

Synthesis and Separation of Fm and No isotopes using TASCA

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TASCA workshop 2007, Davos,

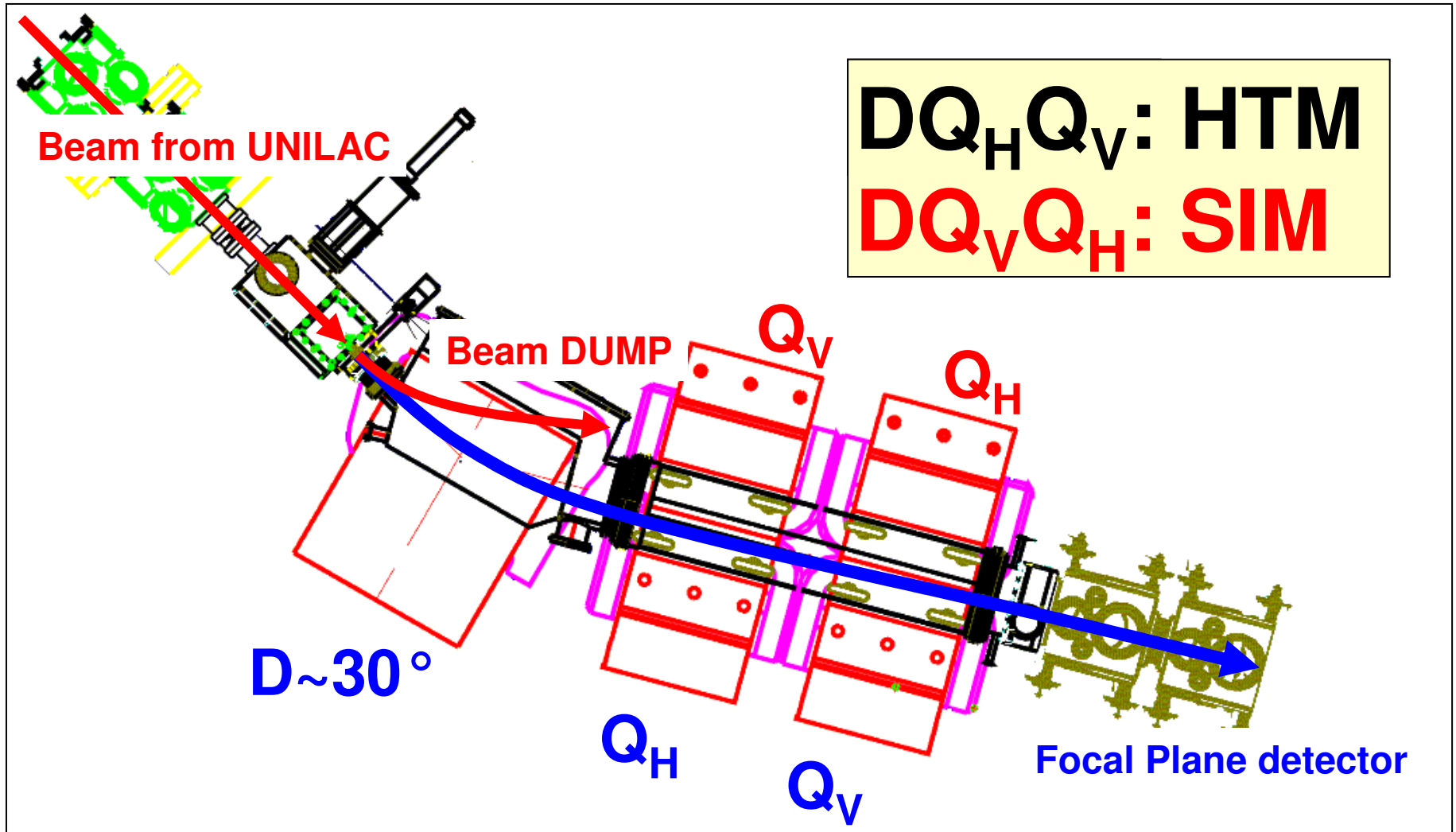


Contents

- The synthesis and separation of the ^{245}Fm .
 - First experiment results of $^{40}\text{Ar}+^{208}\text{Pb}$ reaction.
 - Second experiment results of $^{40}\text{Ar}+^{208}\text{Pb}$ reaction.
- The synthesis and separation of ^{256}No .
 - Experimental results of $^{22}\text{Ne}+^{238}\text{U}$.
- The synthesis and separation of ^{252}No .
 - Experimental results of $^{48}\text{Ca}+^{206}\text{Pb}$.
- The synthesis and separation of ^{254}No .
 - Experimental results of $^{48}\text{Ca}+^{208}\text{Pb}$ reaction (Helium and Hydrogen).

