MARS: Momentum Achromat Recoil Spectrometer

Part 2

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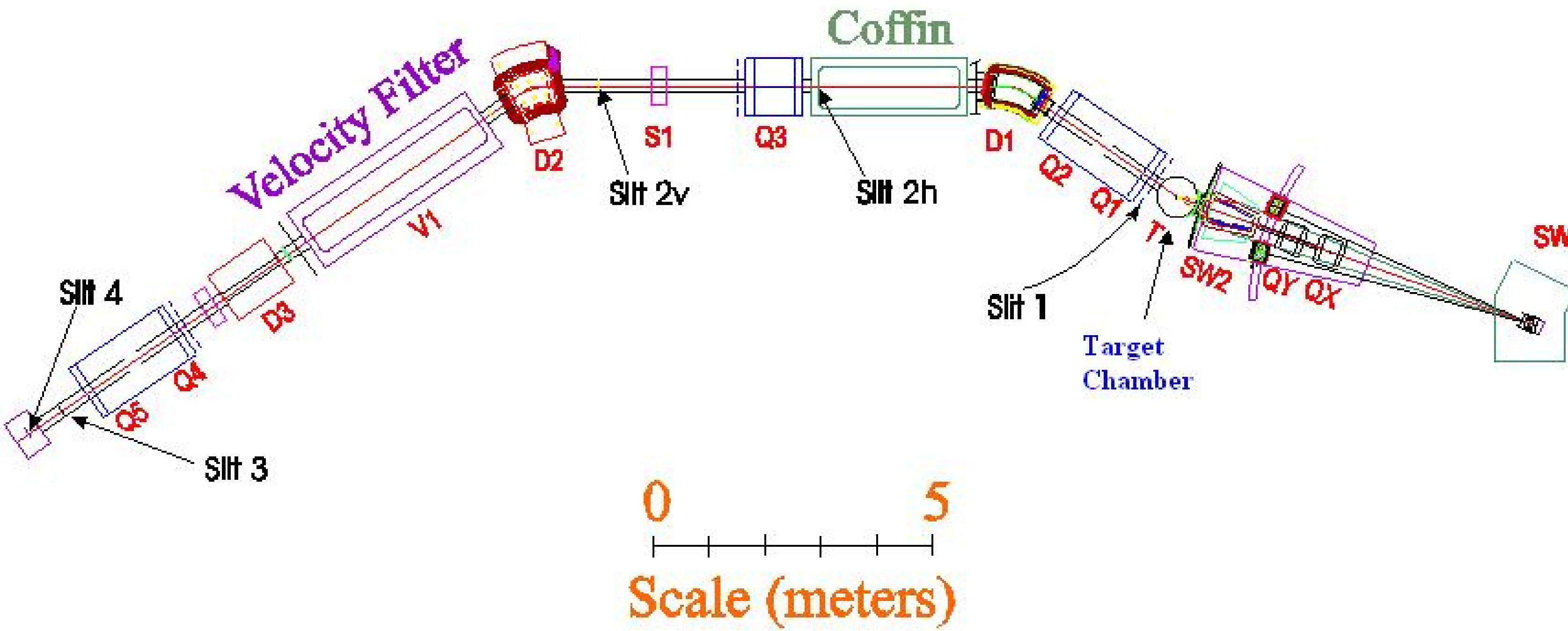
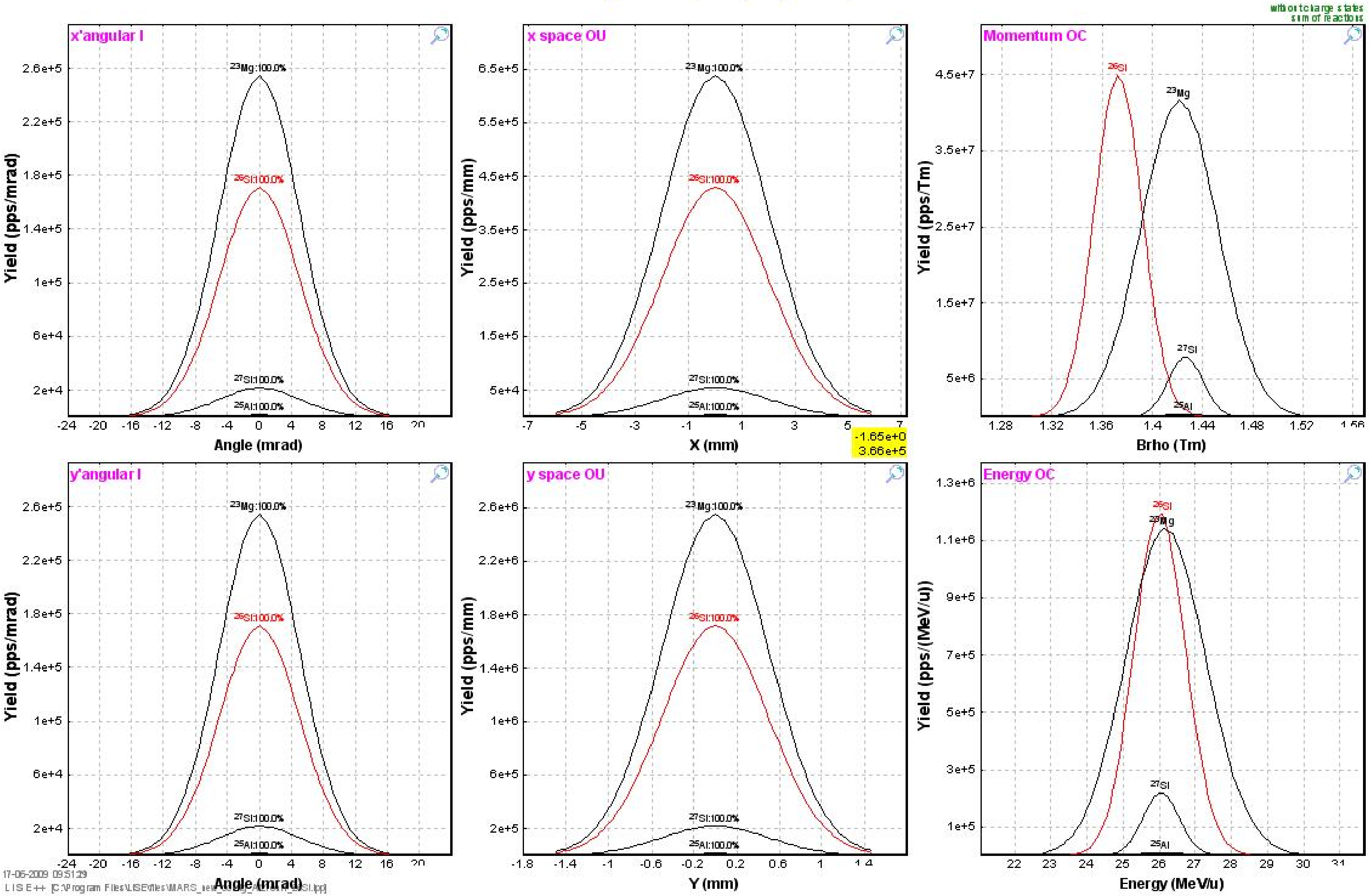
Cyclotron Institute

Momentum Achromat Recoil Spectrometer

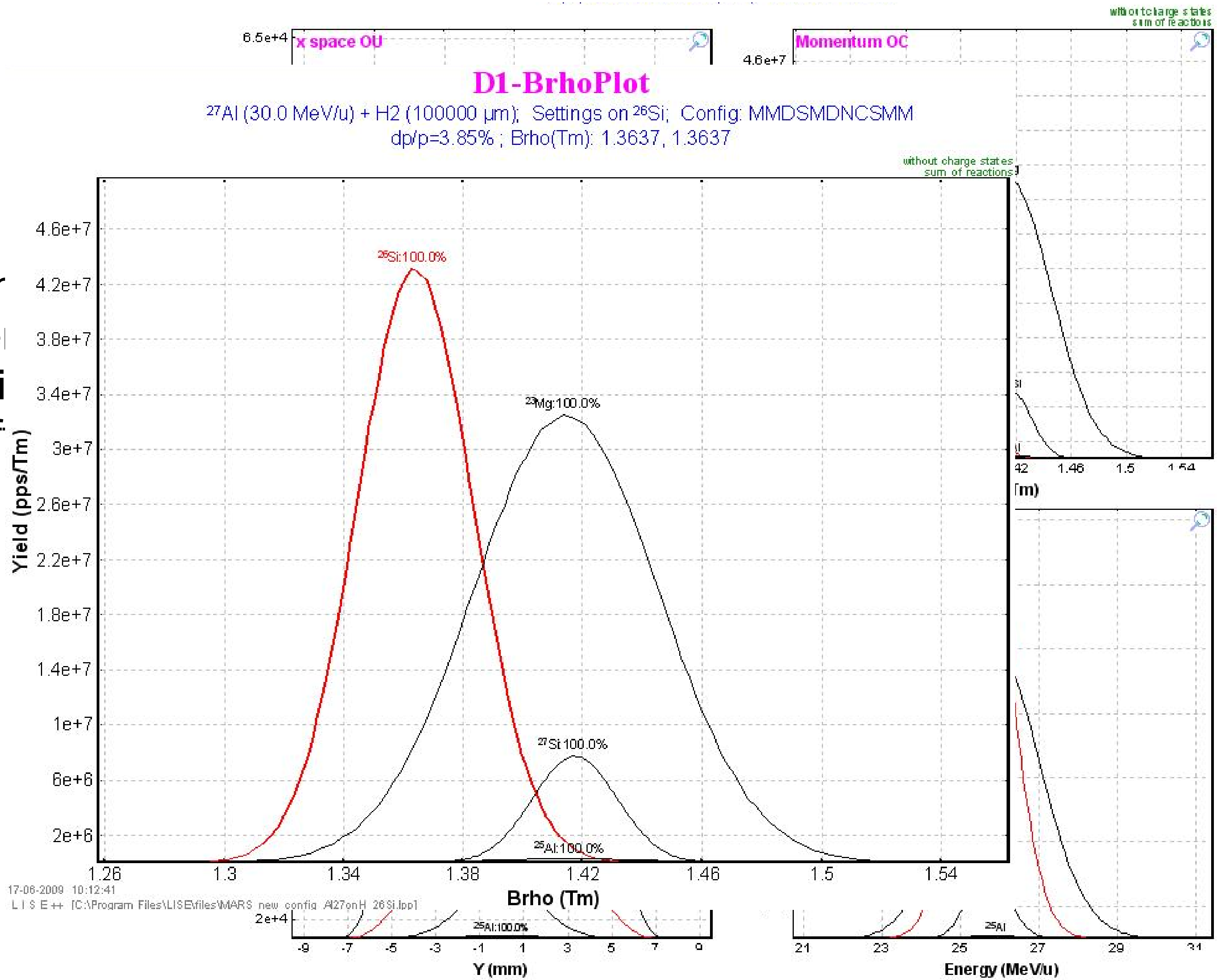


Target

^{27}Al (30.0 MeV/u) + H2 (100000 µm); Settings on ^{26}Si; Config: MMDSMDNCSMM
dp/p=3.85% ; Brho(Tm): 1.3637, 1.3637

