Detectors for the focal plane of RITU

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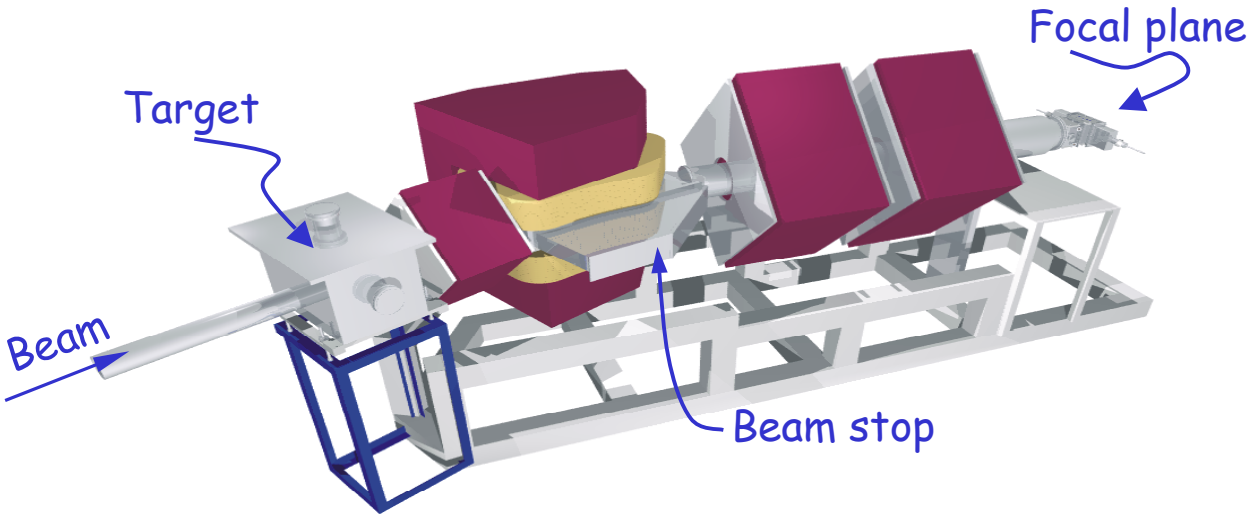
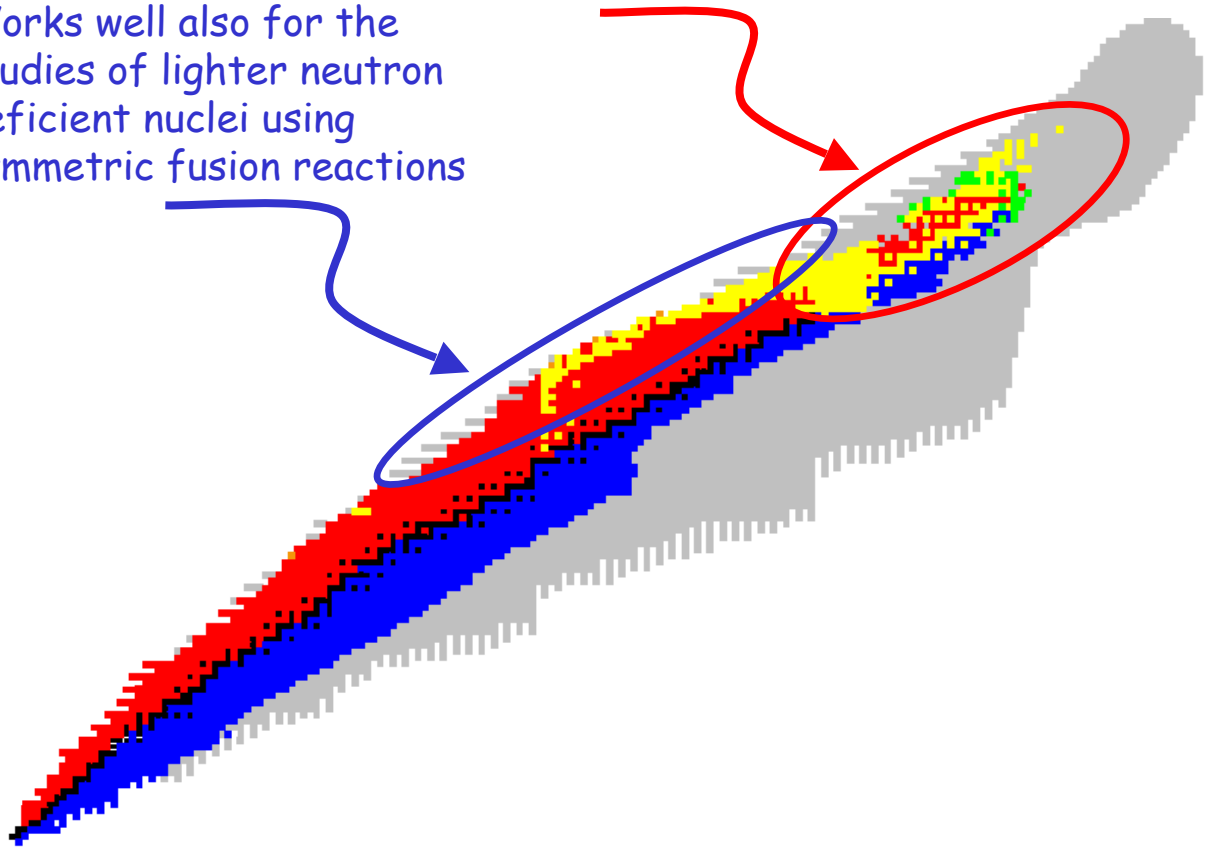
The gas-filled recoil separator RITU



Designed for the studies of the heaviest elements using asymmetric fusion reactions

Works well also for the studies of lighter neutron deficient nuclei using symmetric fusion reactions



Gas filled separator

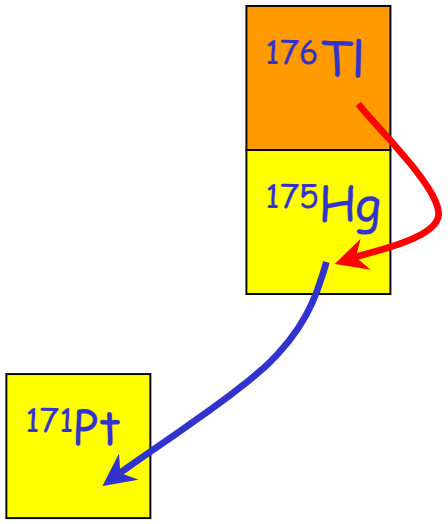
- Efficiency is good

$^{86}Kr + {}^{90}Zr \rightarrow {}^{174}Os + 2n$	>50%
$^{54}Fe + {}^{141}Pr \rightarrow {}^{191}At + 4n$	~40%
$^{28}Si + {}^{172}Yb \rightarrow {}^{196}Po + 4n$	~20%

- But mass resolution is poor

  fusion products can not be identified using mass information

- Identification of the fusion products is usually based on correlated decay chains (proton and alpha decays)

