Recoil Tagging and Recoil Decay Tagging with Vamos and Exogam

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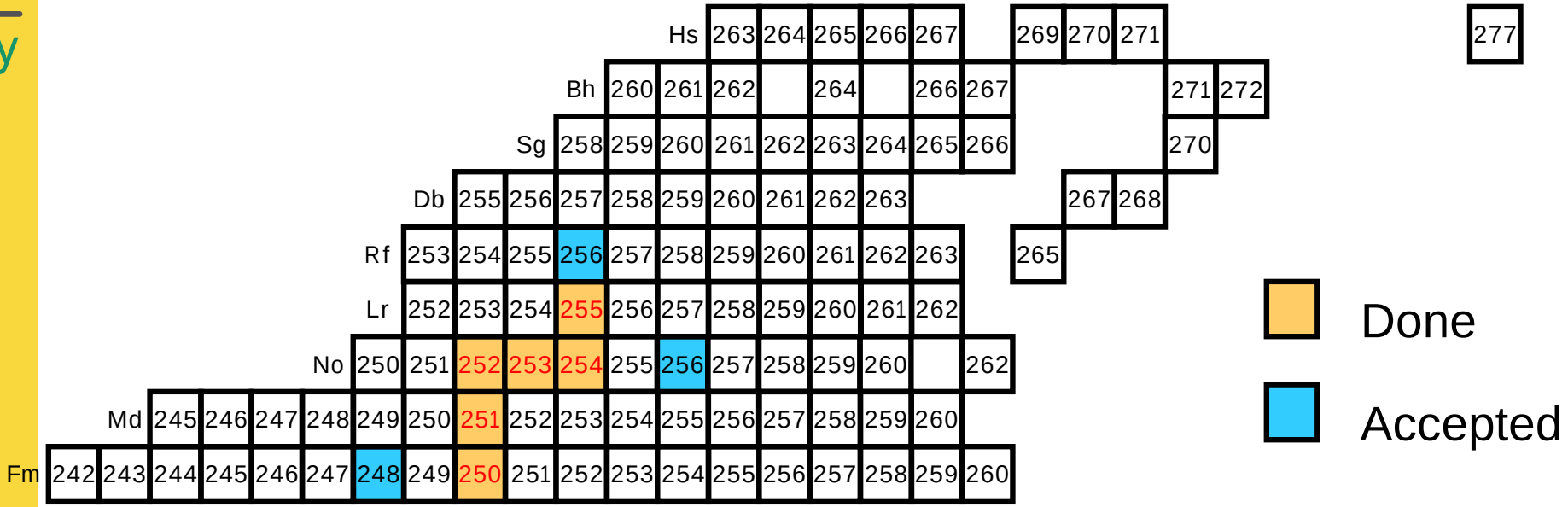
- Introduction and motivations
- Performances of Exogam and Vamos
- Test experiment
- New developments

Prompt spectroscopy of transfemium elements

Achievements at JYFL and Argonne



Why doing transfermium spectroscopy @ GANIL ?

Opportunities for Ganil

- Done : mainly ^{48}Ca-like + ^{208}Pb-like reactions

- Asymmetric reactions populate other nuclei, but are difficult. Examples :
  - $^{18}O + ^{238}U \rightarrow ^{252}Fm$
  - $^{22}Ne + ^{238}U \rightarrow ^{255}No$

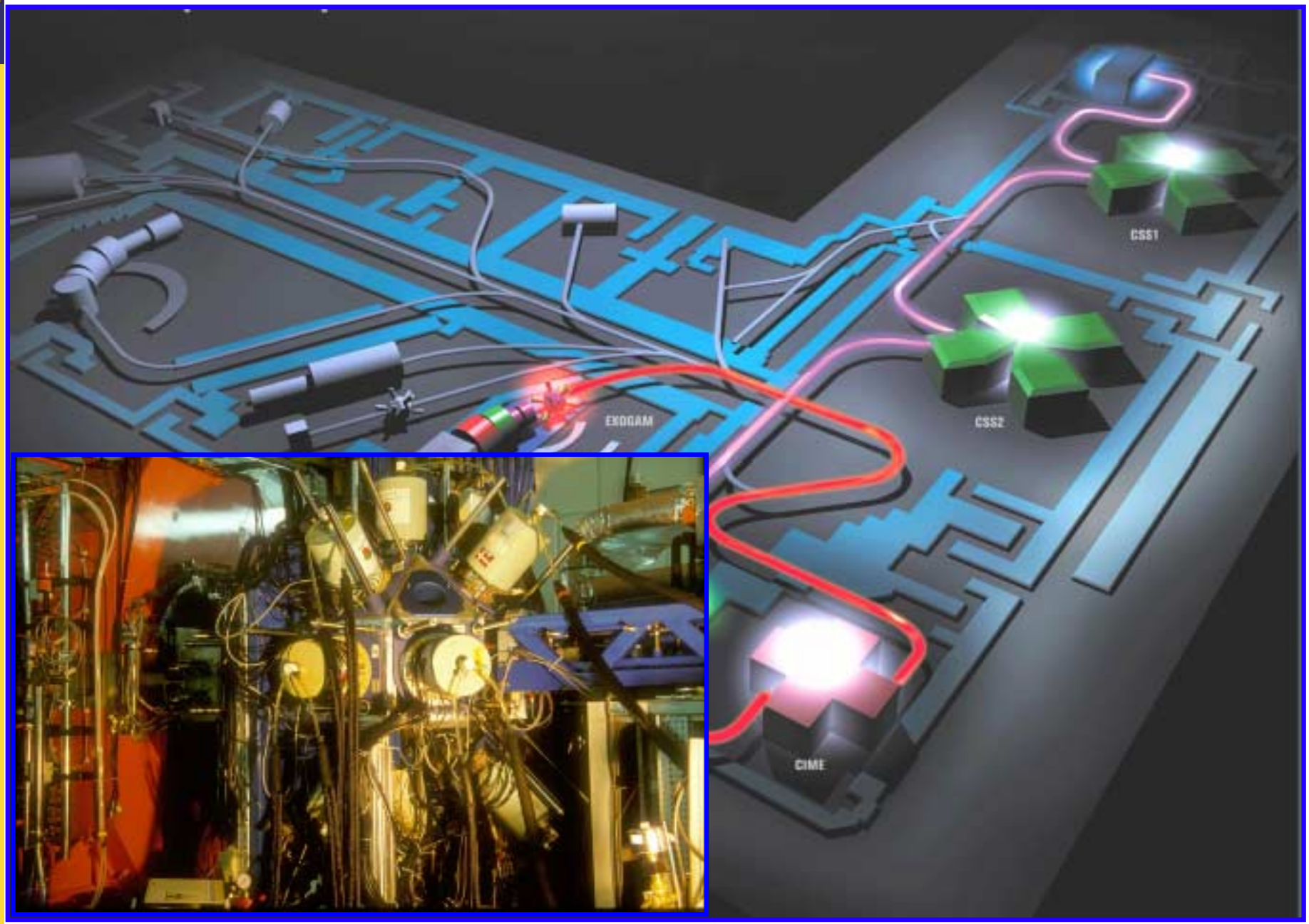
- Lifetime (differential plunger) measurements are difficult (degrader foil, straggling).