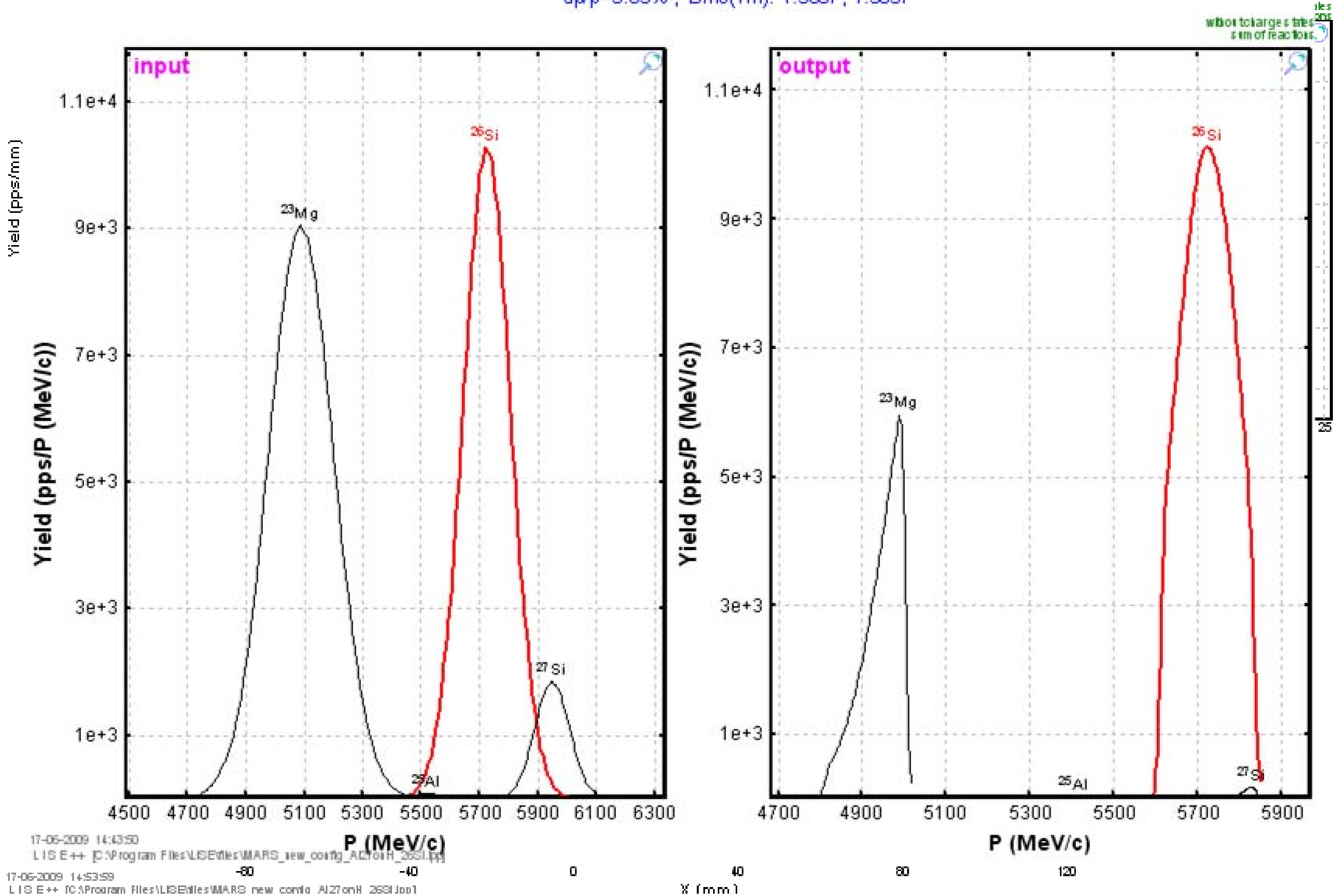


- Space, r
and ene
distributi
beam af
through
D1

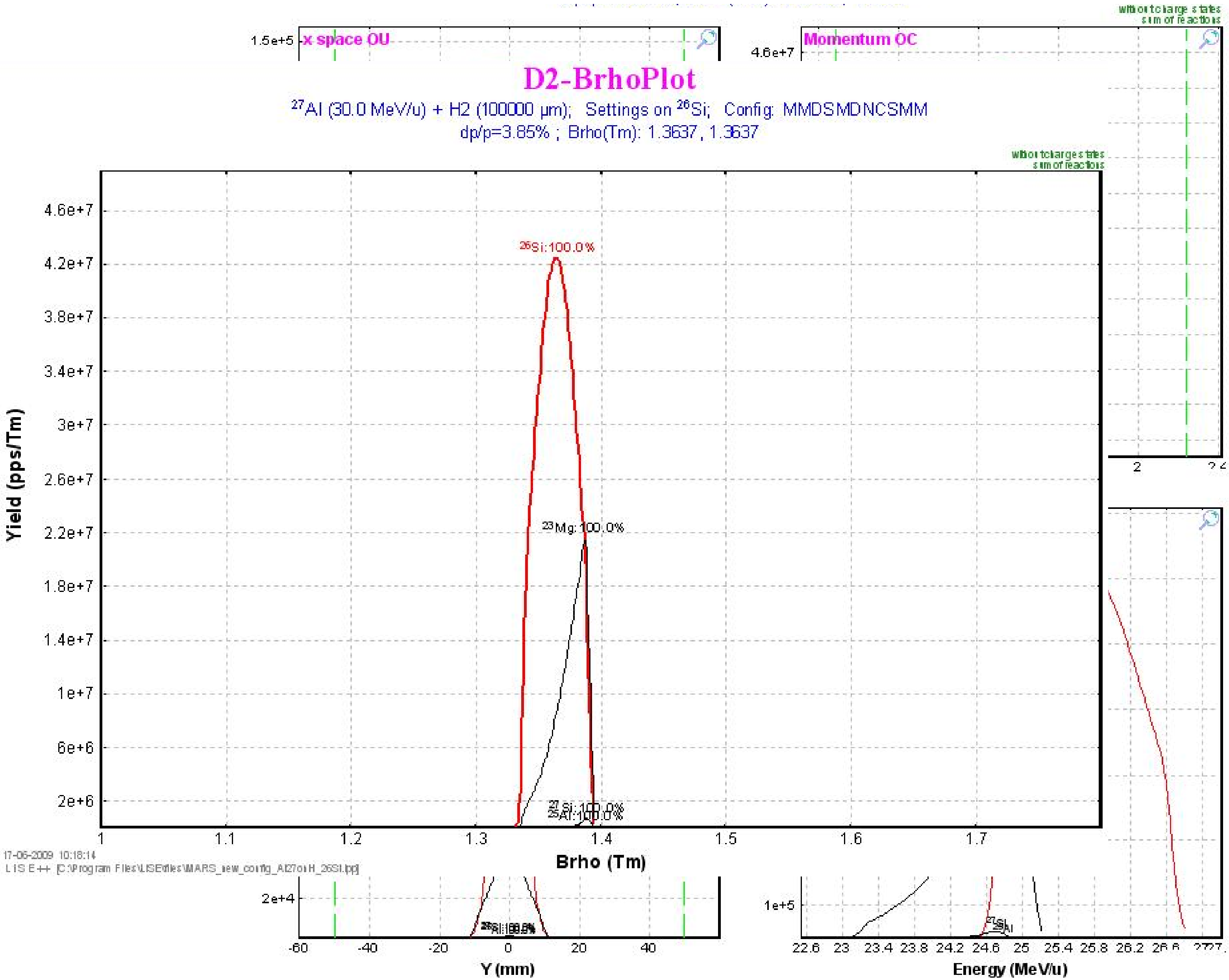


Slits #2 Coffin-Moment

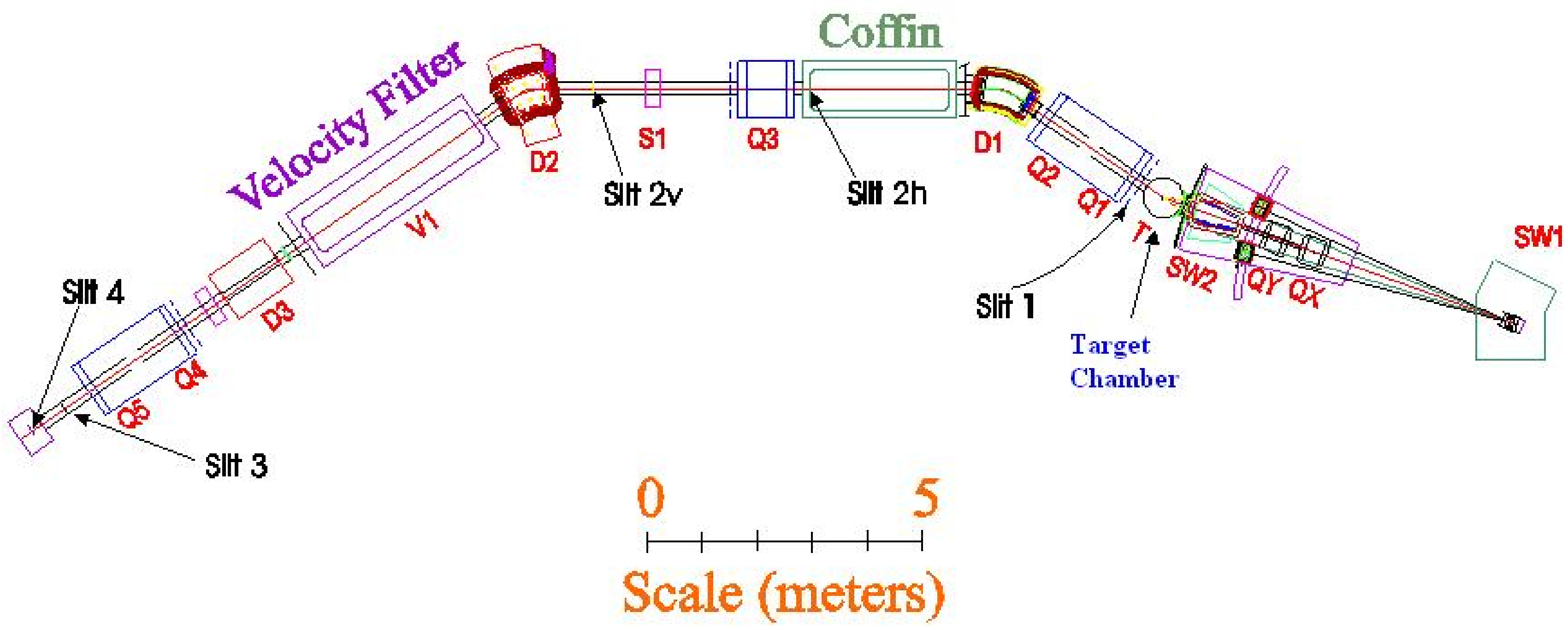
^{27}Al (30.0 MeV/u) + H2 (100000 μm); Settings on ^{26}Si; Config: MMDSMDNCSMM
dp/p=3.85% ; Brho(Tm): 1.3637, 1.3637

