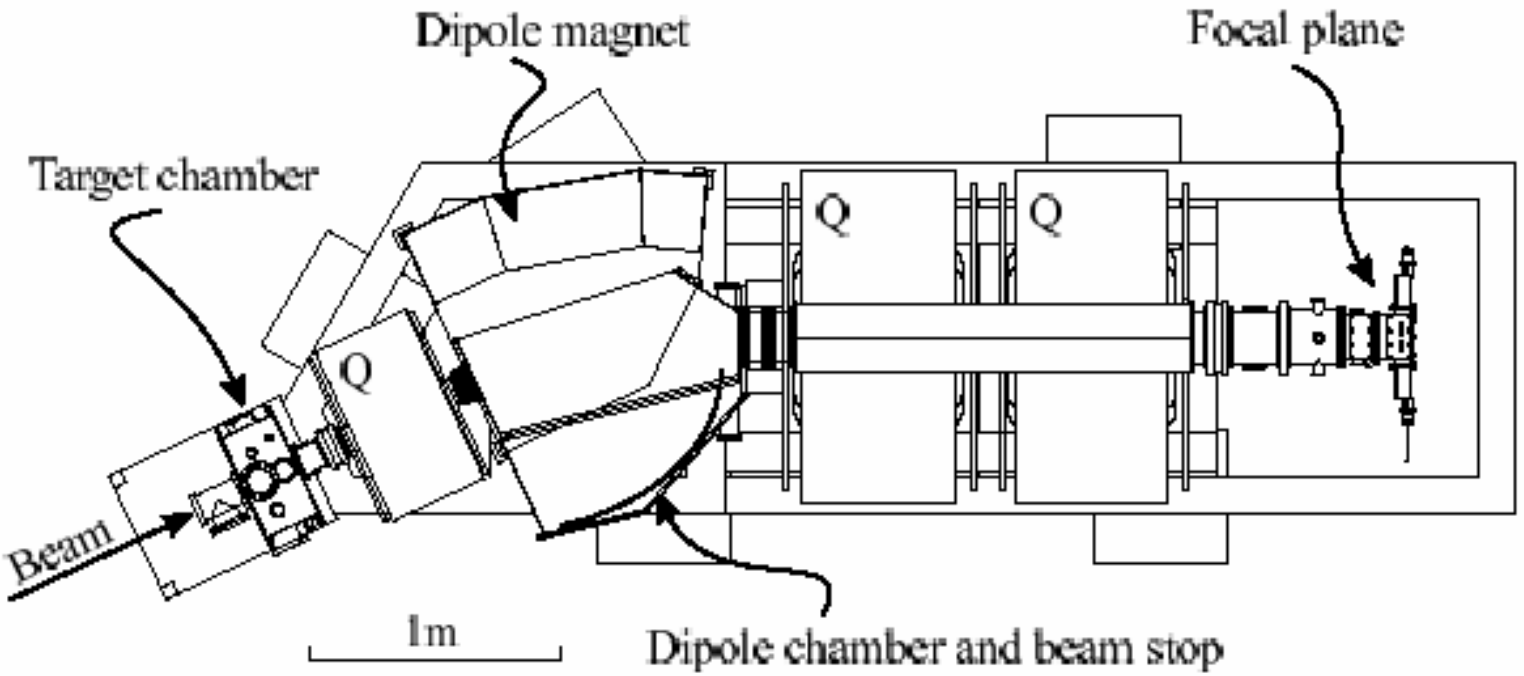
RITU @ JYFL

Focal-plane spectroscopy
- α-decay (α-γ, α-e-coincidence)
- proton decay
- isomeric γ-decay

In-beam spectroscopy
- JUROSPHERE and JUROGAM campaigns
  - plunger
- SACRED campaigns

Recoil Gating (RG) and Recoil Decay Tagging (RDT)

Matti Leino	Rauno Julin	
Sarah Eeckhaudt	Tuomas Grahn	Liverpool
Heikki Kettunen	Paul Greenlees	Manchester
Ari-Pekka Leppänen	Peter Jones	GSI
Jan Saren	Sakari Juutinen	Helsinki
Catherine Scholey	Markus Nyman	
Juha Uusitalo	Janne Pakarinen	
	Panu Rahkila	



- Magnetic configuration QDQQ
- Maximum beam rigidity 2.2Tm
- Bending radius 1.85 m
- Angular acceptance 8 msr
  - measured with alpha source
- Dispersion 10 mm/% of Bρ
- Dipole bending angle 25º
- Total length 4.8 m

Eur. Phys. J. A 16, 457–467 (2003)
DOI 10.1140/epja/i2002-10130-9

THE EUROPEAN
PHYSICAL JOURNAL A

Investigations into the alpha-decay of ^{195}At

H. Kettunen[1,a], T. Enqvist[1], M. Leino[1], K. Eskola[2], P.T. Greenlees[1], K. Helariutta[1,b], P. Jones[1], R. Julin[1], S. Juutinen[1], H. Kankaanpää[1], H. Koivisto[1], P. Kuusiniemi[1], M. Muikku[1,c], P. Nieminen[1], P. Rahkila[1], and J. Uusitalo[1]