- Spectroscopy of odd and heavier nuclei require large efficiency.

- Spiral II intense neutron-rich radioactive beams open new perspectives

Why are Vamos & Exogam adapted ?

Exogam and Vamos



Optics simulations
$^{238}U(^{22}Ne,4n)^{256}No$

Setup :

E_{WF} = 300 kV/m

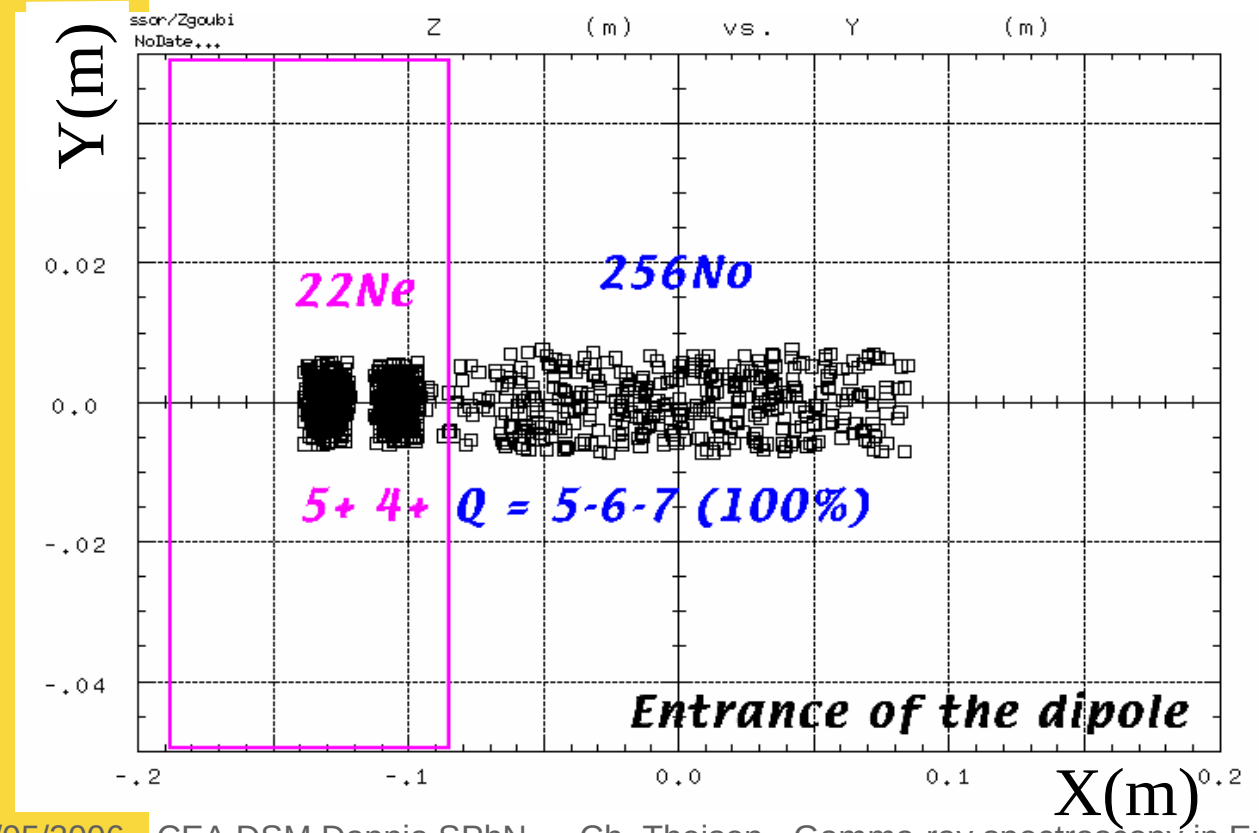
B_{WF} = 0.172 T $x/\delta_{[WF]}$ ~ -0.12 cm/%