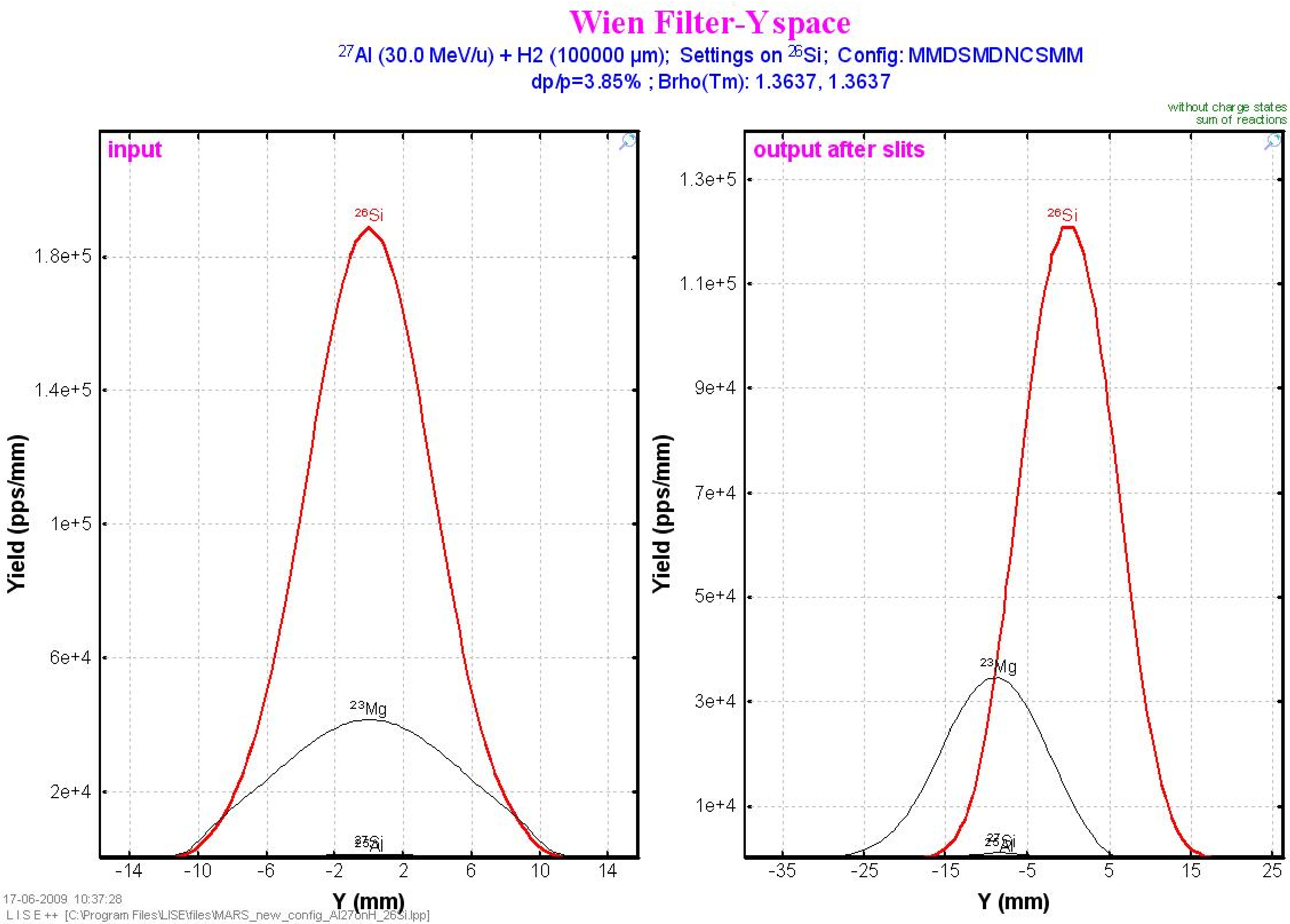


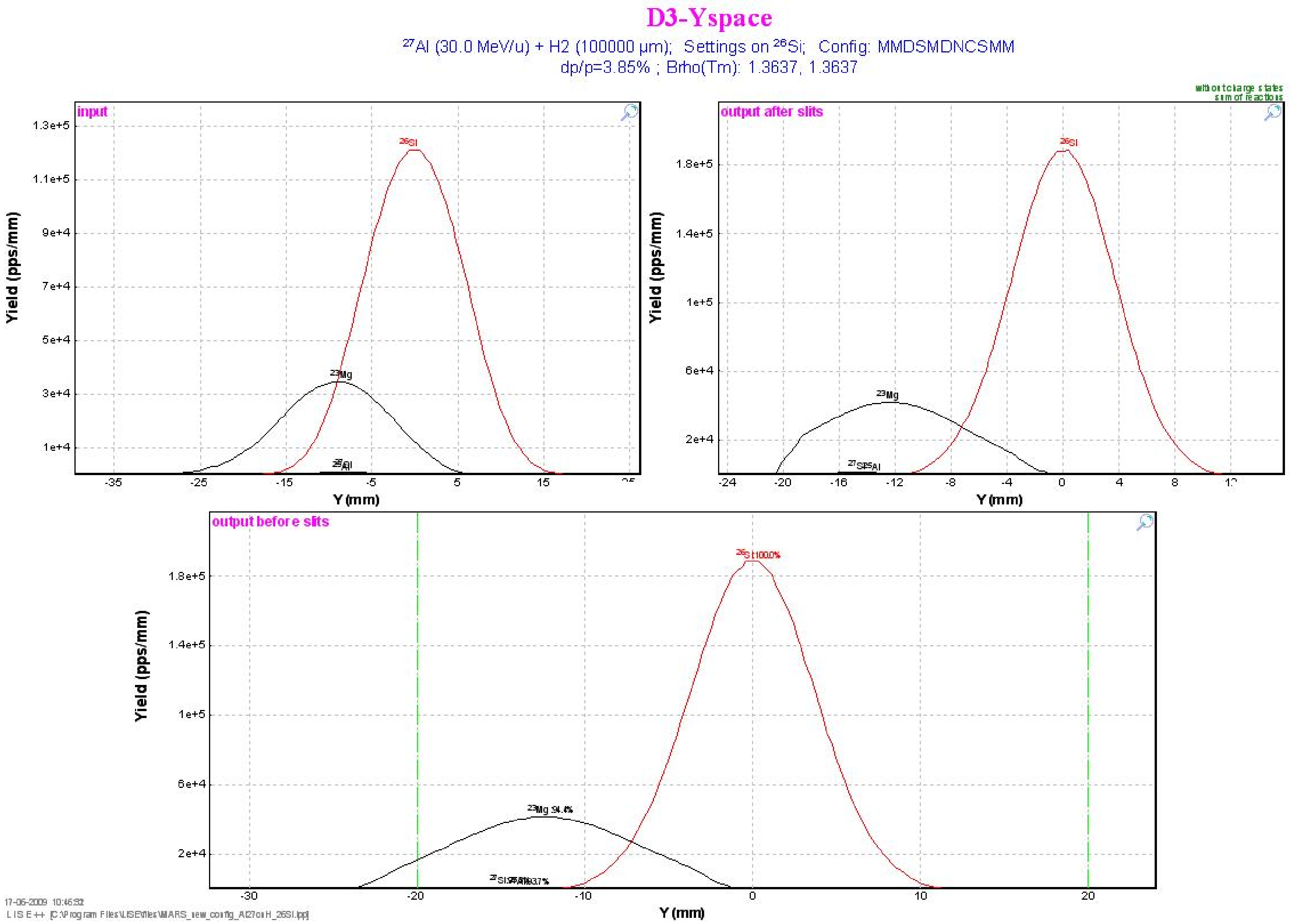
- Space, and ene distribut beam a through