TransActinide Separator and Chemistry Apparatus

TASCA



TransActinide Separator and Chemistry Apparatus

TASCA

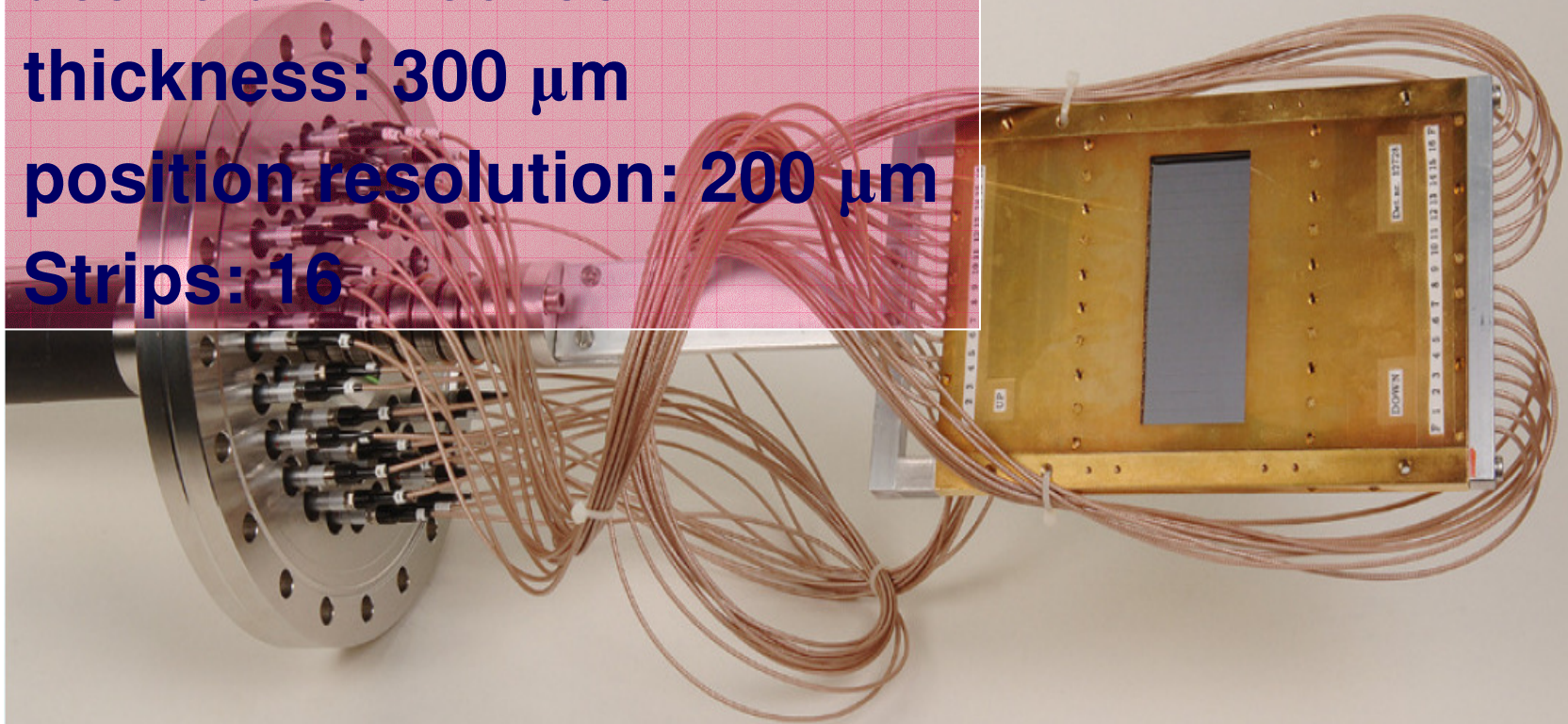
material: Si

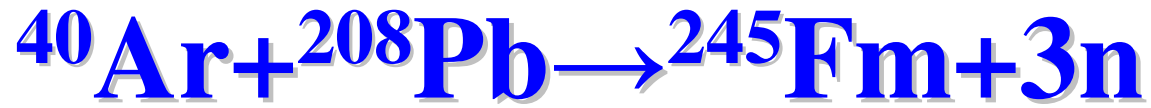
active area: 80x35 mm²

thickness: 300 μm

position resolution: 200 μm

Strips: 16





Experiment T005

- Projectile: ^{40}Ar
 - Charge state: 10+

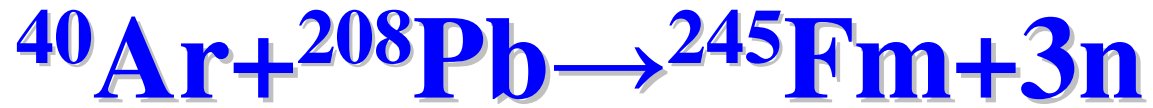
- Target: ^{208}PbS
 - Thickness: $426 \mu\text{g}/\text{cm}^2$
 - Backing foil: $40 \mu\text{g}/\text{cm}^2$ (C)
 - Coating foil: $10 \mu\text{g}/\text{cm}^2$ (C)

