Slowed-down beams at LISE Spectrometer

Omar Kamalou

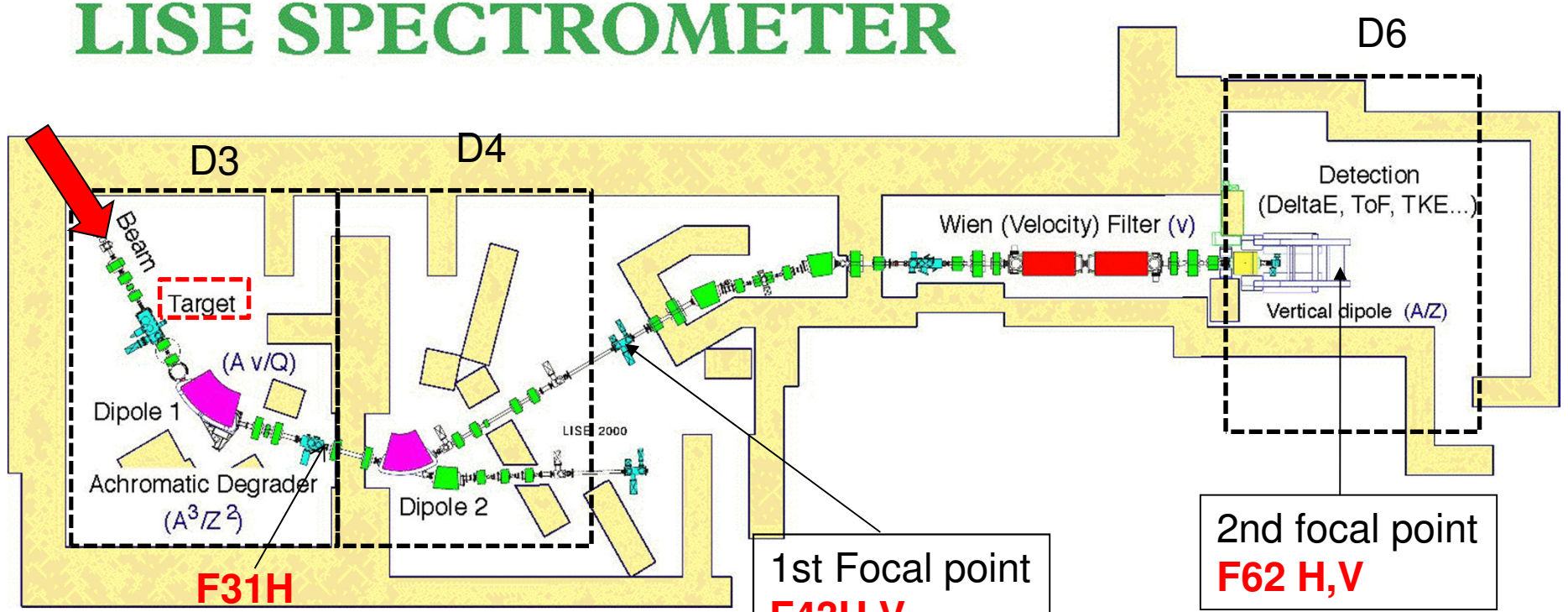
On the behalf of LISE Team.

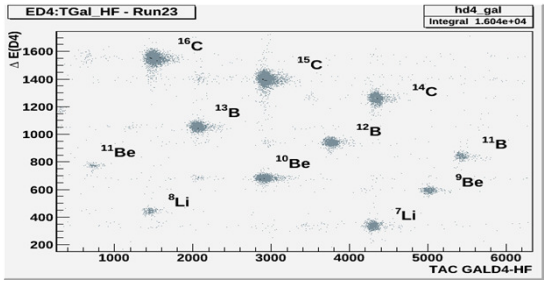
Ganil

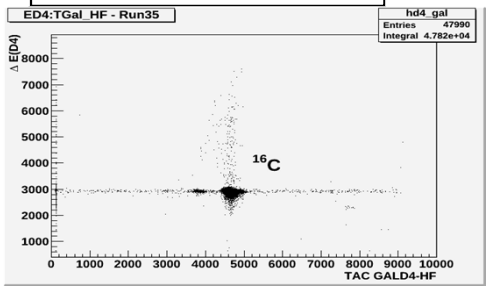
OUTLINE

- LISE Spectrometer
- Secondary beam energy reduction
- Caviar detector
- New quadrupoles in D6
- Conclusion

LISE SPECTROMETER

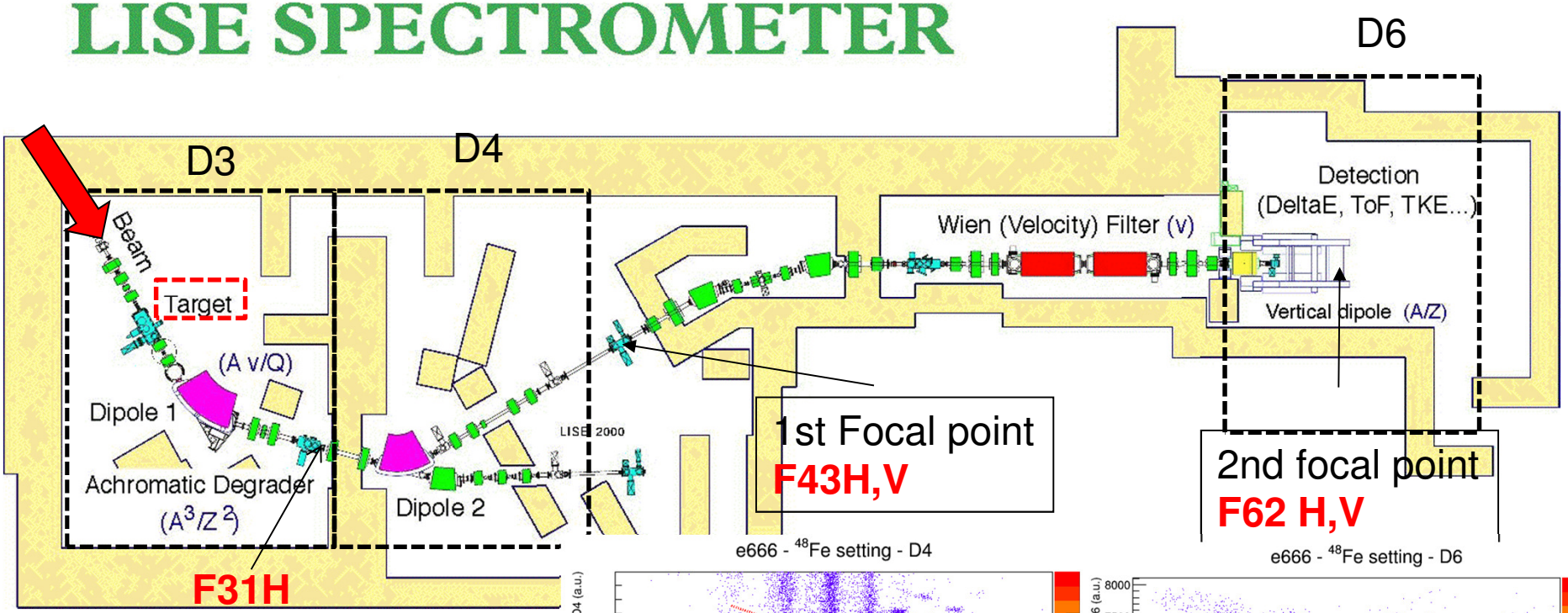


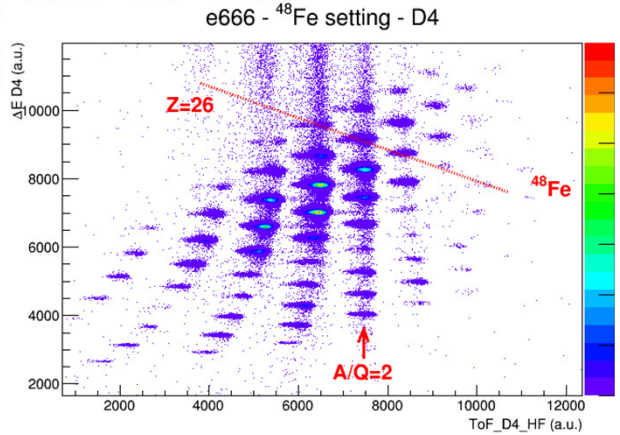


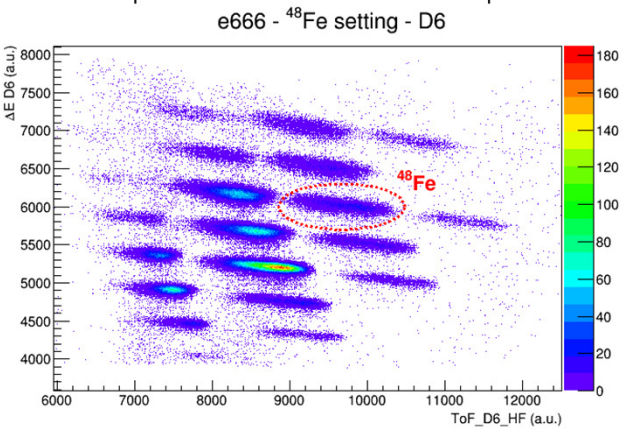


- **First selection (D31): A/Z**
- **Second selection (achromatic degrader): $(\Delta B\rho)/(B\rho)=KA^3/Z^2$**
- **Third selection : Wien filter -> velocity**

LISE SPECTROMETER







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Energy reduction of the secondary beam

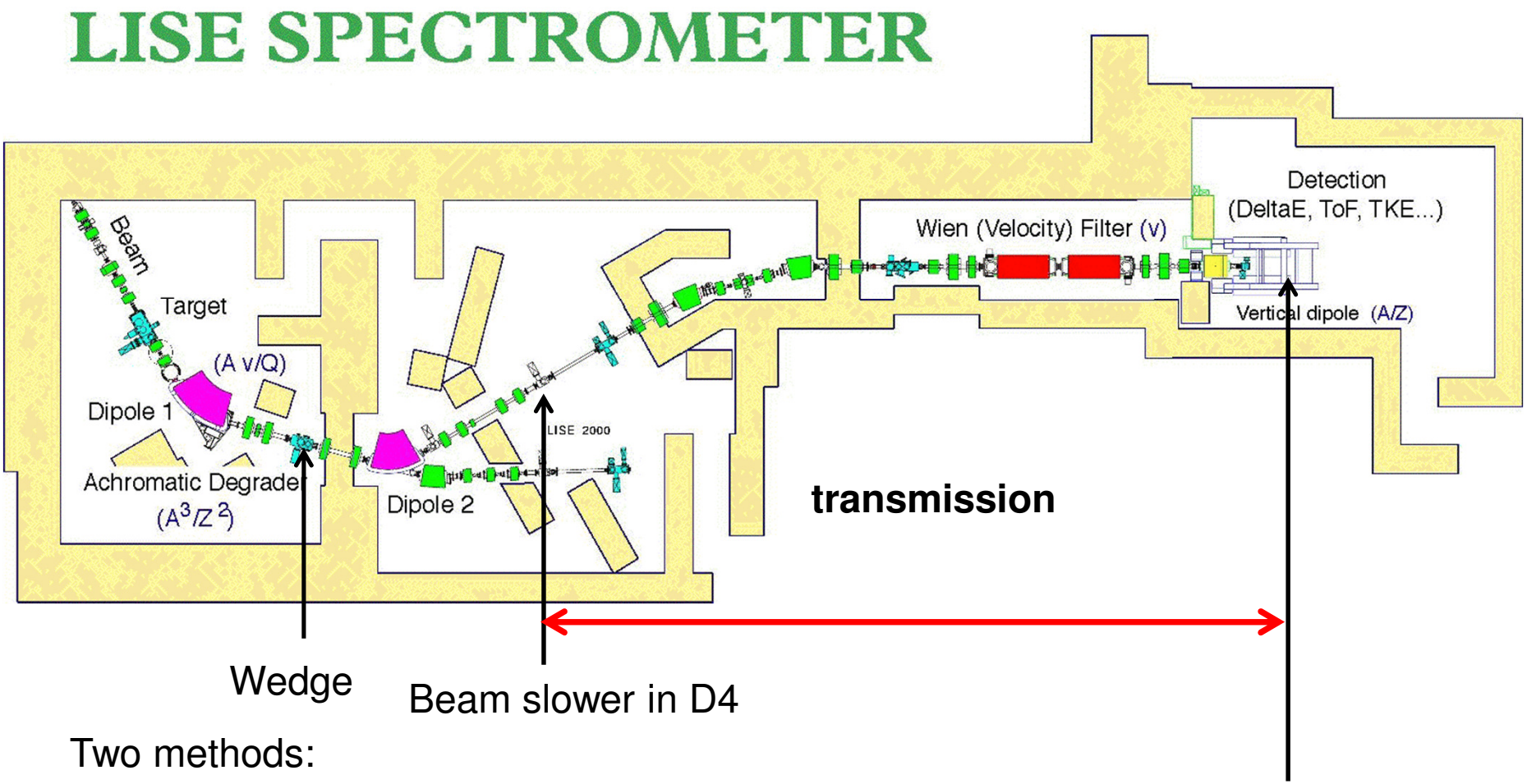
T16-05 proposal **(O. Kamalou *et al.*)**

Primary beam: ^{36}S @ **77.93 Mev/A**
Beam intensity: 4 µAe

Target: Be,1340 µm
Wedge in the dispersive plane:Be,1000 µm
Beam slower located after slits 43 : Al foil with differente thicknesses

Secondary beam: ^{34}Al @ [10-50] Mev/A

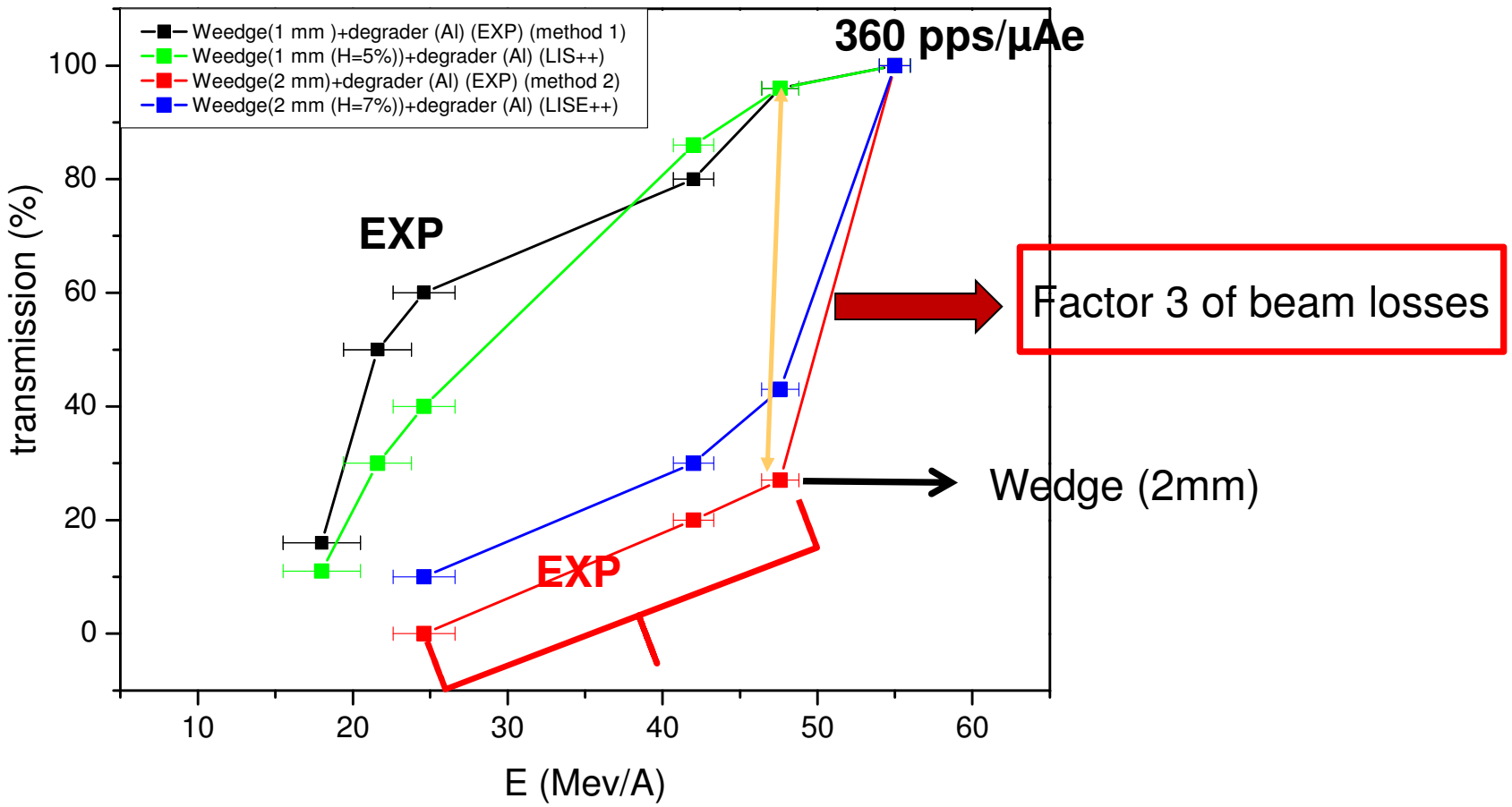
Transmission as function of beam energy: ^{34}Al (1)