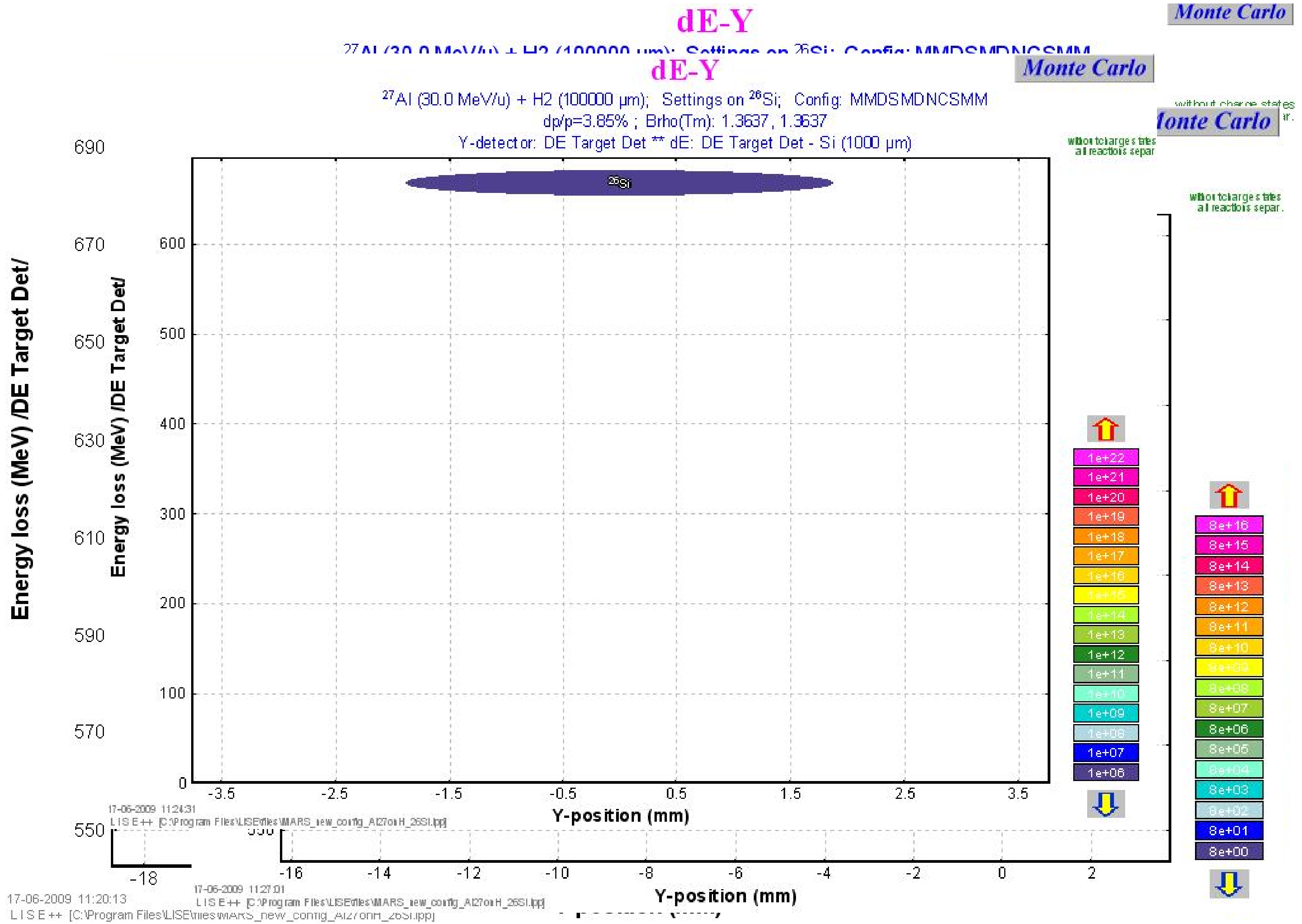
Momentum Achromat Recoil Spectrometer

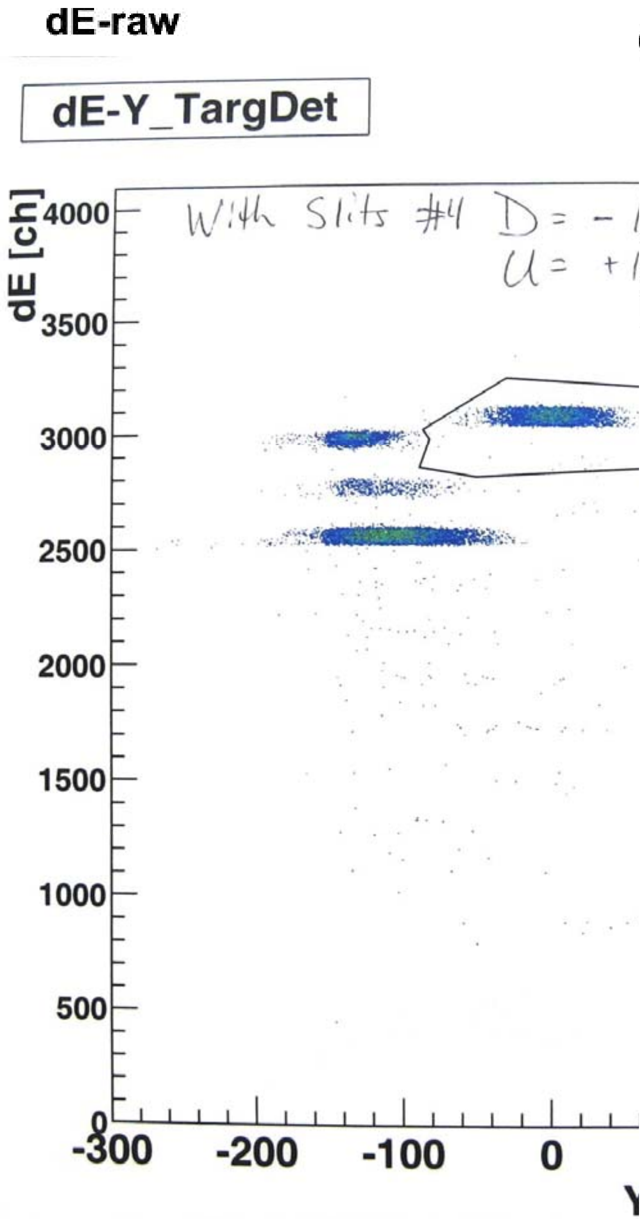



Wien Filter-Y space
27Al (30.0 MeV/u) + H2 (100000 µm); Settings on 26Si; Config: MMDSMDNCSMM
dp/p=3.85% ; Brho(Tm): 1.3637, 1.3637
without charge states
sum of reactions
input
output after slits
26Si
23Mg
27Si
25Al
Yield (pps/mm)
Y (mm)
17-06-2009 10:37:28
L I S E ++ [C:\Program Files\LISE\files\MARS_new_config_Al27onH_26Si.lpp]

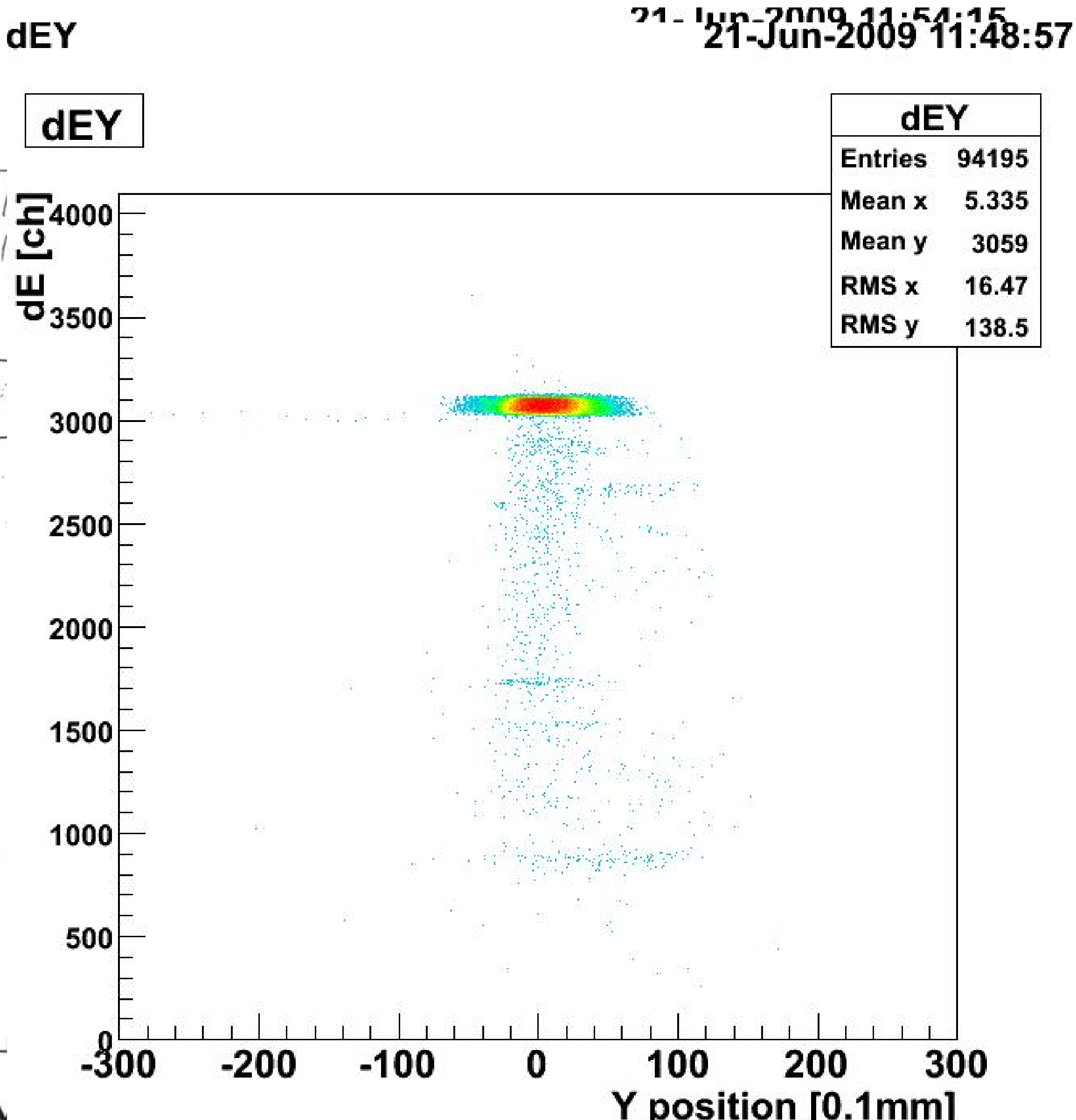


D3-Yspace
27Al (30.0 MeV/u) + H2 (100000 μm); Settings on 26Si; Config: MMDSMDNCSMM
dp/p=3.85% ; Brho(Tm): 1.3637, 1.3637
input
output after slits
output before slits
Yield (pps/mm)
Y (mm)
26Si
23Mg
26Si 100.0%
23Mg 94.4%
17-06-2009 10:45:32
LISE++ [C:\Program Files\LISE\files\MARS_new_config_Al27onH_26Si.lpp]


dE-Y
Monte Carlo
^{27}Al (30.0 MeV/u) + H2 (100000 μm); Settings on ^{26}Si; Config: MMDSMDNCSMM
dp/p=3.85% ; Brho(Tm): 1.3637, 1.3637
Y-detector: DE Target Det ** dE: DE Target Det - Si (1000 μm)
Energy loss (MeV) /DE Target Det/
Y-position (mm)
^{26}Si
17-06-2009 11:20:13
17-06-2009 11:24:31
17-06-2009 11:27:01