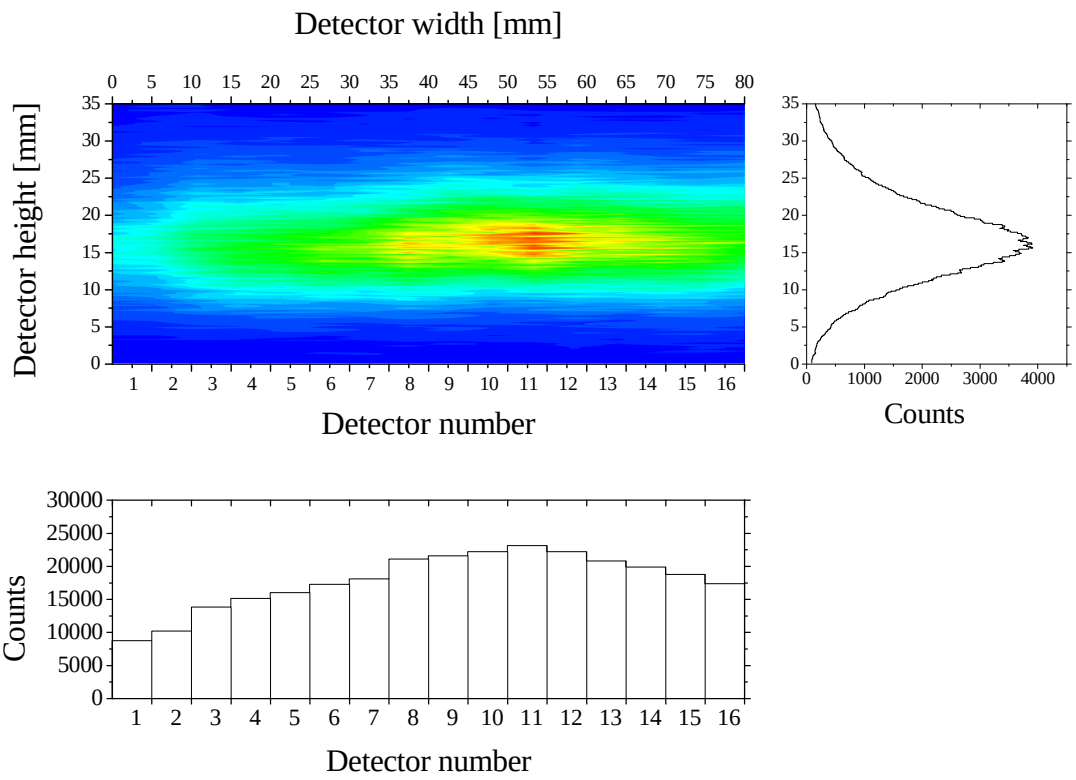


Previously unknown decay

is identified via correlation with

Known daughter decay

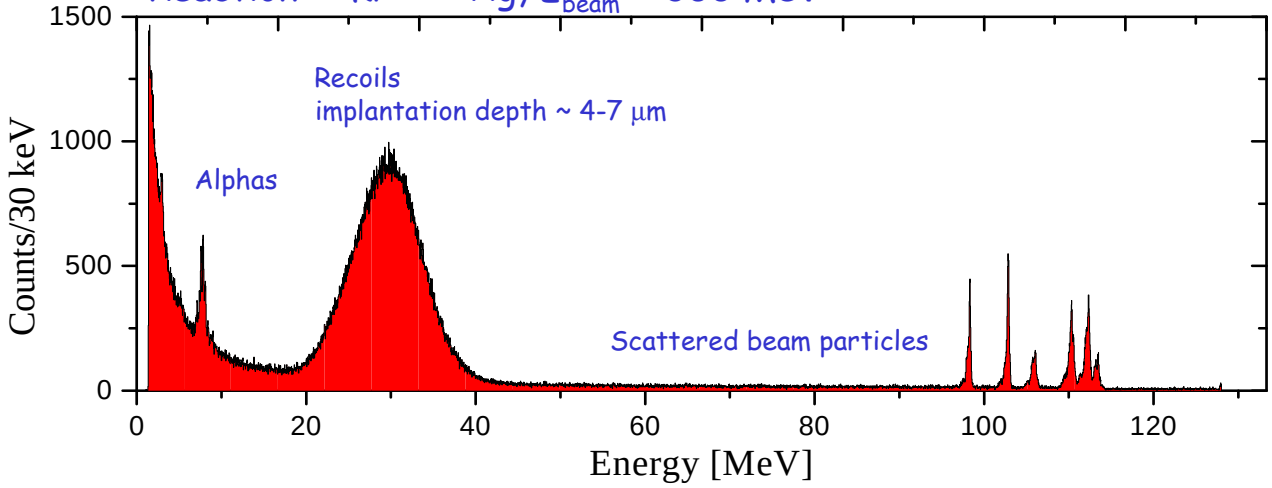
- Typical recoil distribution



- Implantation energy

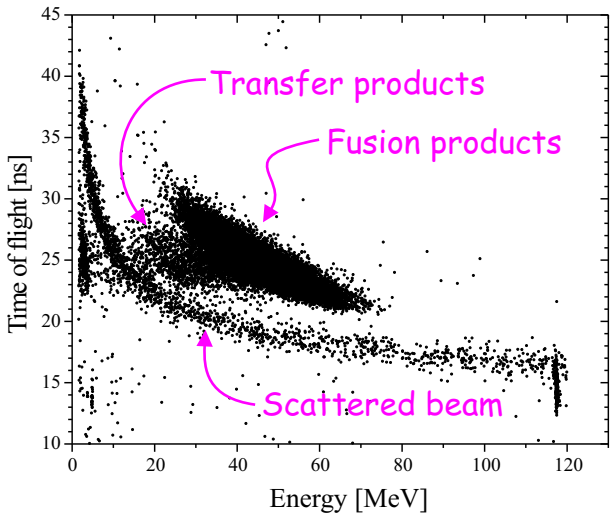
recoil energy typically order of tens of MeV
-> implantation depth only a few µm in Si

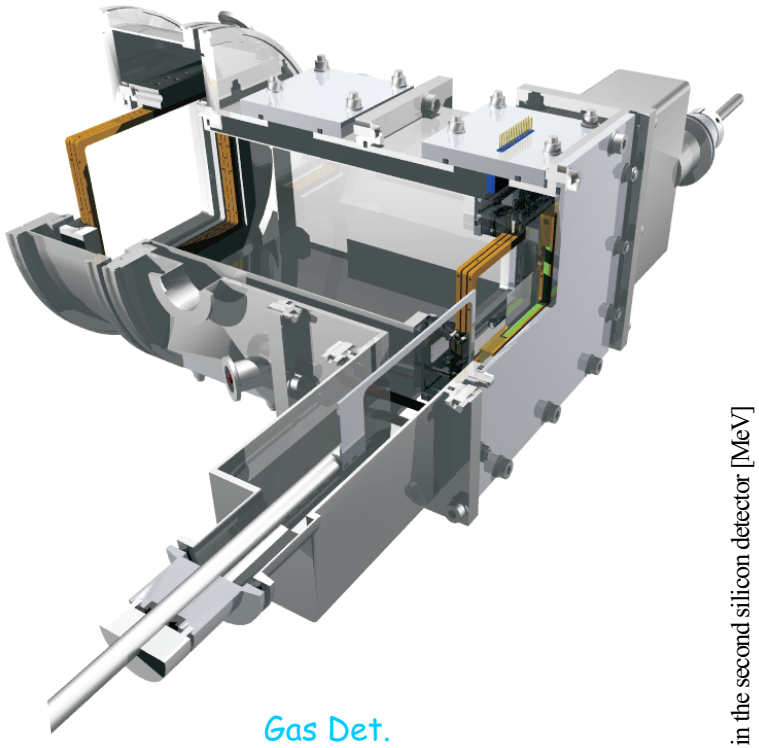
Reaction: ^{83}Kr + ^{109}Ag, E_{beam} ~ 360 MeV



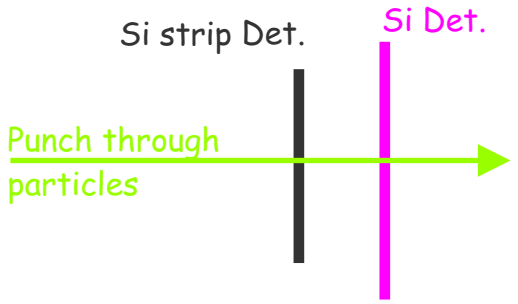
The focal plane detector set-up used in the proton decay studies