Two methods:

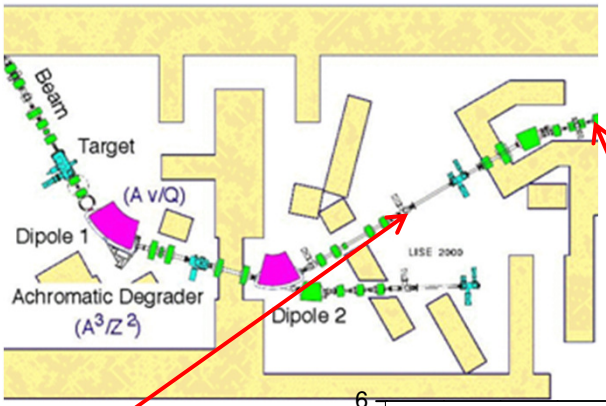
1. **Be Wedge=2 mm** and different thickness of beam slower
2. **Be Wedge=1 mm** and different thickness of beam slower

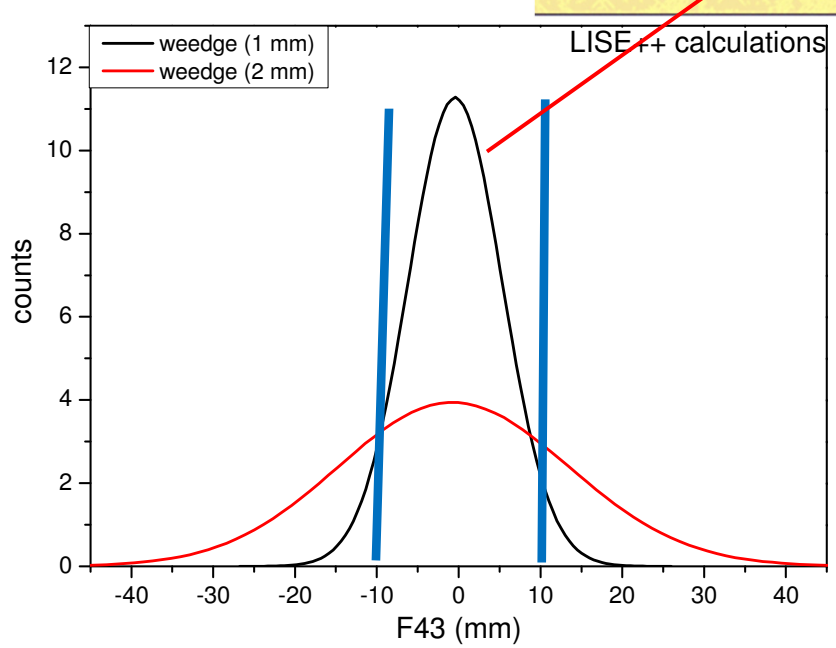
Transmission as function of beam energy: ^{34}Al (2)

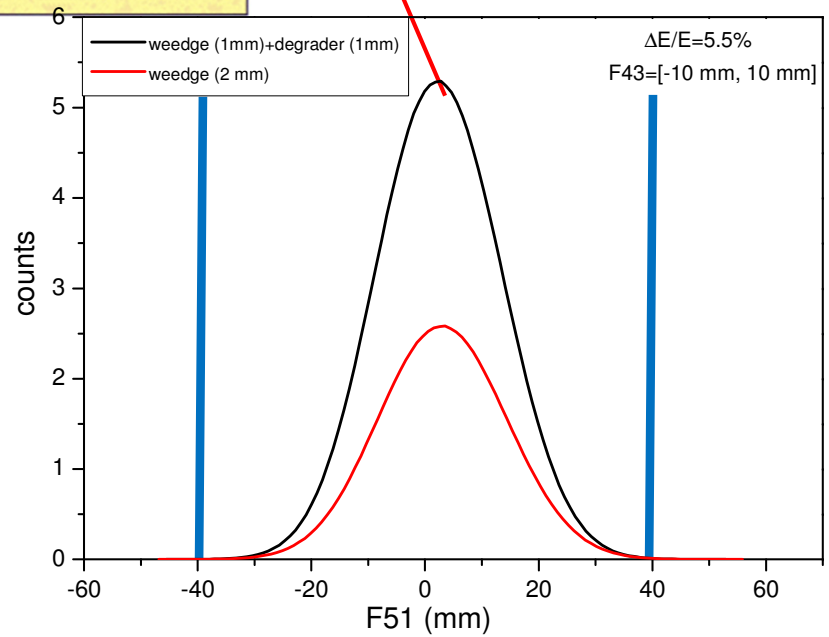


Beam profilers at F43 and F51: ^{34}Al

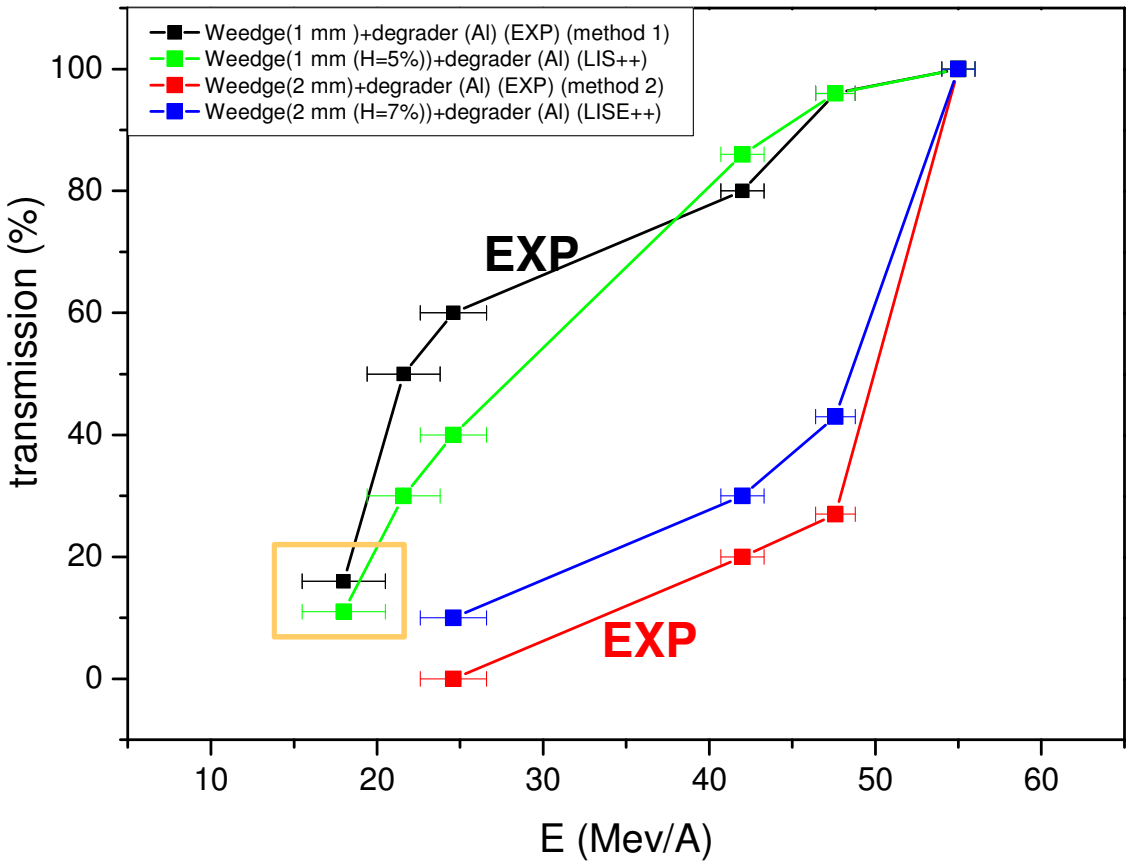
LISE SPECTROME



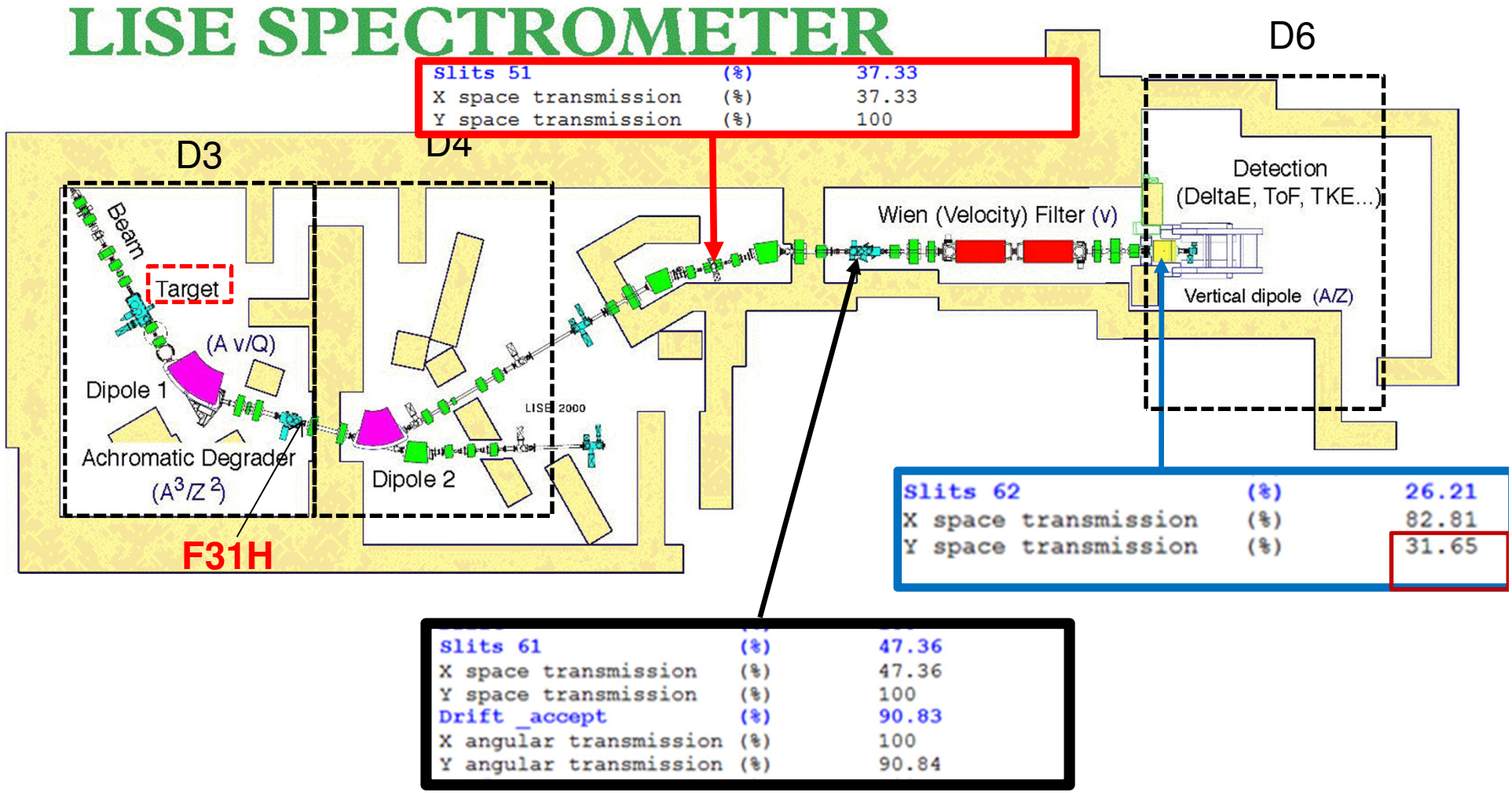




Transmission as function of beam energy: ^{34}Al

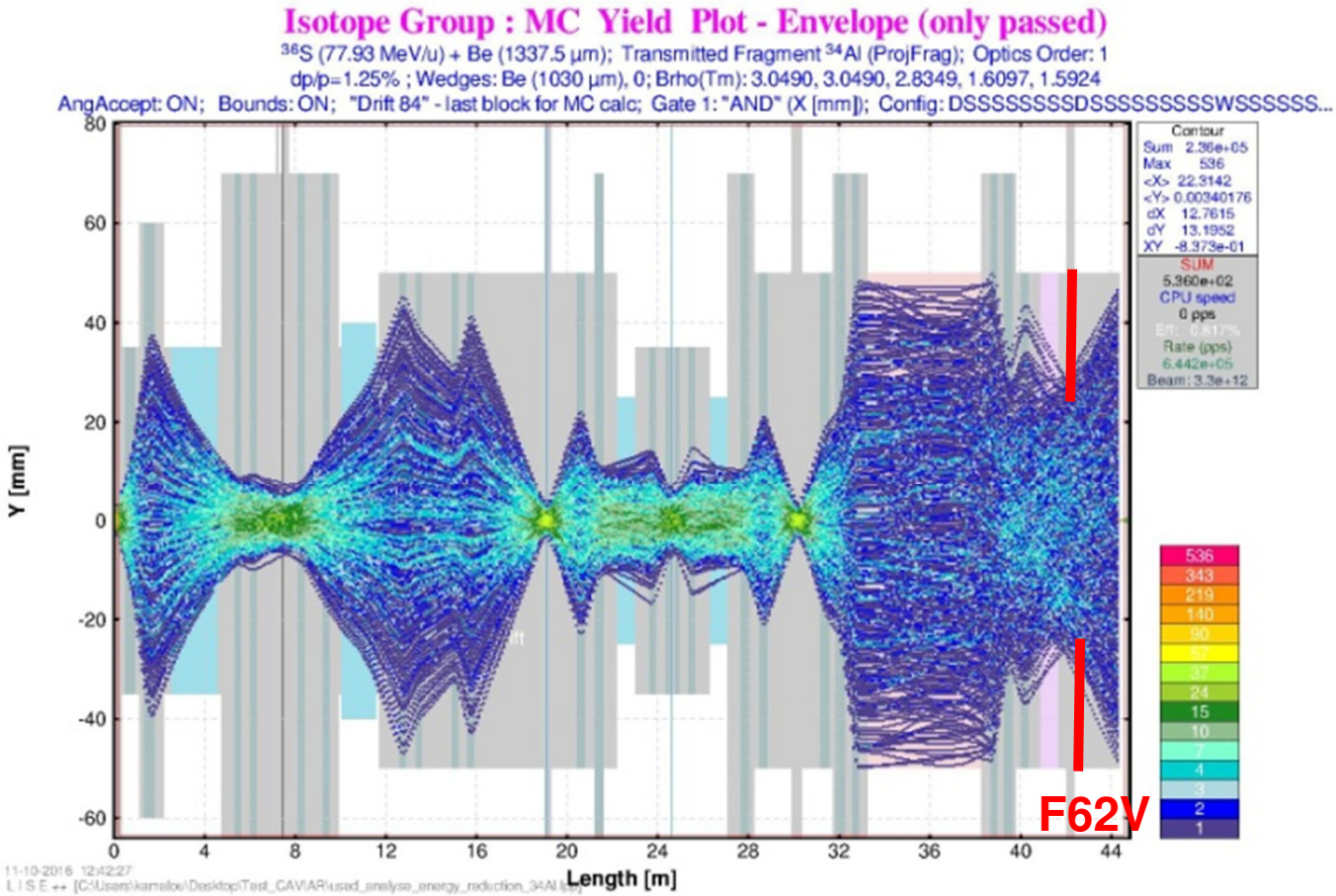


Transmission at 18 Mev/A



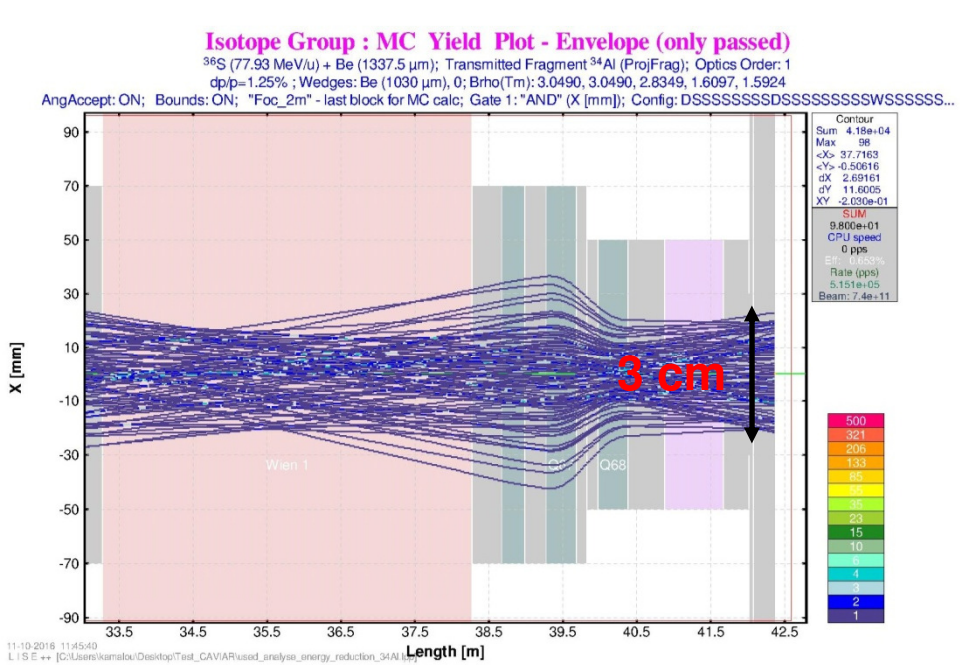
Still we can do some improvement at slit 62 (in the vertical plane)