B_{dip} = 2100 G Deflection angle = 25°

Beam spot : 1.5 mm, ΔE/E +/- 0.1%

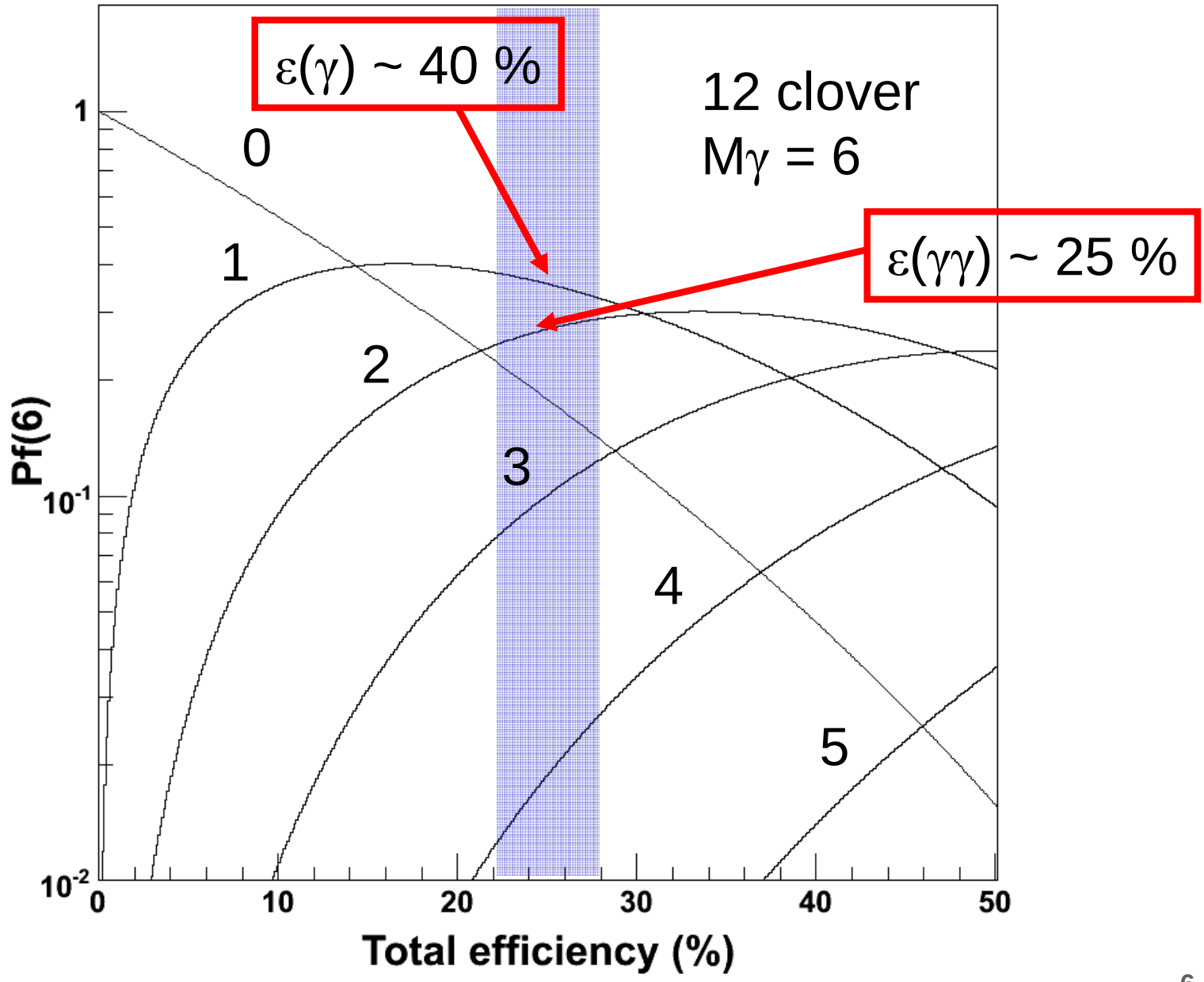
Reaction products :

Δθ = Δφ = +/- 4 ° ; ΔBρ = +/-10 %



- Beam rejection (before the dipole)
- Large transmission
- Scattered beam ?