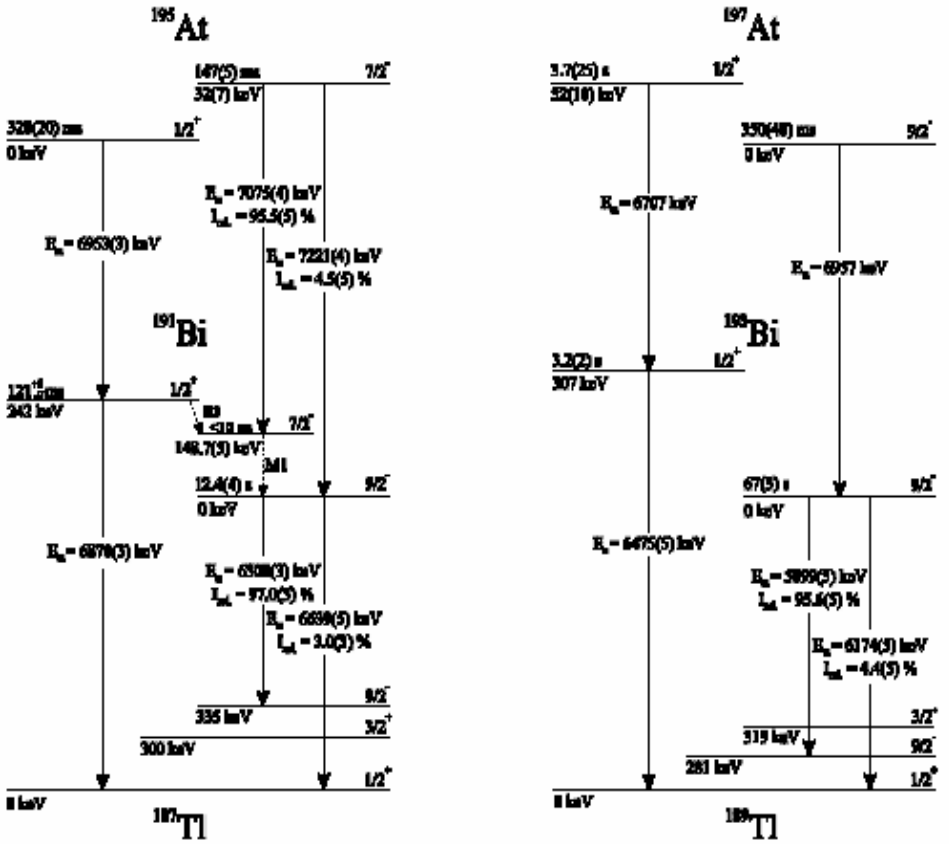


Fig. 7. The decay properties and low-lying levels in ^{195}At and ^{197}At and in the corresponding daughter nuclei ^{191}Bi and ^{193}Bi. The data are taken from the present work and from refs. [13,15] (see also fig. 6).

Differential pumping system @ RITU

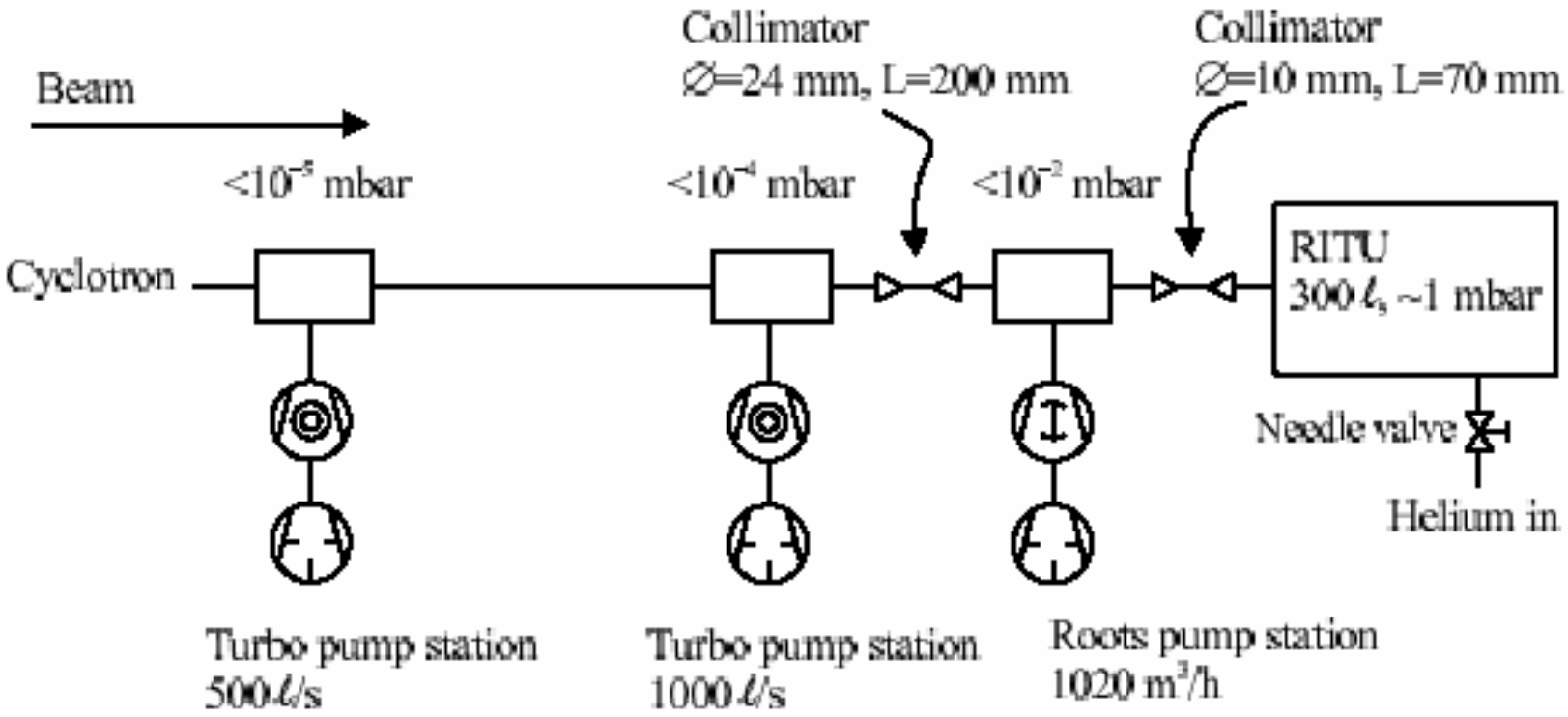


Figure 3.5: Schematic drawing outlining the differential pumping of helium filling gas of RITU.