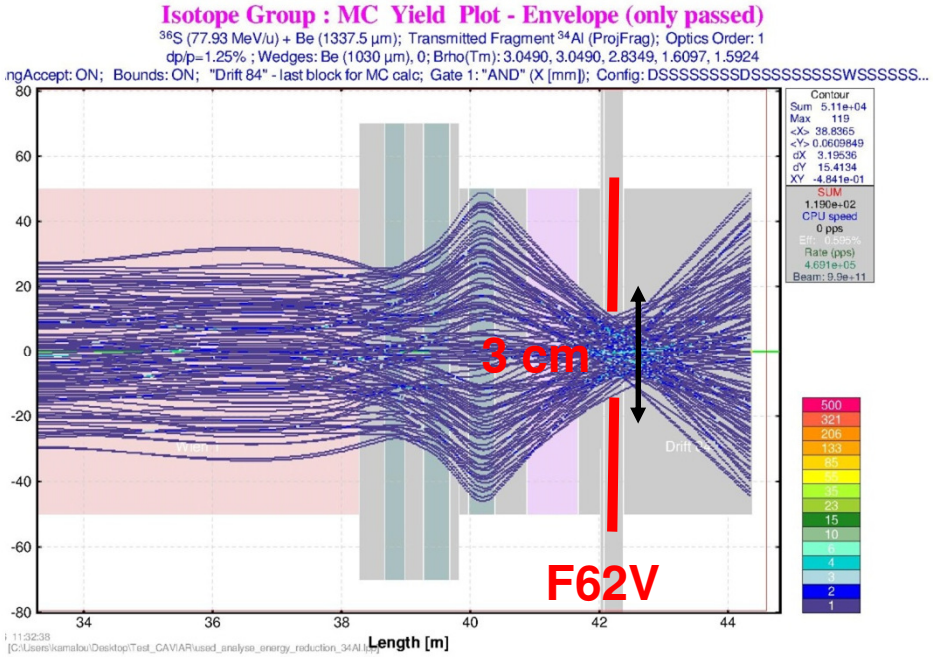
Beam envelope at 18 Mev/A



The beam is very large at the slit 62 in the vertical plane

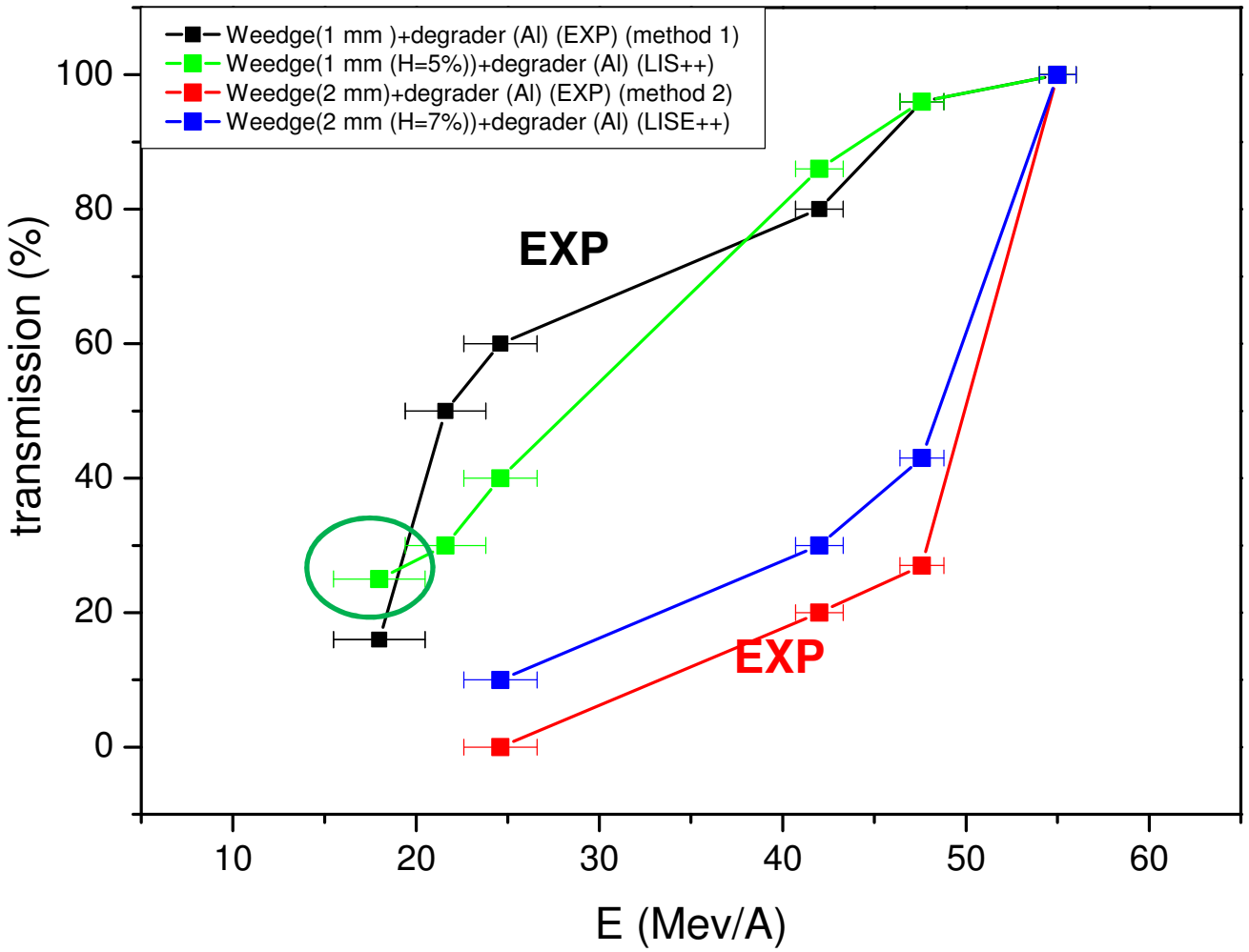
Optimization of the last Quadrupoles at 18 Mev/A



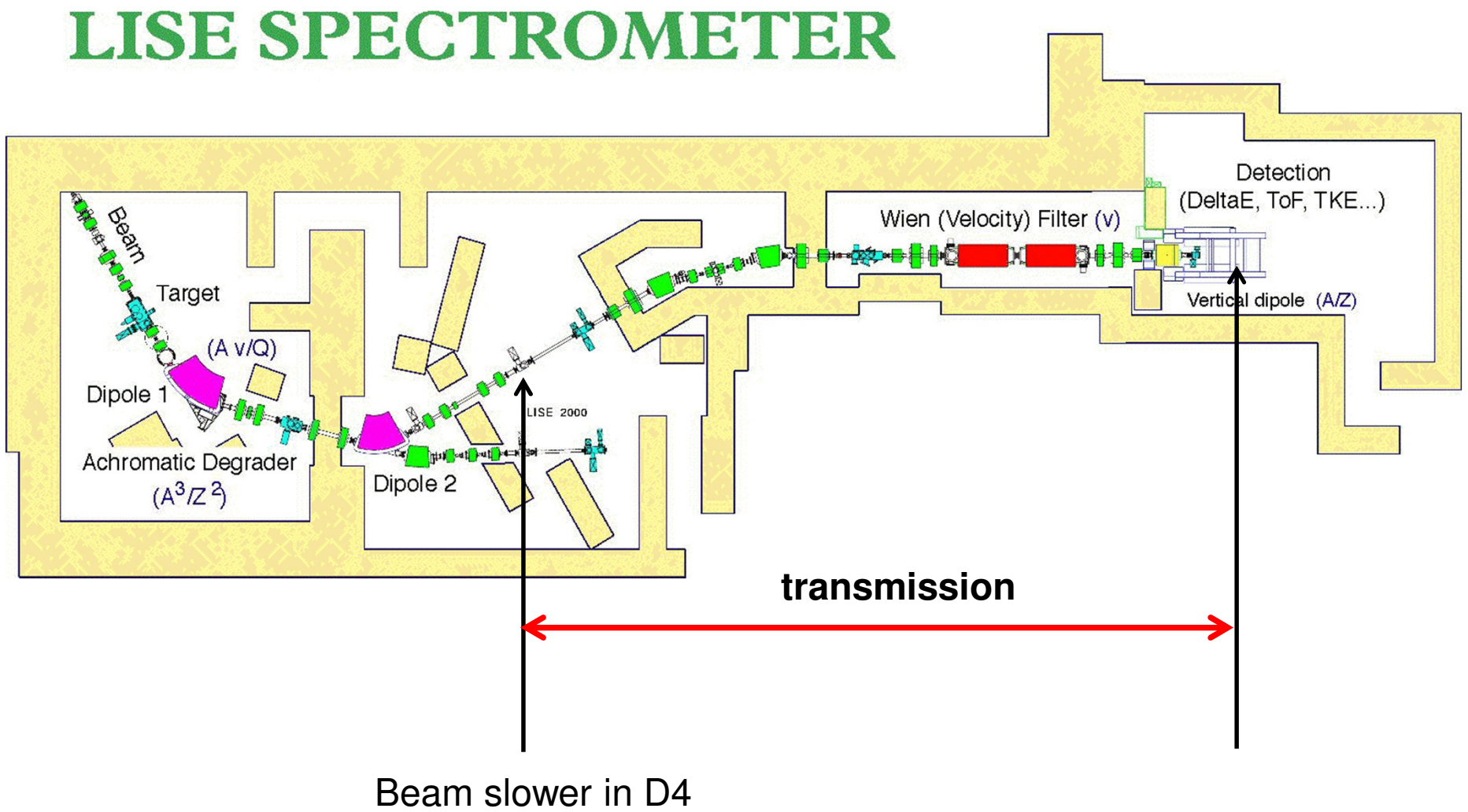


We can reach 26 % of transmission at 18 Mev/A (instead of 10 %)

Transmission as function of beam energy: ^{34}Al



Study case: Energy reduction: $^{58}Ni \rightarrow ^{56}Ni$ (1)

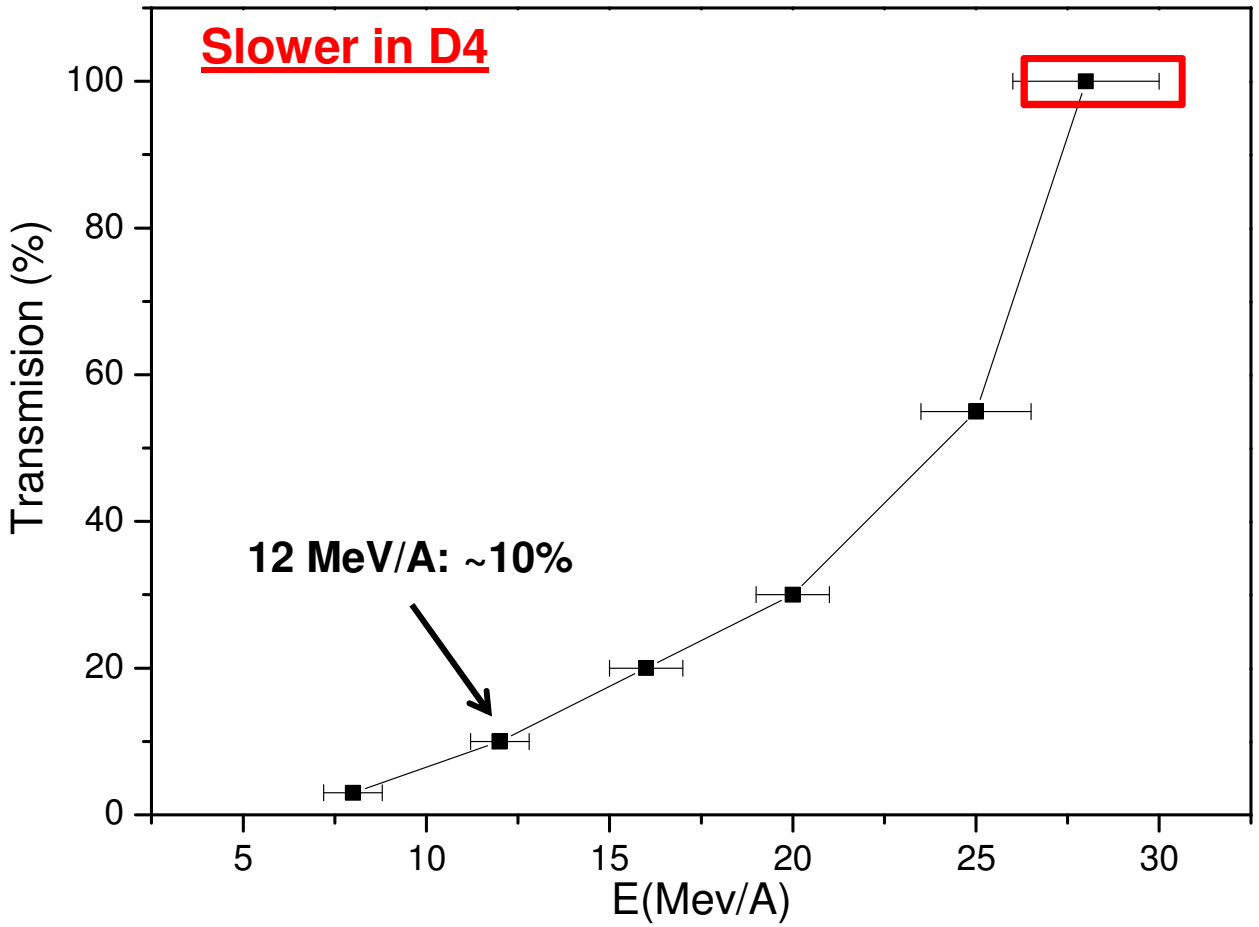


Beam slower in D4

Study case: Energy reduction: $^{58}Ni \rightarrow ^{56}Ni$ (2)