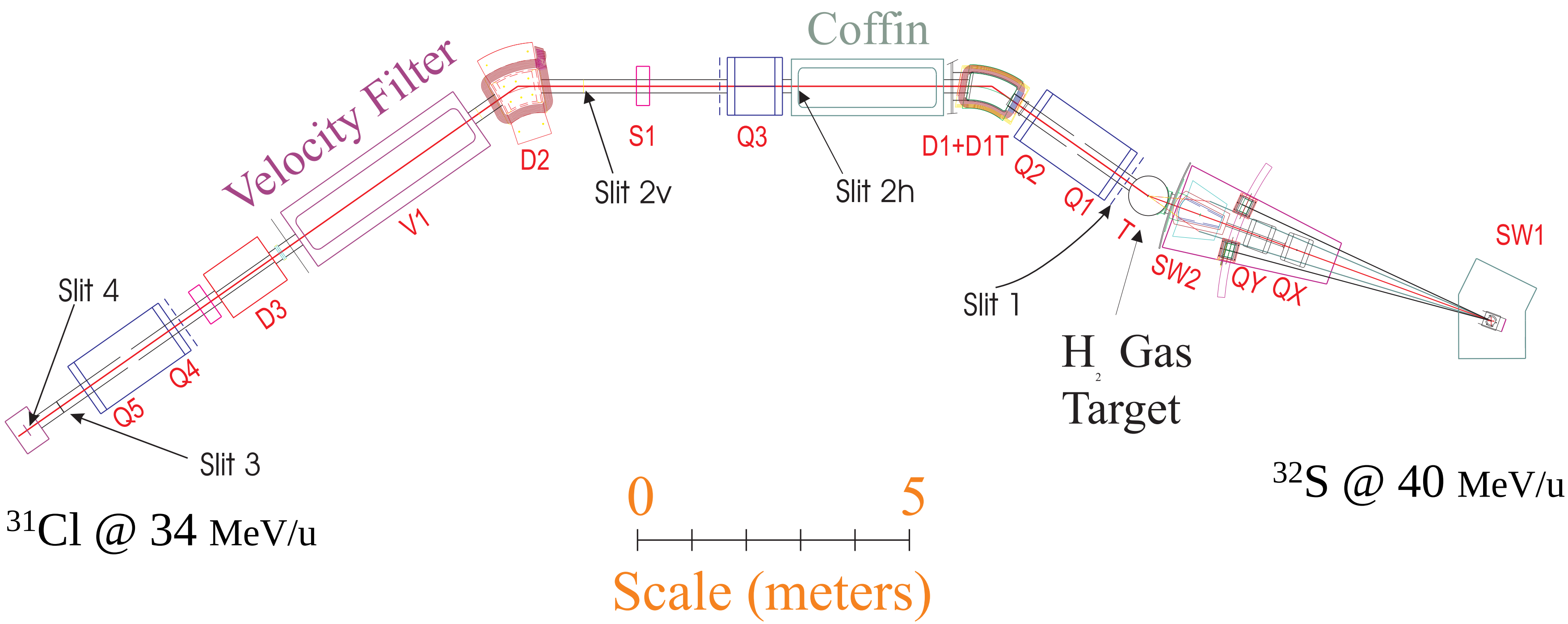
dE-raw
dE-Y_TargDet
dE [ch]
With Slits #4 D= -1
U= +1
4000
3500
3000
2500
2000
1500
1000
500
0
-300
-200
-100
0



dEY
21-Jun-2009 11:48:57
dEY
dEY
Entries 94195
Mean x 5.335
Mean y 3059
RMS x 16.47
RMS y 138.5
dE [ch]
4000
3500
3000
2500
2000
1500
1000
500
0
-300
-200
-100
0
100
200
300
Y position [0.1mm]

Okaaay…so now what?

Example –RUN1107: β-delayed p-decay of ^{31}Cl



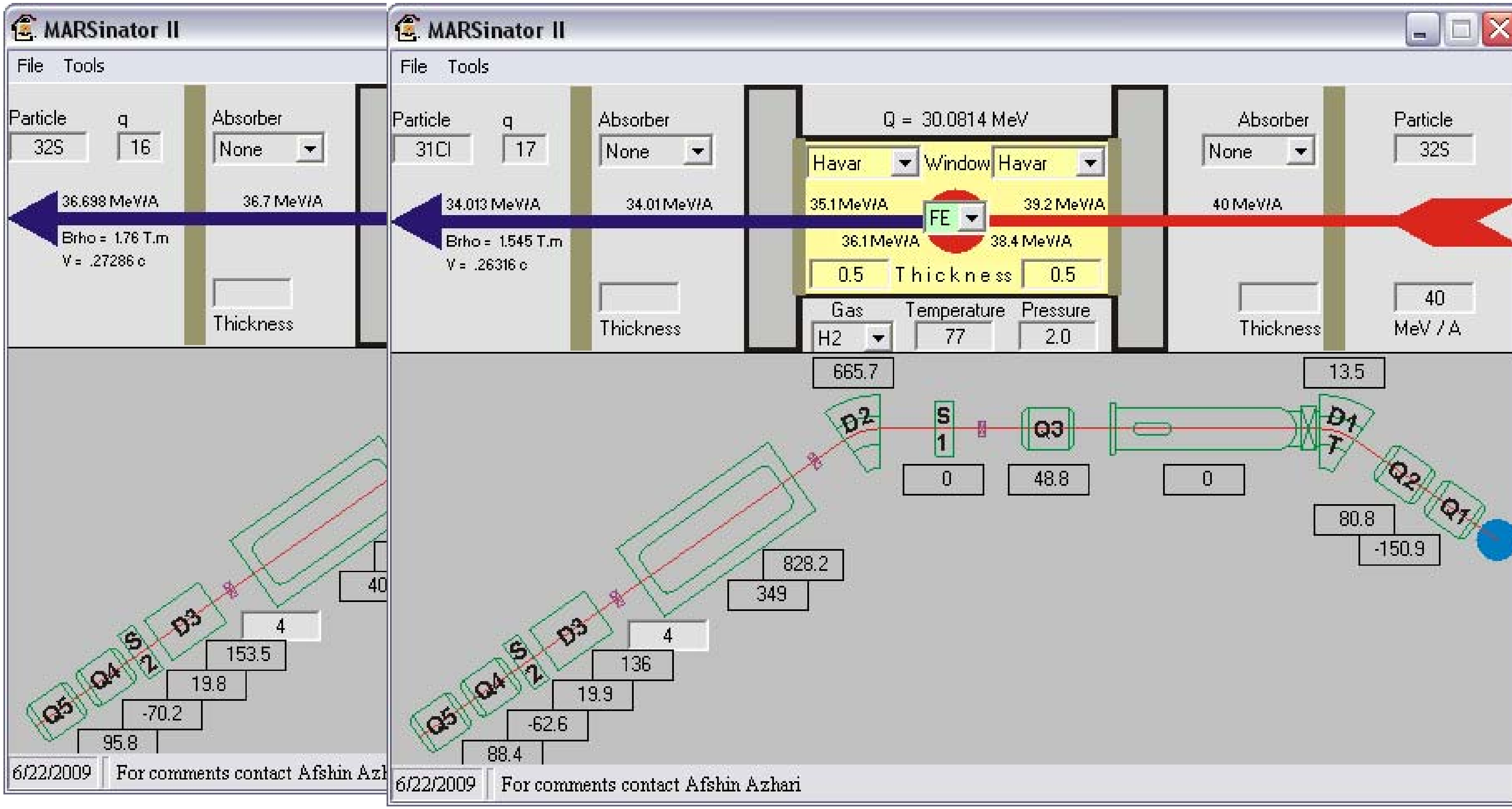
Purity: > 85 % (at target det)
Intensity: ~ 2-3000 pps
Difficult - pure & intense 31Cl

Primary beam ^{32}S @ 40A MeV – K500 Cyclotron
Primary target LN_2 cooled H_2 gas p=2 atm
Secondary beam ^{31}Cl @ 34 A MeV

