Low Energy Cluster Resonances near α-threshold of Stellar Neutron Sources

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Scientific Motivation

Neutron Sources for the s-process

- 2 main n-source reactions :

^{13}C (α,n) ^{16}O

^{22}Ne (α,n) ^{25}Mg

- Stellar reaction sequence for the build up of ^{22}Ne and ^{26}Mg sources:

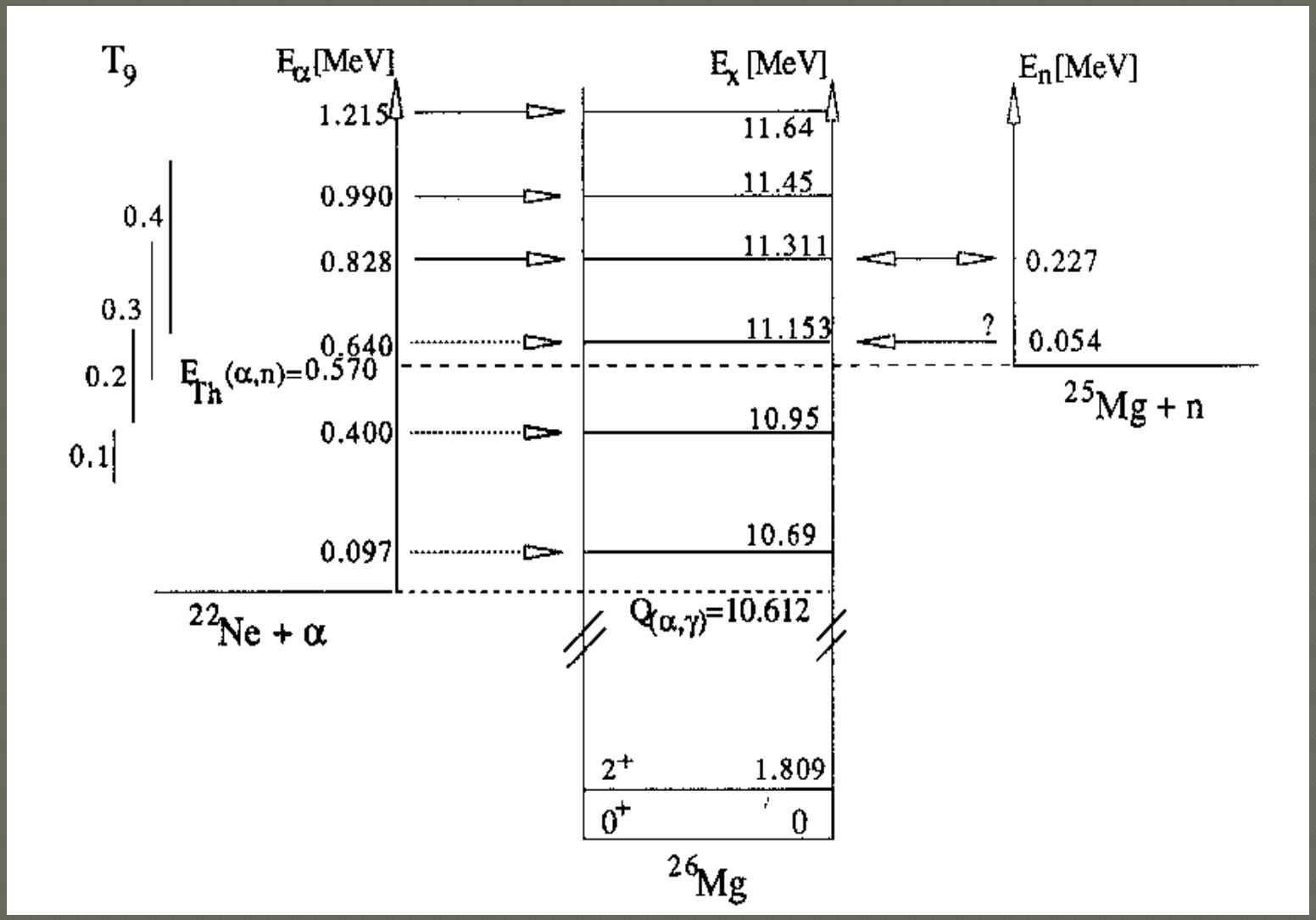
$$^{14}N(\alpha,\gamma)^{18}F(\beta^+,\nu)^{18}O(\alpha,\gamma)^{22}Ne(\alpha,n)^{25}Mg$$

OR

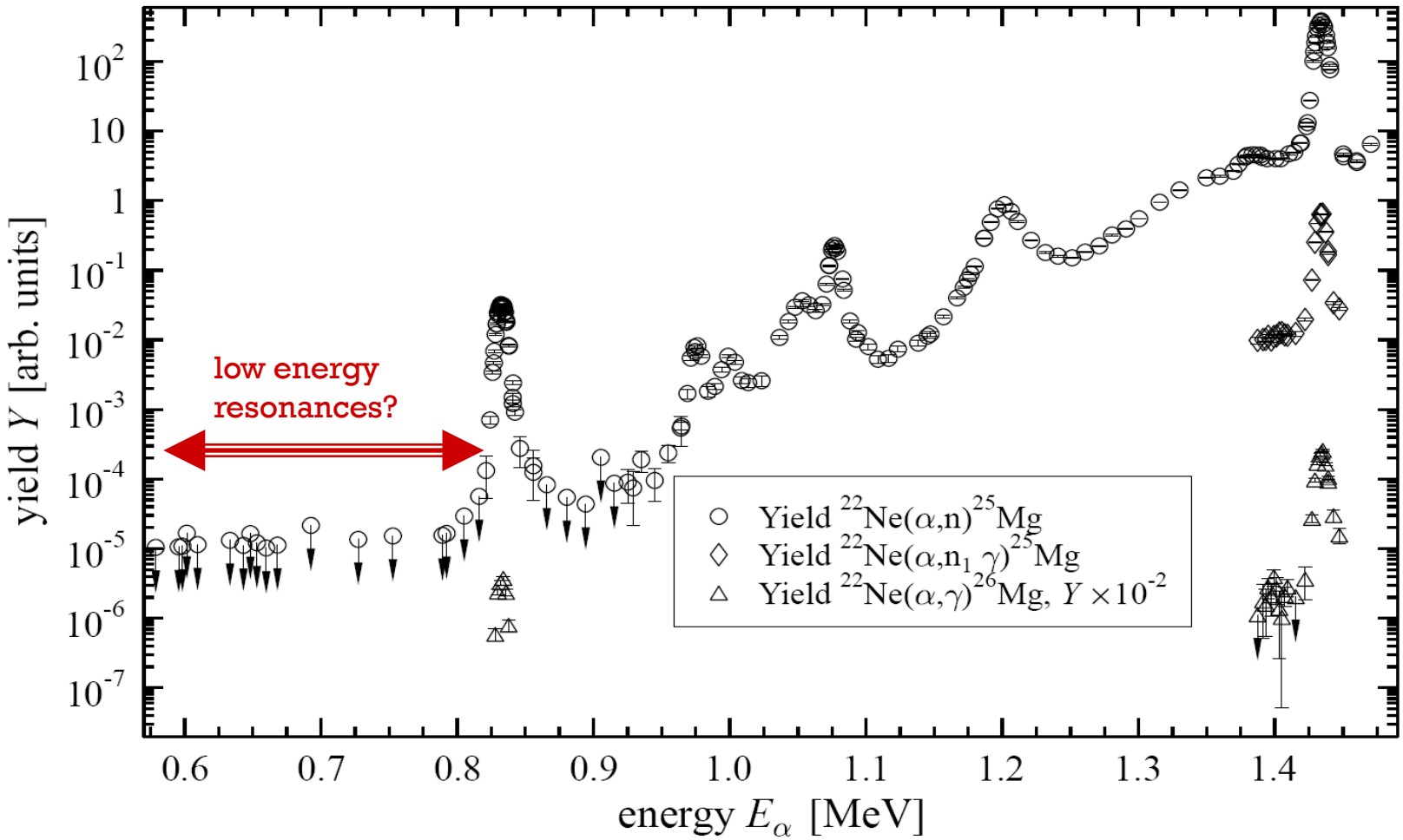
$$^{14}N(\alpha,\gamma)^{18}F(\beta^+,\nu)^{18}O(\alpha,\gamma)^{22}Ne(\alpha,\gamma)^{26}Mg(\alpha,n)^{29}Si$$