LISE ++ calculation

1.10^5 pps/ µAe



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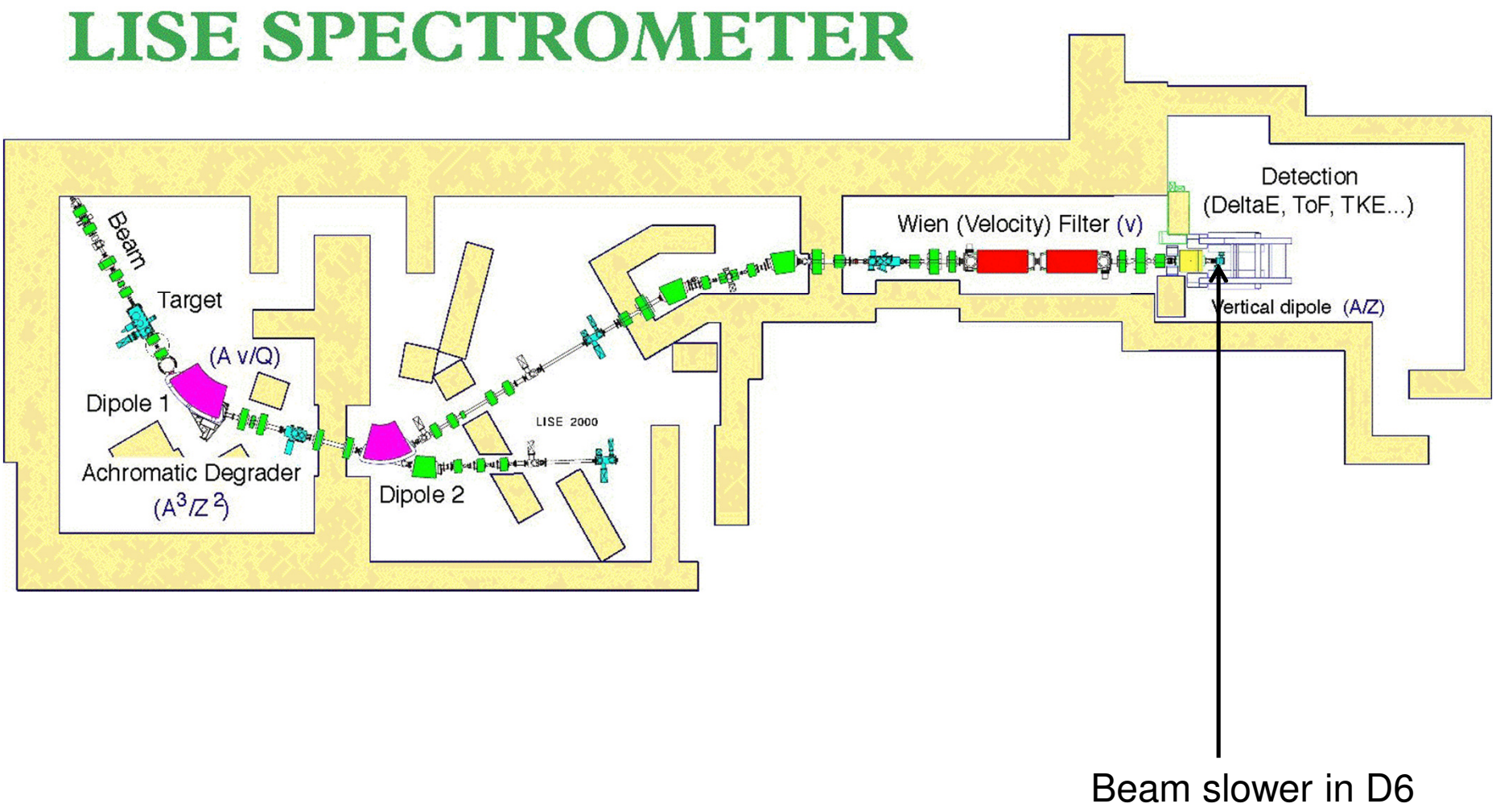
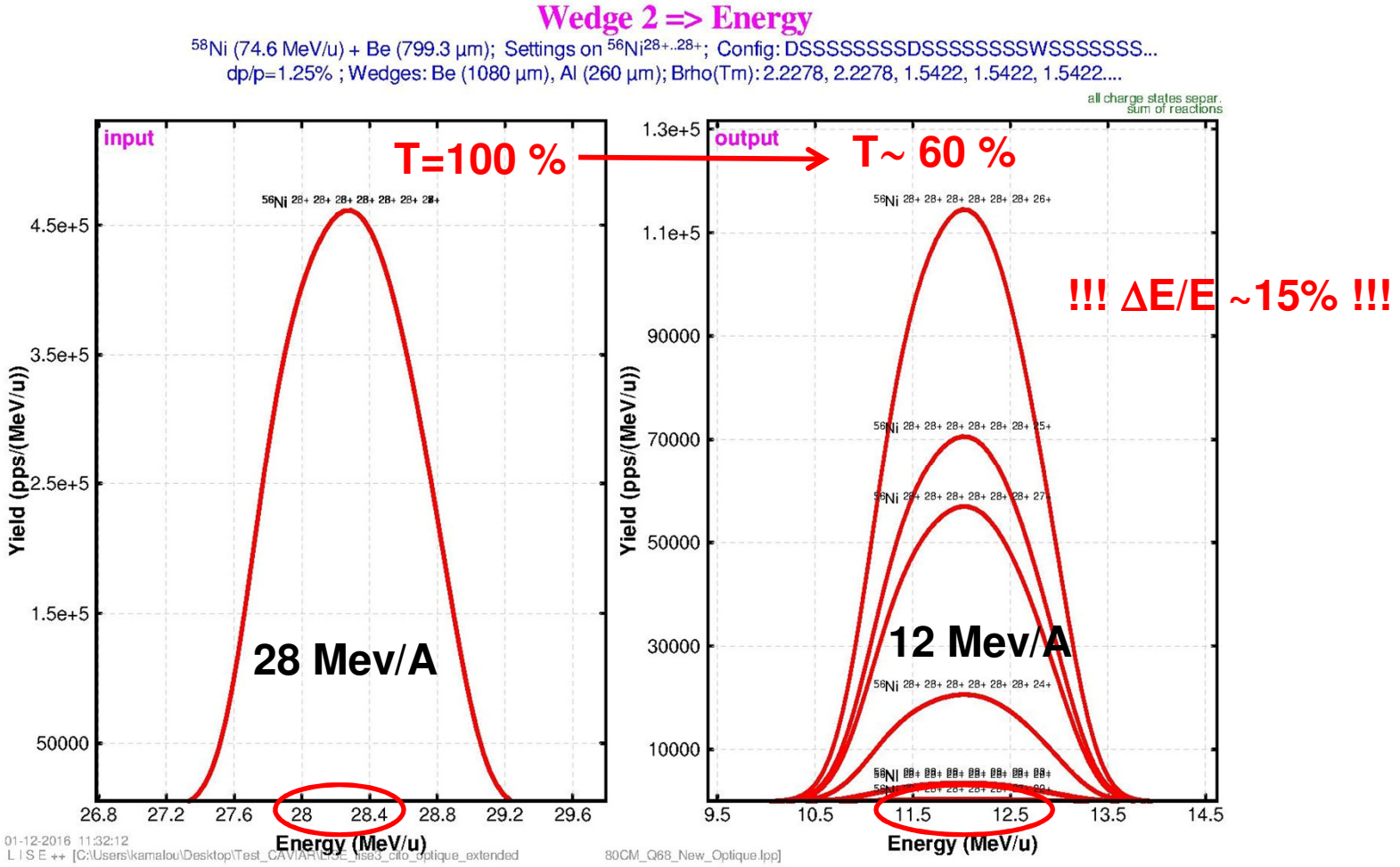
Study case: Energy reduction in D6: $^{58}Ni \rightarrow ^{56}Ni$



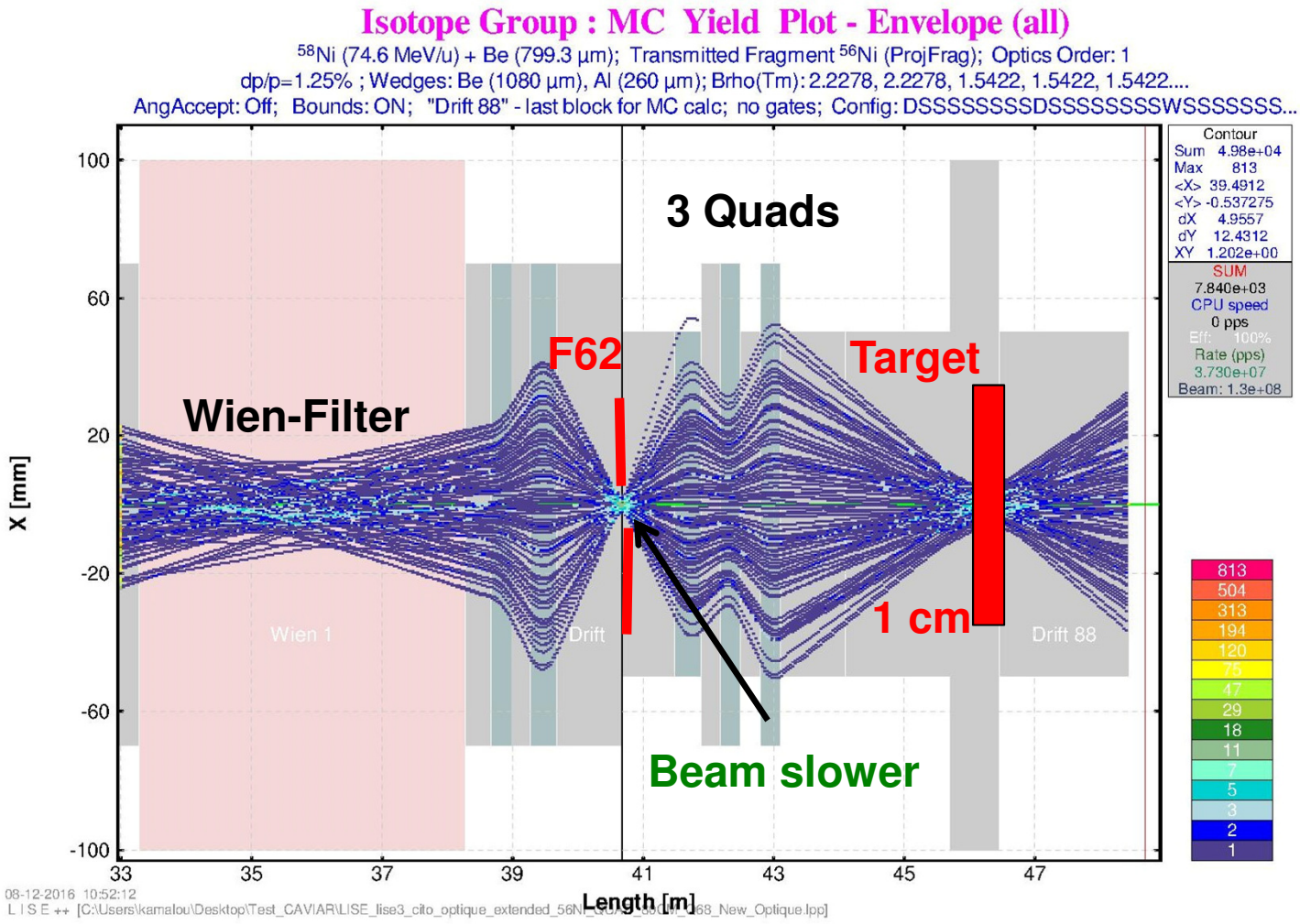
Energy Distribution of ^{56}Ni

Beam slower in D6: from 28 MeV/A in D4 to 12 MeV/A in D6



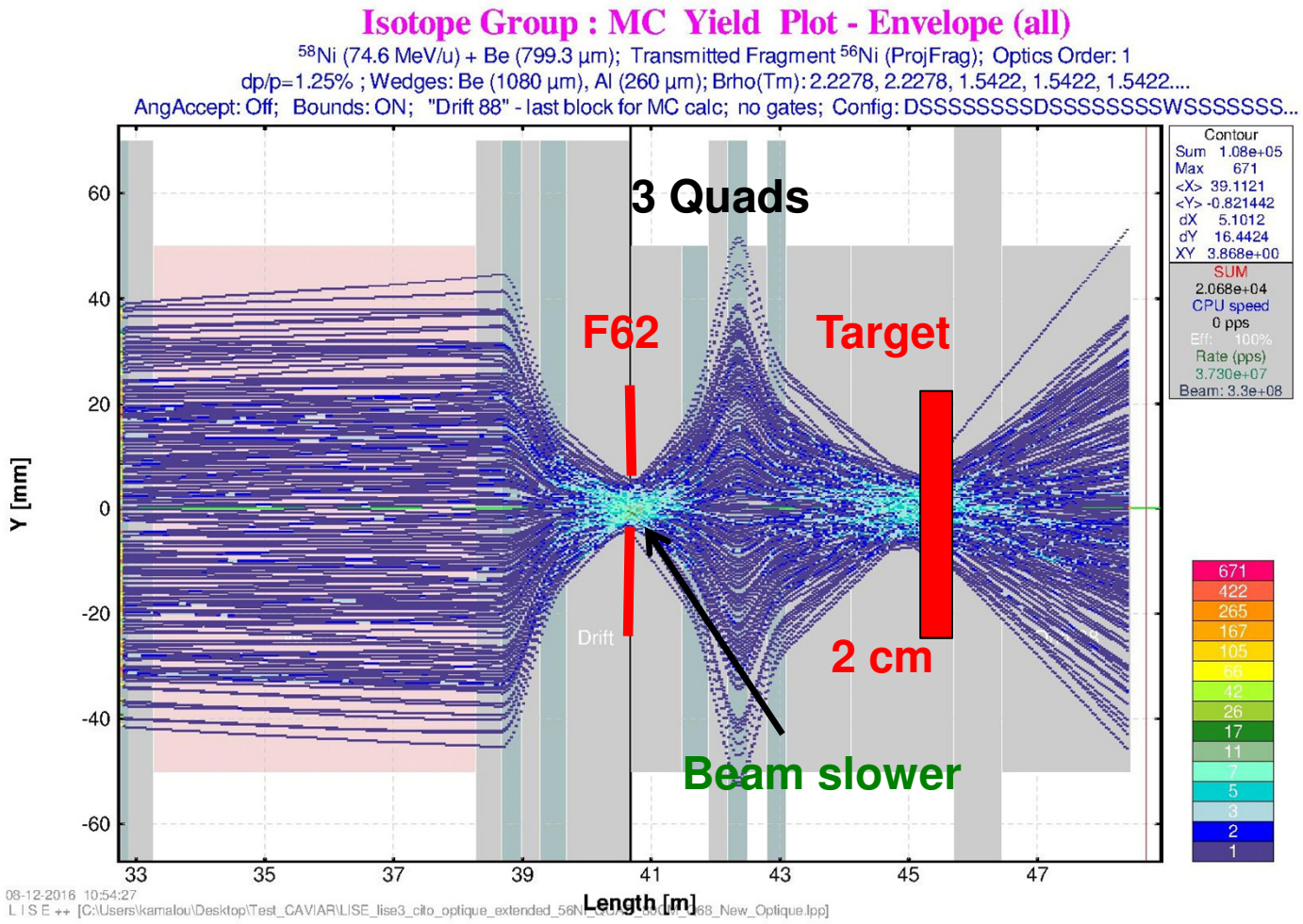
We gain at least a factor 6 in term of beam intensity

Beam Envelope in X plane of ^{56}Ni at 12 Mev/A



!!! Very high Q values required to focus the beam on the target
--> case by case feasibility study (input needed) !!!