MARS Settings – Marsinator II

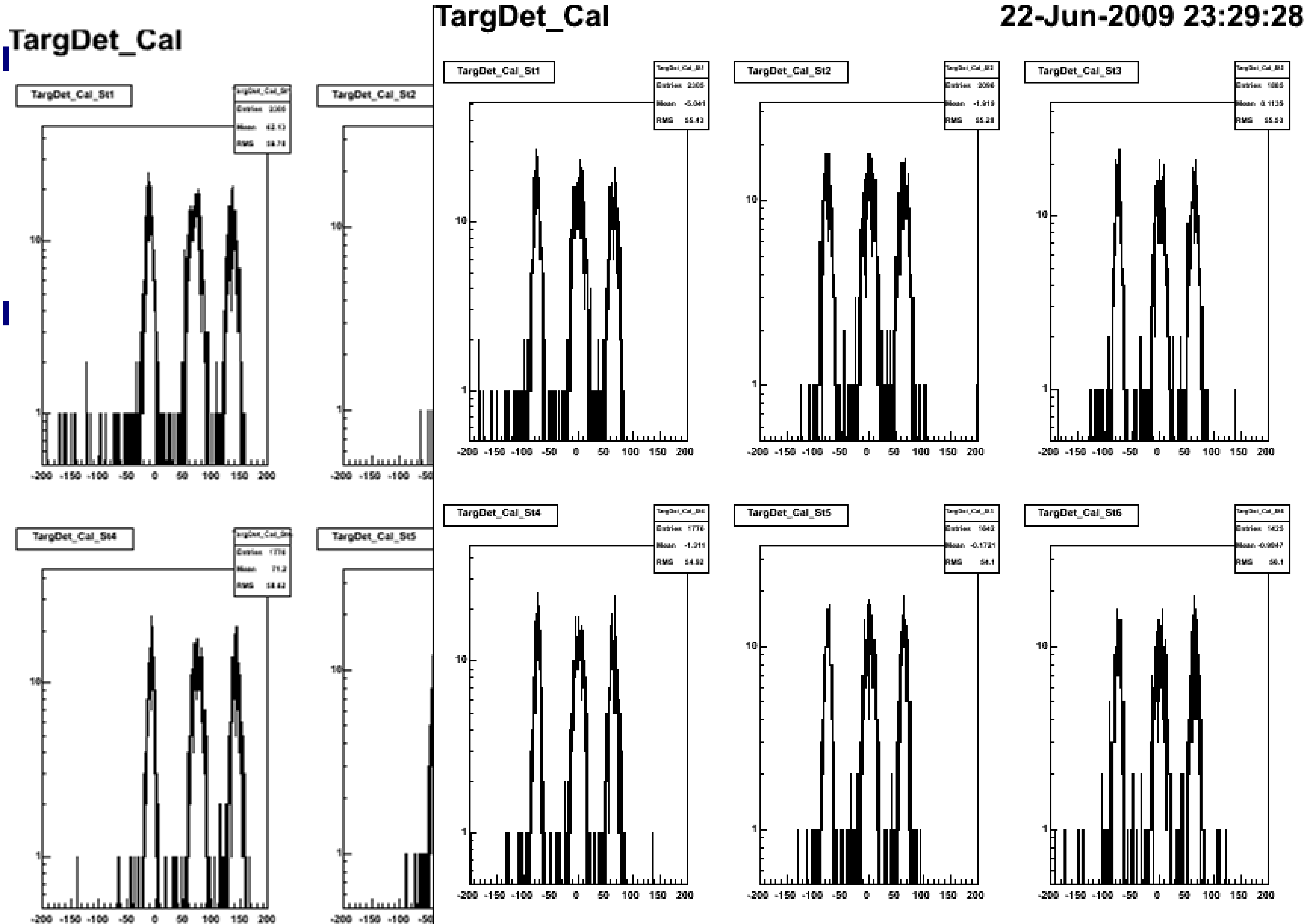
Primary beam settings

Secondary beam settings

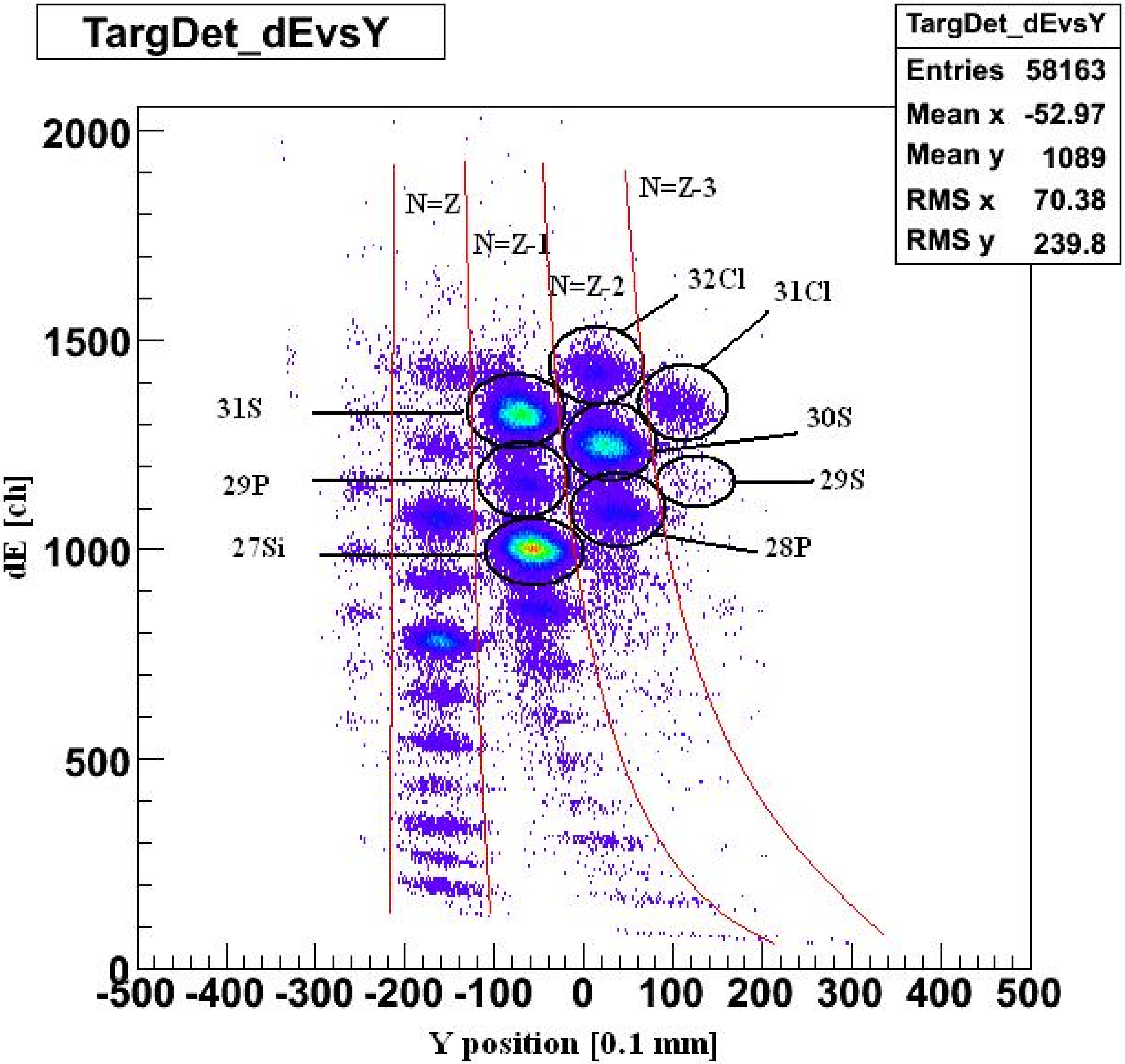


Production and separation of ^{31}Cl

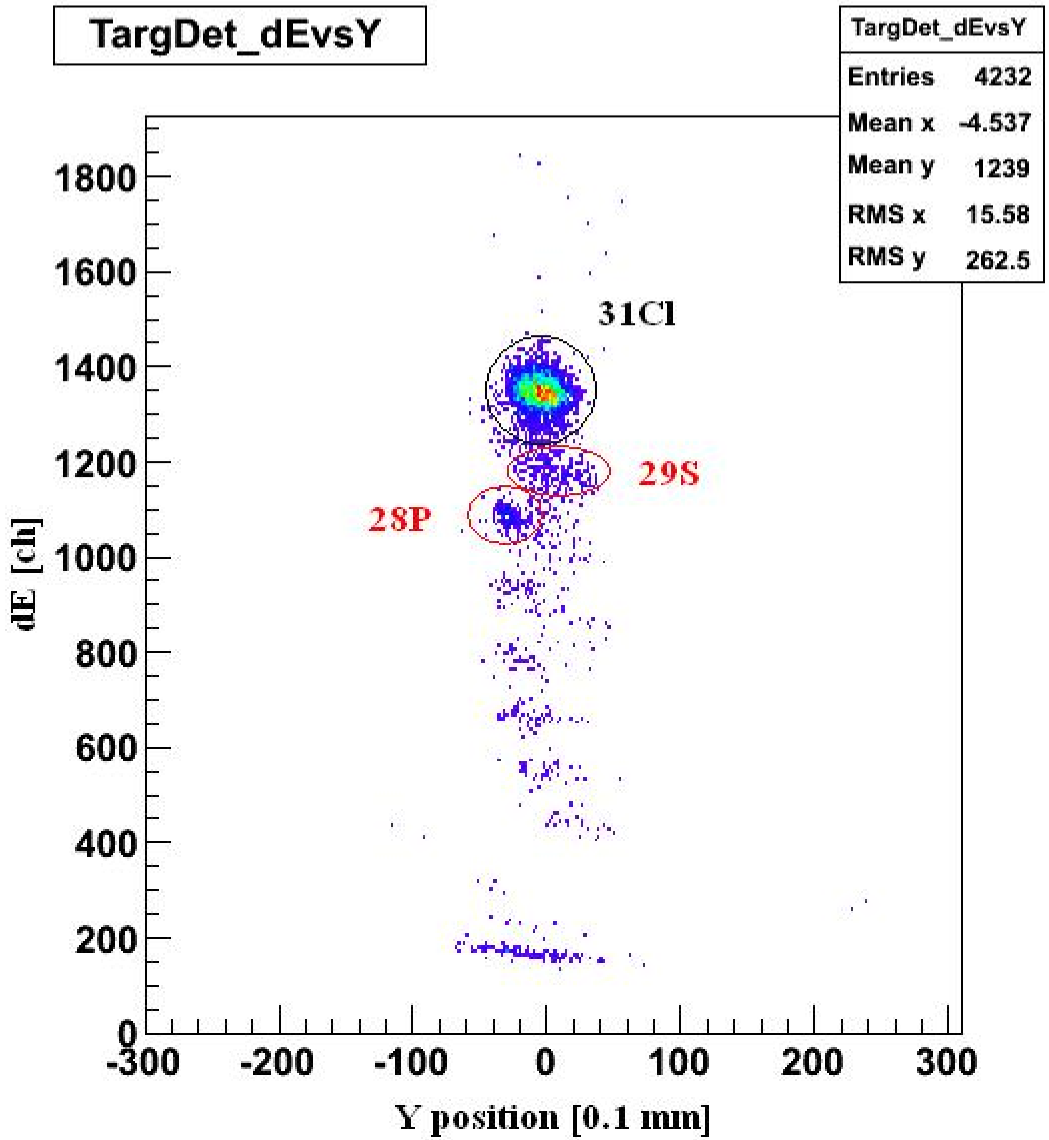
- Check beam from cyclotron on viewer - centered
- Set MARS for primary beam – used values found with Marsinator
- Close coffin slits and adjust D_{12} to find and center the beam – found at D_{12}=765.7A ($D_{12\text{-calc}}$=785.7A)
- Set MARS for secondary beam – used values found with Marsinator
- Find FC position in coffin for maximum primary beam intensity – found at 190cm


TargDet_Cal
TargDet_Cal
22-Jun-2009 23:29:28
TargDet_Cal_St1
TargDet_Cal_St2
TargDet_Cal_St3
TargDet_Cal_St4
TargDet_Cal_St5
TargDet_Cal_St6
Entries
Mean
RMS
-200 -150 -100 -50 0 50 100 150 200

- D_3 s… …ue
  D_3=1… …n Run
- S4 –



- Close S4 as much as possible – T/B=2.5/0.411cm – M/q selection
- D_{12} scan – maximiz
  found D_{12}=665.9A
- Q_4-Q_5 scan – impro
  Q_5=90A
- Another D_3 scan to
- Closed S4 B to 0.2