- The (α,n) reactions have negative Q-value

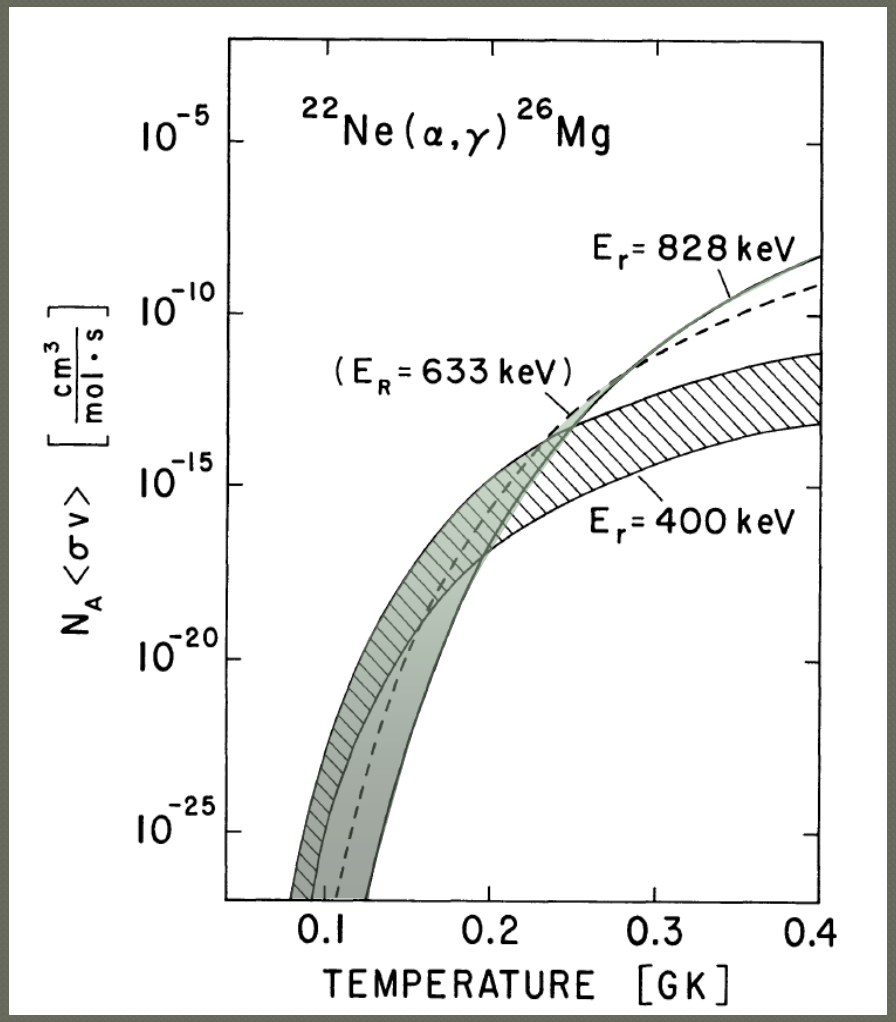
Present Information

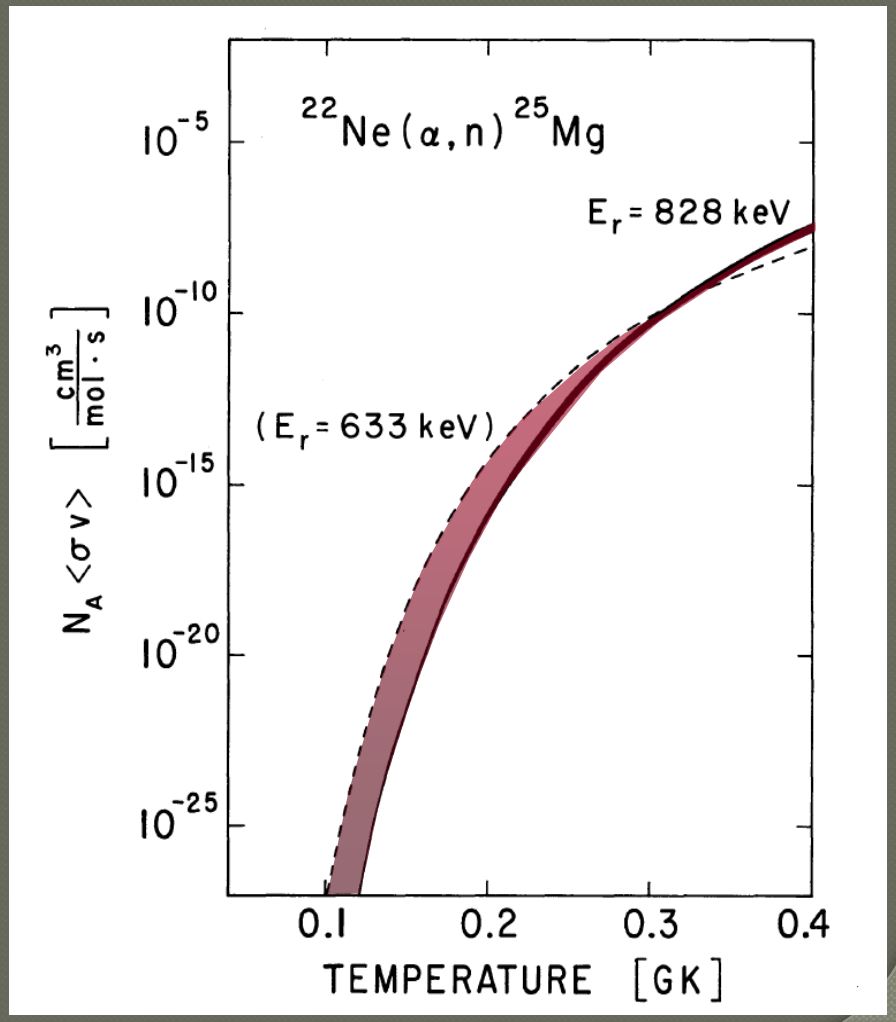


Example : $^{22}Ne(\alpha,n)^{25}Mg$

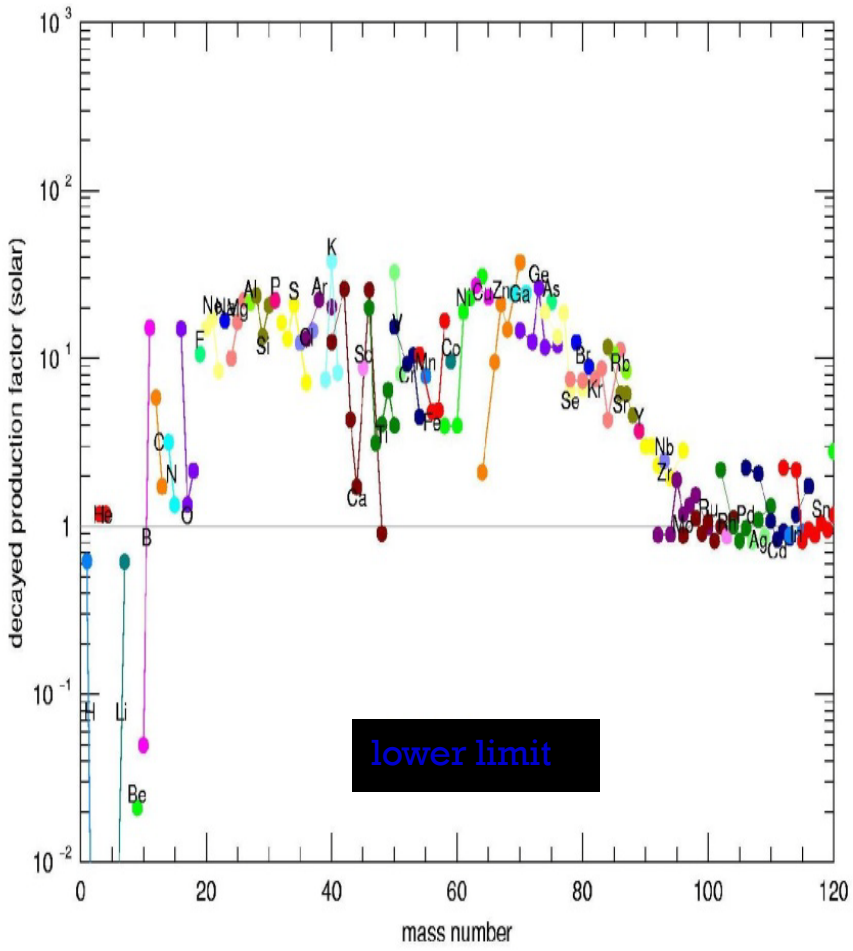


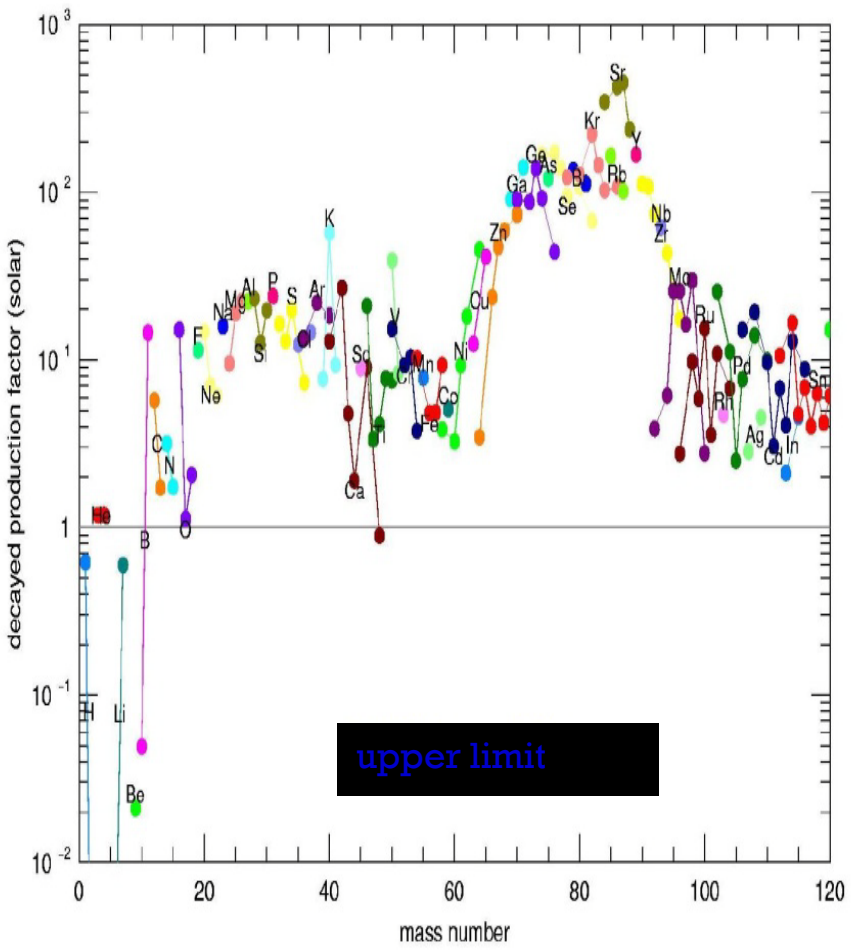
Reaction Rate Limits