Eur. Phys. J. A 17, 537–558 (2003)
DOI 10.1140/epja/i2002-10162-1

THE EUROPEAN
PHYSICAL JOURNAL A

Alpha-decay studies of the new isotopes ^{191}At and ^{193}At

H. Kettunen[a], T. Enqvist, T. Grahn, P.T. Greenlees, P. Jones, R. Julin, S. Juutinen, A. Keenan, P. Kuusiniemi, M. Leino, A.-P. Leppänen, P. Nieminen, J. Pakarinen, P. Rahkila, and J. Uusitalo

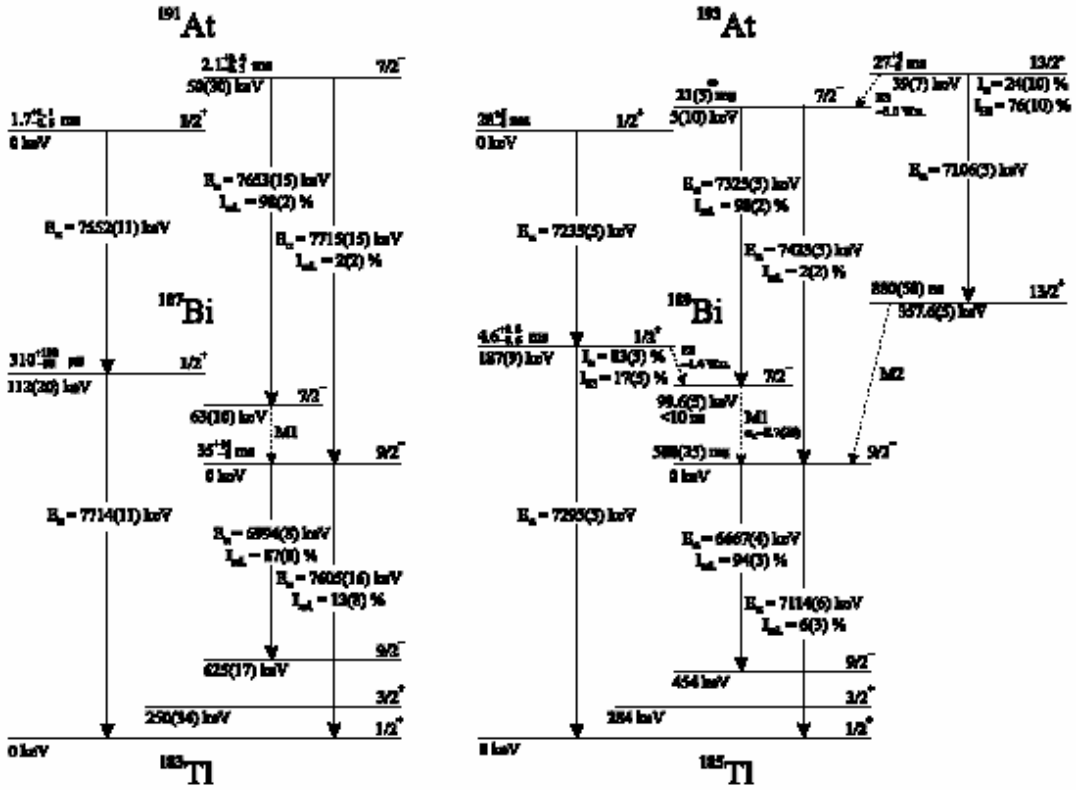


Fig. 10. Proposed alpha-decay schemes of ^{191}At and ^{193}At. The decay properties of the $13/2^+$ state shown for ^{189}Bi were taken from refs. [50,51]. [a]: this is the corrected value (measured value without correction is $(31.8^{+1.5}_{-1.3})$ ms). See text and fig. 6 for more details.

PHYSICAL REVIEW C **69**, 054323 (2004)

Decay studies of ^{170,171}Au, $^{171-173}$Hg, and ^{176}Tl

H. Kettunen, T. Enqvist, T. Grahn, P. T. Greenlees, P. Jones, R. Julin, S. Juutinen, A. Keenan, P. Kuusiniemi, M. Leino, A.-P. Leppänen, P. Nieminen, J. Pakarinen, P. Rahkila, and J. Uusitalo