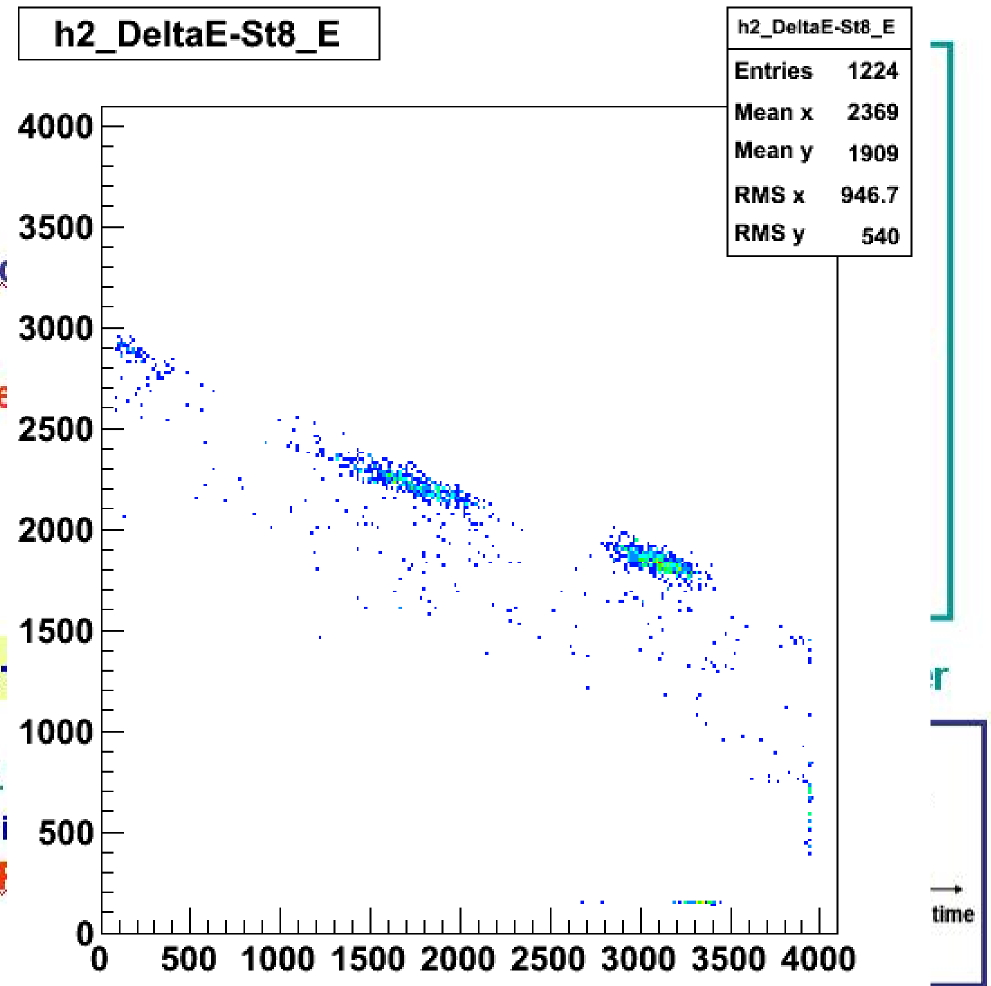


^{31}Cl production rate
8.3ev/nC ~ 3600 pps

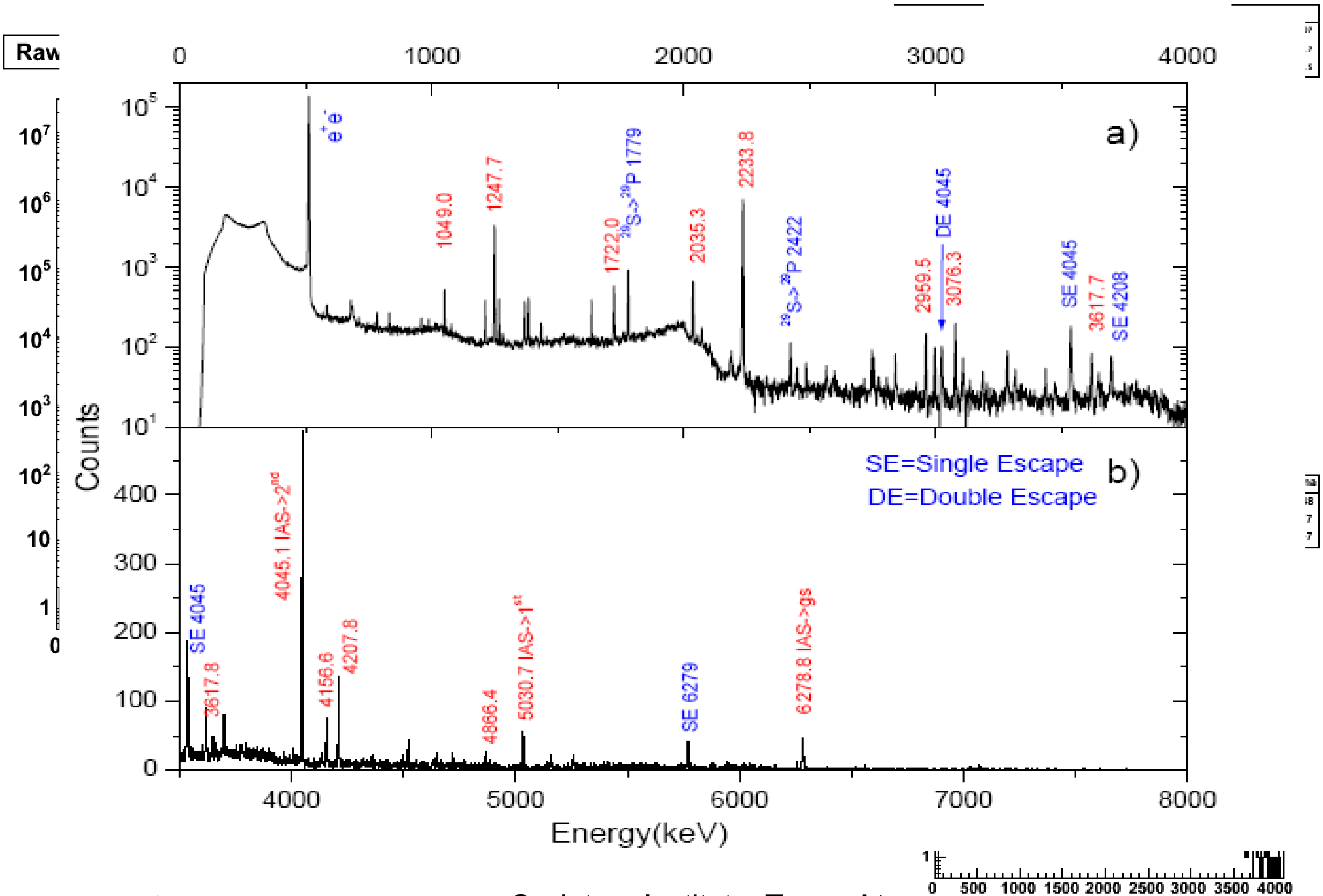
Impurities ~ 20%

Implantation of ^{31}Cl - steps

- Exact same setup
- Drop target detector
- Start rotating the degrader
- ^{31}Cl ions should disappear from p-det for $\varphi_{p\text{-calc}}$=39.3°
- ^{31}Cl ions should disappear from β-det for $\varphi_{b\text{-calc}}$=28.3°
- $\varphi_{middle\text{-calc}}$=35°
- Rotated degrader from 0° to 44°
- Found φ_b=34°, $\varphi_{p\text{-calc}}$=44° and φ_{middle}=39.6°

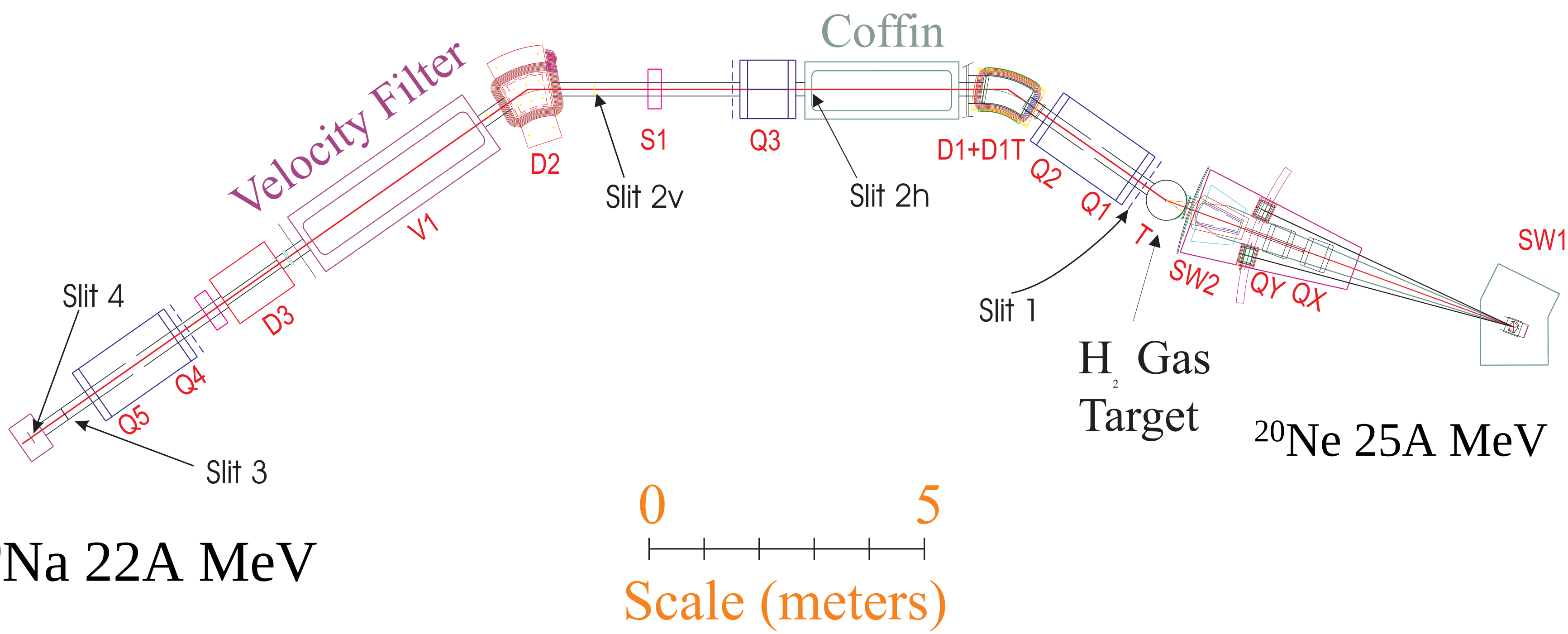


31Cl β-delayed p-decay



Momentum Achromat Recoil Separator

In-flight RB production



Purity: > ?! % (at target det)
Intensity: ~ ?! pps
difficult - ?!