Exogam efficiency



Test experiment Nov. 2004 ^{18}O + ^{208}Pb

dapnia SPhN

cea

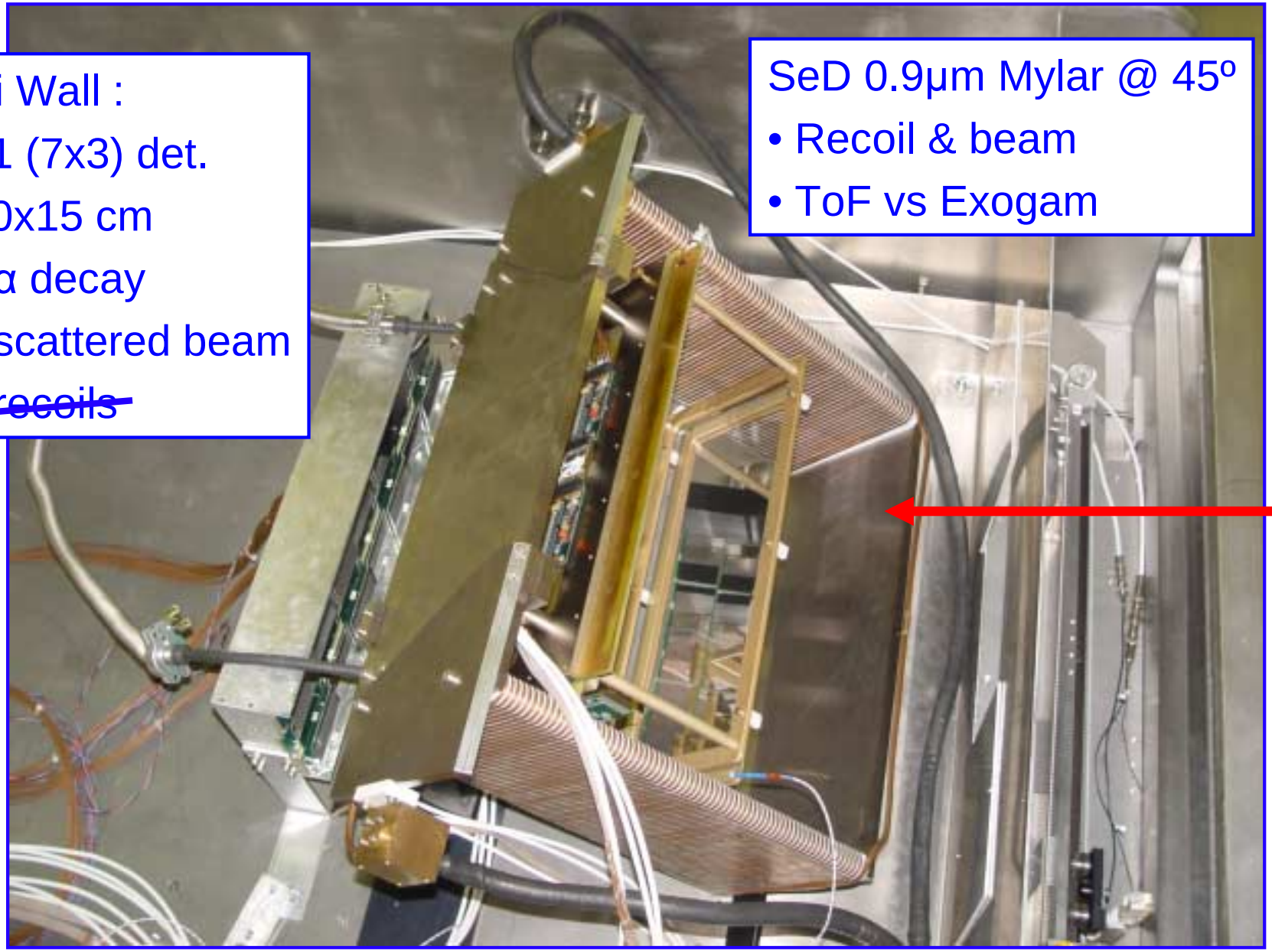
saclay

Si Wall :

21 (7x3) det.

50x15 cm

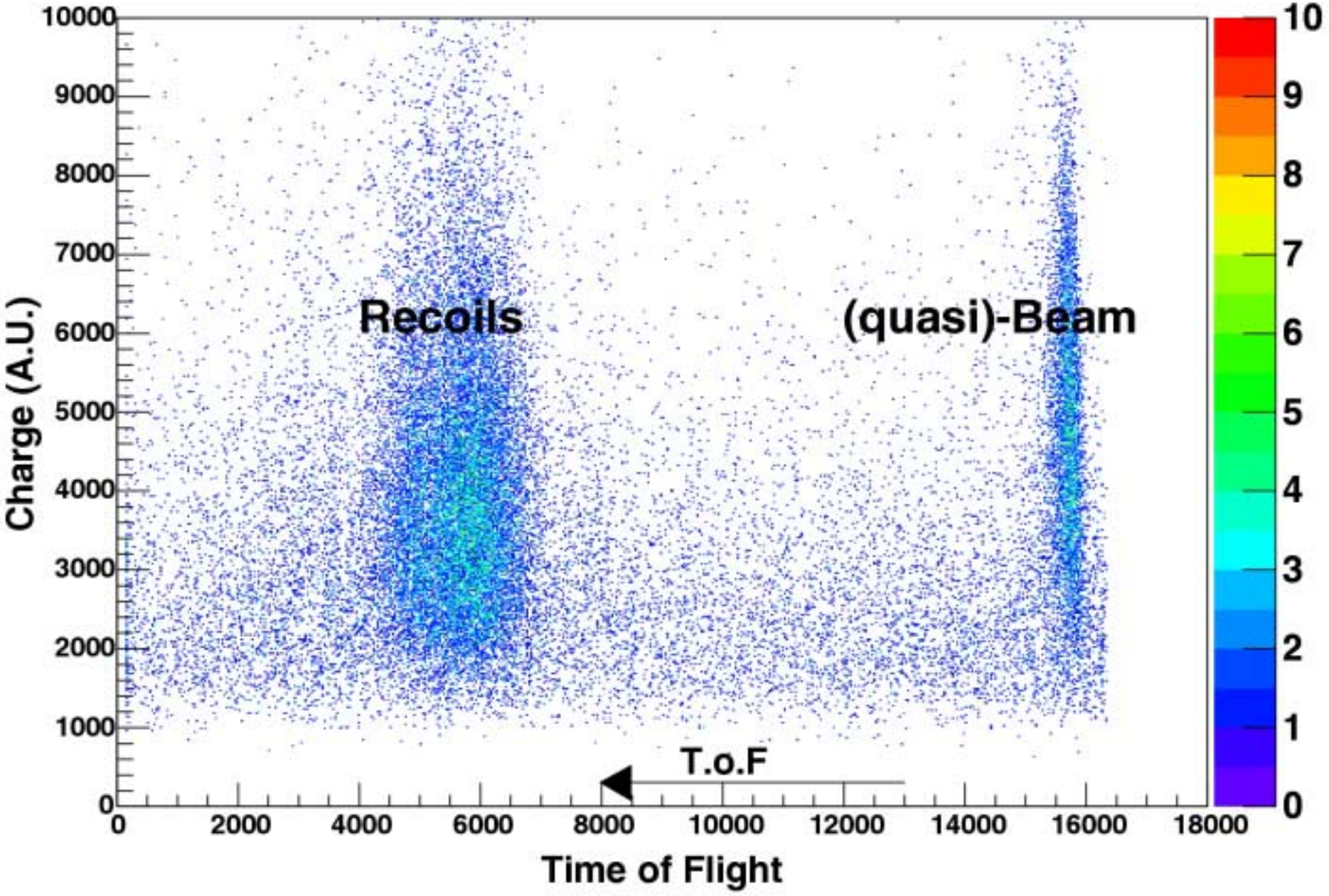
- α decay
- scattered beam
- ~~recoils~~