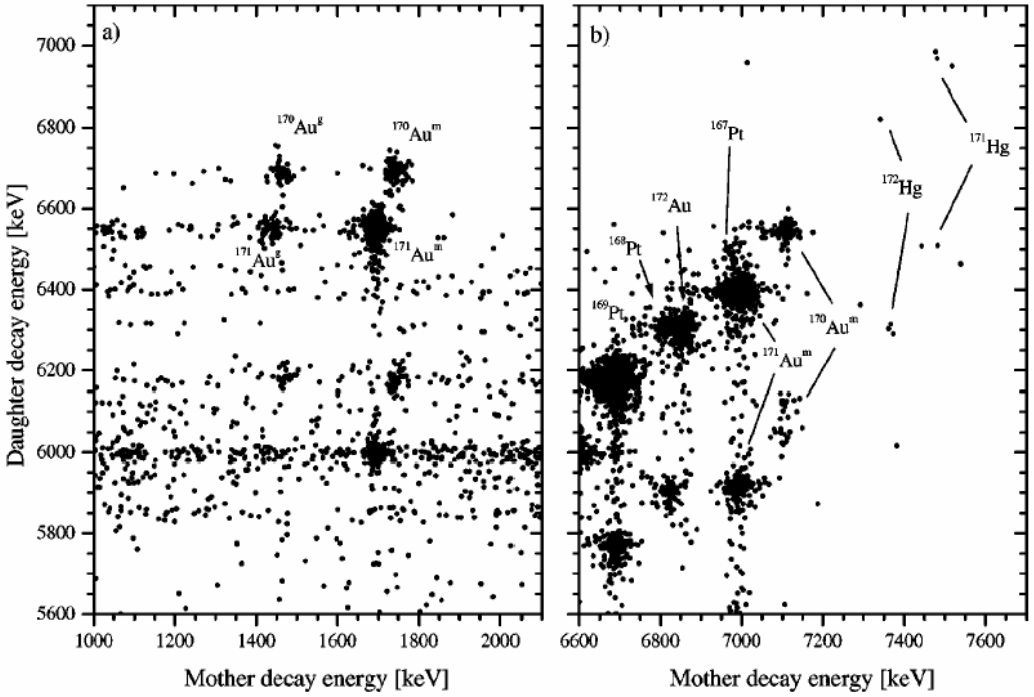
Department of Physics, University of Jyväskylä, P.O. Box 35, FIN-40014 Jyväskylä, Finland

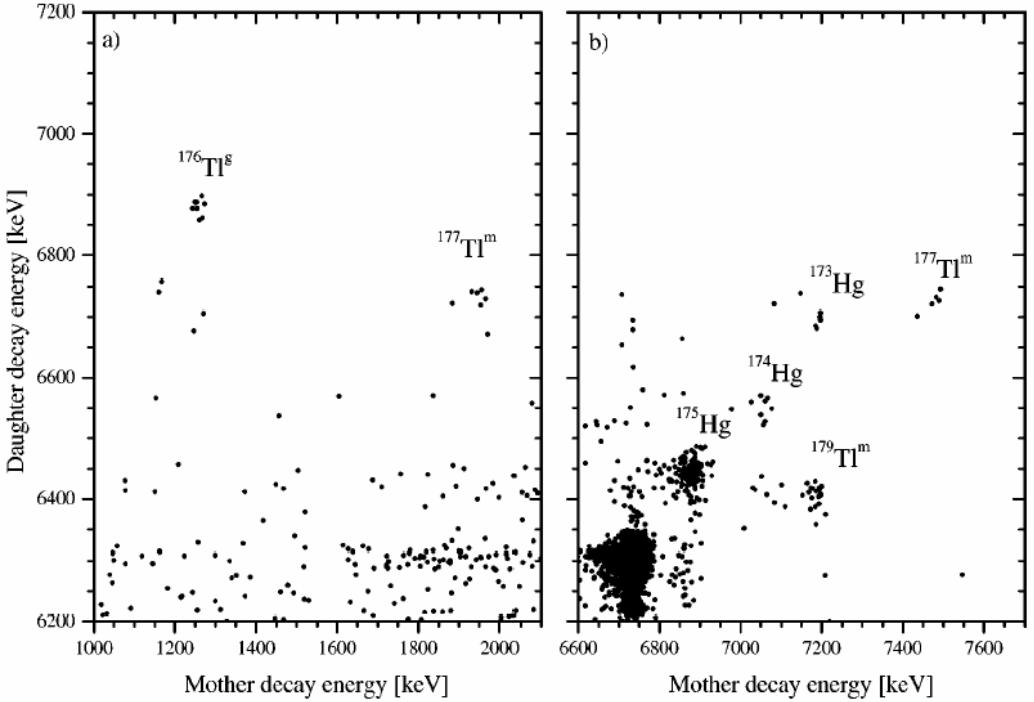
(Received 9 December 2003; published 28 May 2004)

TABLE III. Proton emission data obtained in the present work. The theoretical proton emission half-lives $T_{1/2}^{\mathrm{WKB}}$ were calculated using the WKB barrier transmission approximation with the real part of the optical model potential given by Becchetti and Greenlees [24]. The electron screening correction to the proton emission energy was taken from Ref. [35].

Nucleus	E_p (keV)	b_p	$T_{1/2}^{p}$	Proton orbital	$T_{1/2}^{\mathrm{WKB}}$	$S^{\mathrm{expt.}}$
^{171}Au^{g}	1437(12)	1	(22^{+3}_{-2}) μs	$s_{1/2}$	5.1 μs	0.23(7)
				$d_{3/2}$	39.2 μs	1.8(6)
				$h_{11/2}$	63.4 ms	~2880
^{171}Au^{m}	1694(6)	0.34(4)	3.2(4) ms	$s_{1/2}$	36.3 ns	$\sim 1.1\times10^{-5}$
				$d_{3/2}$	271 ns	$\sim 8.5\times10^{-5}$
				$h_{11/2}$	400.8 μs	0.13(2)
^{170}Au^{g}	1463(12)	0.89(10)	321(70) μs	$s_{1/2}$	3.0 μs	0.009(3)
				$d_{3/2}$	22.9 μs	0.071(20)
				$h_{11/2}$	37 ms	115(40)
^{170}Au^{m}	1743(6)	0.58(5)	1064(100) μs	$s_{1/2}$	16.3 ns	$\sim 1.5\times10^{-5}$
				$d_{3/2}$	122 ns	$\sim 1.1\times10^{-4}$
				$h_{11/2}$	180 μs	0.17(3)
^{177}Tl^{m}	1954(12)	0.55(20)	(290^{+150}_{-110}) μs	$s_{1/2}$	1.9 ns	$\sim 6.4\times10^{-6}$
				$d_{3/2}$	13 ns	$\sim 4.6\times10^{-5}$
				$h_{11/2}$	16.1 μs	0.06(3)
^{176}Tl^{g}	1258(18)	~1	$(5.2^{+3.0}_{-1.4})$ ms	$s_{1/2}$	1.49 ms	0.29(20)
				$d_{3/2}$	11.2 ms	2.2(15)
				$h_{11/2}$	17.5 s	~2400