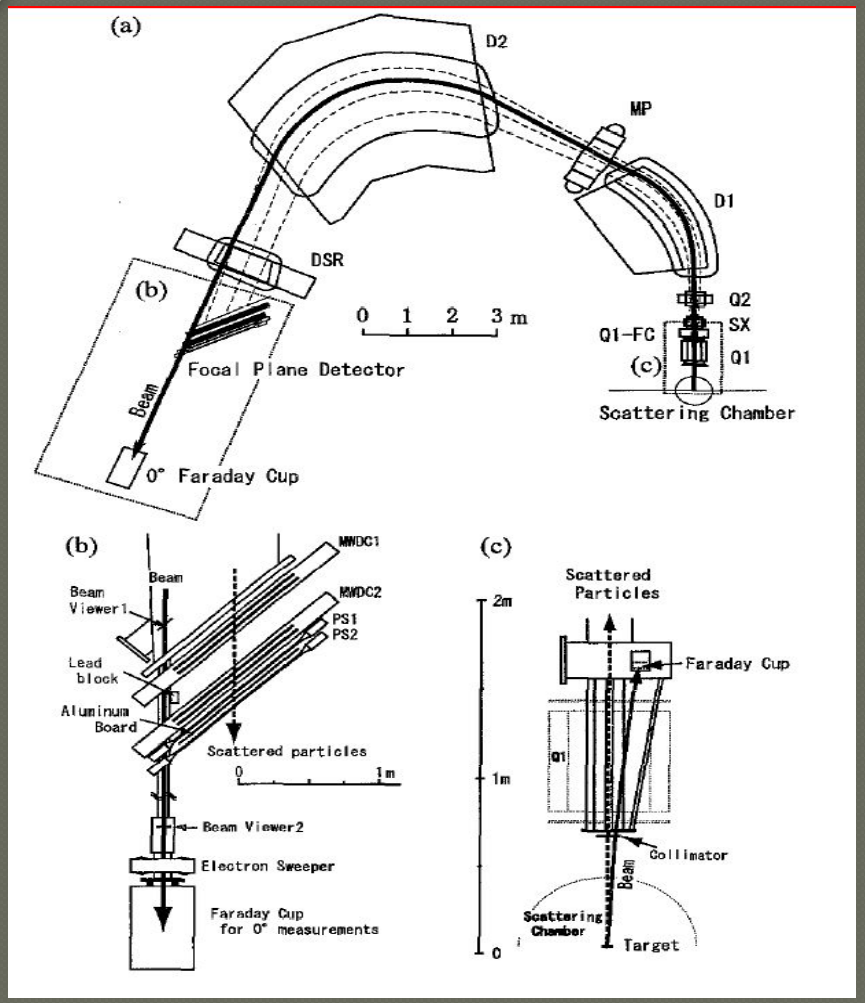


Weak s-process abundances





Measurements at RCNP using Grand Raiden



- (α,α′) reaction at 0° and finite angles
- 200MeV α – beam dispersion matched
- α′ detected at Focal Plane
- Horizontal and vertical positions and angles measured
- Information used to reconstruct kinematics at target