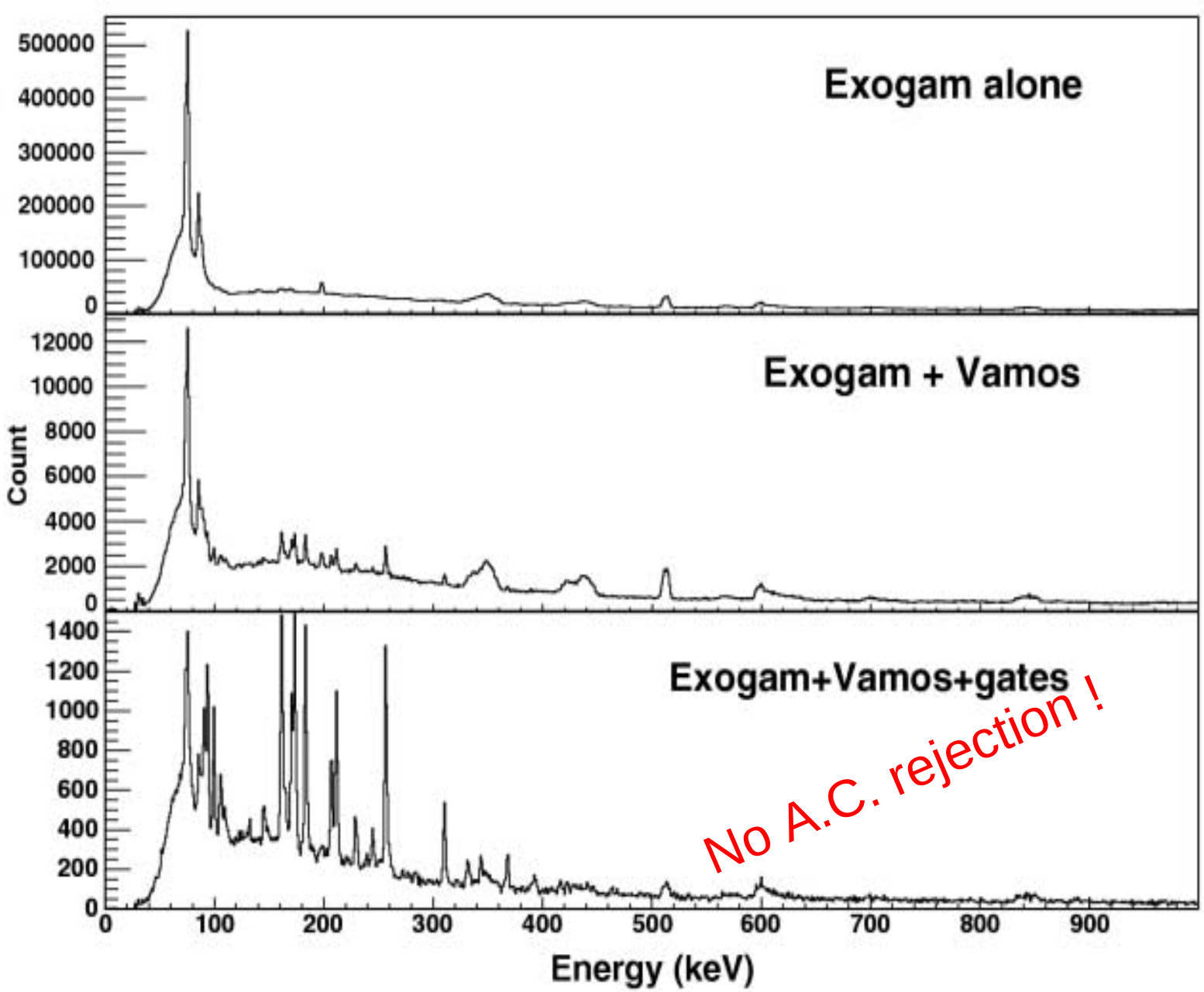
SeD 0.9µm Mylar @ 45º

- Recoil & beam
- ToF vs Exogam

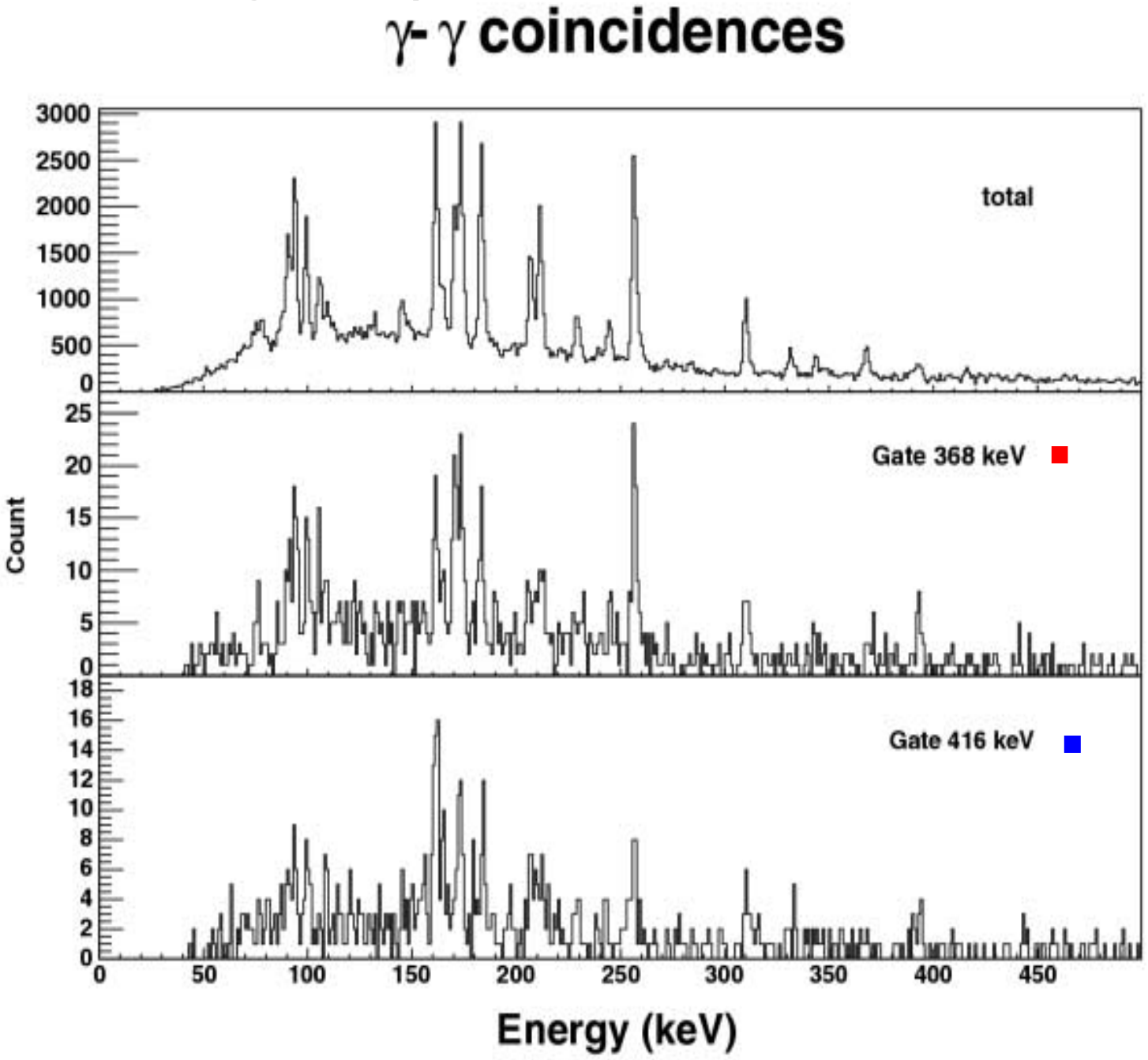
Identification

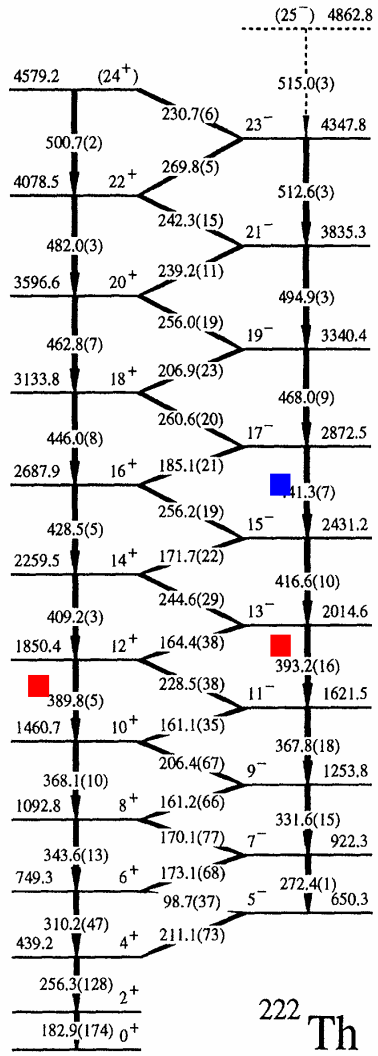