The beam pulse structure



beam on: 5 ms

beam off: 15 ms

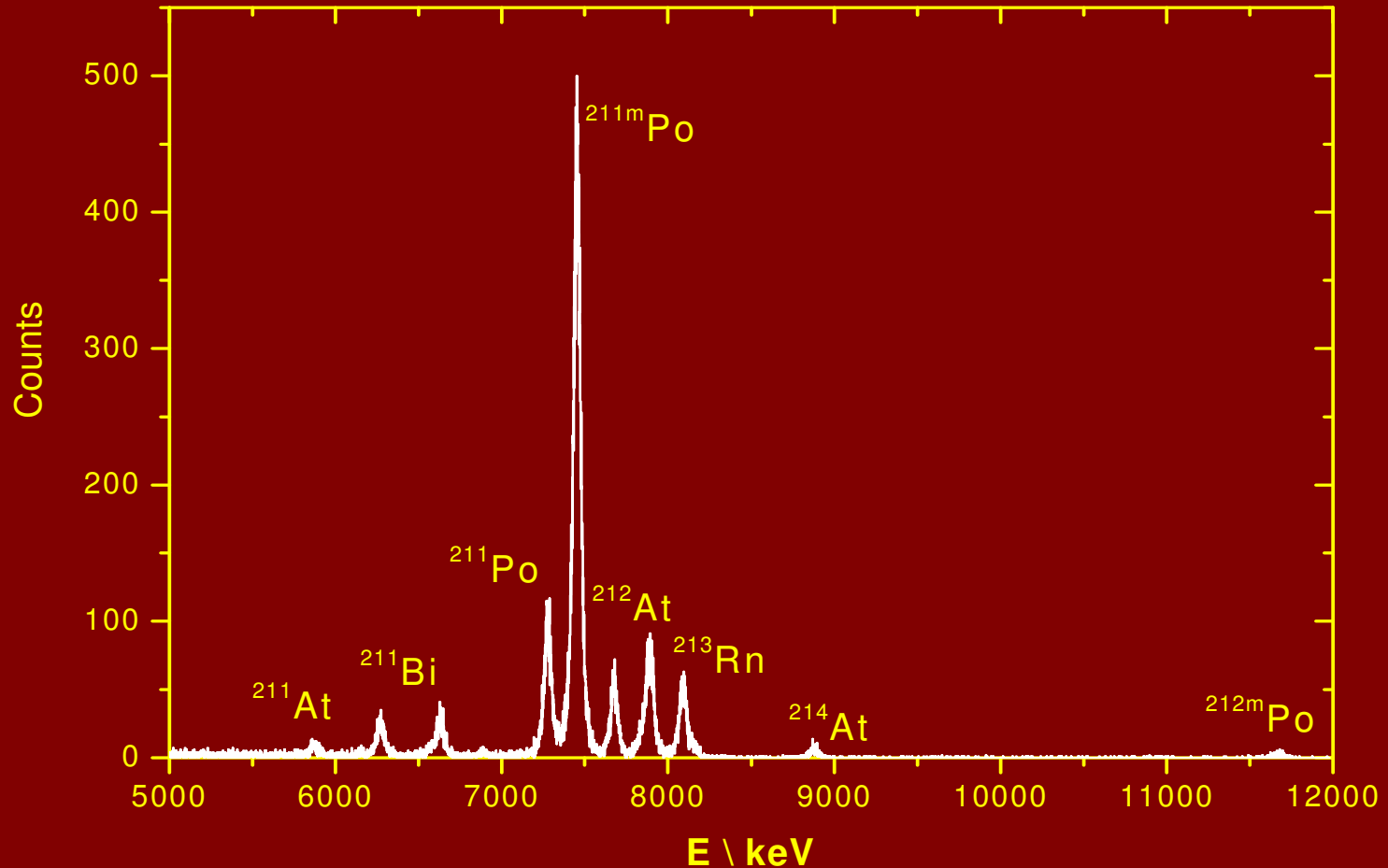


Experiment T005

• Projectile: ^{40}Ar

• Target: ^{208}Pb

Alpha spectrum in during the beam off period



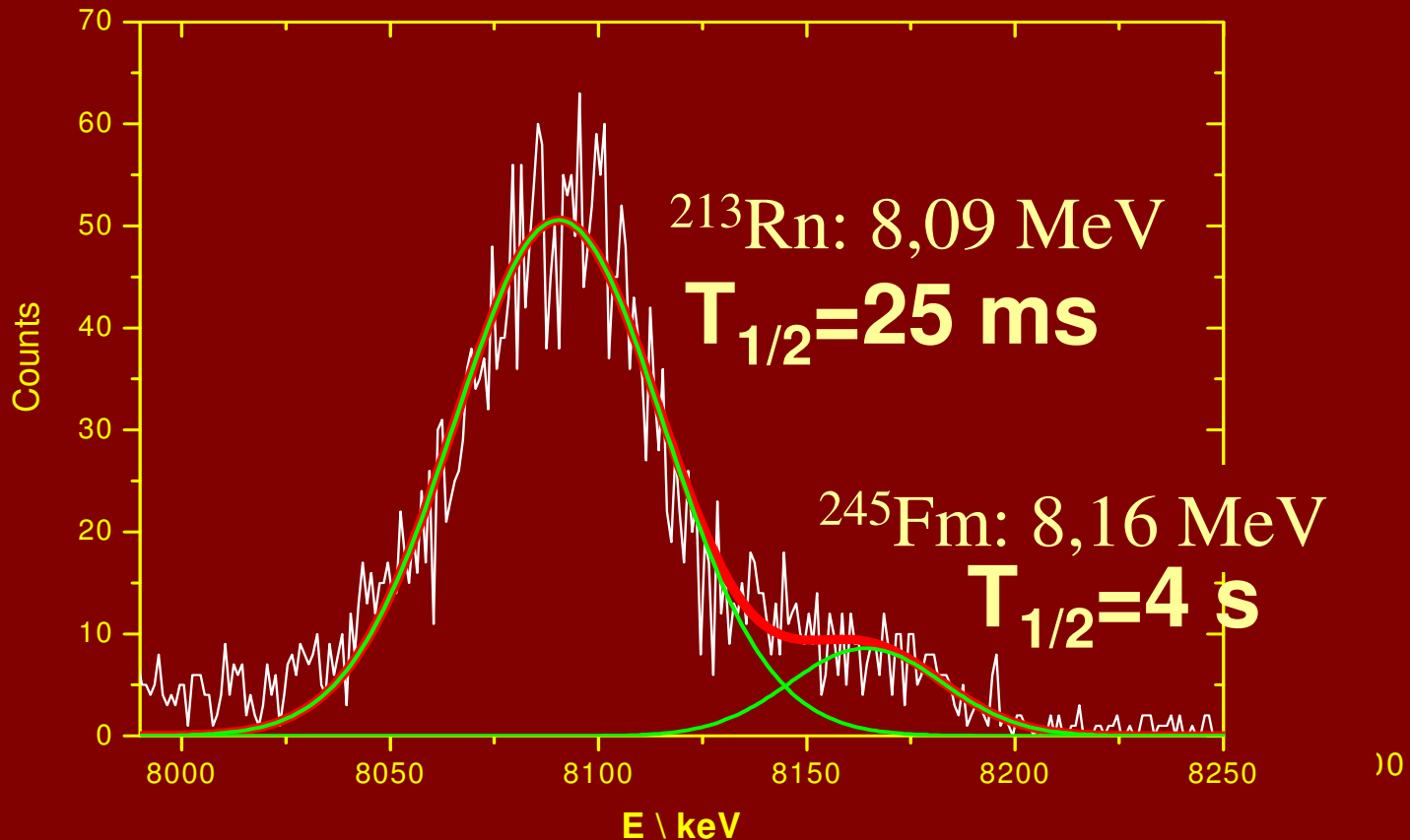


Experiment T005

• Projectile: ^{40}Ar

Alpha spectrum in during the beam off period

• Target

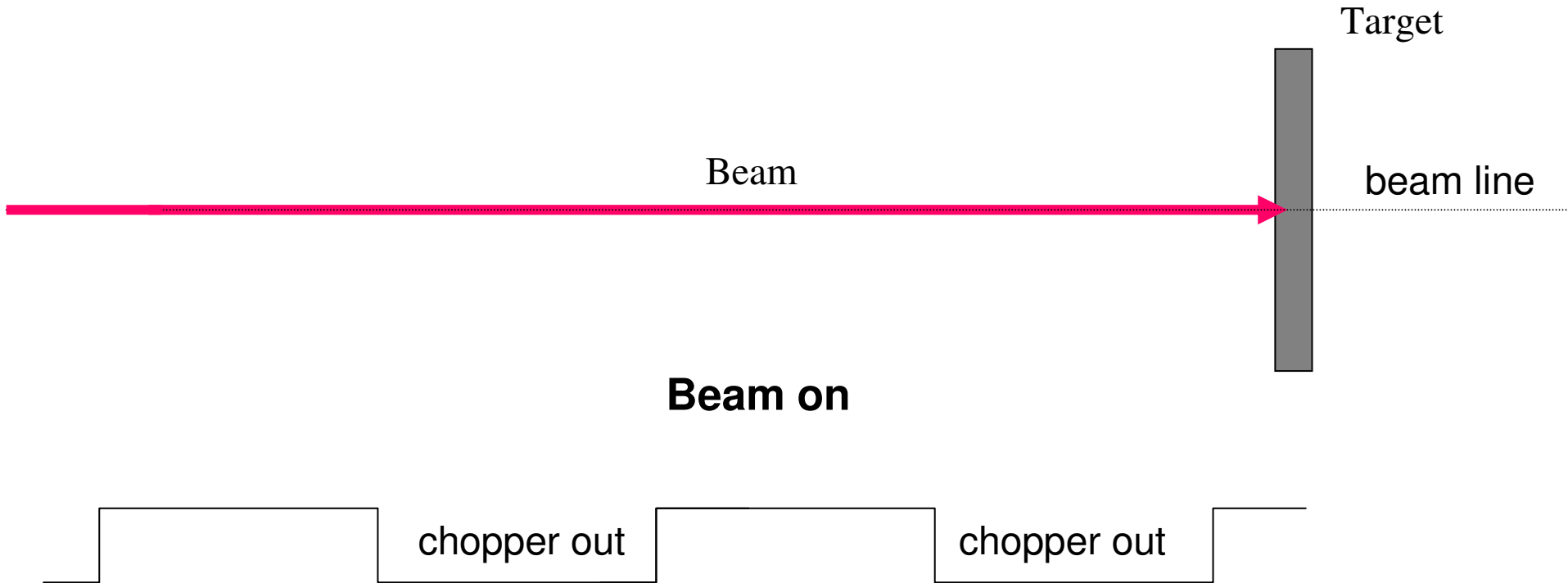


TF

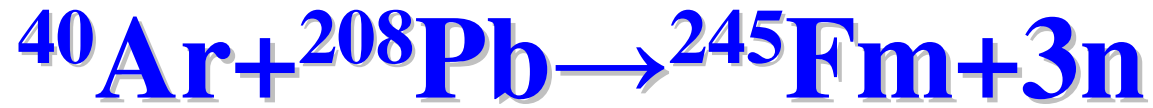
Beam structure



Beam structure



We can great the additional beam on / off condition using the copper.