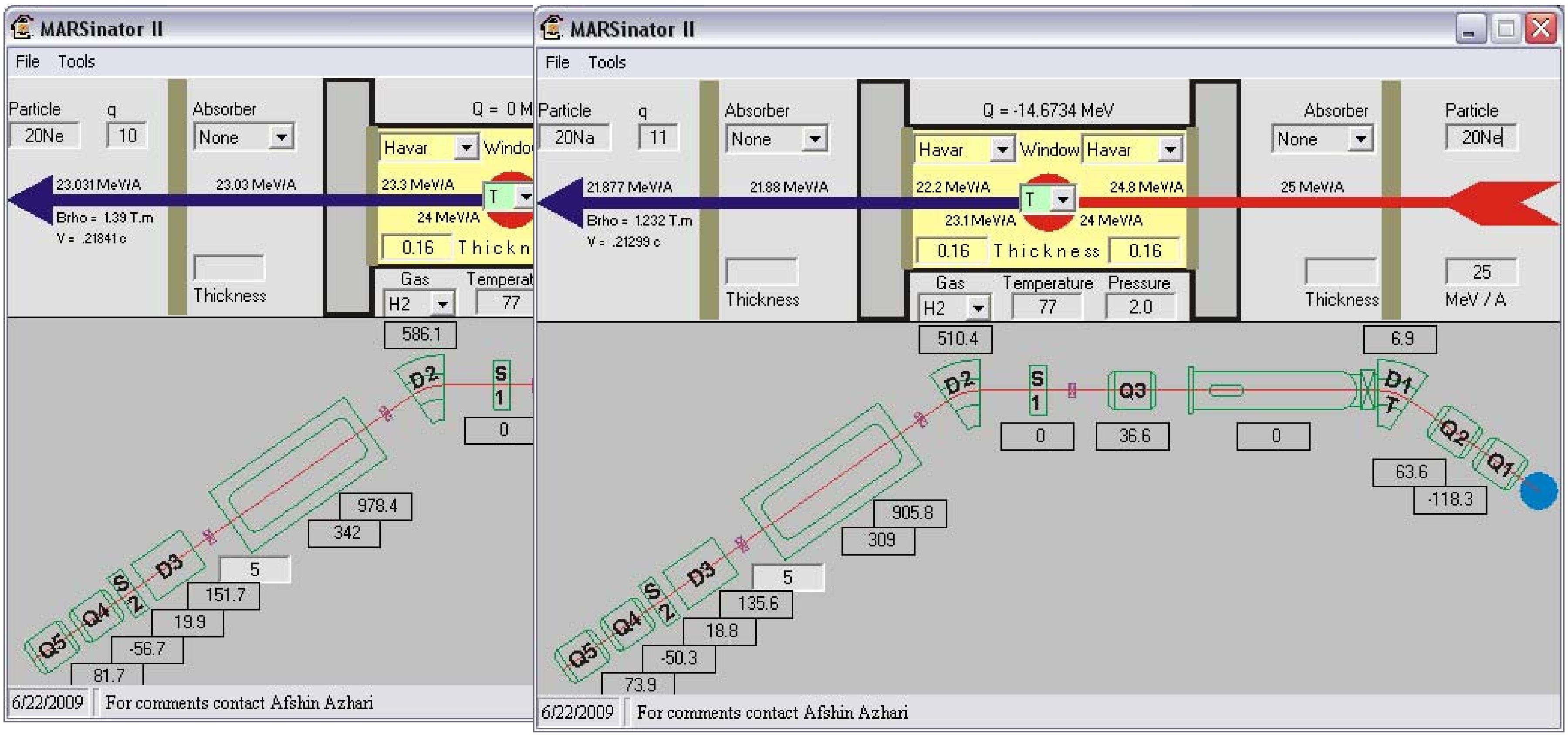
Primary beam ^{20}Ne @ 25A MeV – K500 Cyclotron
Primary target LN$_2$ cooled H$_2$ gas p=2 atm
Secondary beam ^{20}Na @ 22 A MeV

(p,2n) reaction

MARS Settings – Marsinator II

Primary beam

Secondary beam



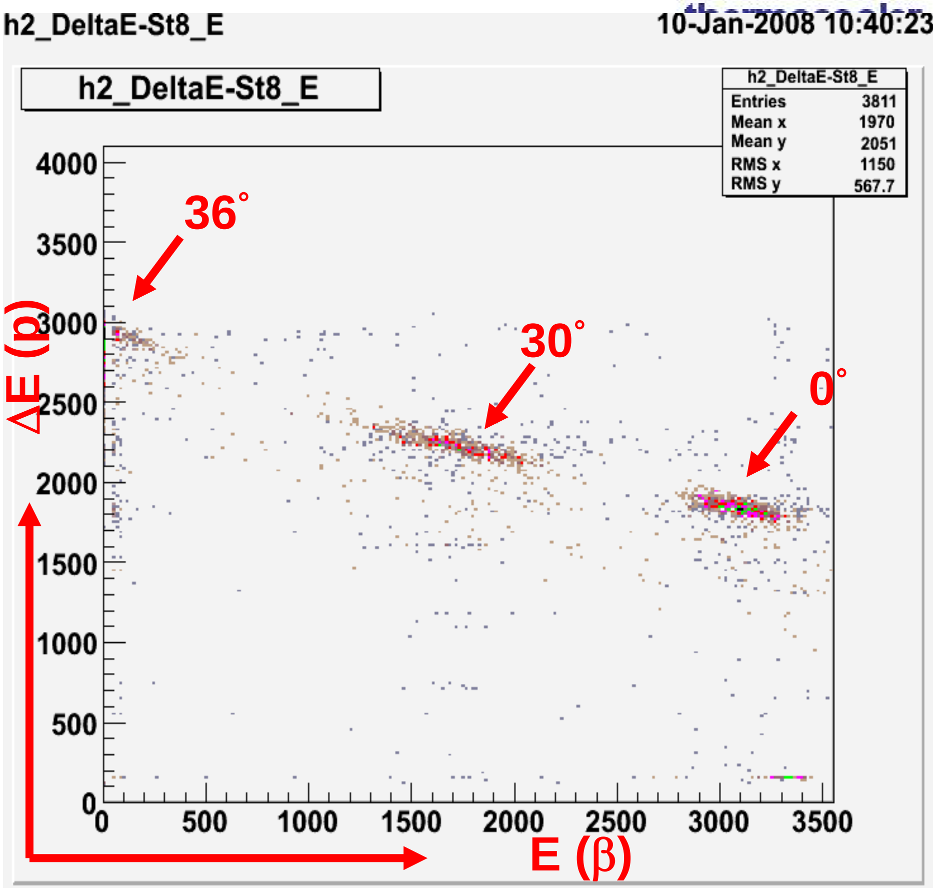
Production and separation of ^{20}Na - steps

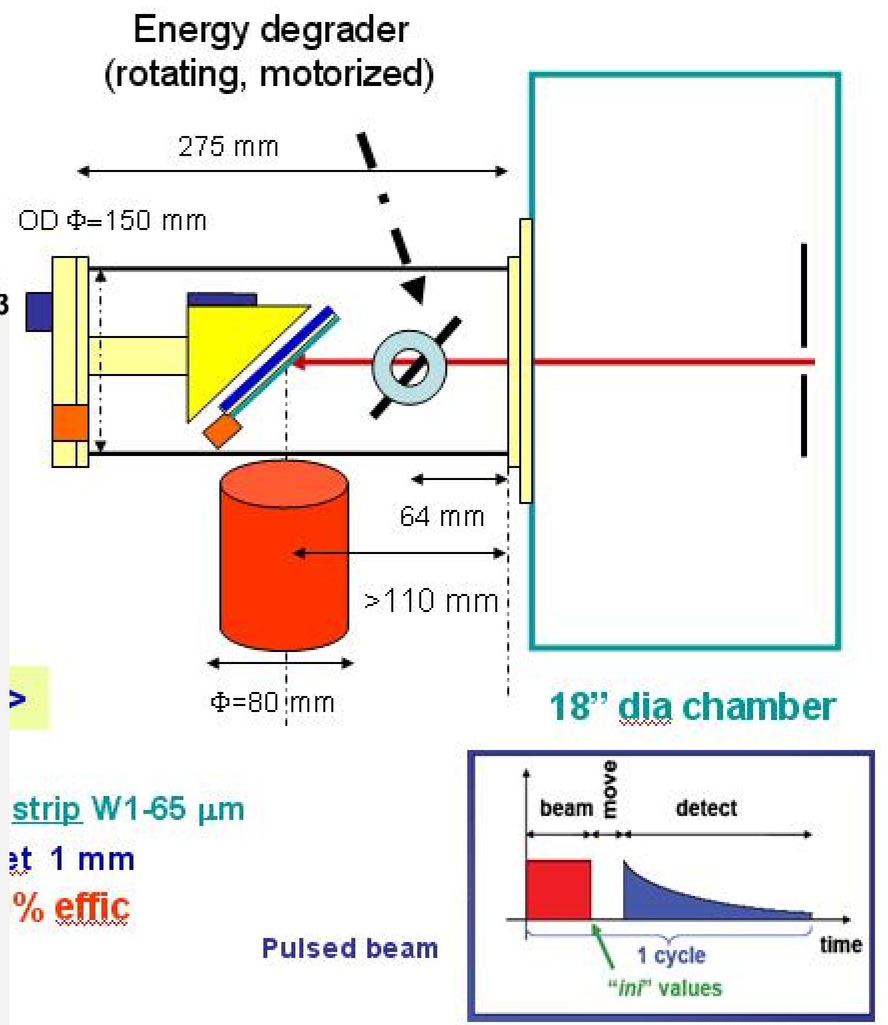
- Check beam from cyclotron on viewer – make sure it's centered, if not adjust BLD1
- Set MARS for primary beam – use values found with Marsinator
- Close coffin slits and adjust D_{12} to find and center the beam – start at $D_{12\text{-calc}}$=586.1A
- Set MARS for secondary beam – use values found with Marsinator
- Find FC position in coffin for maximum primary beam intensity
- Position calibration for target detector

- D_3 scan – identify ions and set for ^{20}Na – start from D_{3calc}= 135.6A
- S4 – fully open – Particle Identification
- Close S4 as much as possible – M/q selection
- D_{12} scan – maximize ^{20}Na production and try to center – start from D_{12calc}=510.4A
- Q_4-Q_5 scan – improve focusing (x and y) – Q_{4calc}=-50.3A and Q_{5calc}=73.9A
- Another D_3 scan to bring ^{20}Na closer to y=0 if needed
- Close slits more if there are impurities that can still be filtered
- Measure production rate and purity of the beam

Implantation of ^{20}Na - steps

- Drop target detector
- Start rotating the degrader
- Expect something like…





Expected …

- ^{20}Na ($T_{1/2}$=448ms) is a known β-delayed α–emitter: 2.148, 3.801 and 4.894 MeV
- Implanted in β-det would give an instructive $\alpha+\beta$ spectrum (as in top fig, from Run0507)
- Implanted in the thin p-det, would show better resolution for α peaks (less β energy loss), like in lower figure
- Is $\beta\gamma$ emitter too: we will have a gamma-ray spectrum measured with Ge detector