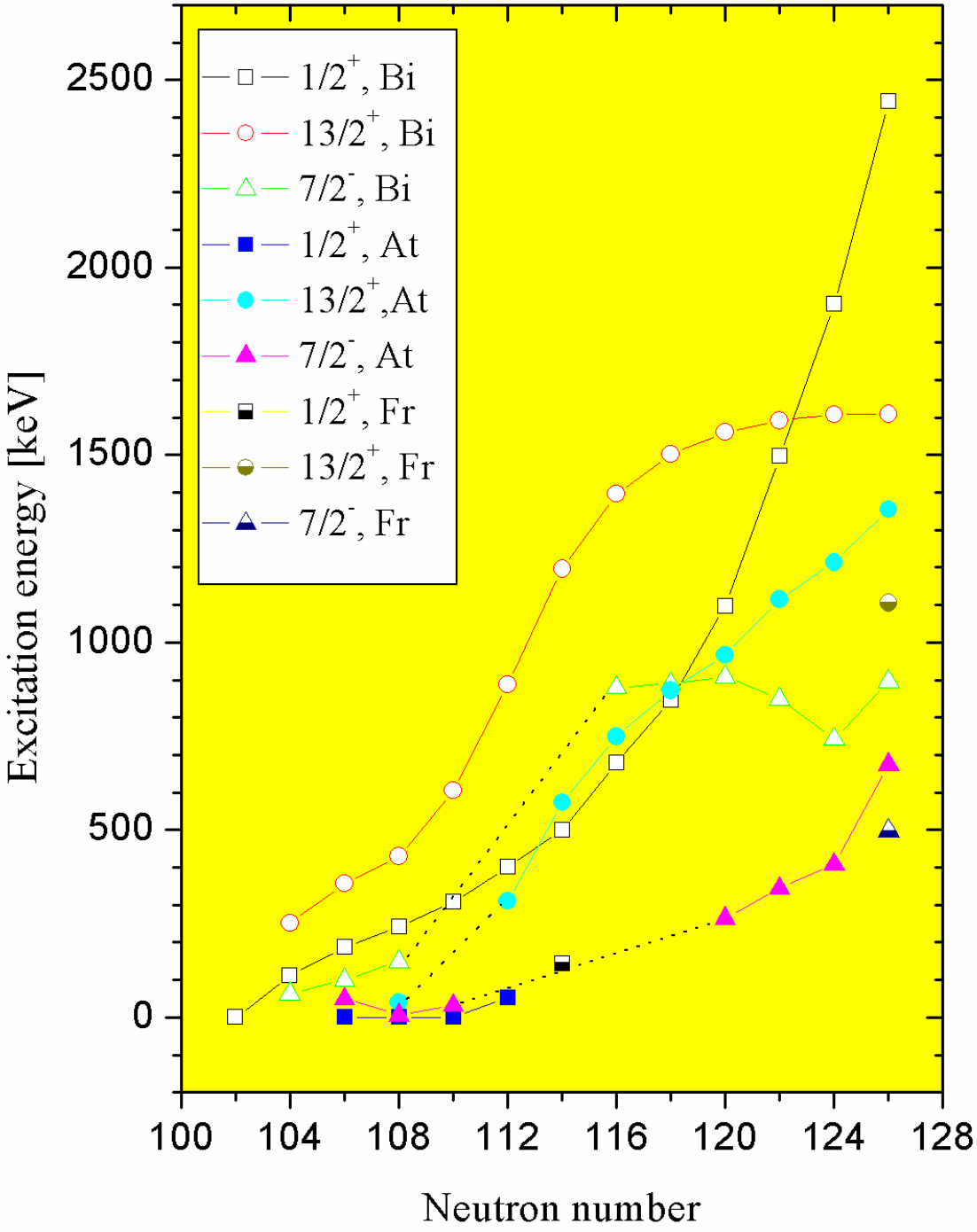
Decay studies of ^{170,171}Au, $^{171\text{-}173}$Hg and ^{176}Tl