- Projectile: ^{40}Ar
 - Charge state: 9+

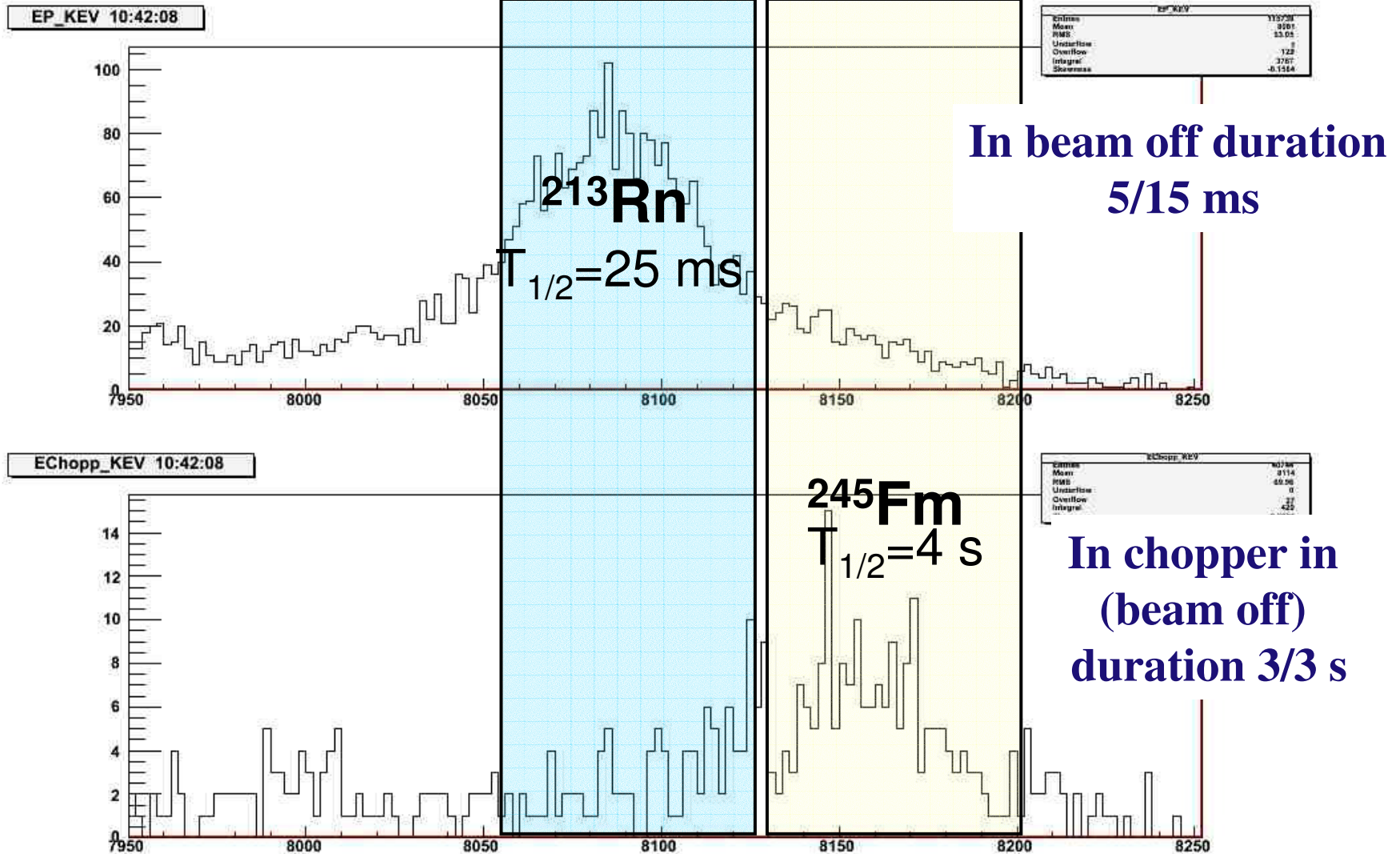
Experiment T007

- Target: ^{208}PbS
 - Thickness: $426 \mu\text{g}/\text{cm}^2$
 - Backing foil: $2 \mu\text{g}/\text{cm}^2$ (Ti)
 - Coating foil: $10 \mu\text{g}/\text{cm}^2$ (C)



- Projectile: ^{40}Ar
- Charge state: 9+

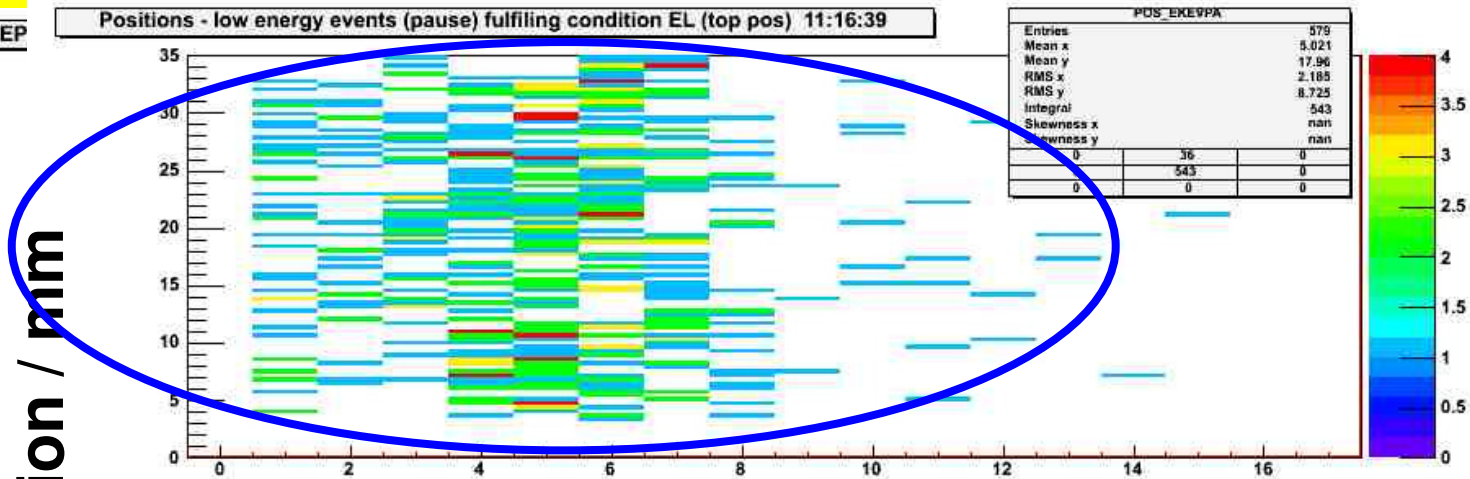
Experiment T007





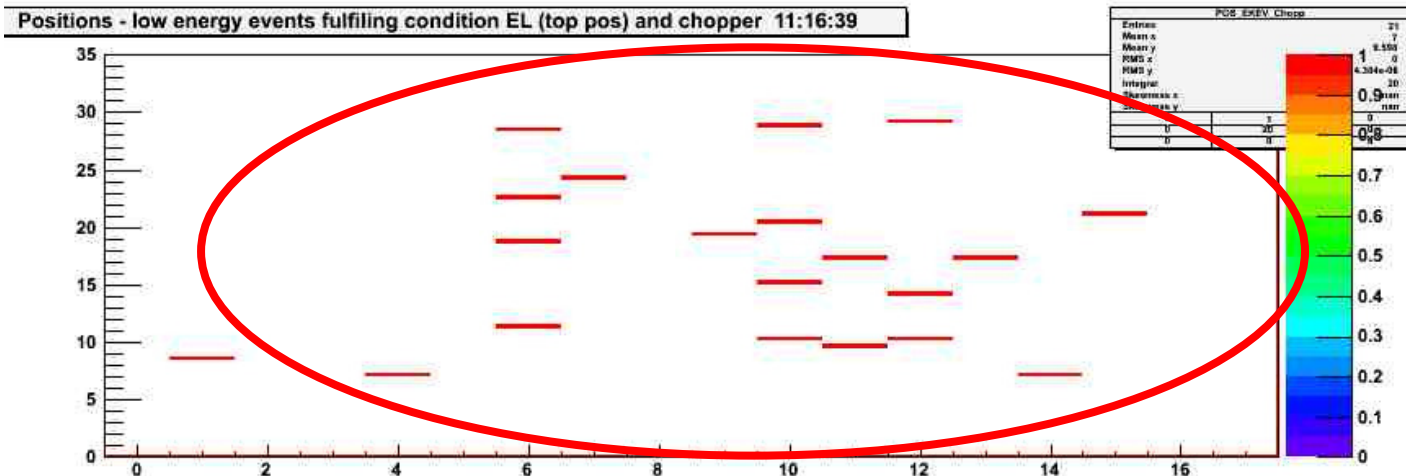
- Project
- Charge state

Position distribution of ^{213}Rn and ^{245}Fm in FPD



Beam off
5/15 ms
 ^{213}Rn

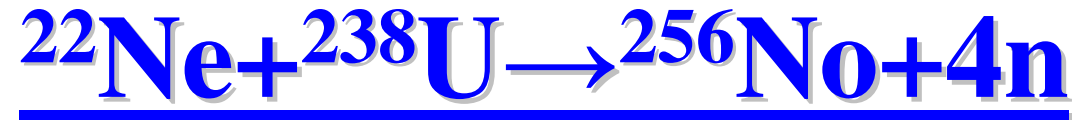
Top position / mm



Beam off
3/3 s
 ^{245}Fm

Strip number

The relative rate of HTM mode is ~2 times higher than SIM

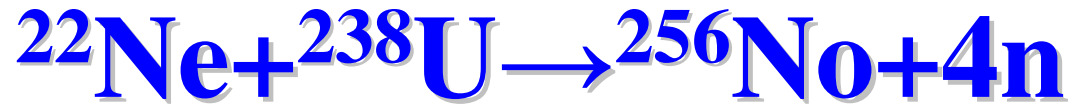


HTM

- **Projectile:** ^{22}Ne
 - **Charge state:** 5+

- **Target:** ^{238}U
 - **Thickness:** 434 $\mu\text{g}/\text{cm}^2$
 - **Backing foil:** 2.3 μg (Ti)
 - **Coating foil:** 10 $\mu\text{g}/\text{cm}^2$ (C)