Exogam spectra

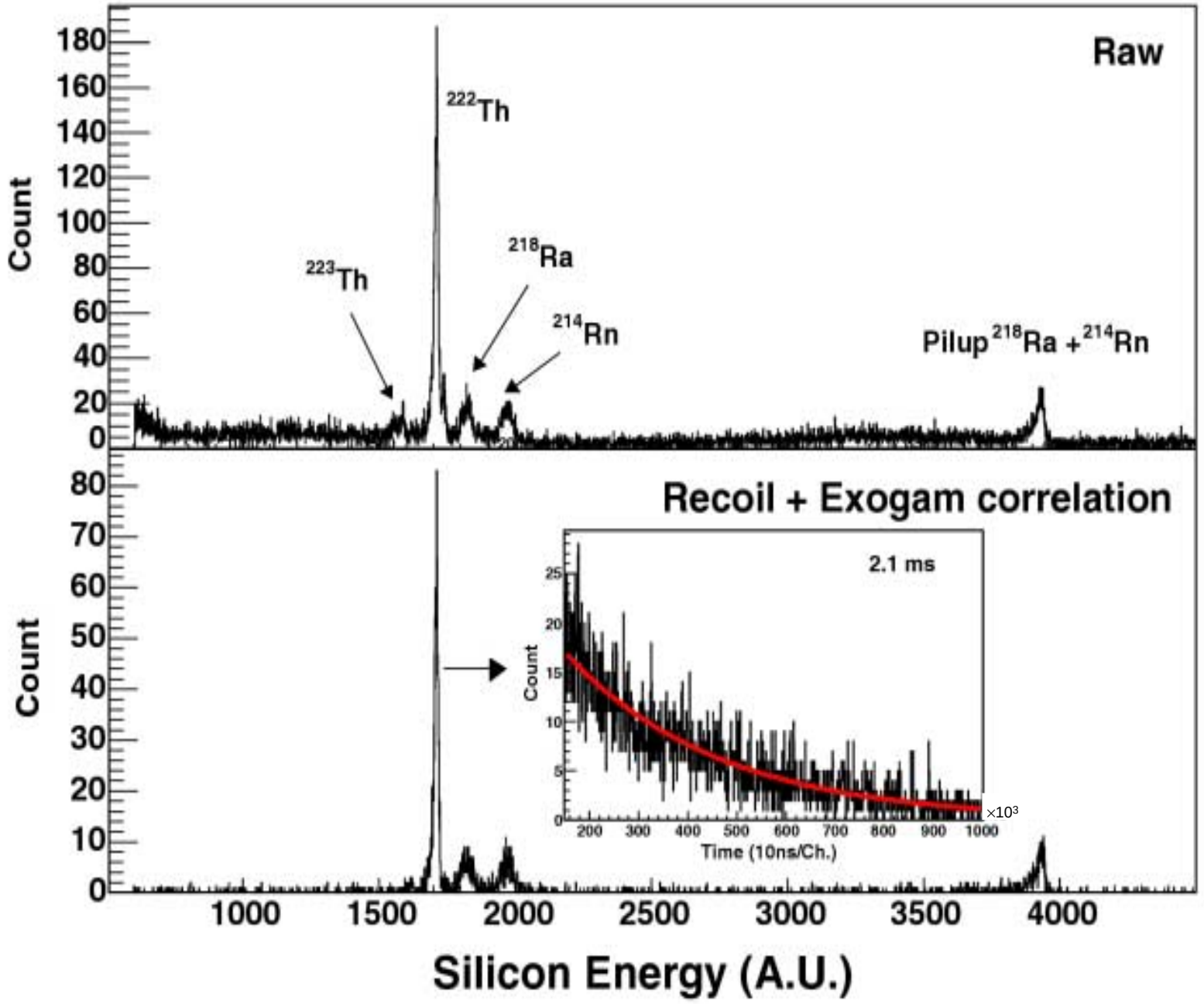


Exogam spectra





Recoil Decay Tagging



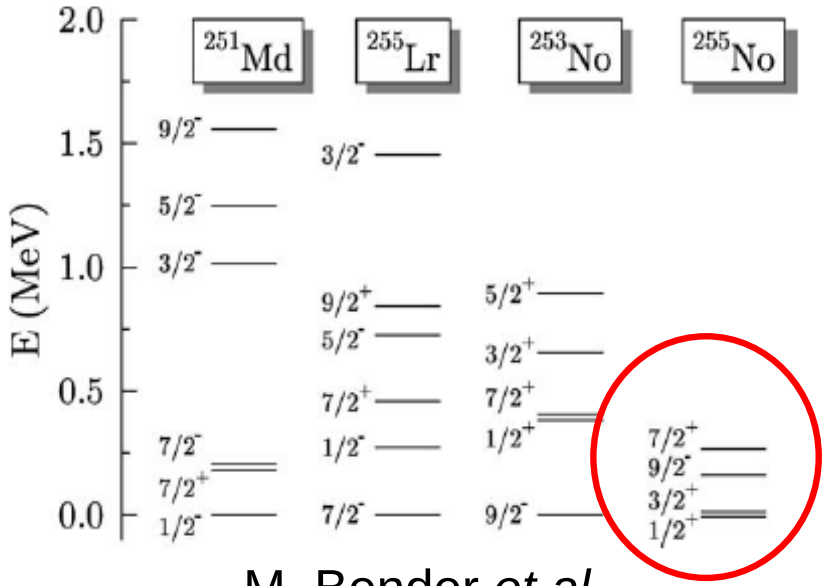
Experiment accepted : ^{255}No