Targets used :
1 solid target : ^{26}Mg (2.5mg/cm^2)
2 gas targets : ^{18}O and ^{22}Ne (each 10mm thick)

Grand Raiden
–p/δp = 37000

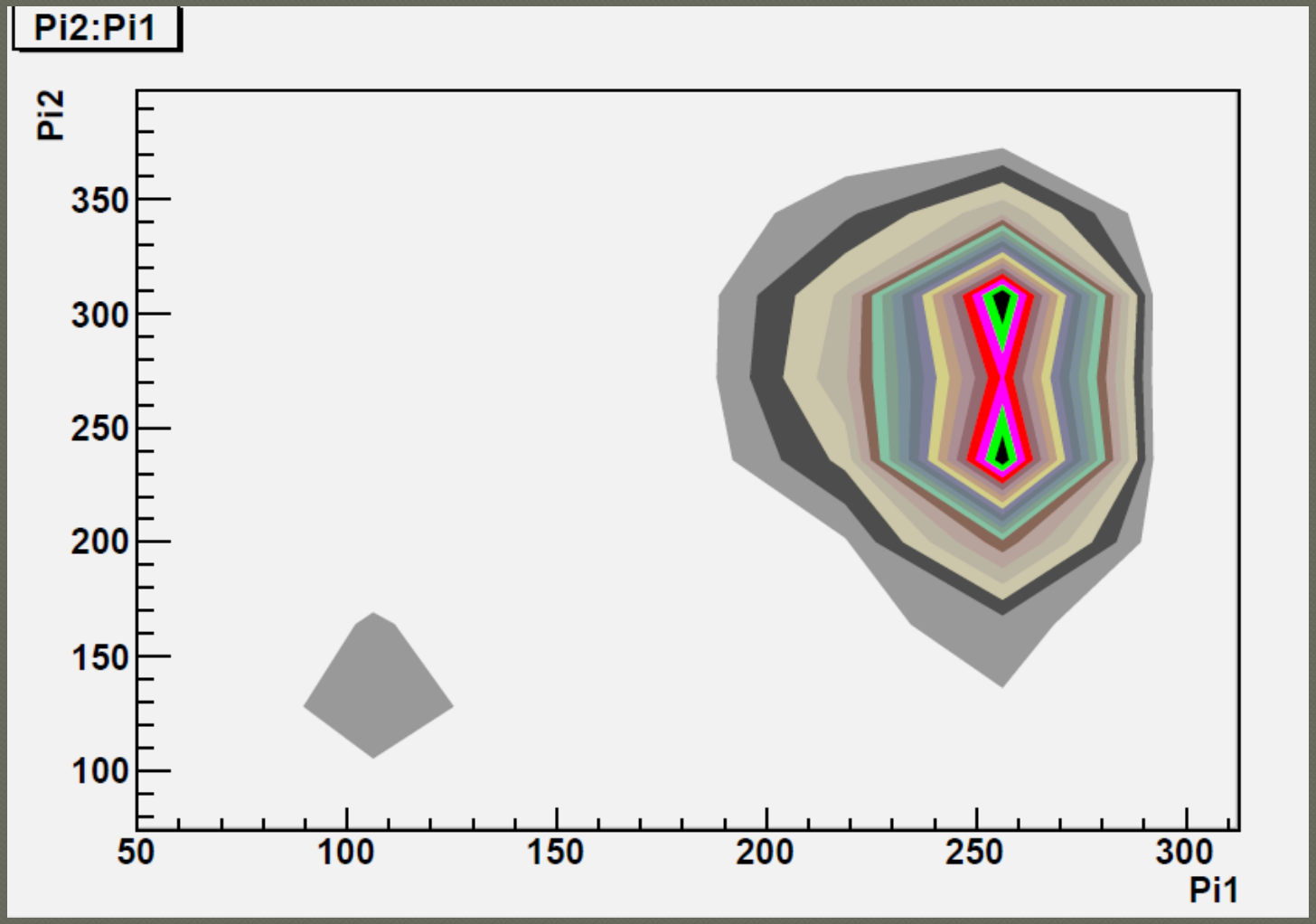
6μm Aramid foil

44mm by 14mm by10mm

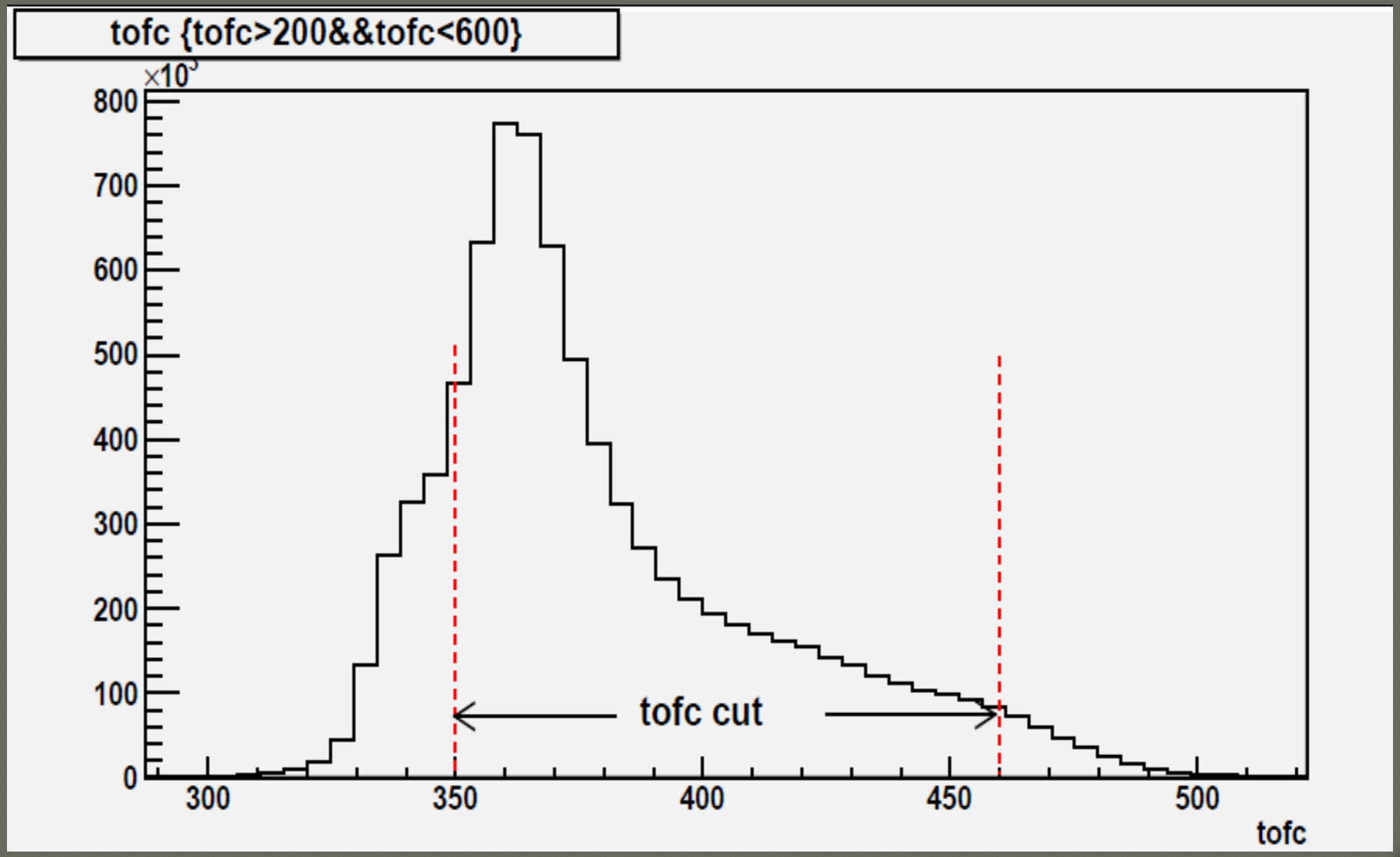
Preliminary Analysis

Cleaner Spectrum :