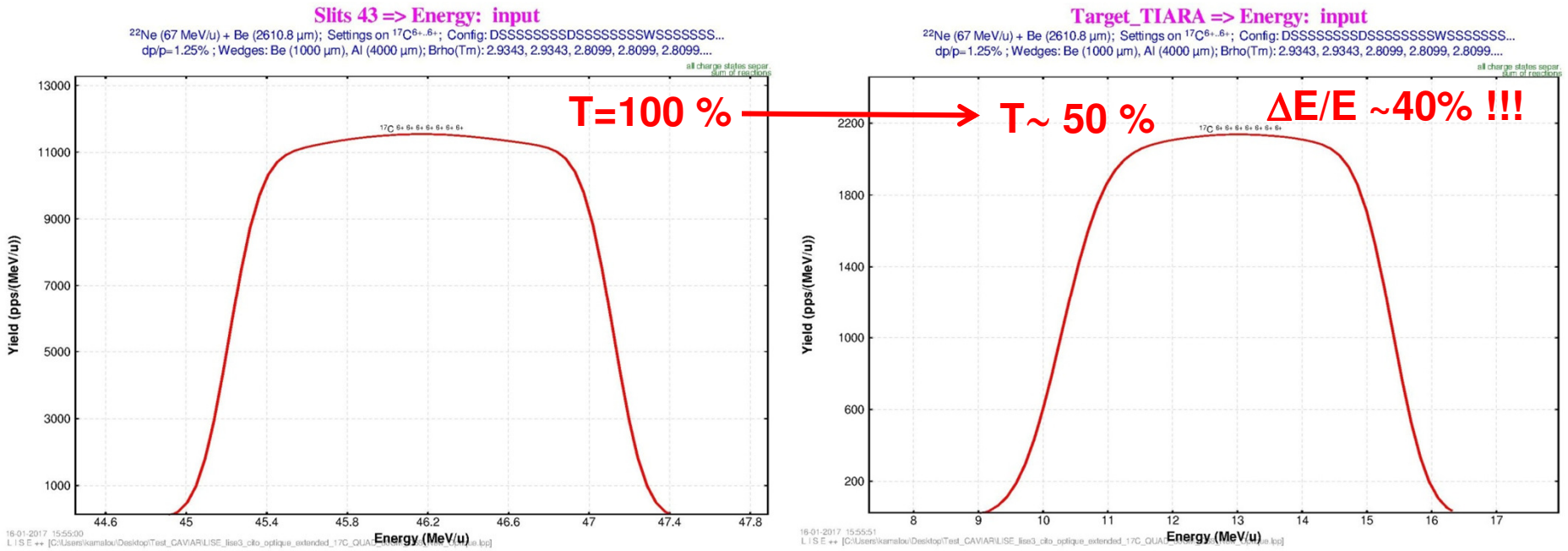
Beam Envelope in Y plane of ^{56}Ni at 12 Mev/A



!!! Very high Q values required to focus the beam on the target
-> case by case feasibility study (input needed) !!!

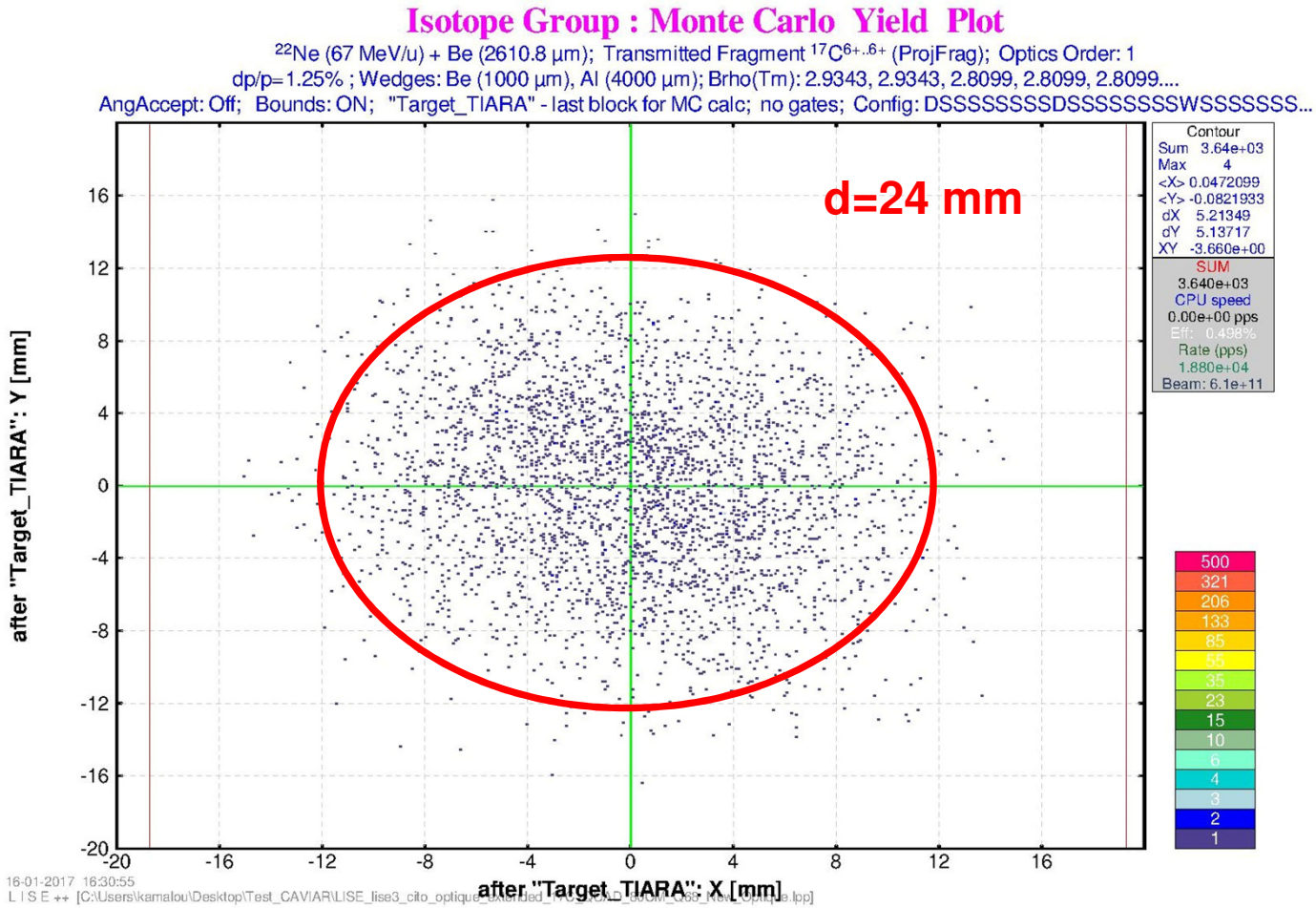
Study case: Energy reduction in D6: $^{22}Ne \rightarrow {}^{17}C$

Beam slower in D6: from 45 MeV/A in D4 to 12 MeV/A in D6



2.10^4 pps/ µAe → **1.10^4 pps/ µAe**

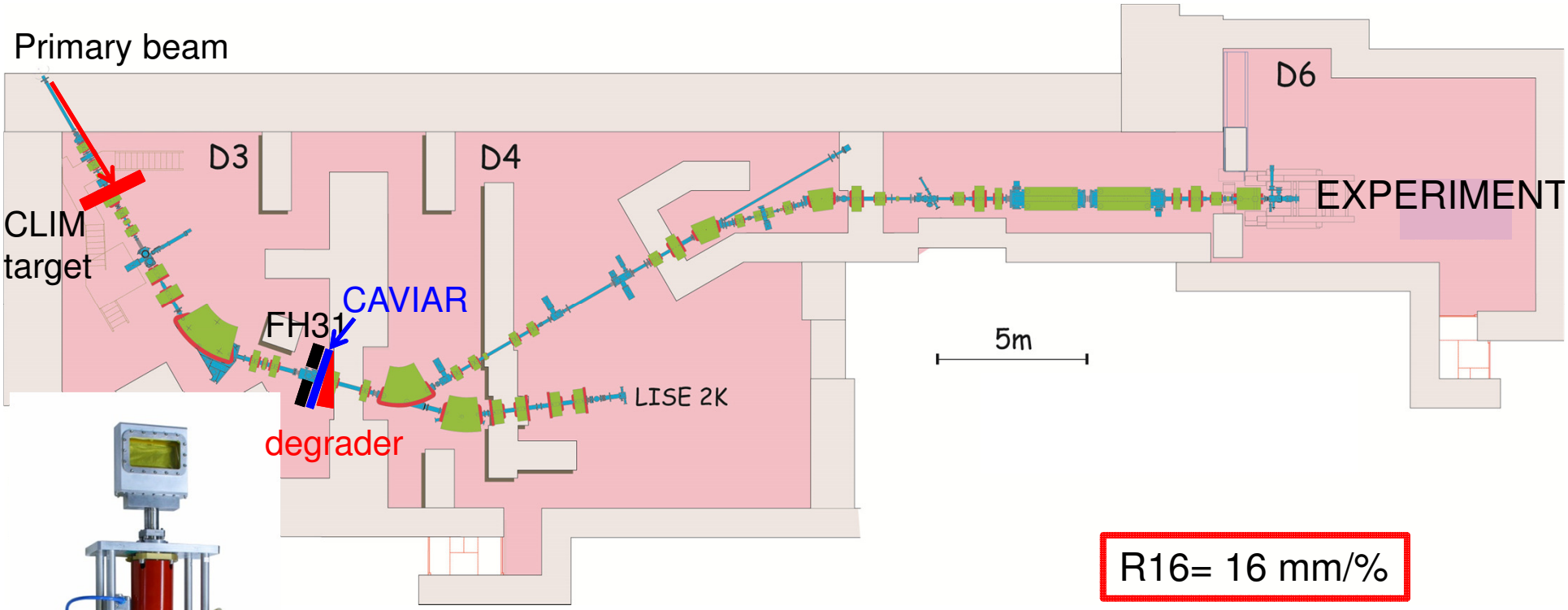
Beam spot of ^{17}C at 12 Mev/A



OUTLINE

- LISE Spectrometer
- Charge state issues
- Secondary beam energy reduction
- **Caviar detector**
- New quadrupoles in D6
- Conclusion

CAVIAR detector in D3

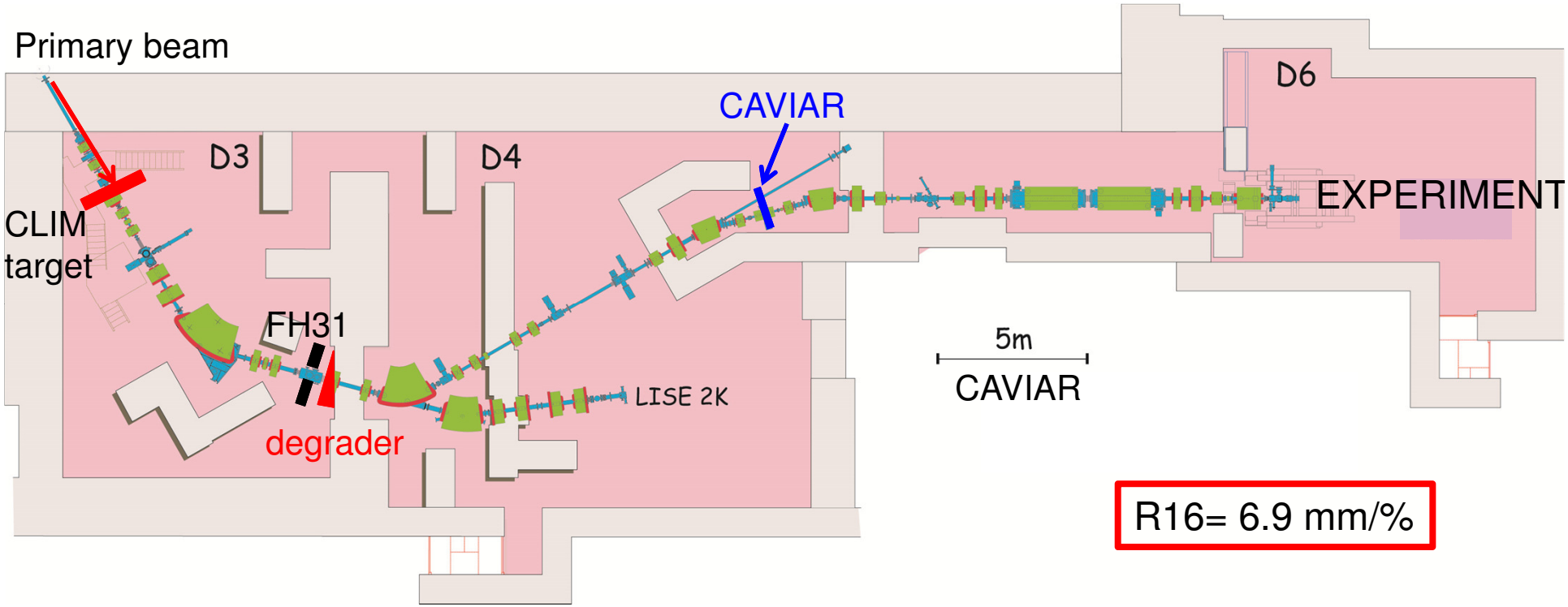


R16= 16 mm/%

CAVIAR gas detector, 96 strips of 1mm each
Brho from the position at the first dispersive focal plane

☹ Too high count rate when secondary beam not very exotic
☹ Most of the time not used

CAVIAR in D4



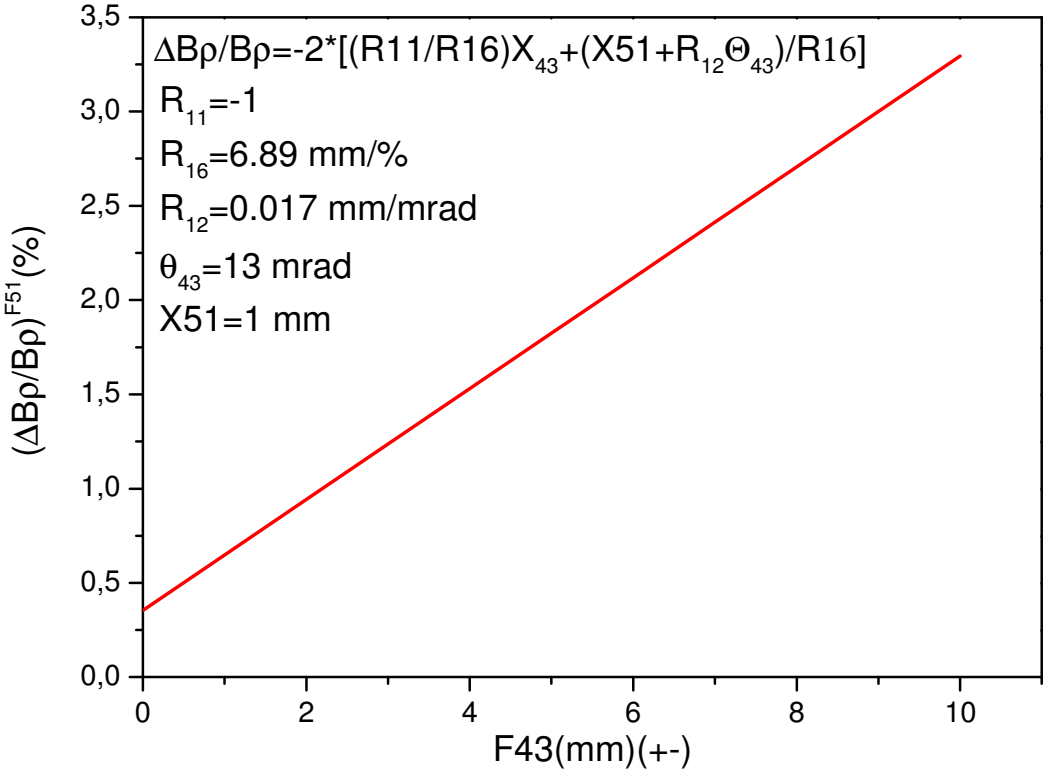
R16= 6.9 mm/%

Brho values from the position at the *second* dispersive focal plane:

- ☺ Weaker secondary beam intensities the detector can handle
- ☺ Can afford larger acceptance of spectrometer (Energy acceptance =8.7 %)
- ☺ Event by event momentum measurement ($\Delta p/p \approx 0.35\%$)
- ☺ Increased resolution in transfer reactions

Momentum resolution of CAVIAR at F51

What can be expected to be checked experimentally



A position detector should be used after the slit F43 to get $\Delta p/p \approx 0.35\%$