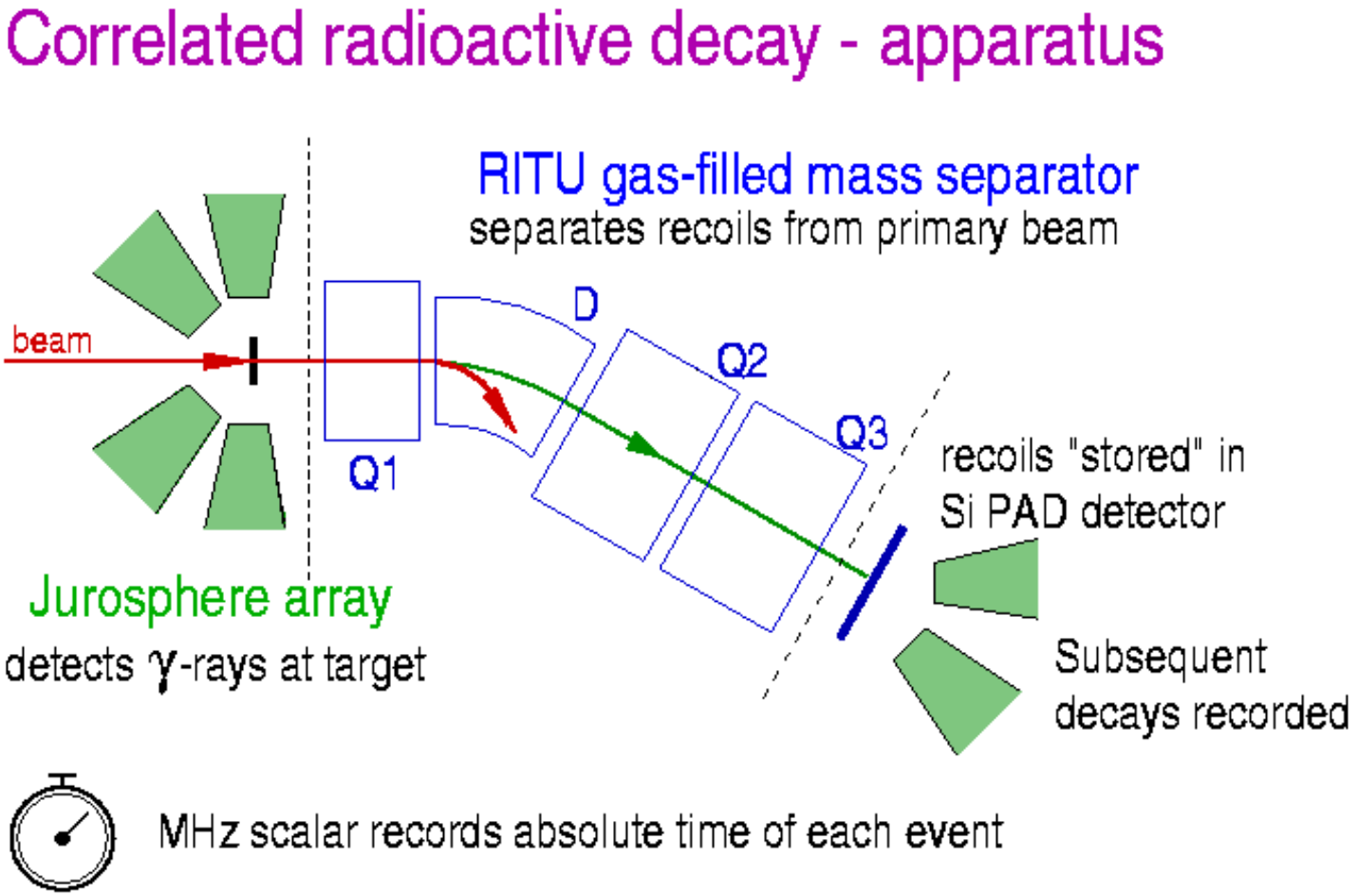


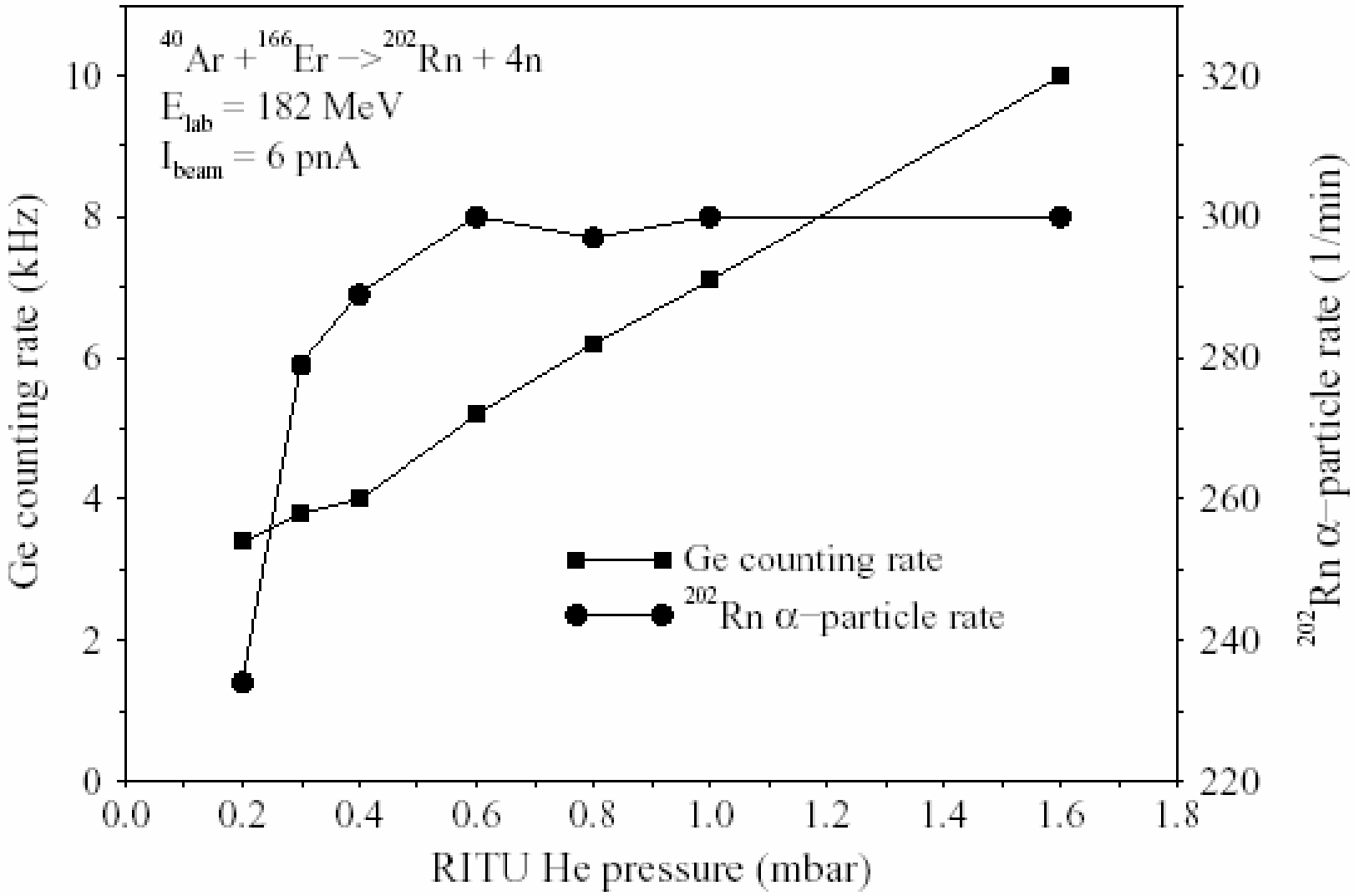
JYFL

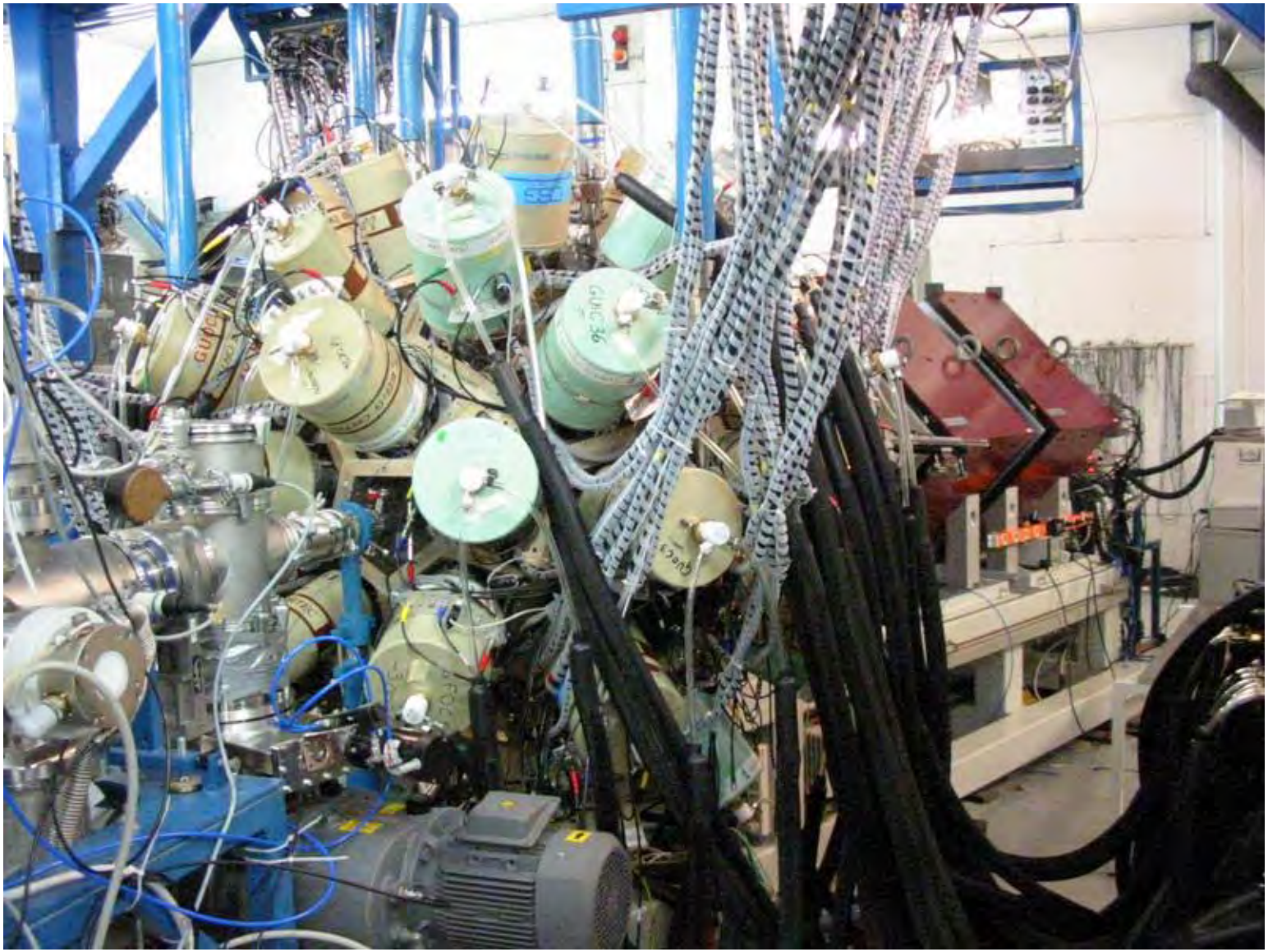
REC SEP @ SHE CHEM


1/2+, Bi
13/2+, Bi
7/2-, Bi
1/2+, At
13/2+,At
7/2-, At
1/2+, Fr
13/2+, Fr
7/2-, Fr
Excitation energy [keV]
2500
2000
1500
1000
500
0
100
104
108
112
116
120
124
128
Neutron number

Recoil Gating (RG) and Recoil Decay Tagging (RDT)