Energy vs. Time of flight

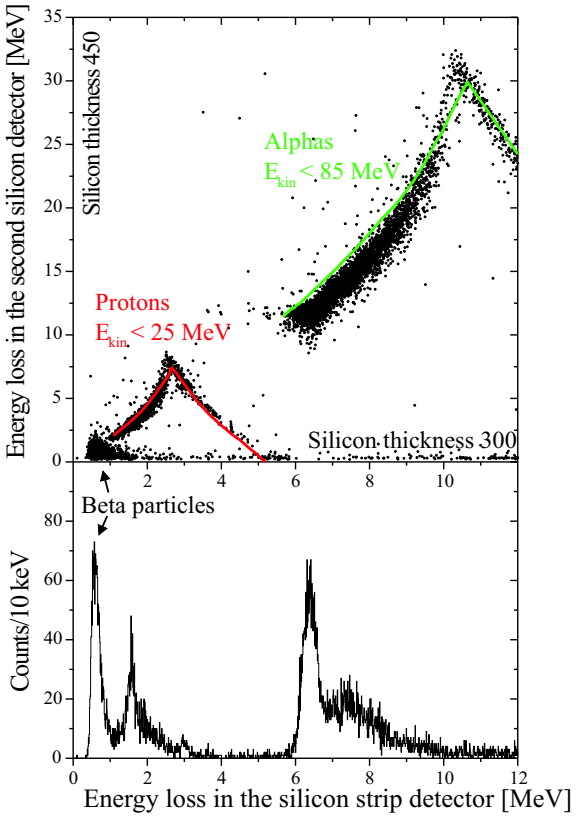




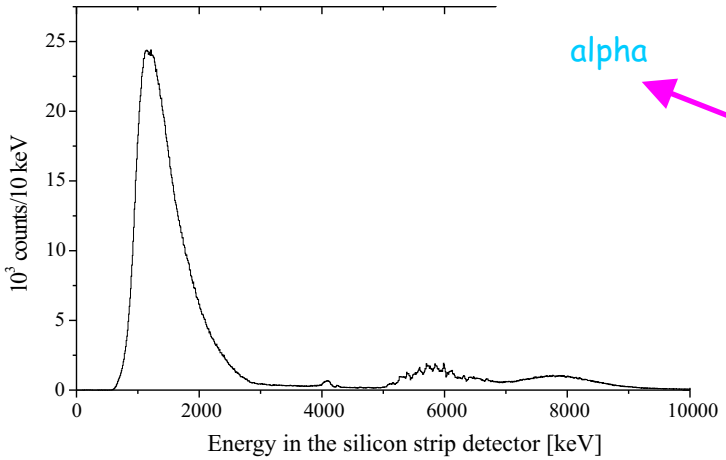
Punch though particles

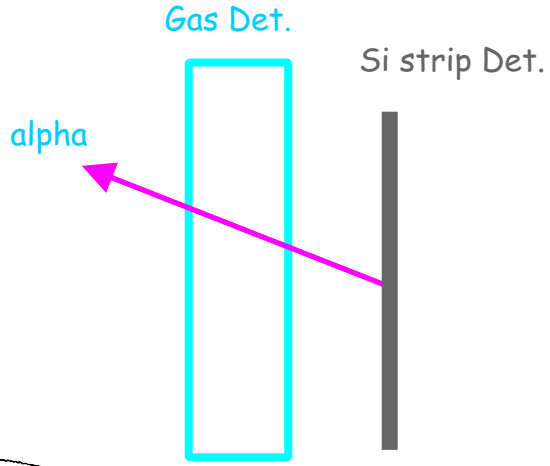


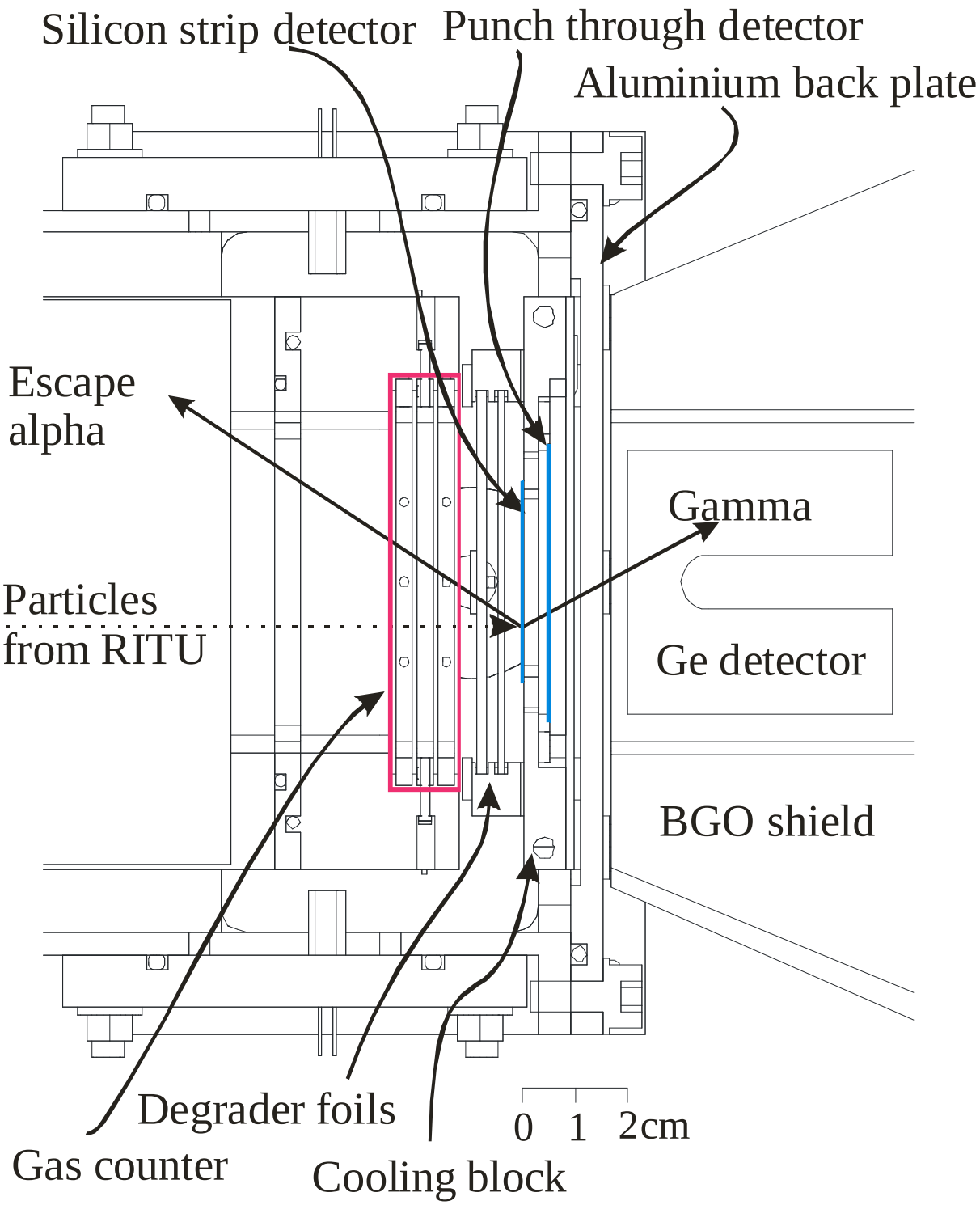
$^{64}Zn + ^{106}Cd$, E_{beam}~360 MeV



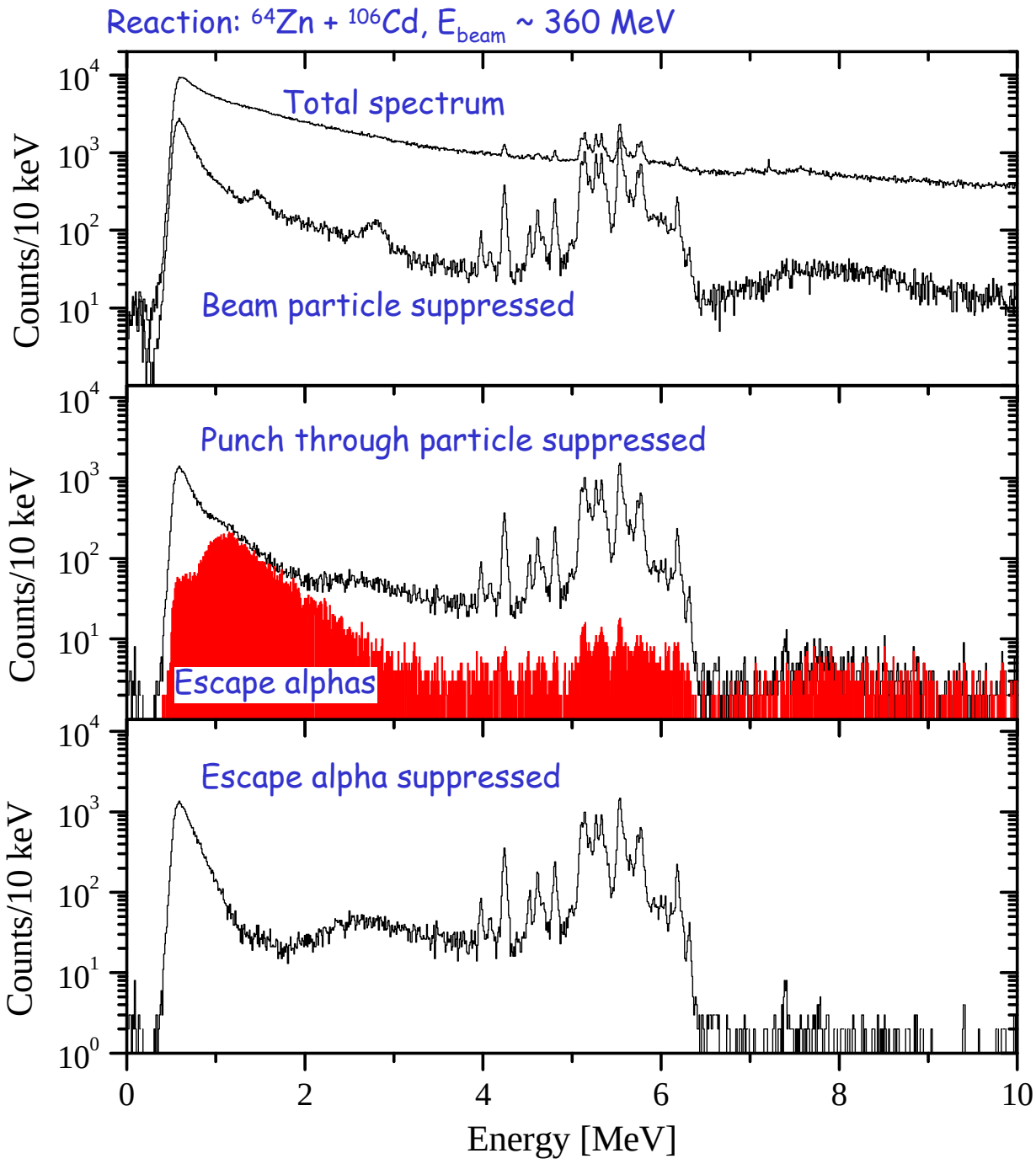