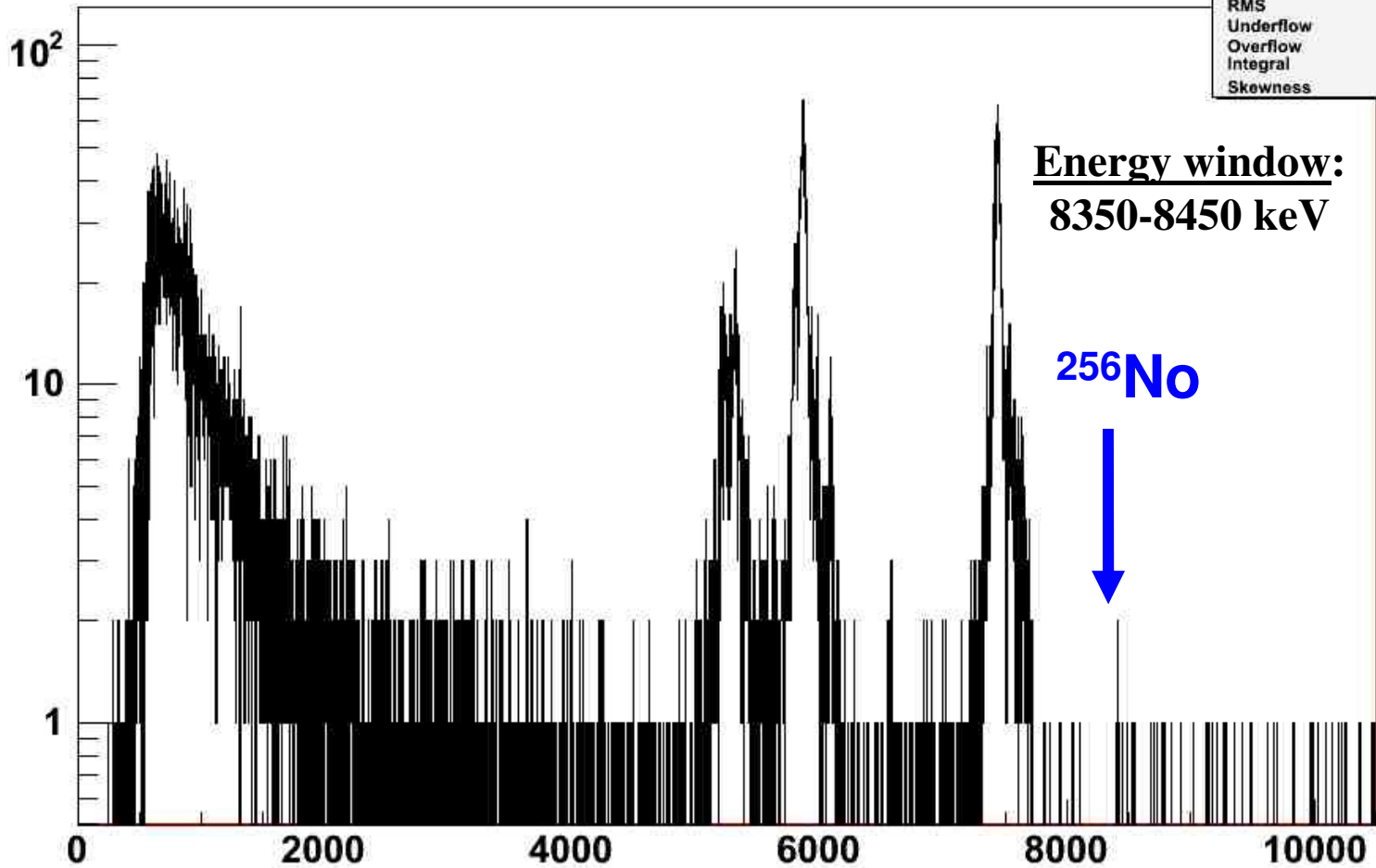
Low energy spectrum in beam off duration 5/15 ms



HTM

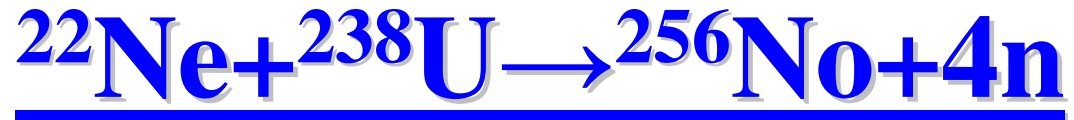
EP_KEY 11:47:37

EP_KEY	
Entries	15763
Mean	3529
RMS	2740
Underflow	0
Overflow	346
Integral	1.463e+04
Skewness	0.2295



Low energy spectrum in beam off duration 5/15 ms

• P
• T



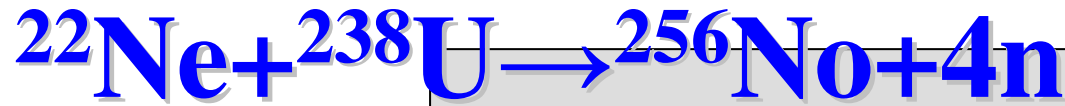
HTM

• Projectile: ^{22}Ne

We measured the background to detect the alpha decay of ^{252}Fm daughter nuclide of ^{256}No

• Target:

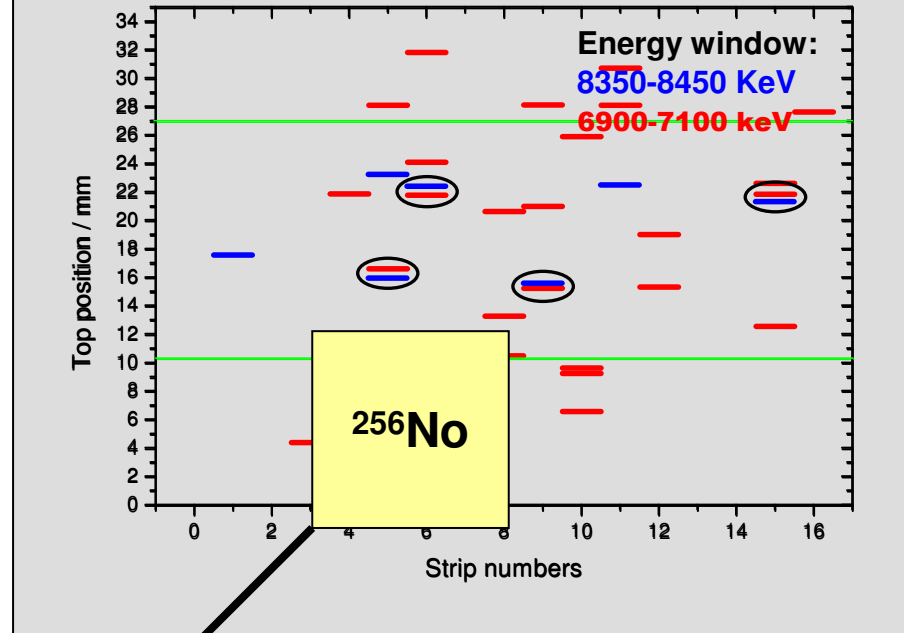
Energy window for ^{252}Fm :
6900-7100 keV