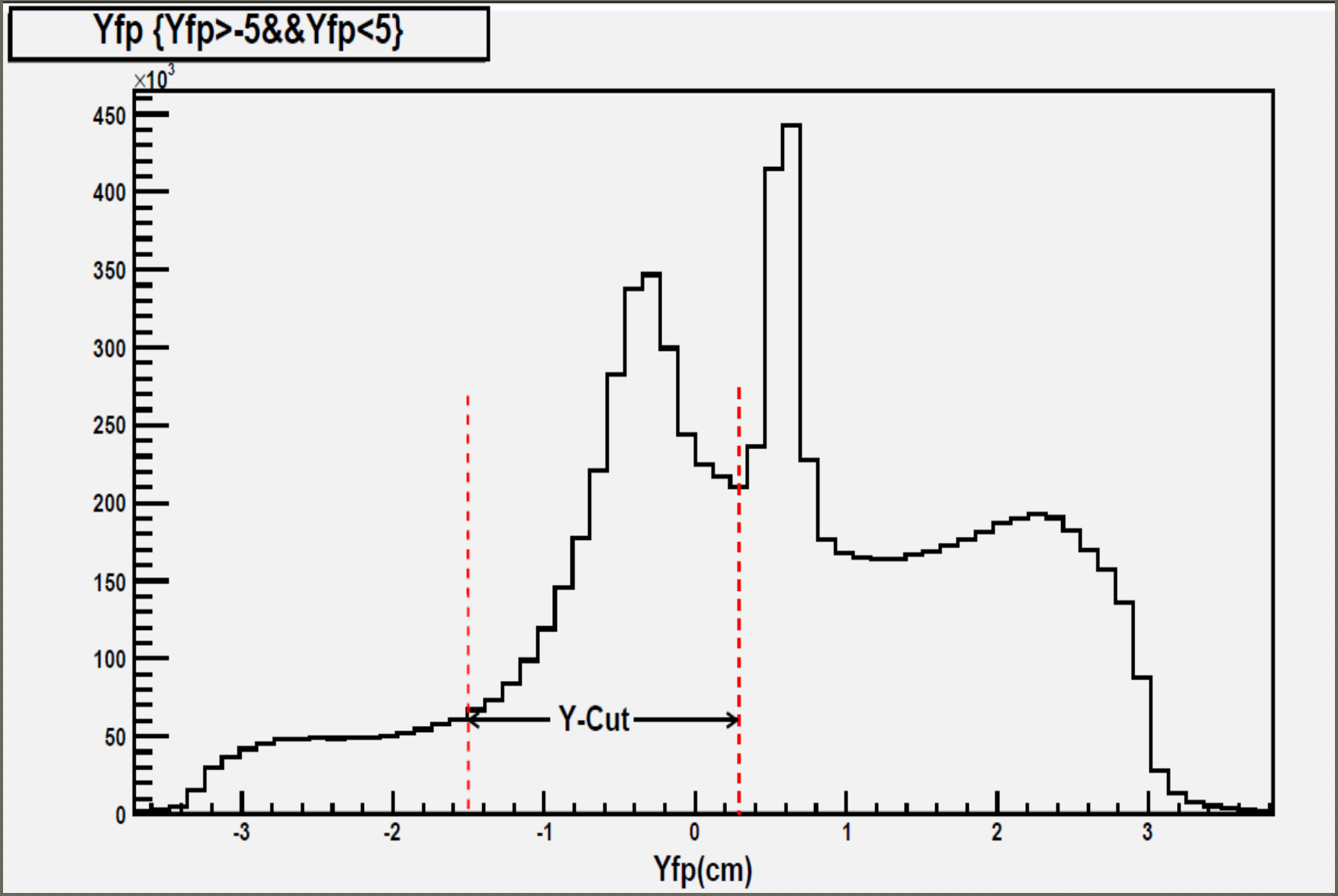
PID :



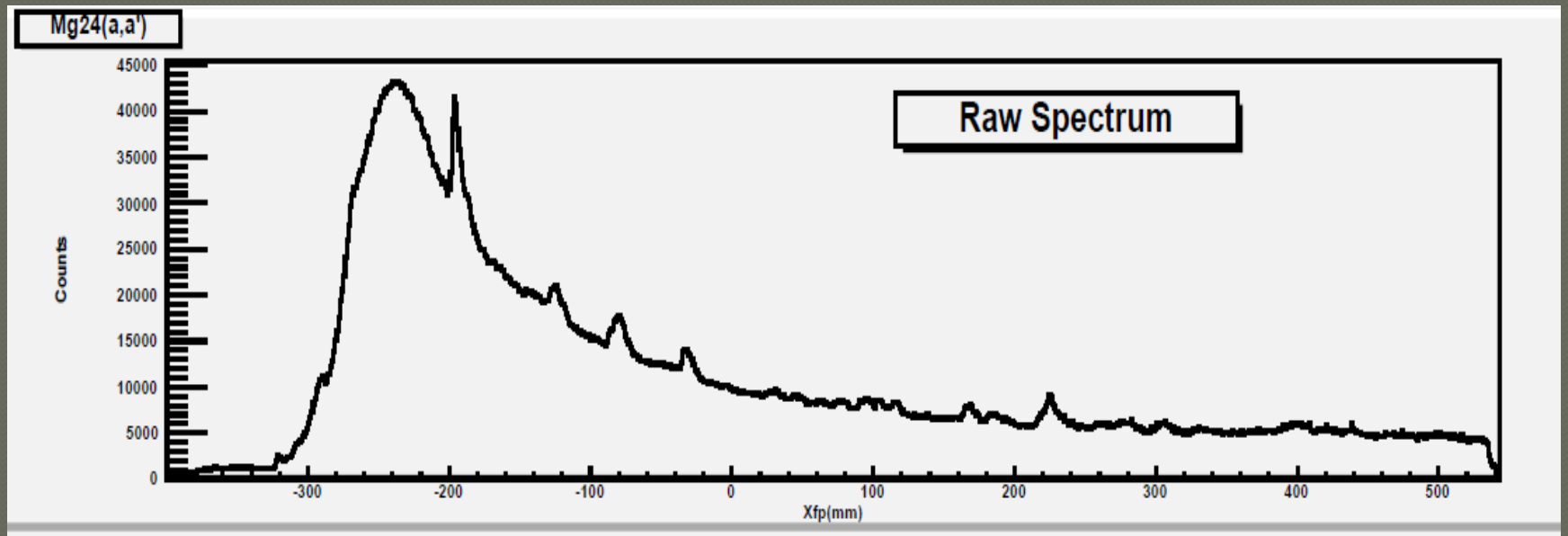
+ TOF :