Escape alphas






Silicon strip detector
Punch through detector
Aluminium back plate
Escape
alpha
Particles
from RITU
Gamma
Ge detector
BGO shield
Degrader foils
Gas counter
Cooling block
0 1 2cm

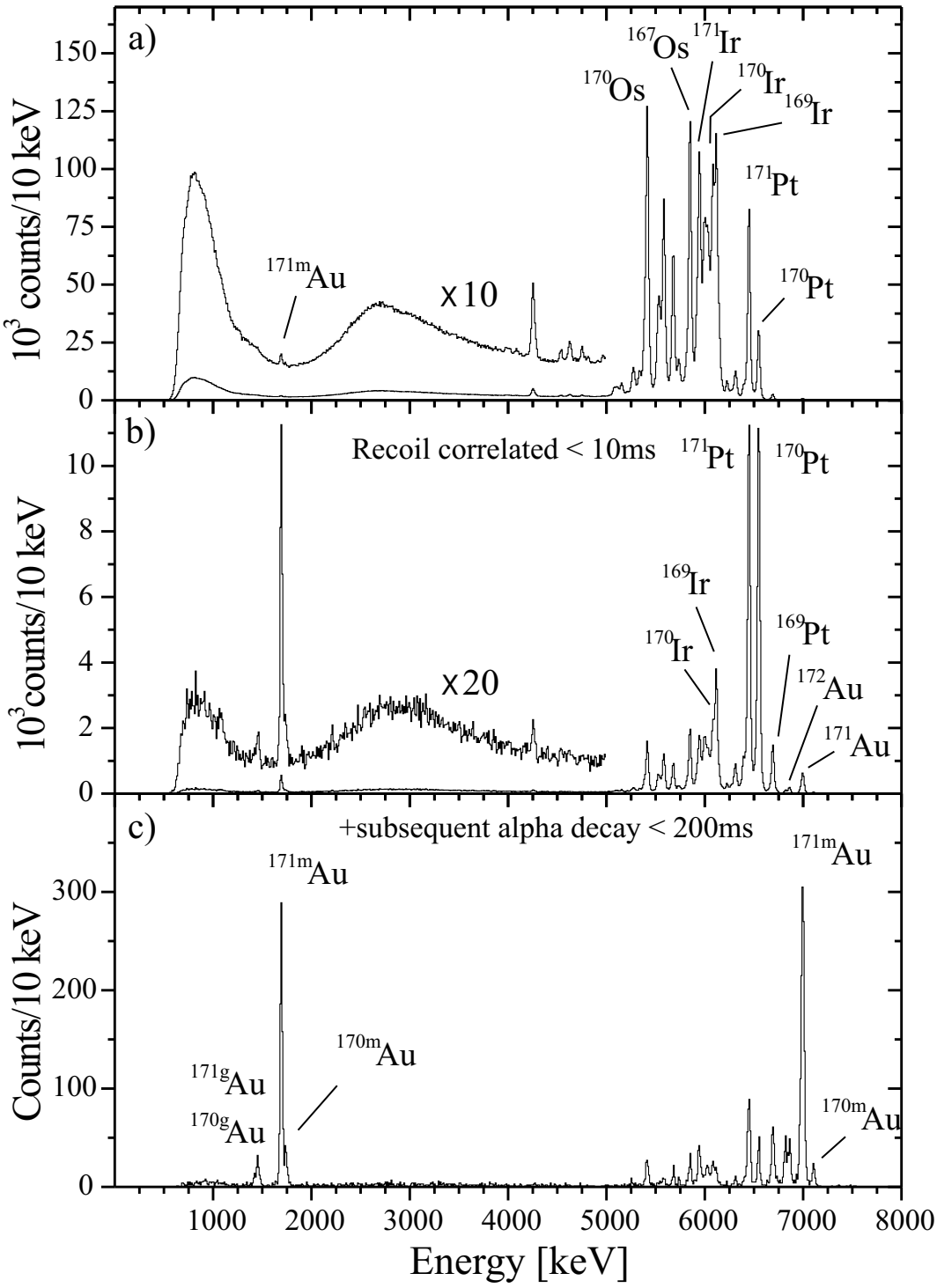
Decay spectrum after back ground suppression