HTM

- Projectile: ^{22}Ne
 - Charge state: 5+

- Target: ^{238}U
 - Thickness: $434 \mu\text{g}/\text{cm}^2$
 - Backing foil: $2.3 \mu\text{g}$ (Ti)
 - Coating foil: $10 \mu\text{g}/\text{cm}^2$ (C)

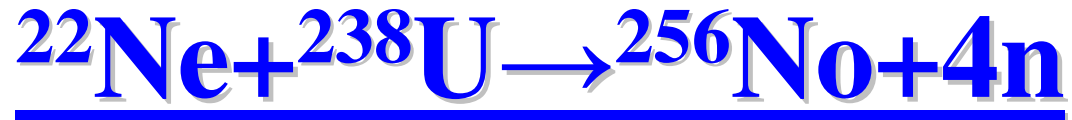


α , (8430 ± 30) keV

— ^{256}No
— ^{252}Fm

^{252}Fm

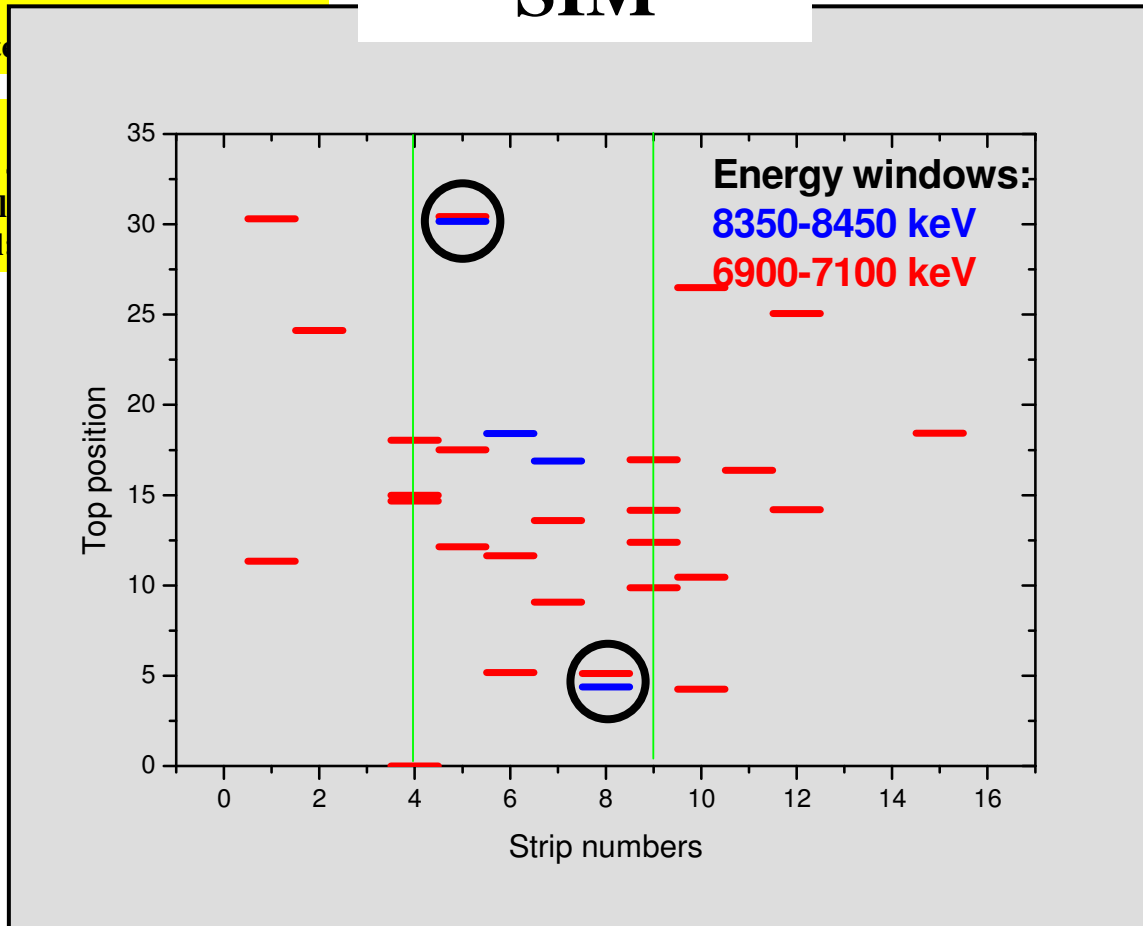
α , (7030 ± 30) keV $T_{1/2} = (20_{-4}^{+14})$ h.
 (6990 ± 30) keV



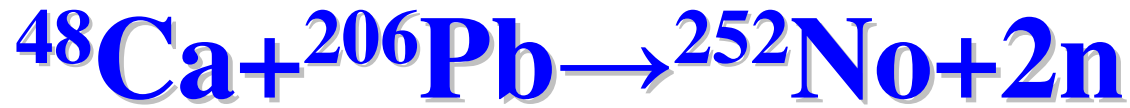
SIM

- Projectile: ^{22}Ne
 - Charge state

- Target: ^{238}U
 - Thickness:
 - Backing foil
 - Coating foil



The relative rate of HTM mode is ~2 times higher than SIM



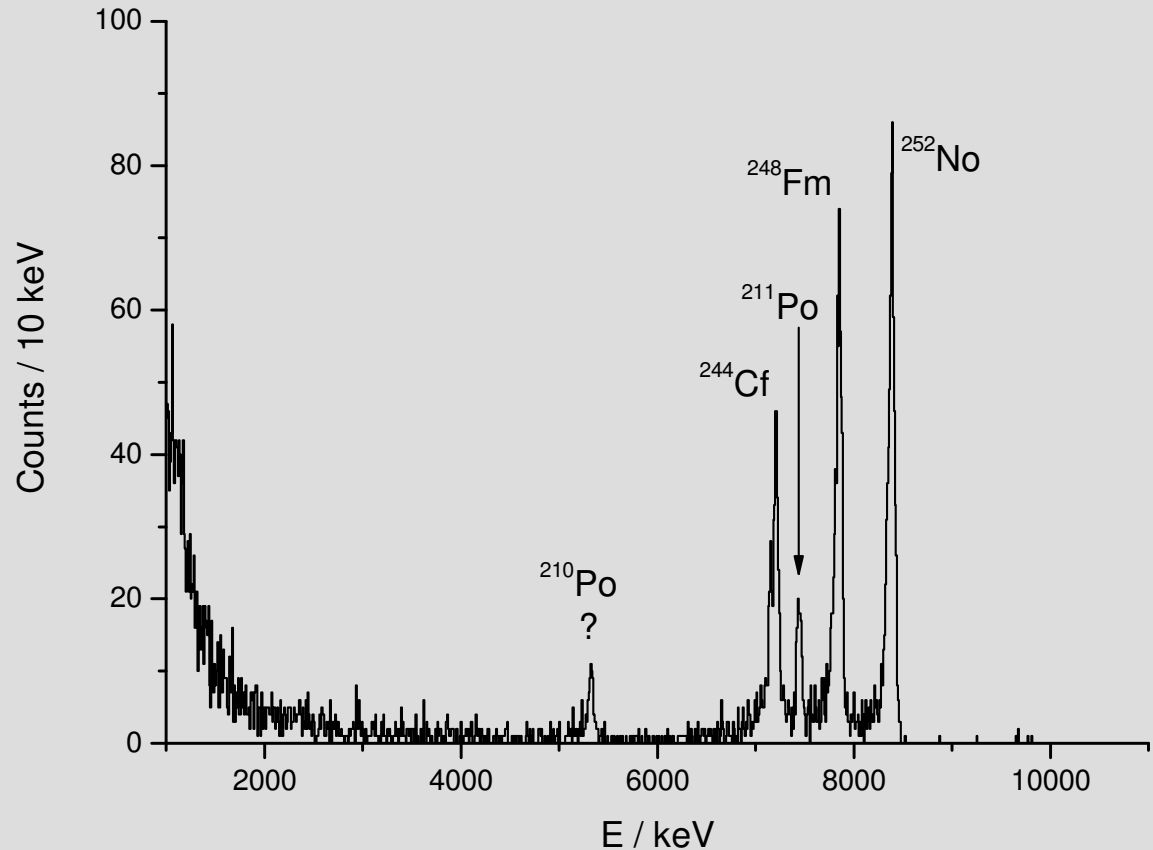
- Projectile: ^{48}Ca
- Charge state: 10+