Saclay, Jyväskylä, Dubna, Krakow, Ganil, Liverpool, CSNSM, IReS, GSI

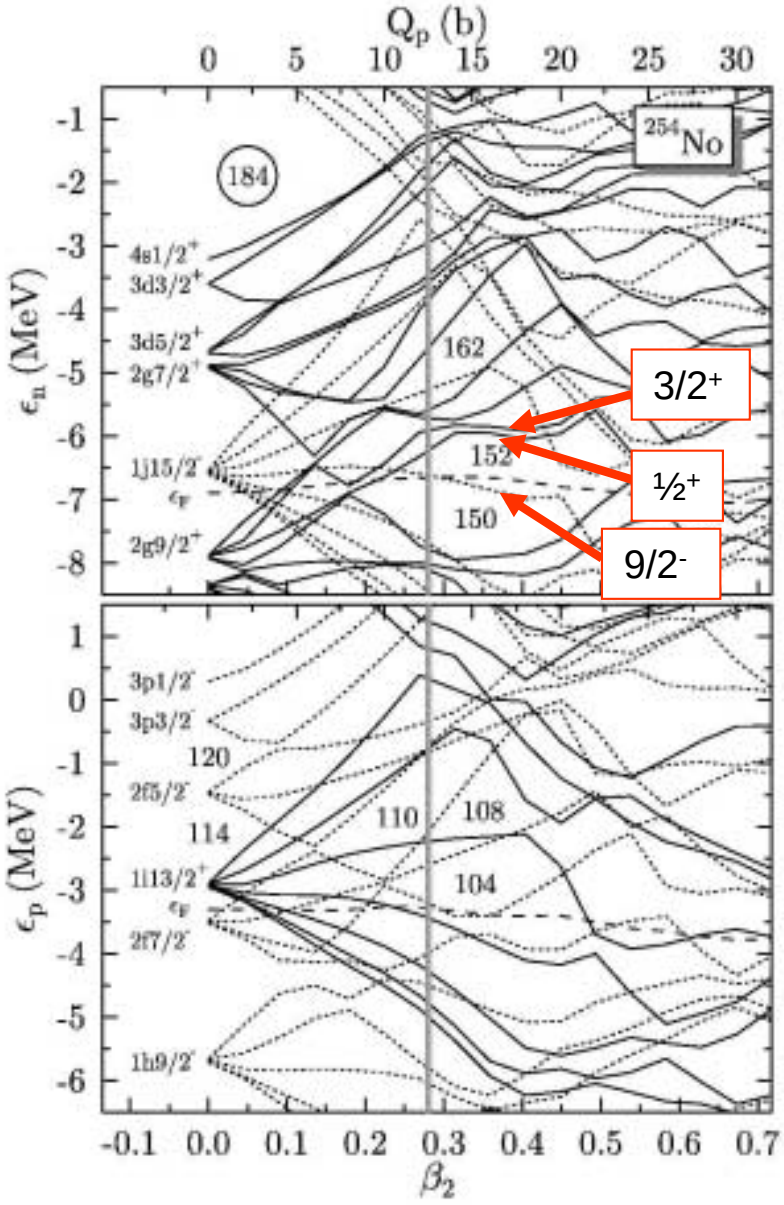
- ^{238}U(^{22}Ne, 5n)^{255}No @ ~120 MeV; σ ~ 200 nb