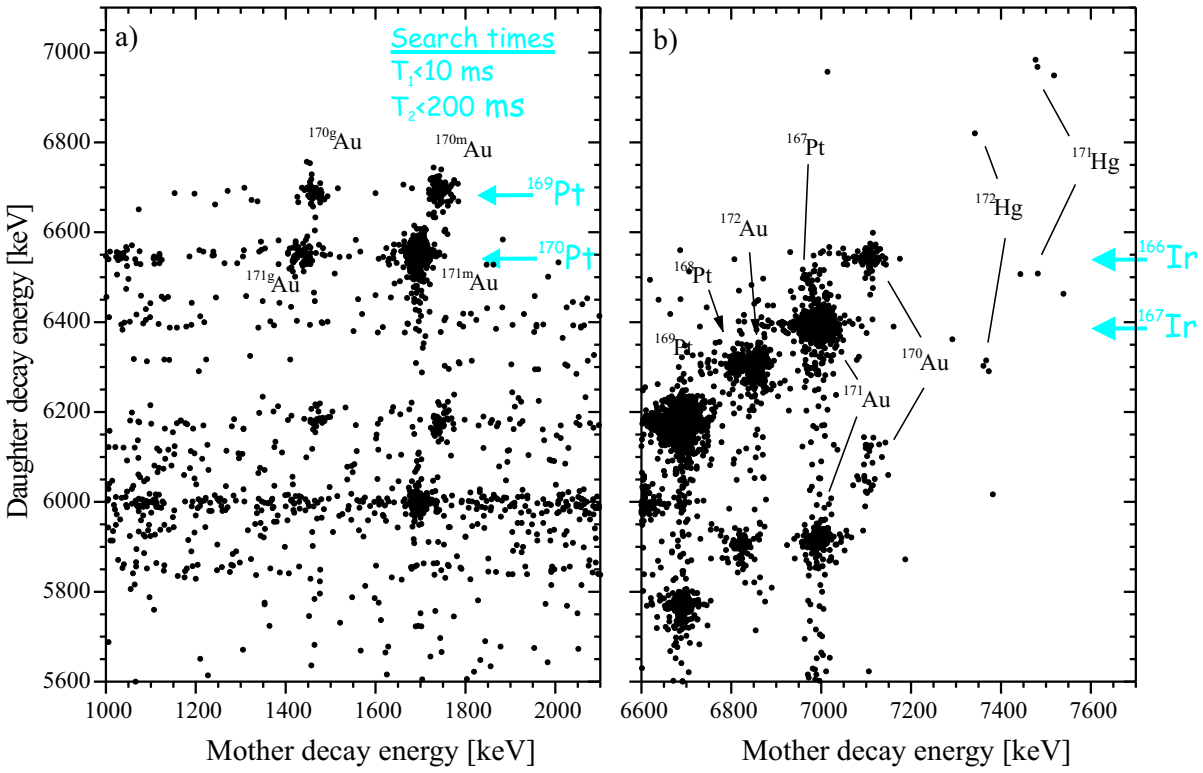


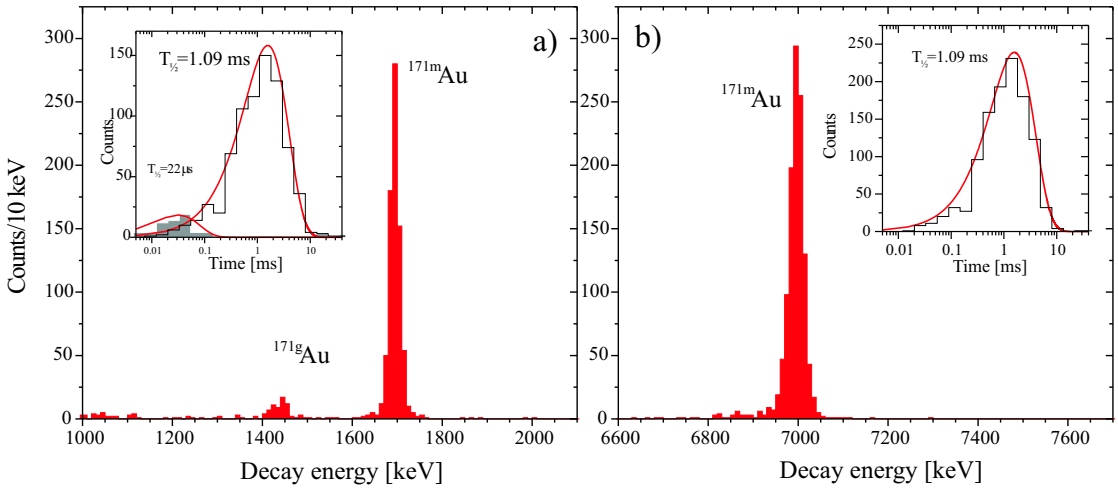
Decay studies of ^{170,171}Au

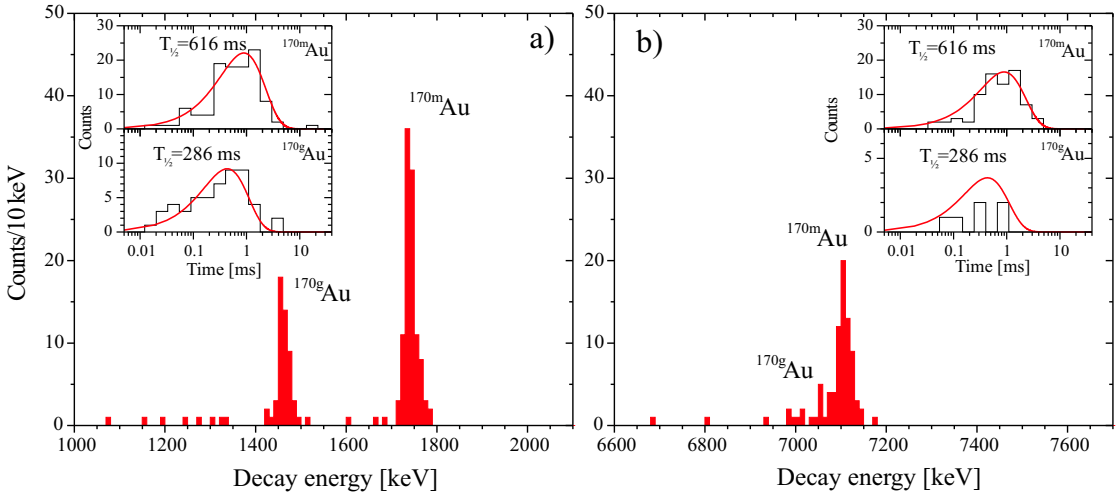
^{78}Kr+^{96}Ru->^{171}Au+p2n, σ~900 nb

^{78}Kr+^{96}Ru->^{170}Au+p3n, σ~60 nb

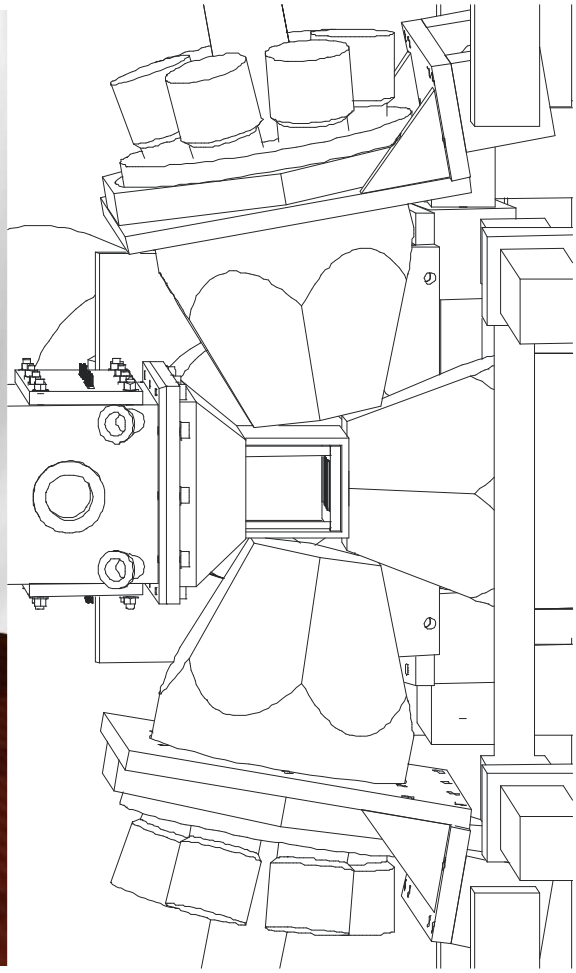


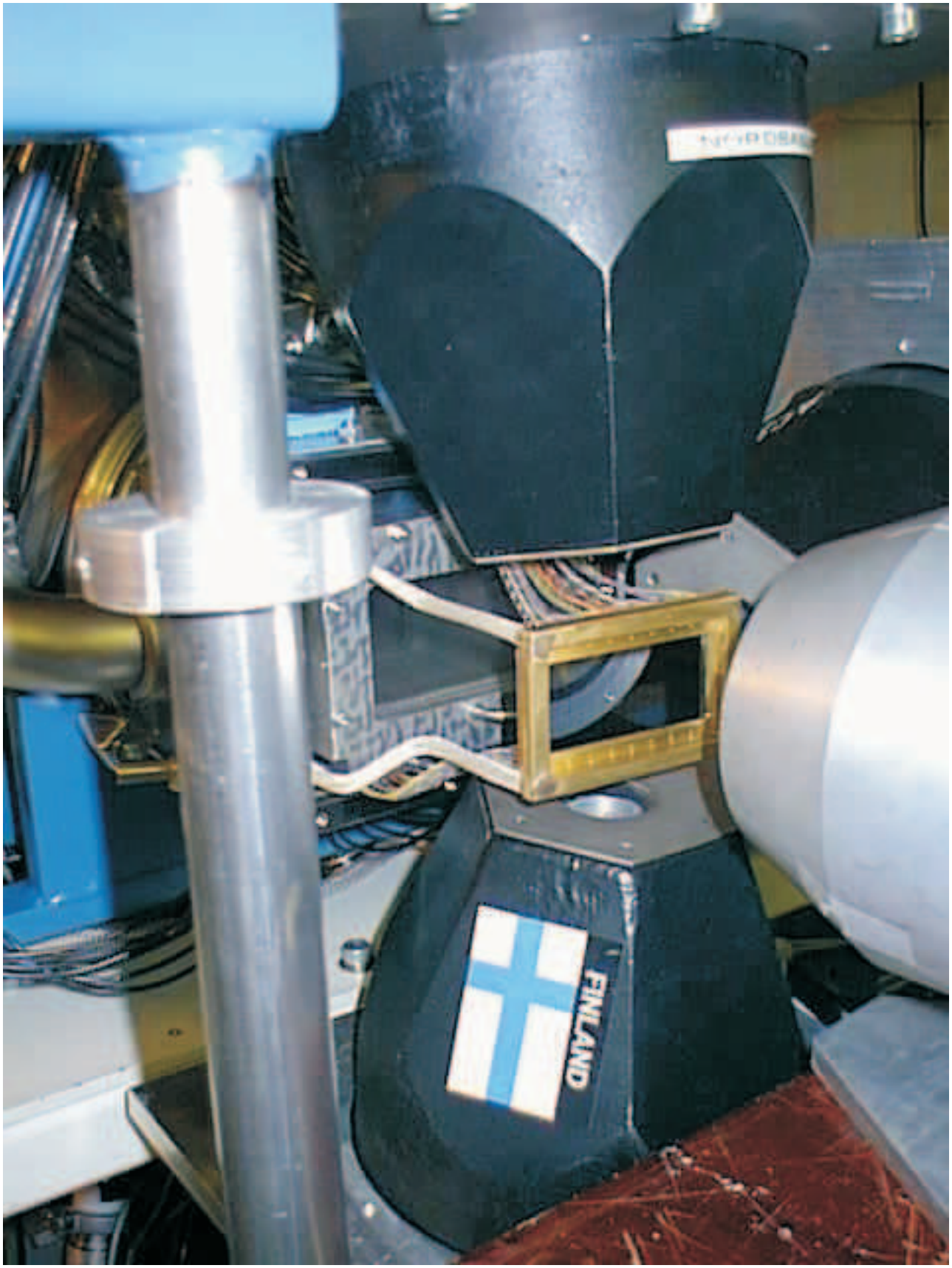

a)
Search times
T1<10 ms
T2<200 ms
170gAu
170mAu
169Pt
170Pt
171gAu
171mAu
b)
167Pt
171Hg
172Hg
172Au
166Ir
168Pt
167Ir
169Pt
170Au
171Au
Daughter decay energy [keV]
Mother decay energy [keV]