HTM

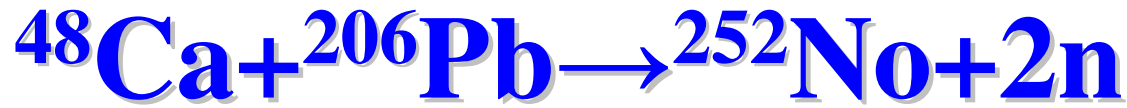
Experiment T008

- Target: ^{206}PbS
 - Thickness: $483 \mu\text{g}/\text{cm}^2$ (Pb)
 - Backing foil: $2.3 \mu\text{g}$ (Ti)
 - Coating foil: $10 \mu\text{g}/\text{cm}^2$ (C)

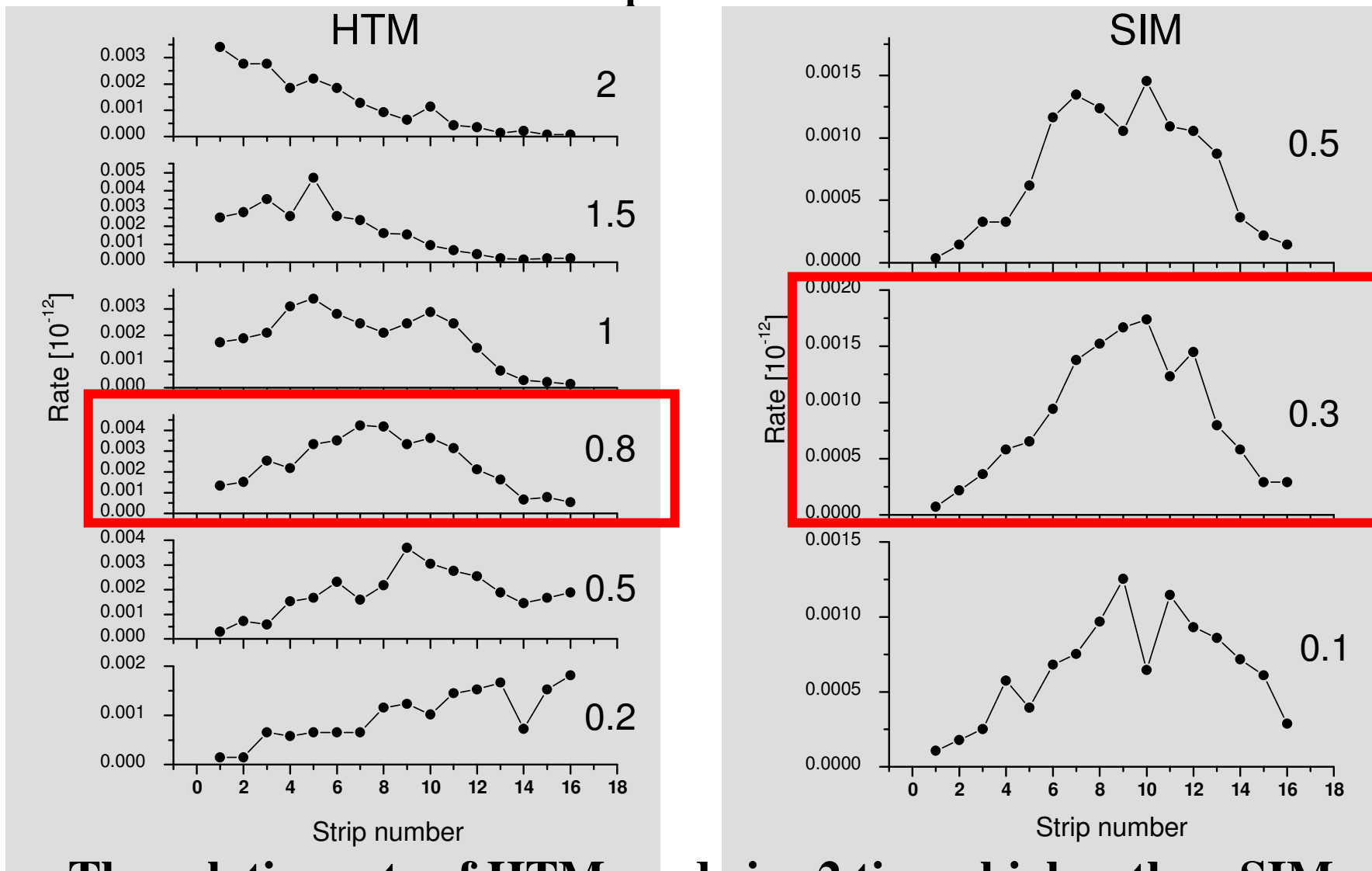
Best setting for this reaction:
Q1=Q2=525 A, D=588A,
He=0.8 mbar



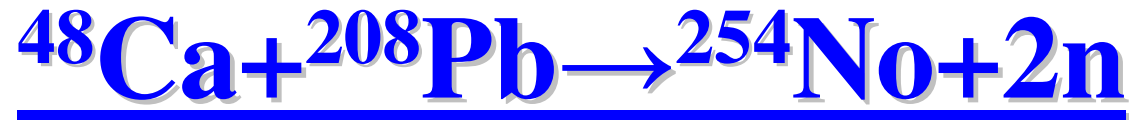
Low energy spectrum in beam off duration 5/15 ms



Distribution of ^{252}No on the focal plane detector depends on helium gas pressure



The relative rate of HTM mode is ~ 2 times higher than SIM



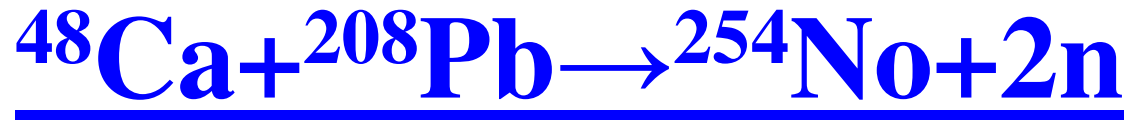
- Projectile: ^{48}Ca
 - Charge state: 10+

- Target: ^{208}PbS
 - Thickness: 468 $\mu\text{g}/\text{cm}^2$
 - Backing foil: 2.3 μg (Ti)
 - Coating foil: 10 $\mu\text{g}/\text{cm}^2$ (C)