OUTLINE

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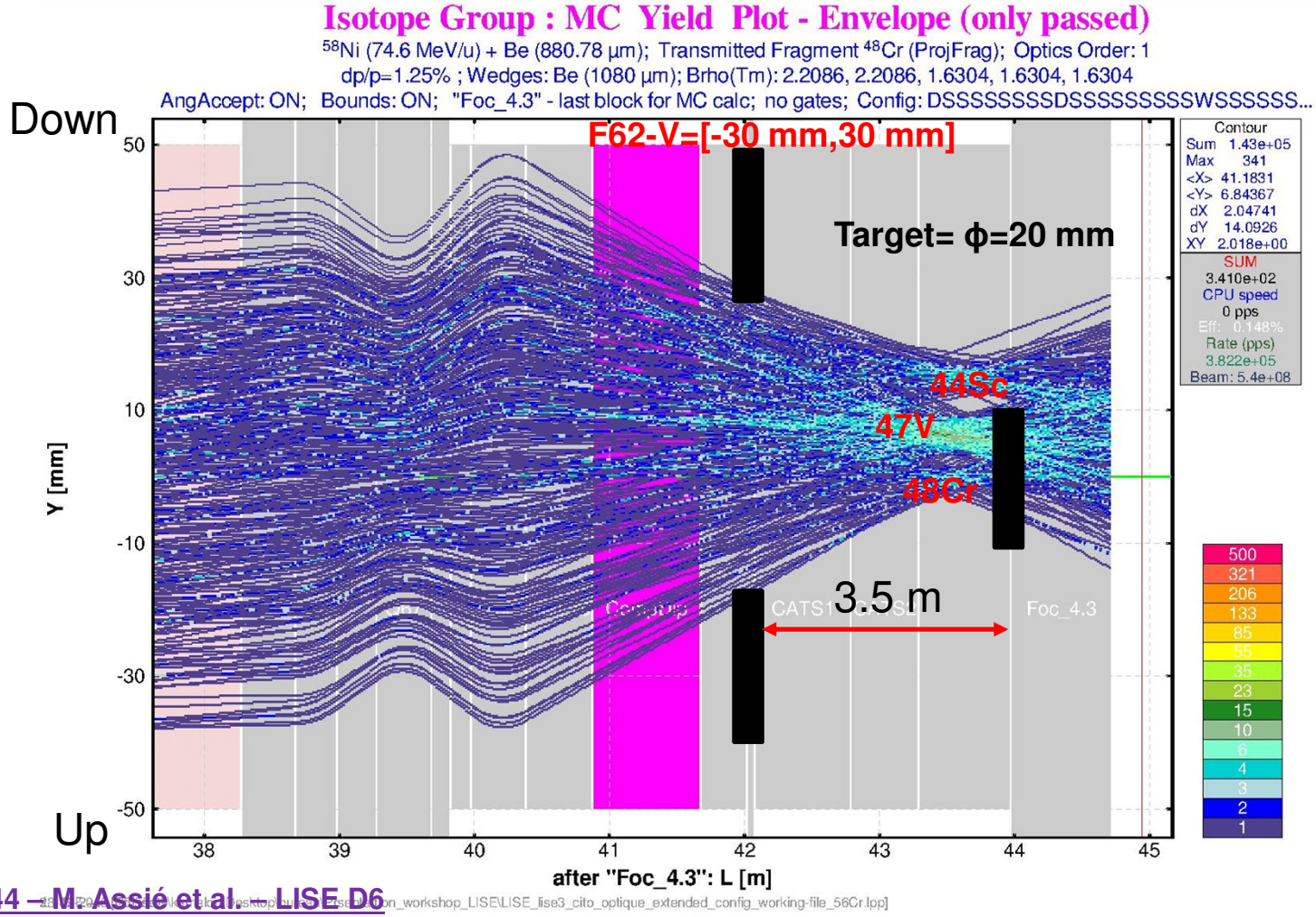
Secondary reaction with the 48Cr beam



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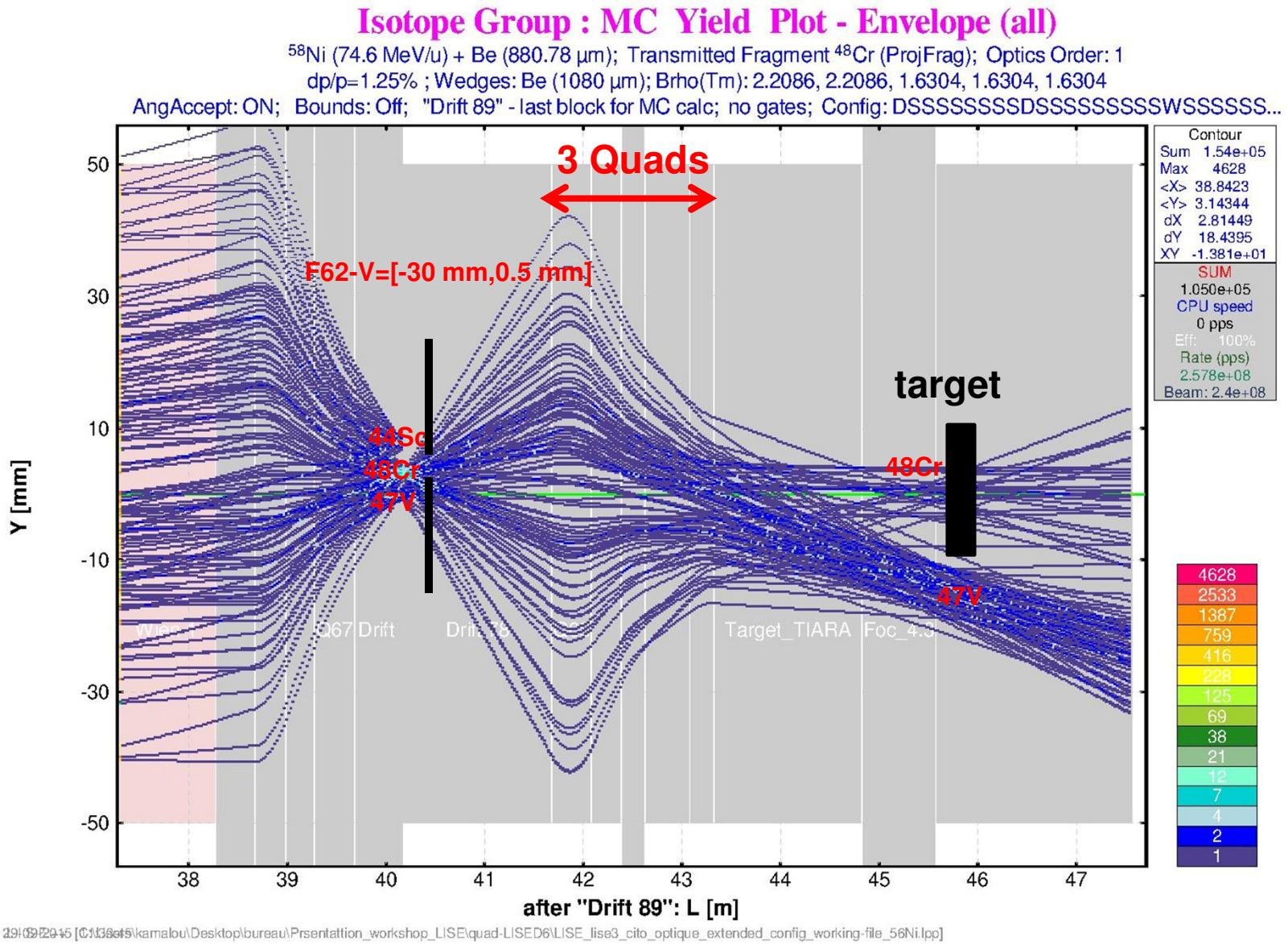
Wien filter selection:

- Focalization on F62V: good selection, large beam spot on the target.
- Focalization on the target: selection with slits is useless.

Example of ^{48}Cr Beam in D6



Conclusion

- The new focus (quadrupoles,…) in D6 is mandatory for transfer reaction experiments (proton-rich nuclei) and beam energy reduction
- For the beam energy reduction, a beam slower can be used in D4 room and/or D6 to further reduce the beam energy (+dedicated diagnostic to measure the beam energy event/event) .
- The performances of caviar detector in F51 are to be further tested (addition of a beam position monitor in D4)

Thank you for your attention

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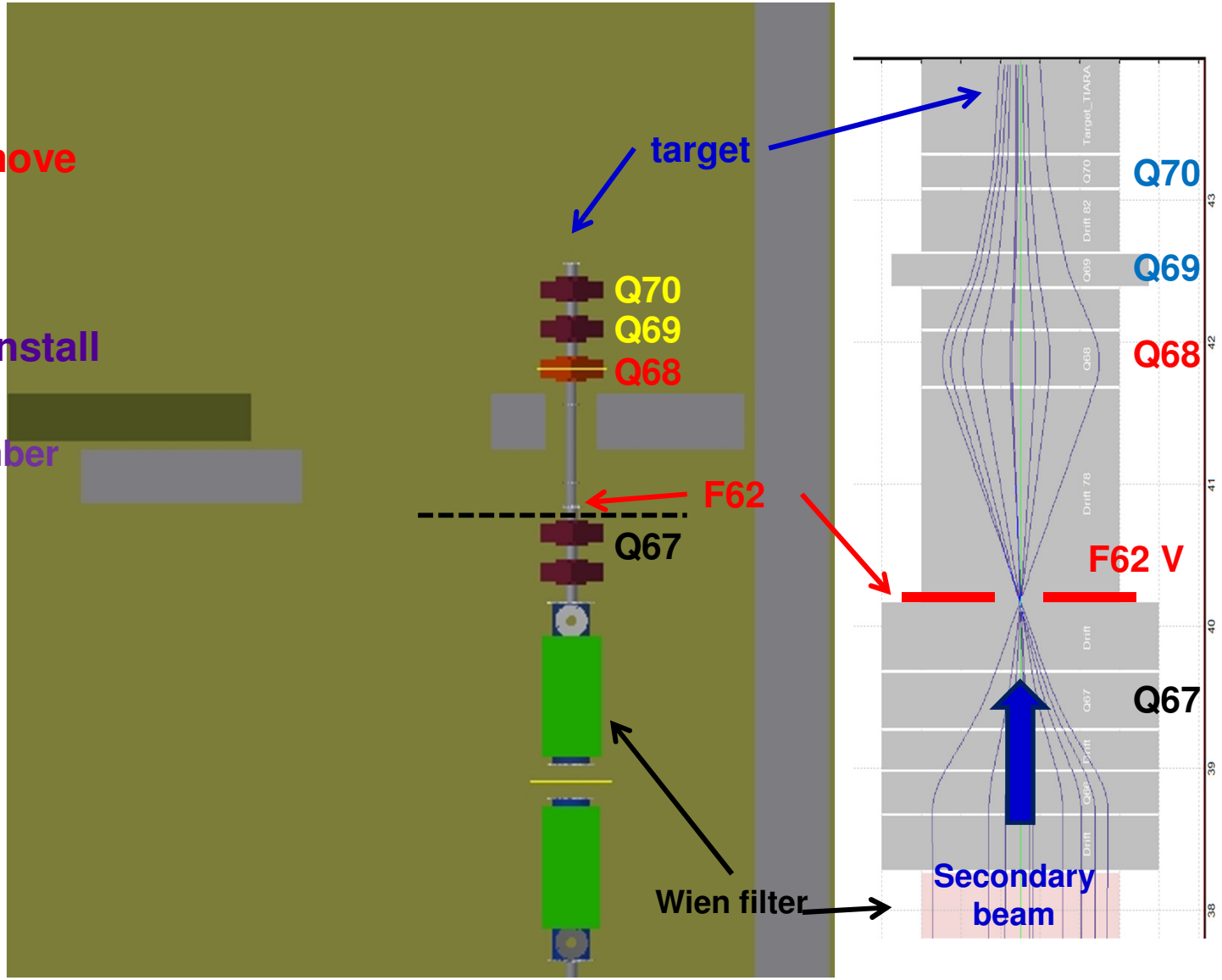
Two new quadrupoles in the D6 room

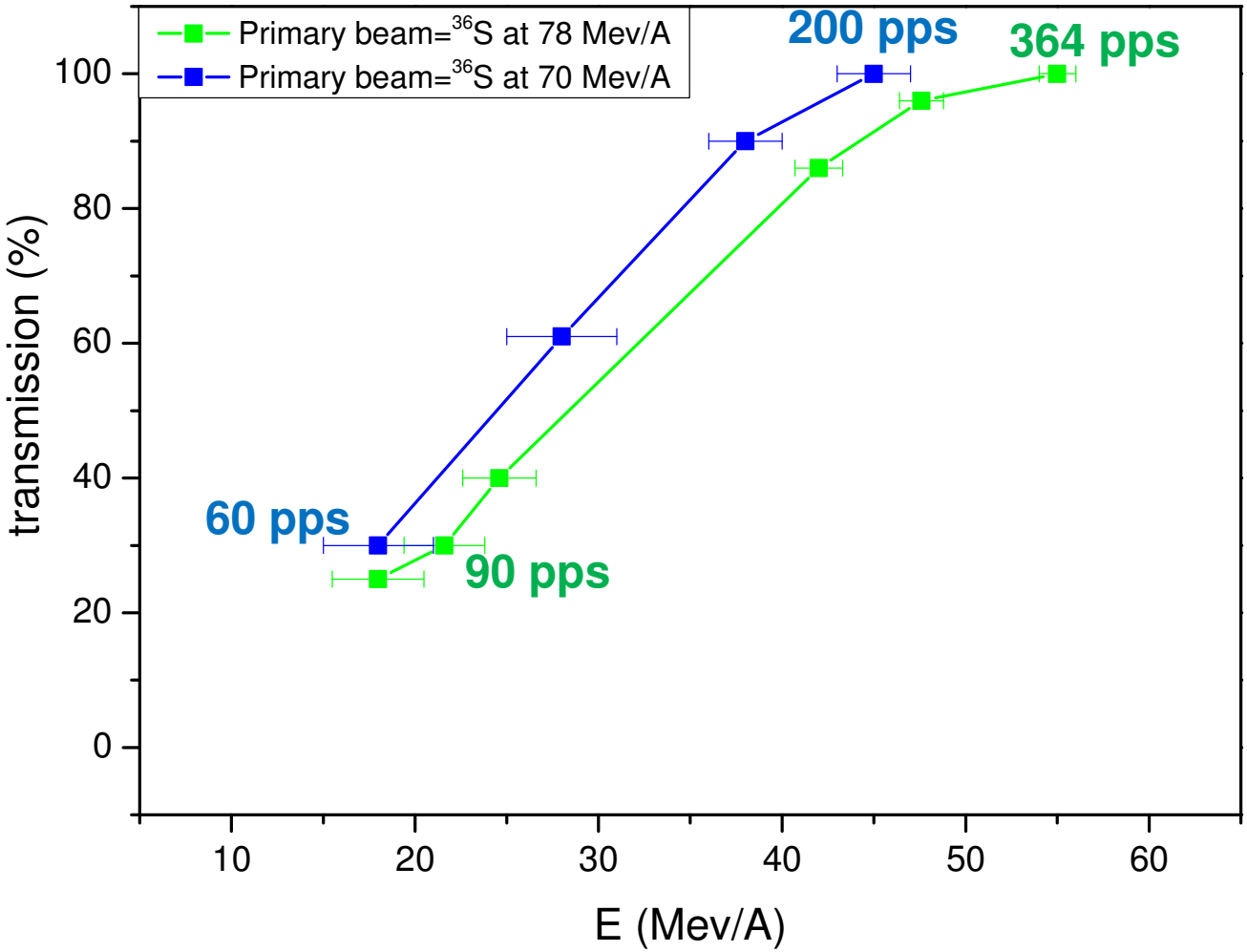
LISE-QD6

- **Equipement to move**
  - F62
  - Q68
- **Equipement to install**
  - Chassis
  - diagnostic chamber
  - Q69, Q70
  - Pumping system