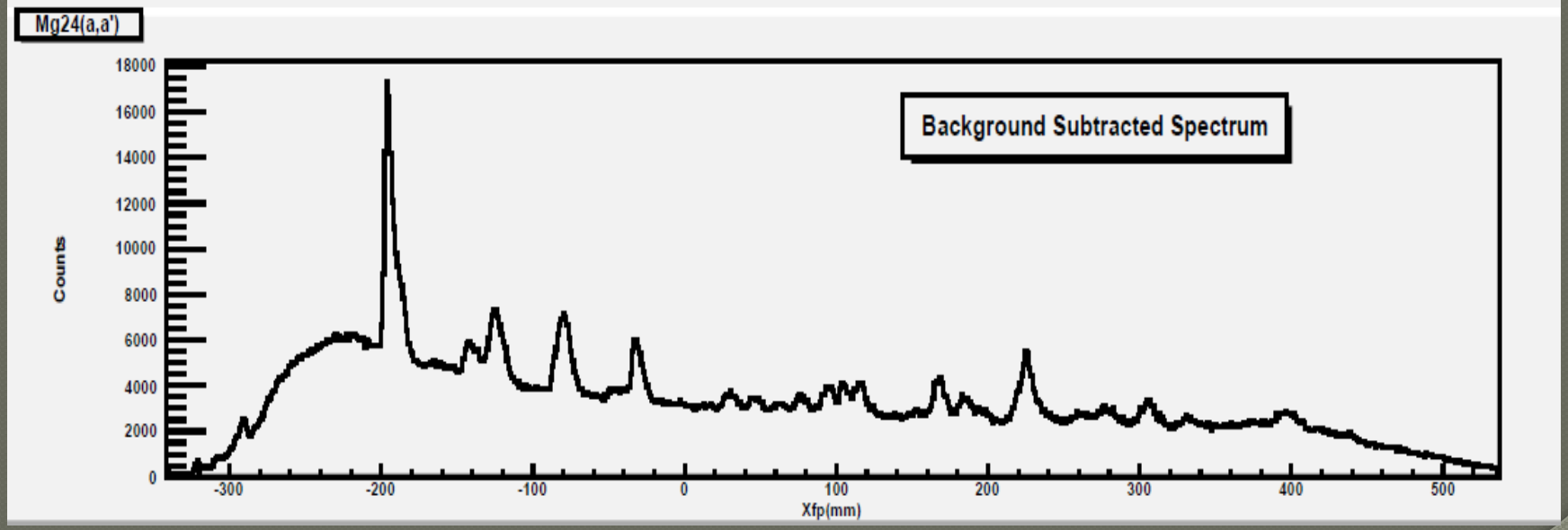

tofc {tofc>200&&tofc<600}
×10³
800
700
600
500
400
300
200
100
0
300
350
400
450
500
tofc
tofc cut

+ Y-Cut :

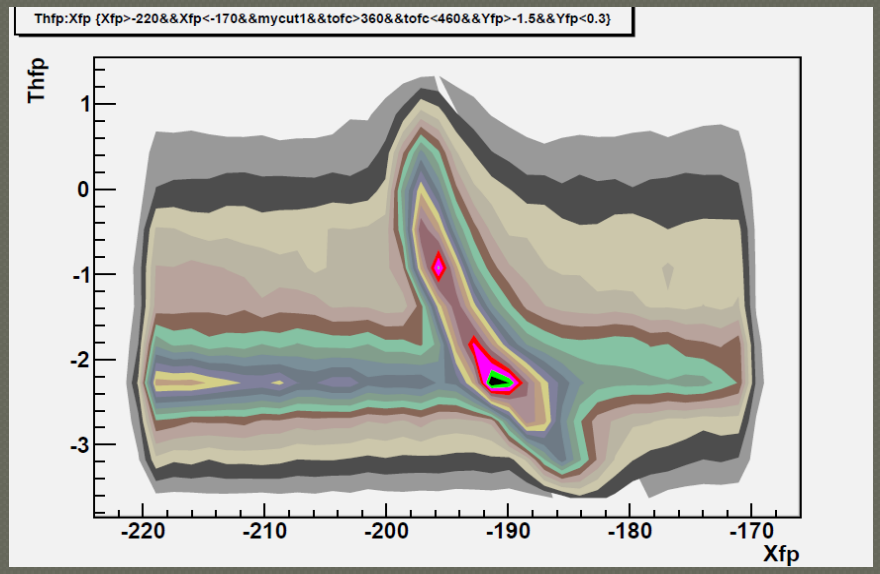

Yfp {Yfp>-5&&Yfp<5}
×10^3
450
400
350
300
250
200
150
100
50
0
-3
-2
-1
0
1
2
3
Y-Cut
Yfp(cm)

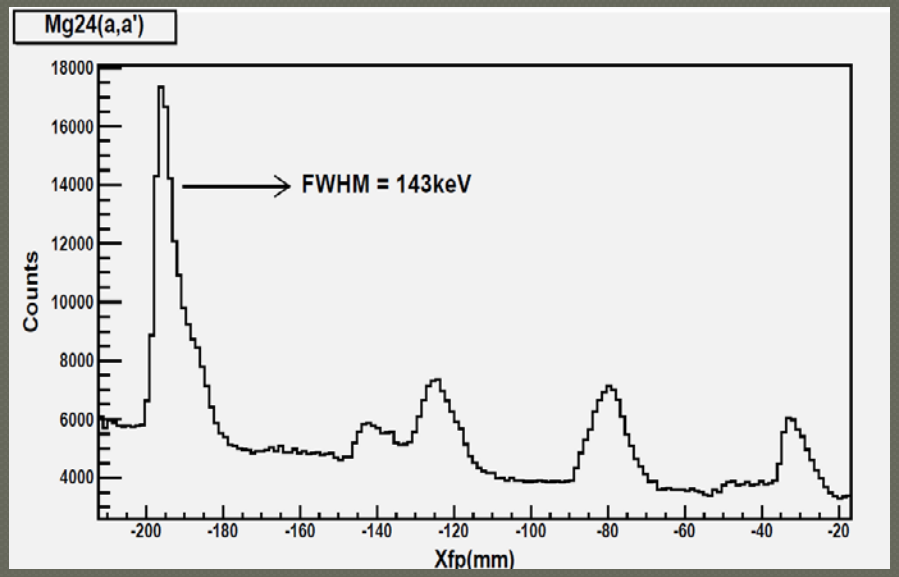
Results in :

