + d 500 A MeV

- Pressure corrections
- Z calibration
- Charge states

To do

^{136}Xe + p 500 A MeV

- Cross sections

^{136}Xe + p 500 A MeV

- Velocity distributions
- Cross sections