Mother decay energy [keV]


a)
T½=1.09 ms
171mAu
T½=22μs
171gAu
Counts
Time [ms]
Counts/10 keV
Decay energy [keV]
b)
171mAu
T½=1.09 ms
Counts
Time [ms]
Decay energy [keV]

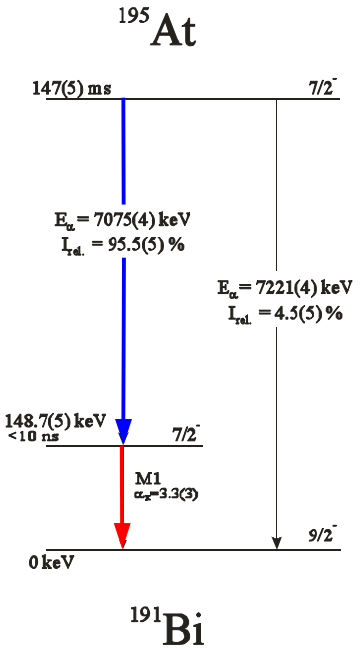

a)
T½=616 ms
170mAu
T½=286 ms
170gAu
Counts
Time [ms]
170mAu
170gAu
Counts/10 keV
Decay energy [keV]
b)
T½=616 ms
170mAu
T½=286 ms
170gAu
Counts
Time [ms]
170mAu
170gAu
Decay energy [keV]

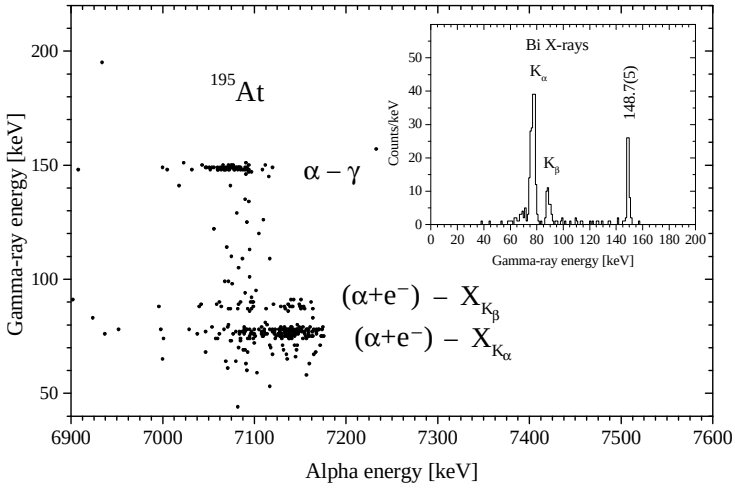
Detection of gamma- and X-rays at the focal plane