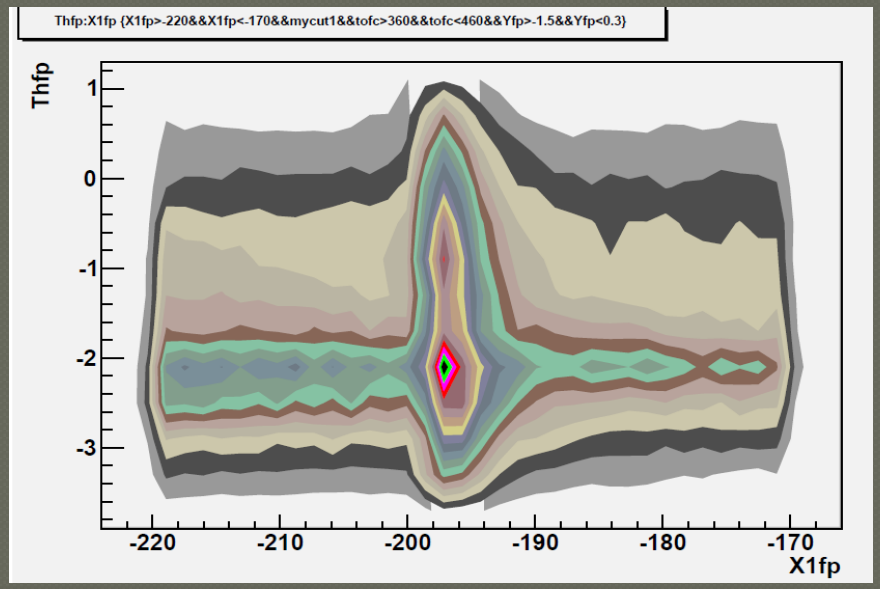

Mg24(a,a')
Raw Spectrum
Counts
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-300
-200
-100
0
100
200
300
400
500
Xfp(mm)

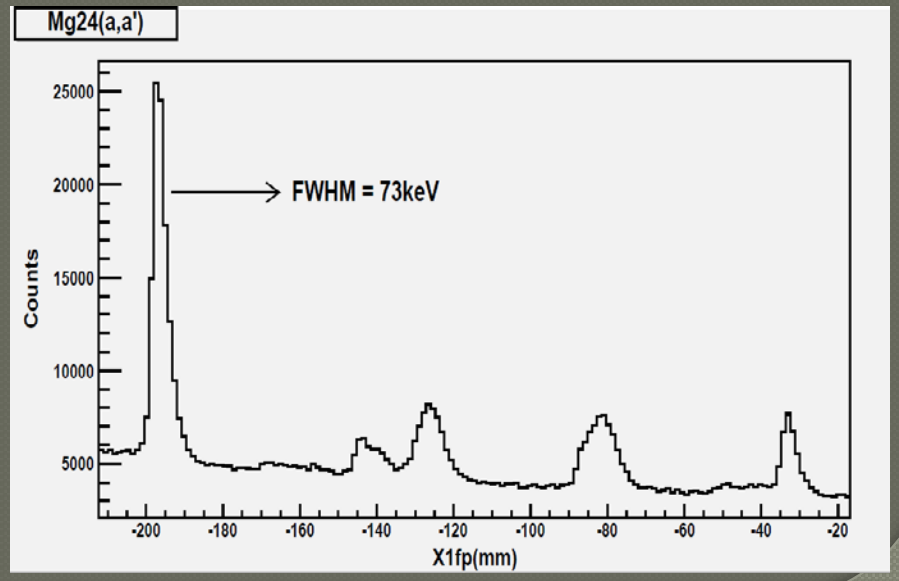

Mg24(a,a')
Background Subtracted Spectrum
Counts
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-300
-200
-100
0
100
200
300
400
500
Xfp(mm)

Better Resolution by correction of focus :