- New windowless Si detectors (not segmented, HARPEE)

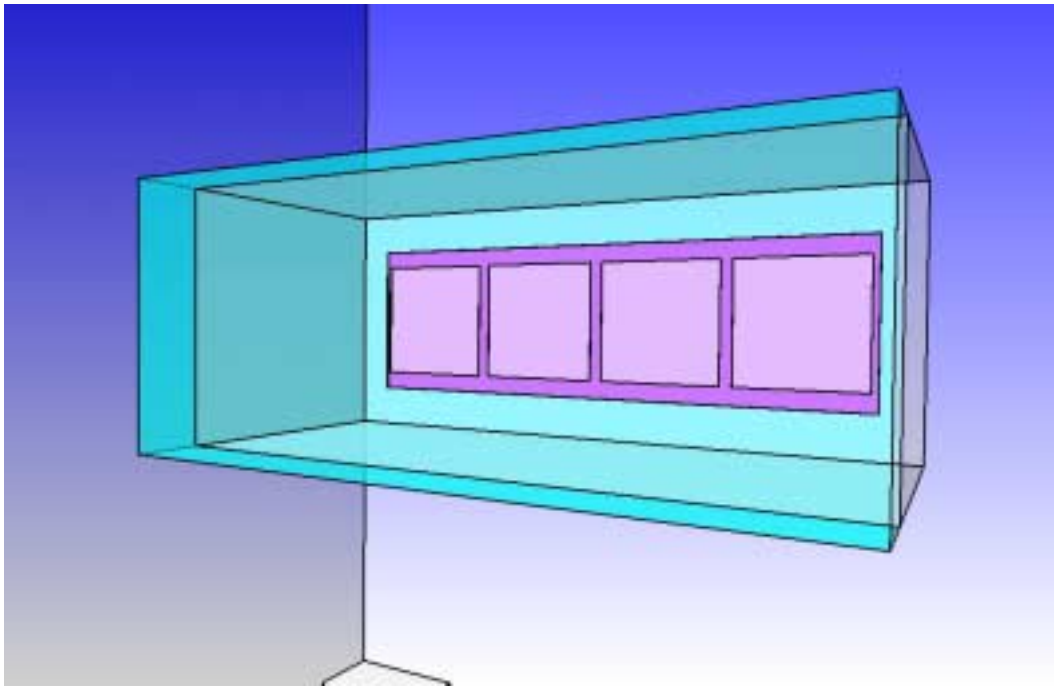
HFB



M. Bender *et al.*



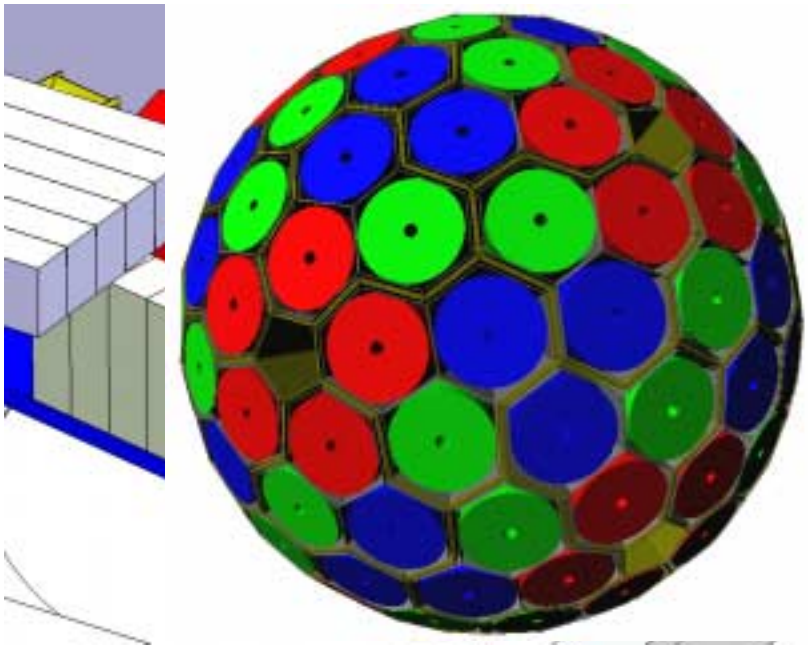
Further developments : MUSETT



Si window-less segmented detectors (MUST-II based)
4 x 10 x 10 cm^2; 1024 electronics channel
Segmentation for RDT measurements
ASICs electronics
Parallel-like readout with time stamping
Ionization – Drift chamber for ΔE and escaped α measurement

Limitations ?

- Limited Fast-Trigger range (1 µs) : problem for long Vamos time of flight
  - We have to find a solution for the ^{255}No experiment !
    - Accept dead-time and event losses !!!
    - Delay exogam by ~ 3 µs (600m cables) !!!
    - Find a trick with the FT stuff (good idea to be tested) ?
    - Use non-exogam electronics ?



- Counting rate limitation

- Beam intensity
  - Rotating target ?

- Solutions for the future :
  - Digital electronics : TNT2 ? Agata-like ?
  - Agata

Conclusion

- Vamos has excellent performances for
  - Asymmetric reactions
  - Large recoil straggling
  - Dispersive mode without WF should be investigated
  - Upgrade for more symmetric reaction ?
- Exogam has excellent efficiency
  - Upgrade to digital electronics ?
- MUSETT :
  - device for slow-heavy ions detection
  - ΔE and α escape measurement (rather fast ions)
- Perspectives with Spiral II beam → working group
- Radioactive targets at Ganil ?
- Direct beam line CIME → G1, G2