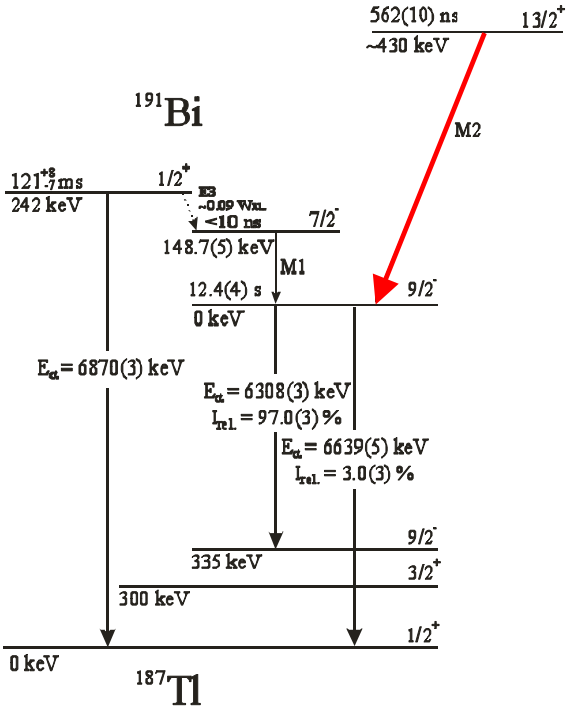

FINLAND

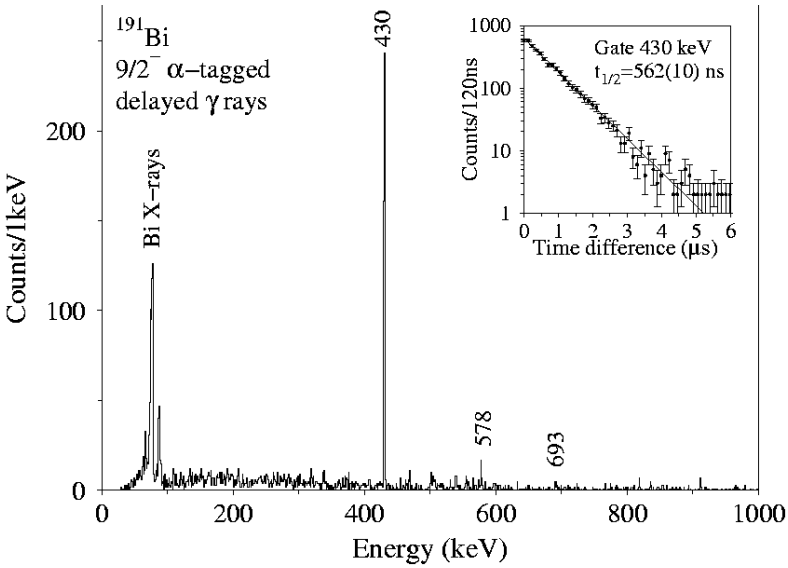
Alpha-gamma coincidences





Recoil isomers

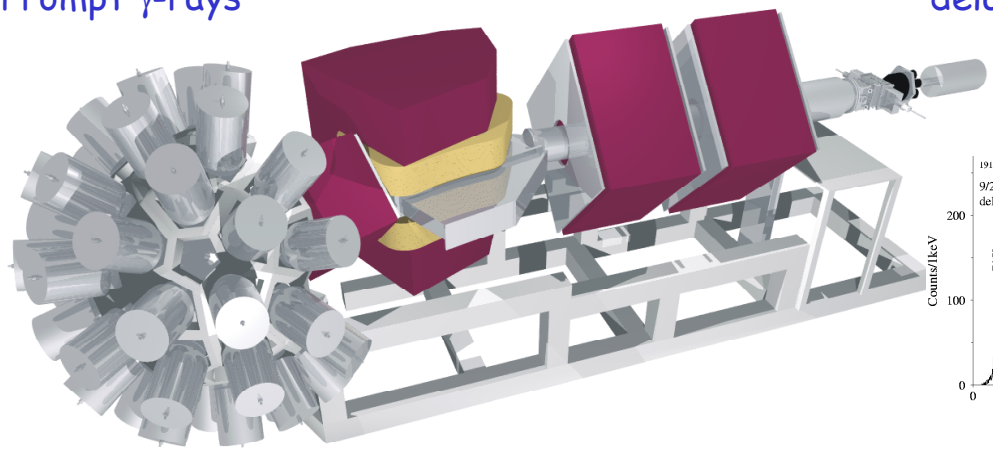


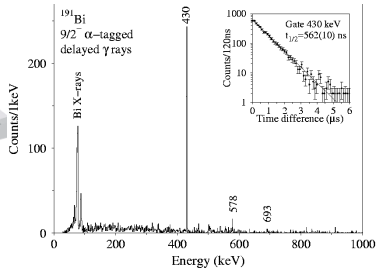


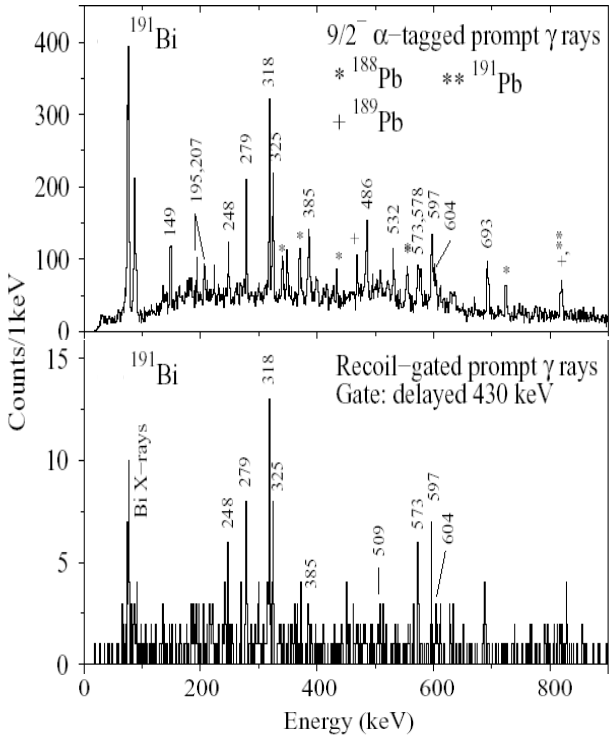
Recoil-isomer tagging

JuroGam
Prompt γ-rays

Focal plane
delayed γ-rays

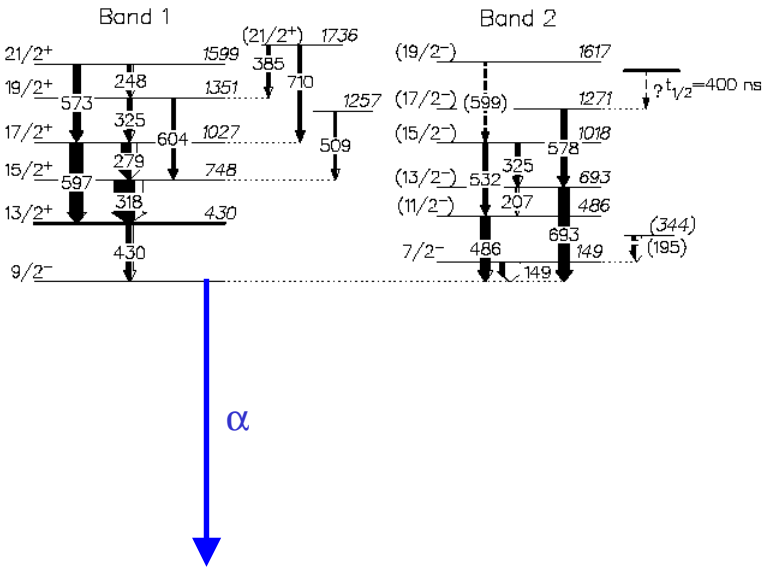






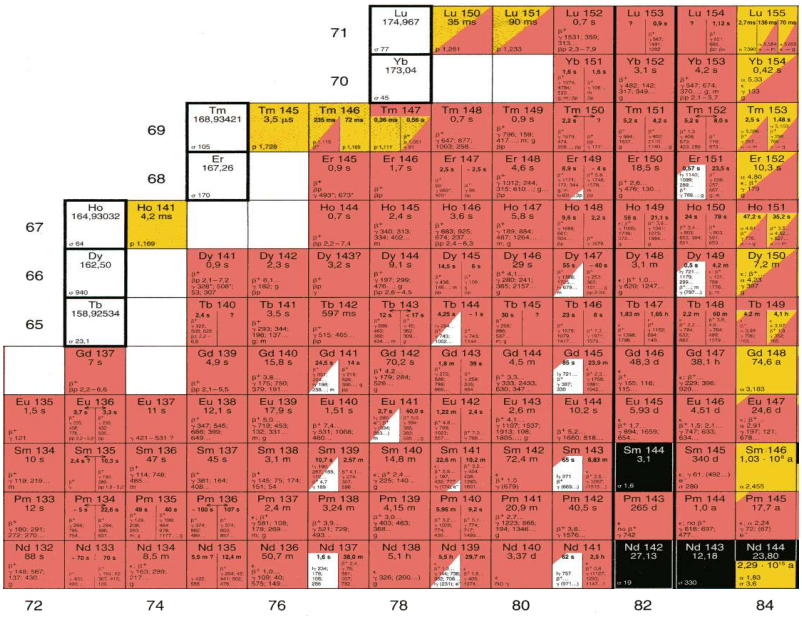
^{191}Bi

P. Nieminen *et al.*,
To be published in Phys. Rev. C

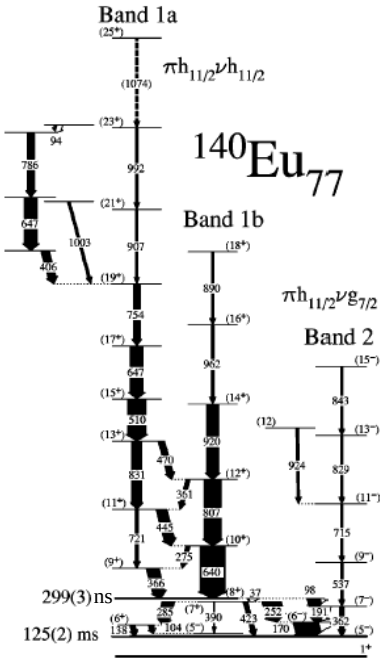