Experiment T008

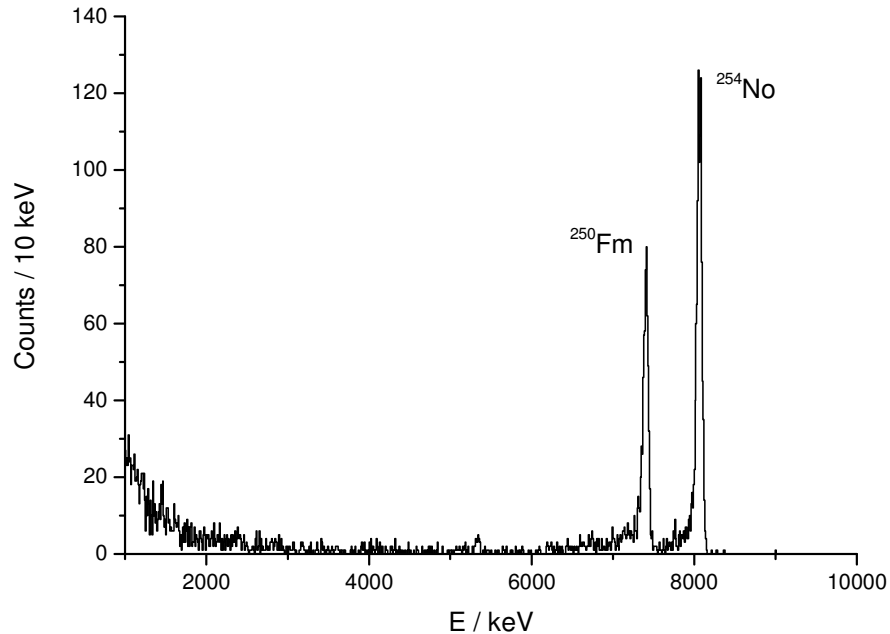
HTM

We used 2 different gases: Hydrogen, Helium



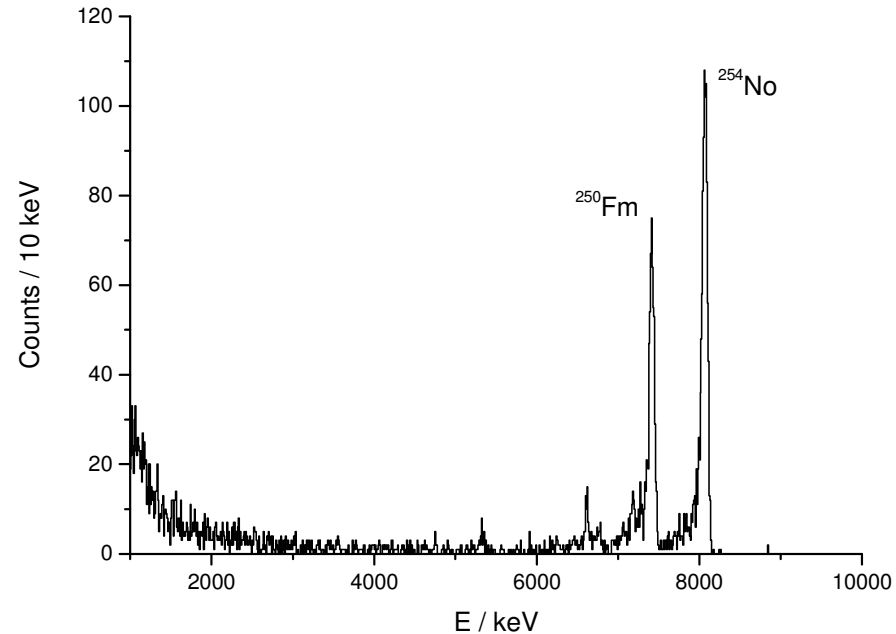
Comparison of alpha spectra

Hydrogen gas

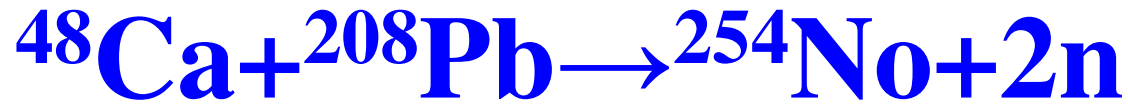


Best setting for this reaction:
Q1=Q2=558 A, D=617A,
H2=1.5 mbar,

Helium gas

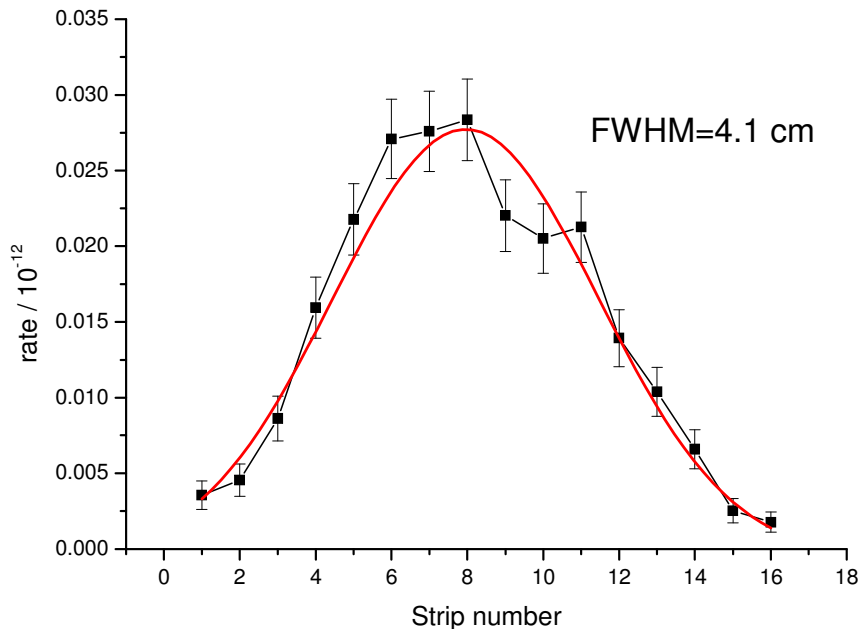


Best setting for this reaction:
Q1=Q2=525 A, D=588A,
He=0.8 mbar,



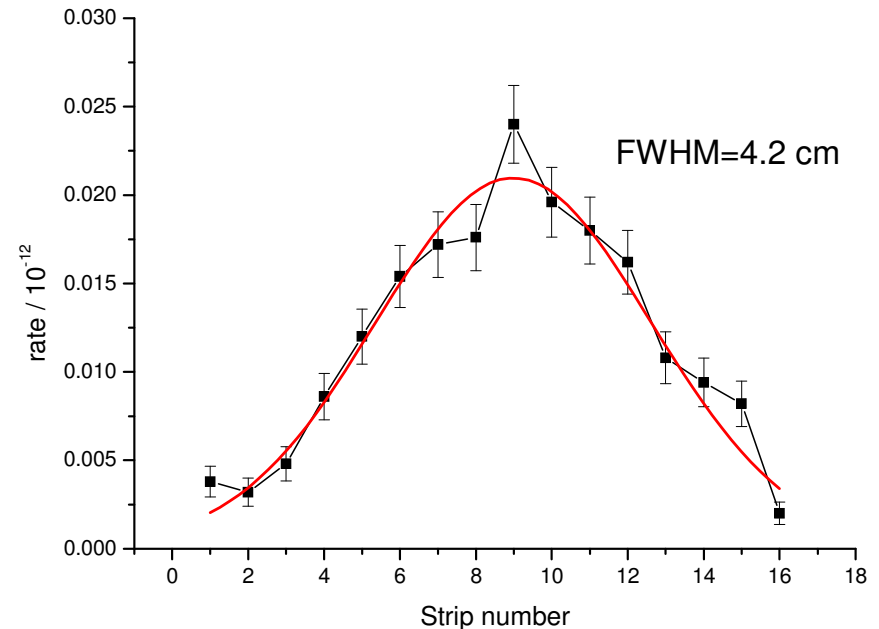
Distribution of ^{252}No in the focal plane detector depends on different gas

Hydrogen gas



Best setting for this reaction:
Q1=Q2=558 A, D=617A,
H2=1.5 mbar,

Helium gas



Best setting for this reaction:
Q1=Q2=525 A, D=588A,
He=0.8 mbar,

Summary and conclusion

- **The first at TASCAs were Synthesized and Separated transuranium isotopes.**
- **The transmission of HTM is about two times higher than SIM**
- **The Helium and Hydrogen gases were compared for the same reaction.**
- **The separation (suppression) of transfer reaction products *seems* better in case of Hydrogen gas.**
- **The transmission *seems* to be better with Hydrogen gas.**