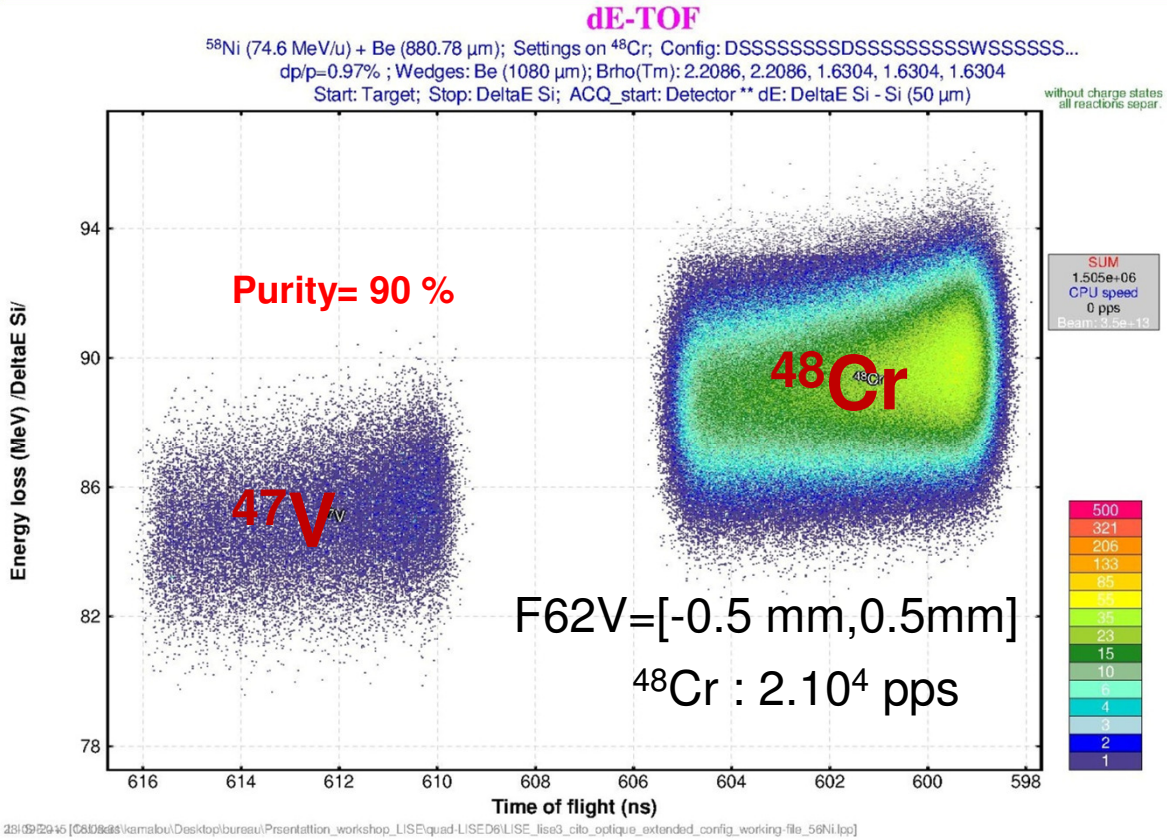


Transmission of ^{34}Al for different primary beam energy

LISE ++ calculation: 1 µAe



Matrix Energy vs Time of flight in D6 using 5 quads



Expriment is possible in the case of ^{48}Cr

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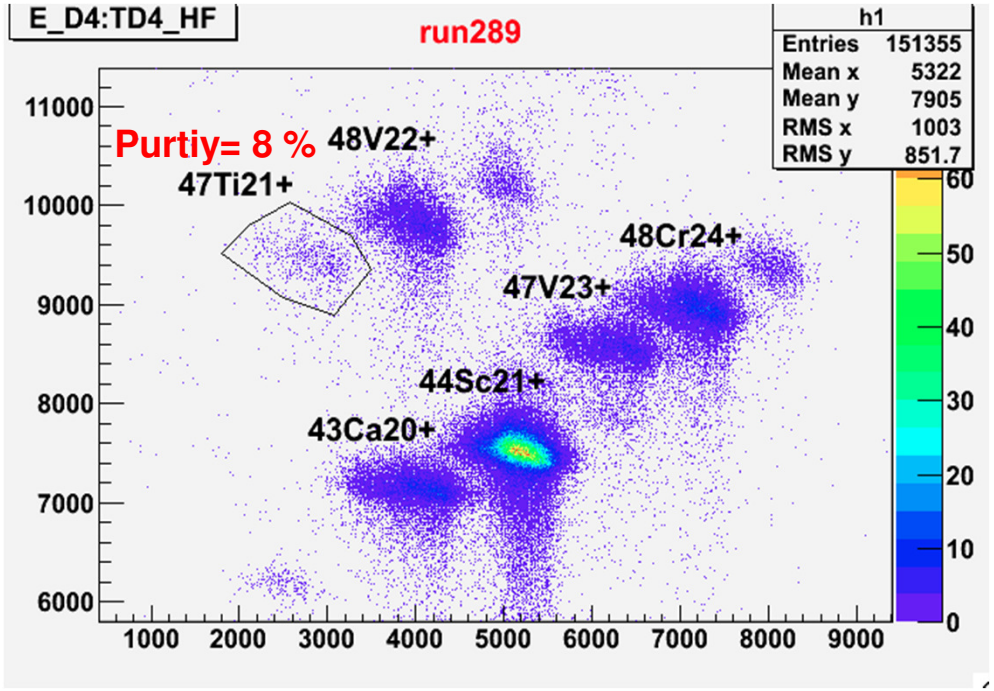
Beam focalization issues in D6: 58Ni→^{48}Cr



EXP: ^{48}Cr : 3.10^{4} pps
LISE++ : 5.10^{4} pps

Secondary target as close as possible to the slits 62 to make an efficient use of the Wien filter : not possible when a reaction target is placed in D6

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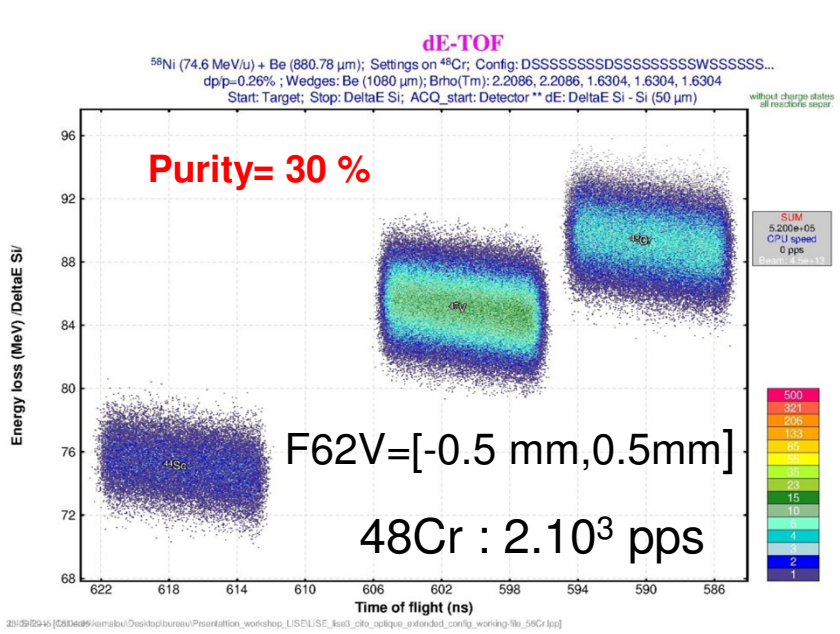
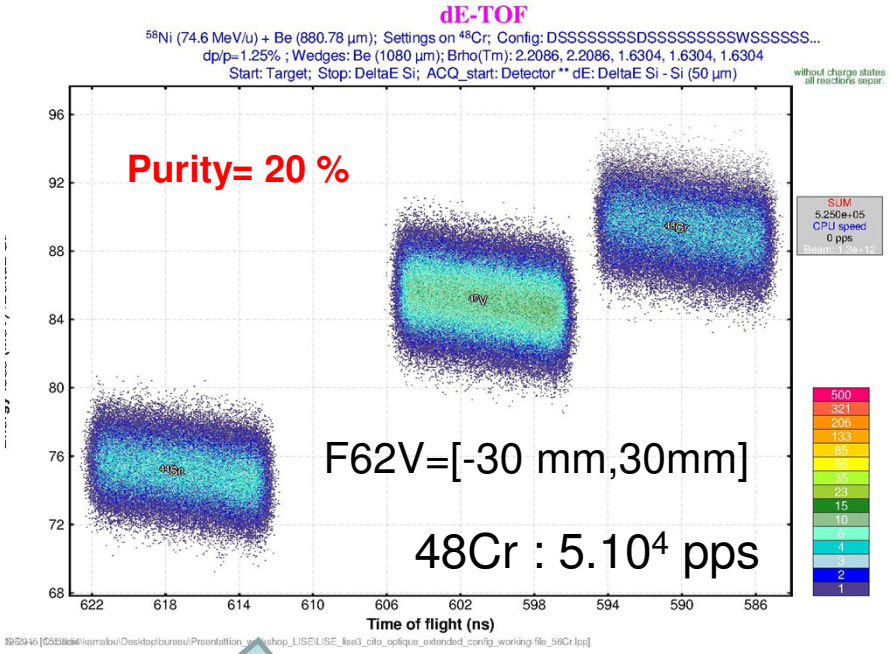
Matrix Energy vs Time of flight in D6





Experiment is not possible in such conditions

Wien filter selection:

- Focalization on F62V: good selection, large beam spot on the target.
- Focalization on the target: selection with slits is impossible.

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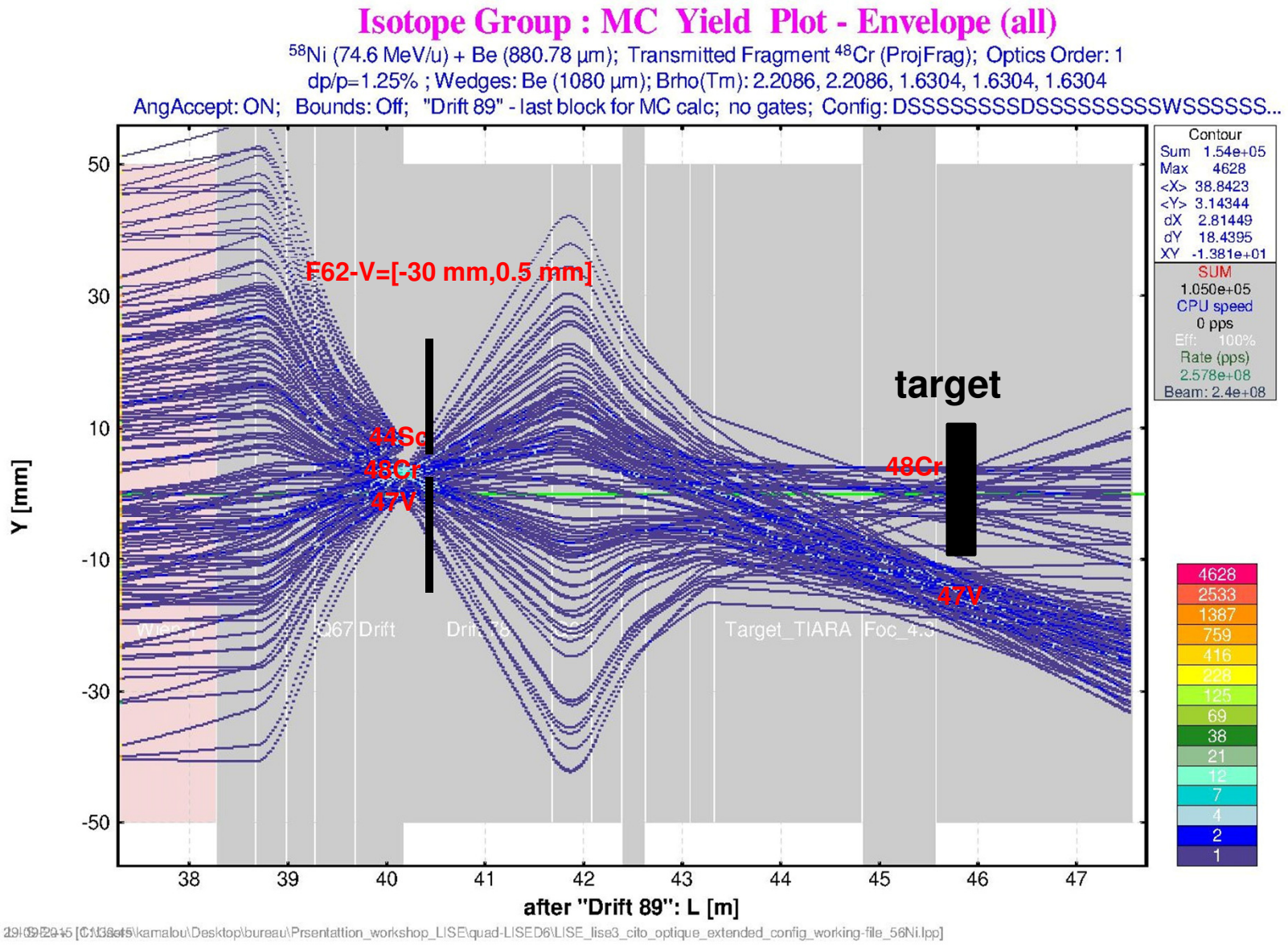
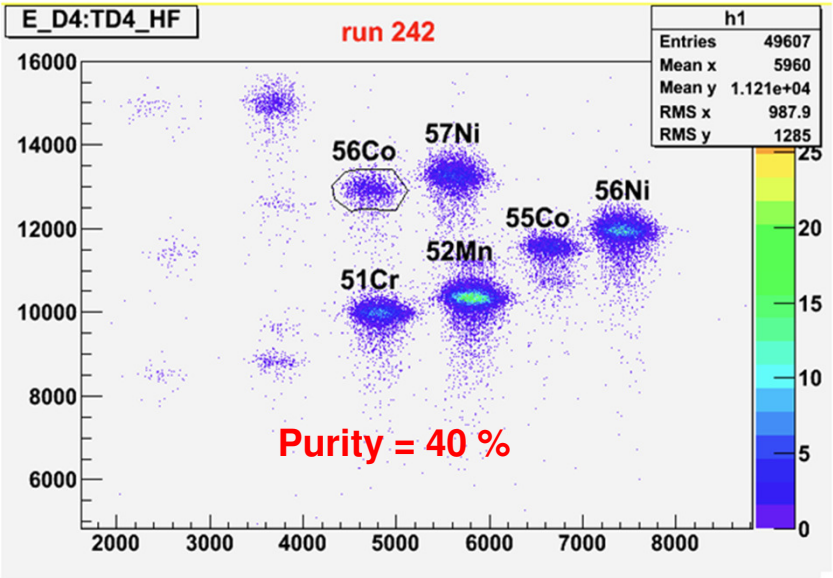
Example of ^{48}Cr Beam in D6



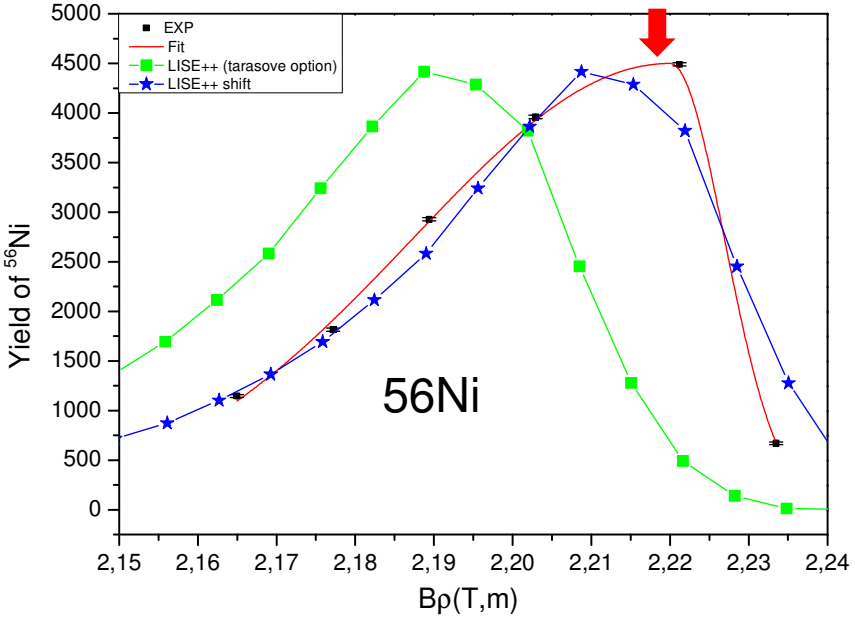
29/09/2015 [C:\Users\kamalou\Desktop\bureau\Prsentattion_workshop_LISE\quad-LISED6\LISE_lise3_cito_optique_extended_config_working-file_56Ni.lpp]

Charge state issues: example of ^{56}Ni

D4



$(\Delta\rho B)/(B\rho)$=0.9% → 14 mm in the slits 31



^{56}Ni: 2.10^5 pps

LISE++ (extended configuration) :