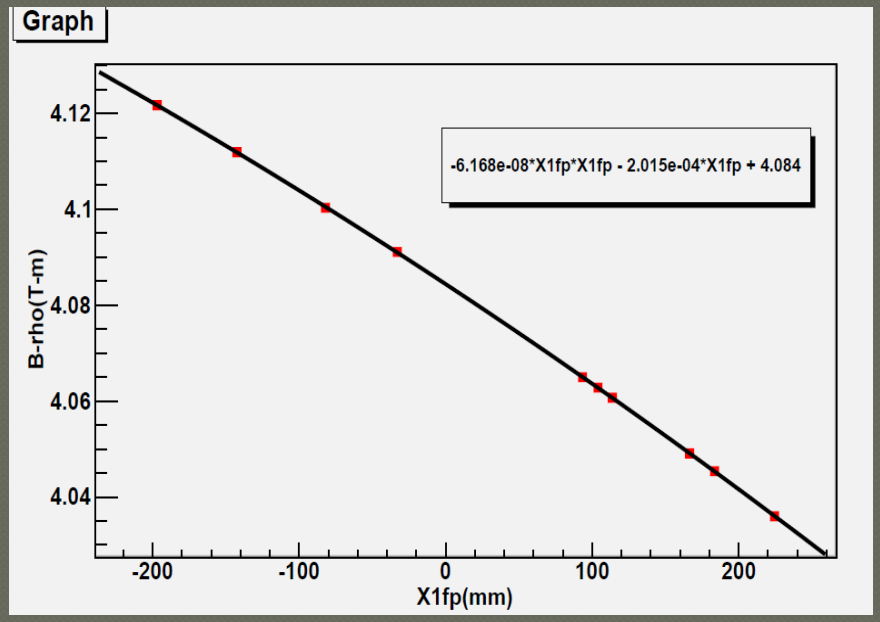


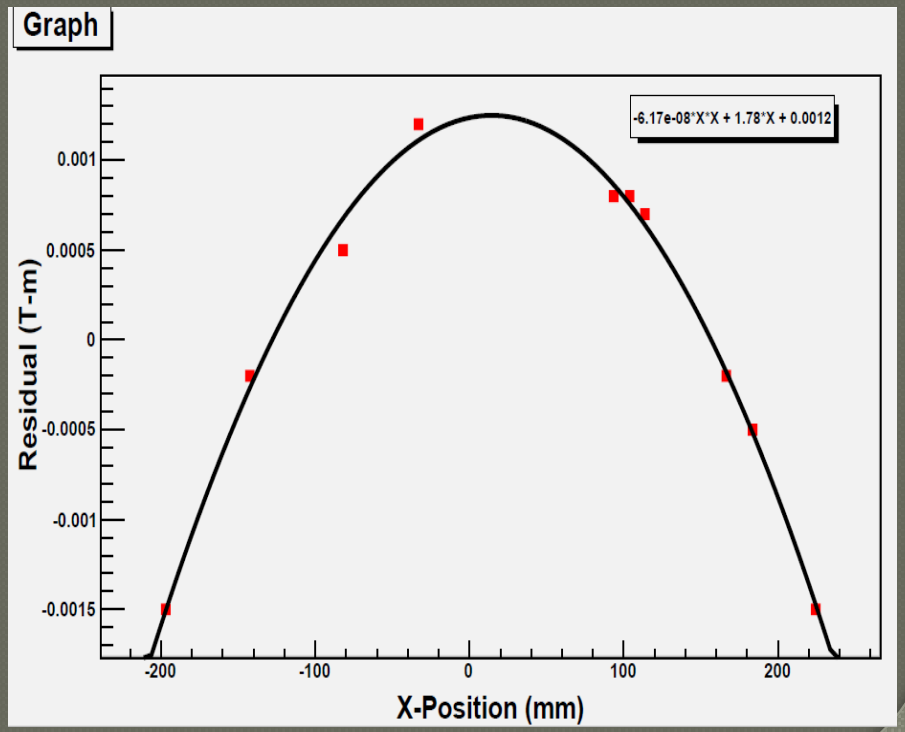




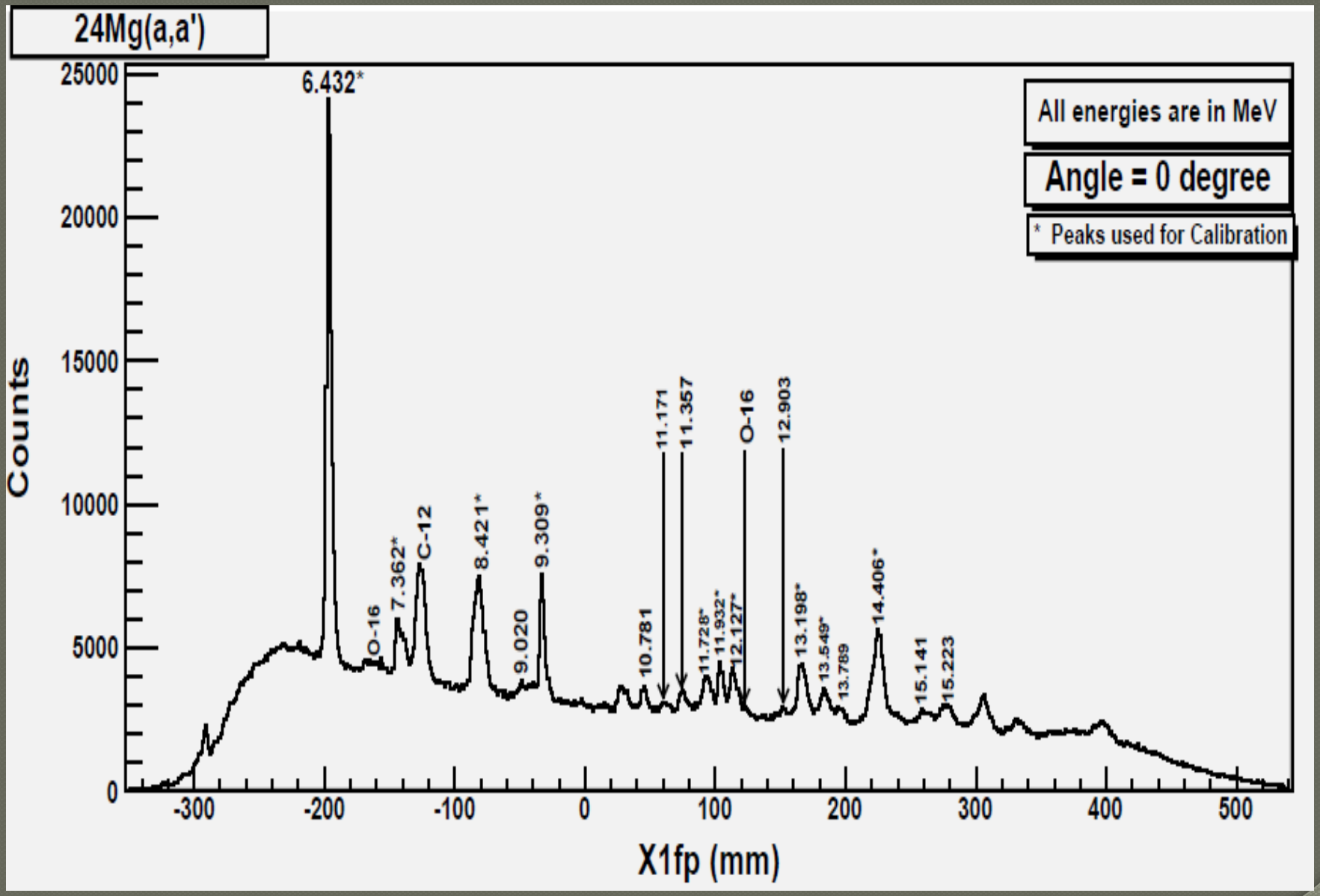


Focal Plane Calibration :

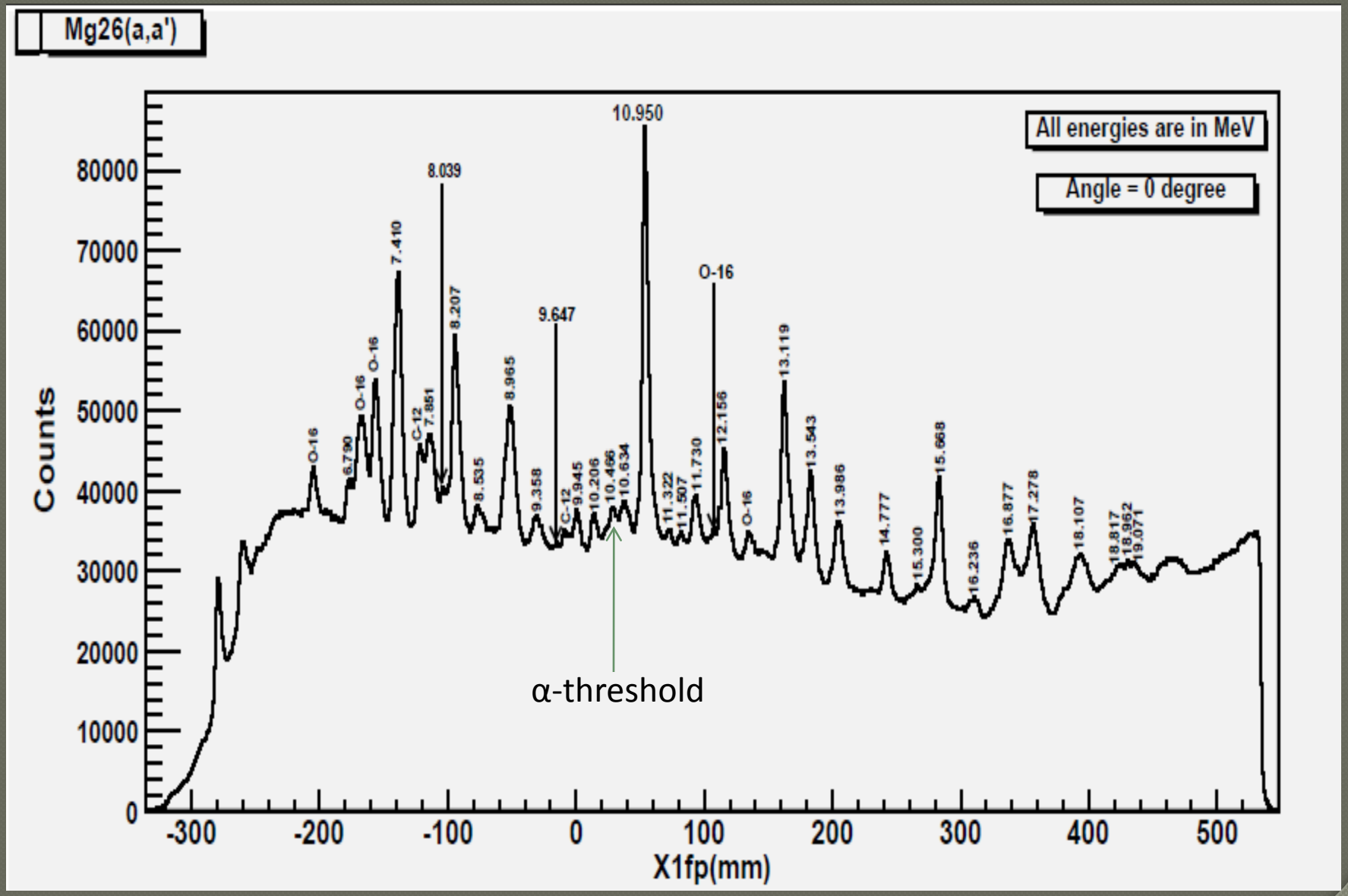




^{24}Mg Spectrum used in energy calibration :



^{26}Mg Spectrum :



Things To Do

- Angle Calibration
- Peak Analysis for 22Ne and 18O
- Identify hidden peaks at finite angles
- Assign spin-parity to different levels
- Reaction Rate Calculation

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