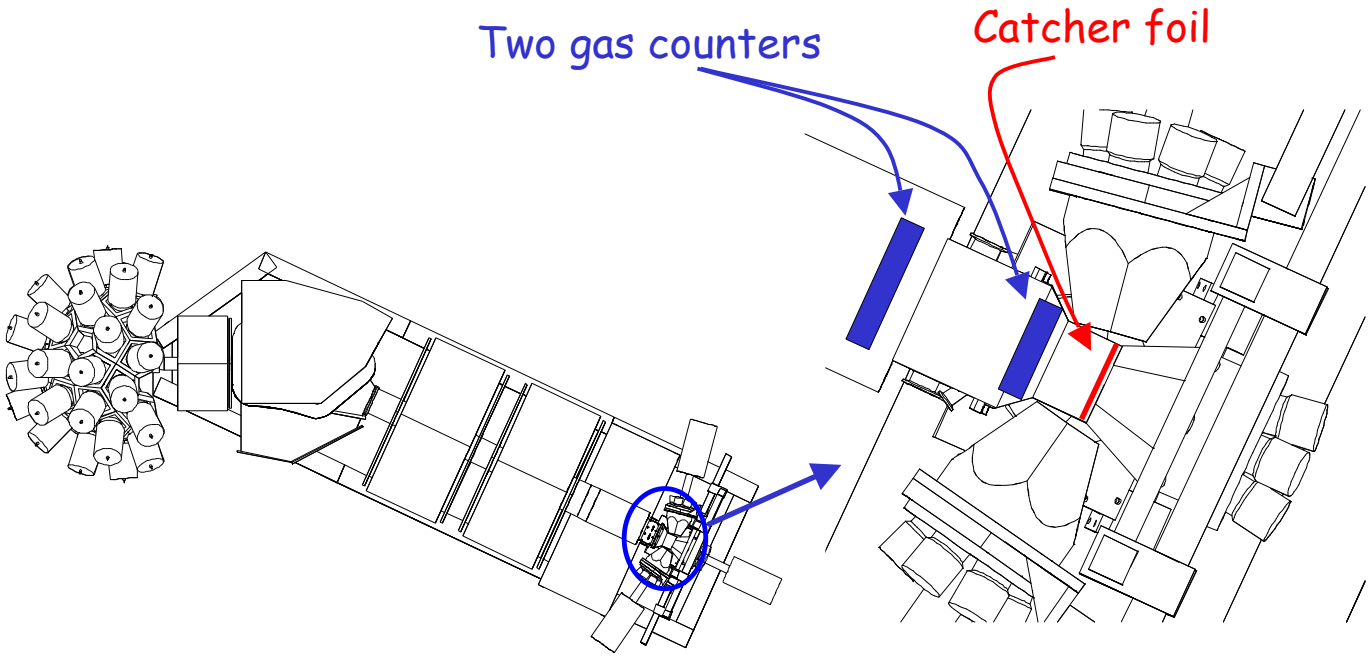
High counting rate at the focal plane + recoil-isomer tagging

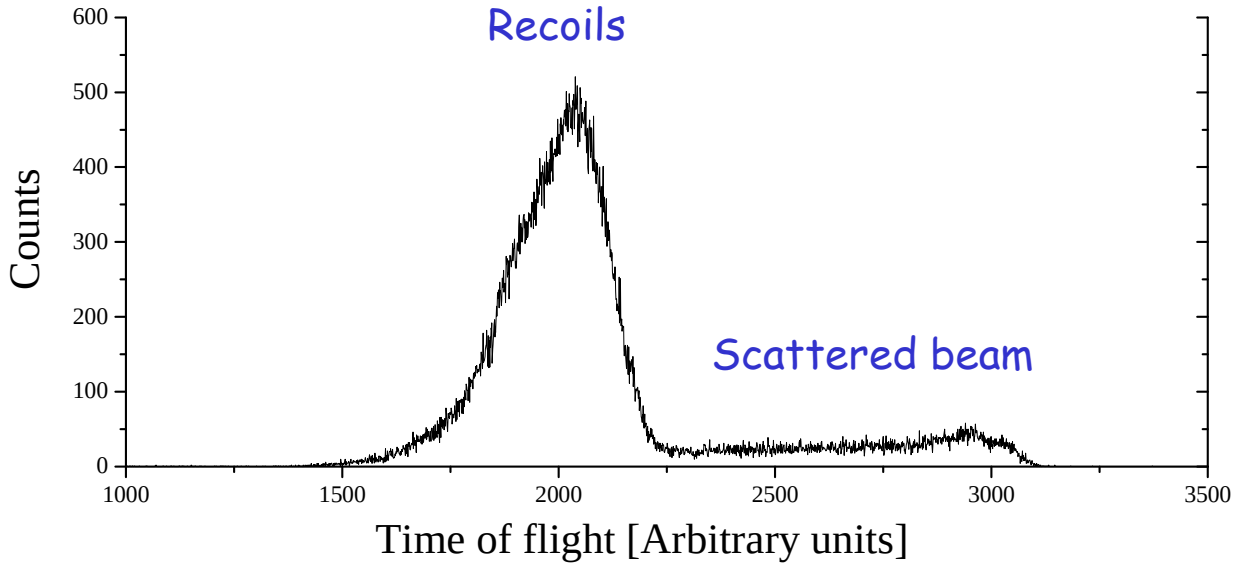
-The mass 140 region
-No alpha/proton activities
-High counting rates at the focal plane
$^{36}Ar+^{107}Ag$ @ 181MeV 5pnA -> 4.3kHz



D.M.Cullen *et al.*,
Phys. Rev. C**66**, 034308(2002)




Two gas counters
Catcher foil


Recoils
Scattered beam
Counts
Time of flight [Arbitrary units]
0
100
200
300
400
500
600
1000
1500
2000
2500
3000
3500

Conversion electrons

α – e^- - coincidences