1.10^5 pps Purity: 20 %

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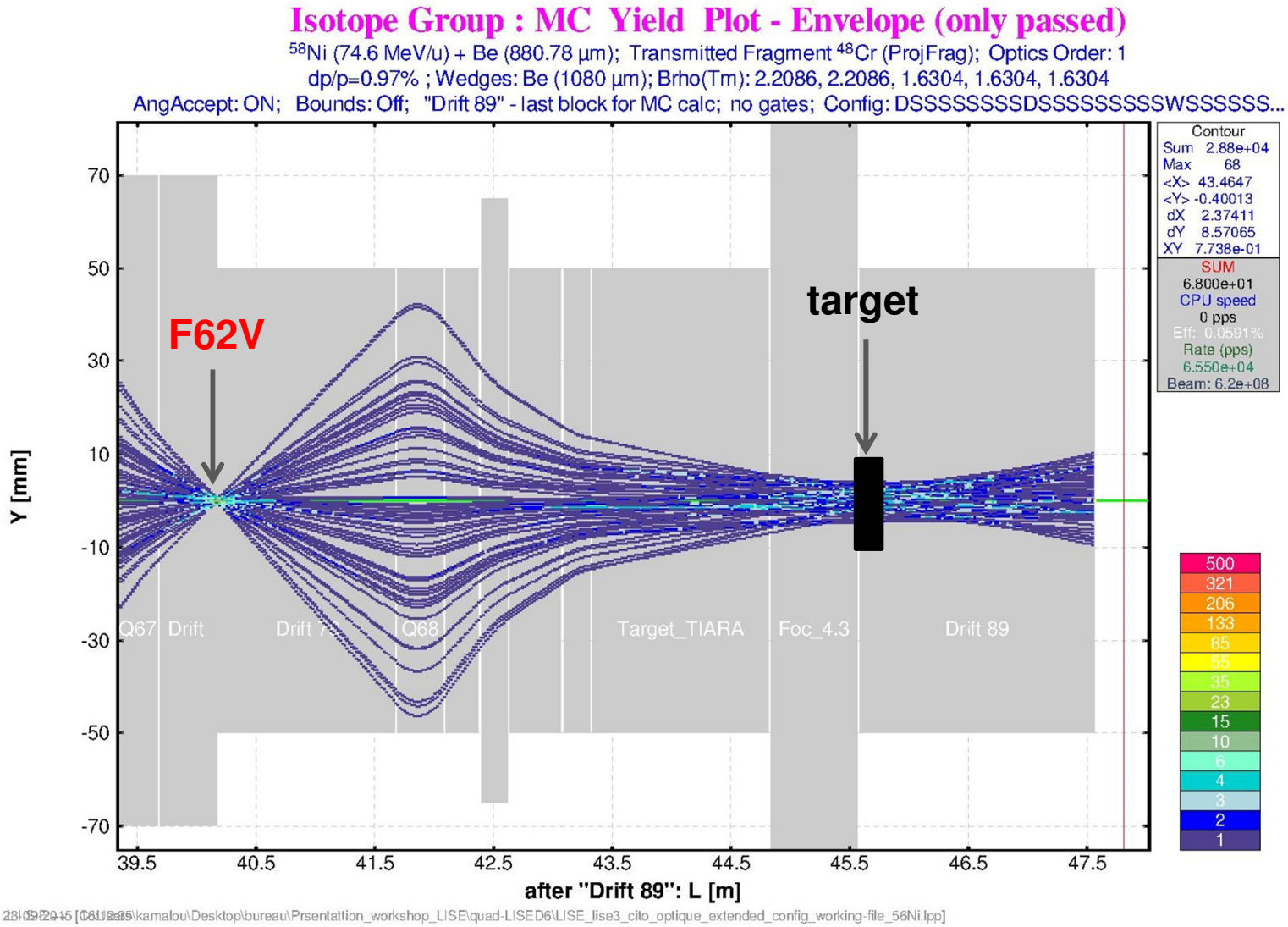
Beam envelope in Y direction in D6 (Zoom)



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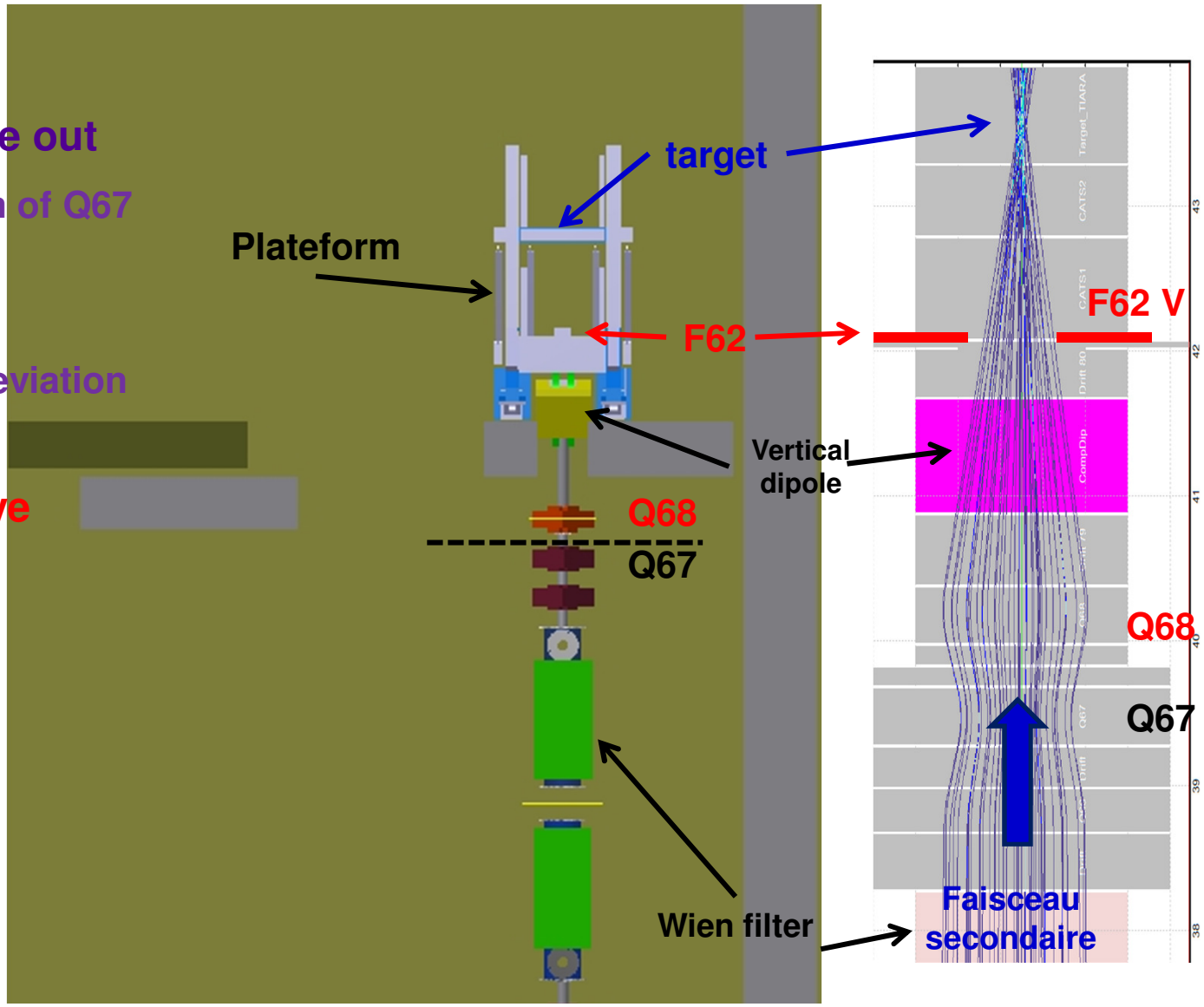
Project Realization (1)

LISE-QD6

- **Equipement to take out**
  - Chassis downstream of Q67
  - diagnostic chamber
  - Plateform
  - Dipole of verticale deviation
- **Equipement to move**
  - F62
  - Q68



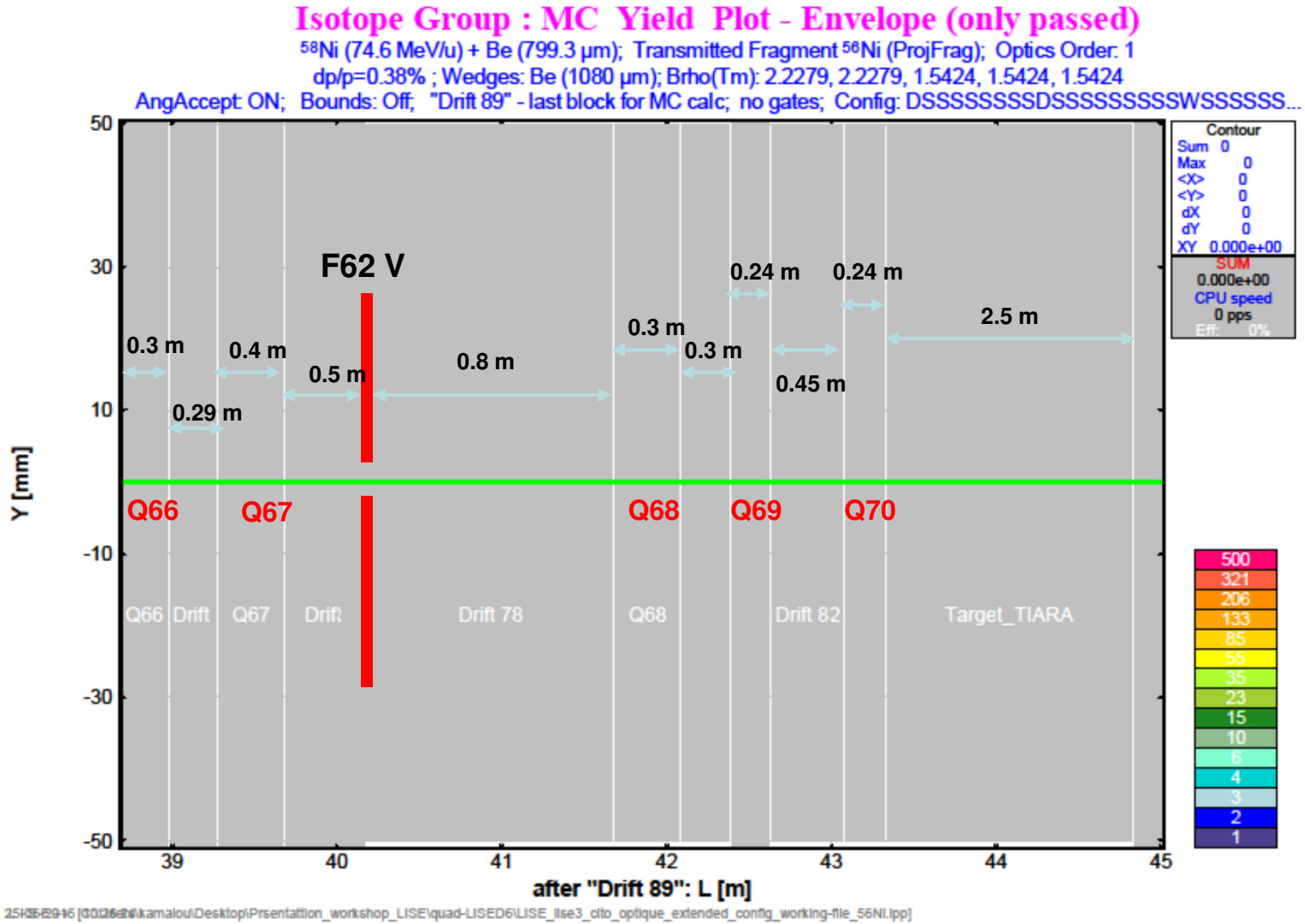
Schedule and Organization

Total: 5,25 h.m sur 8 mois, en 2017

		Janv/Fév -17	Mars 17 à Mai-17	≥ Mai-17
Mécanique				
Etudes	- 0,5 h.m	2 mois*		
Suivi fab.	- 0,1 h.m		3 mois	
SSR	- 0,3 h.m	1 sem		
Chantier	- 3,35 h.m			***3 mois***

- **Coût : 40 k€**
  - Châssis support : 5 k€
  - Chambre diagnostic : 10 k€
  - Chambres à vide : 5 k€
  - Servitudes (câblage) : 10 k€
  - Pompage : 10 k€

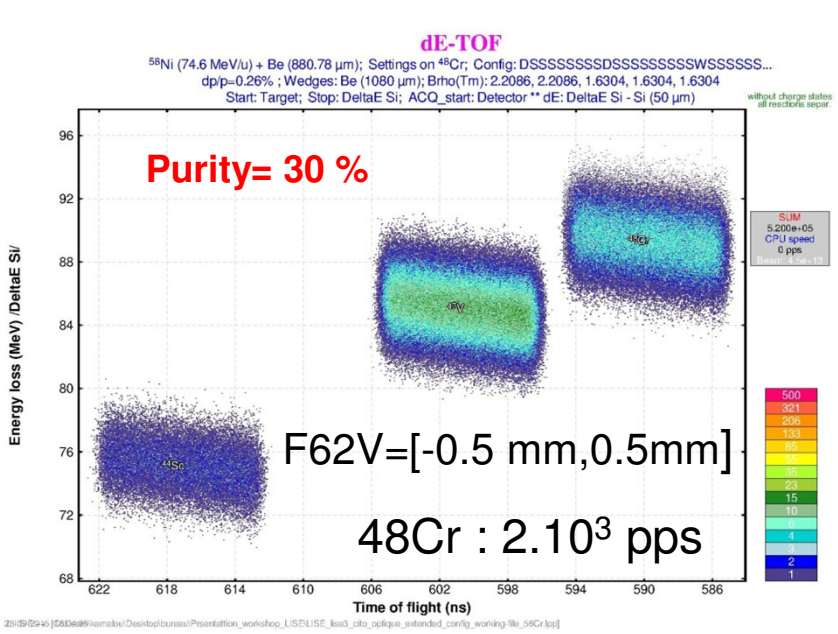
Two new quadrupoles in the D6 room

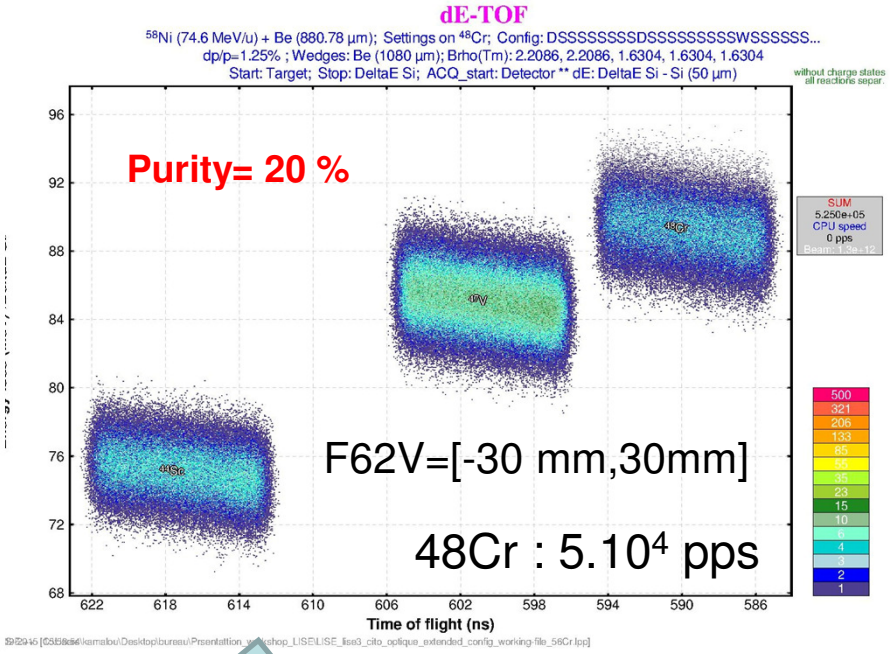


Ω=1.5 msr

(BR)max=2.4 T.m

Matrix Energy vs Time of flight in D6





Experiment is not possible in such conditions

Wien filter selection:

- Focalization on F62V: good selection, large beam spot on the target.
- Focalization on the target: selection with slits is impossible.

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Beam spot sizeat the target (56Ni@12 Mev/A)

new quadrupoles