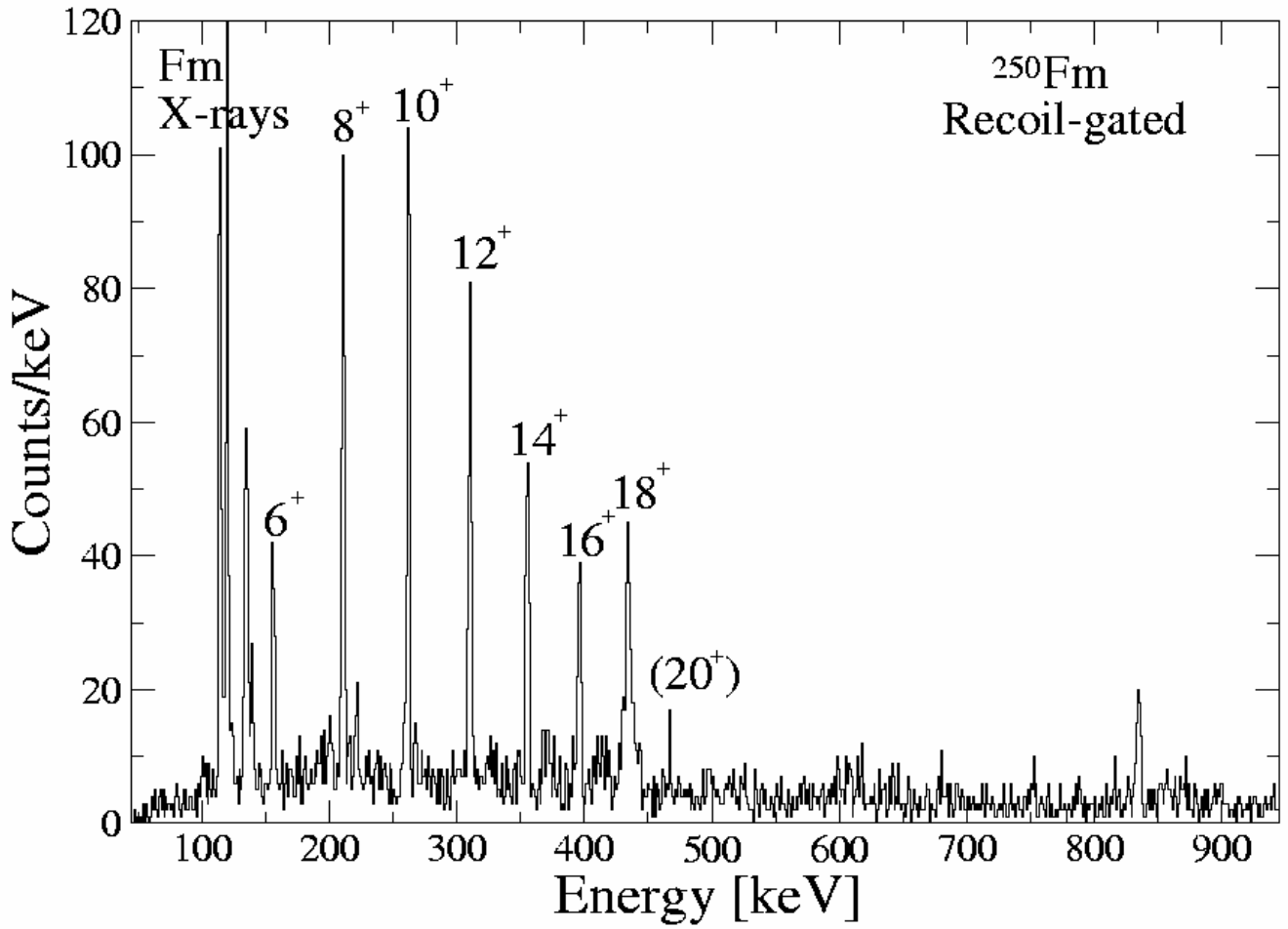



^{40}Ar + ^{166}Er -> ^{202}Rn + 4n
E_{lab} = 182 MeV
I_{beam} = 6 pnA
Ge counting rate
^{202}Rn α–particle rate
Ge counting rate (kHz)
^{202}Rn α–particle rate (1/min)
RITU He pressure (mbar)
0
2
4
6
8
10
220
240
260
280
300
320
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8



$^{48}Ca + {}^{204}HgS \rightarrow {}^{250}Fm + 2n$

Sarah Eeckhaudt, Amy Pritchard et al.,



letters to nature

A triplet of differently shaped spin-zero states in the atomic nucleus ^{186}Pb

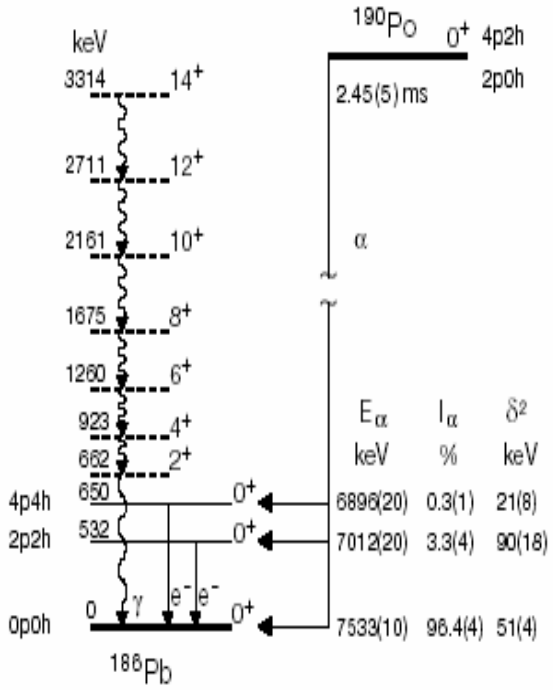
A. N. Andreyev*, M. Huyse*, P. Van Duppen*, L. Weissman*, D. Ackermann†, J. Gerl†, F. P. Heßberger†, S. Hofmann†, A. Kleinböhl†, G. Münzenberg†, S. Reshitko†, C. Schlegel†, H. Schaffner†, P. Cagarda‡, M. Matos‡, S. Saro‡, A. Keenan§, C. Moore§, C. D. O'Leary§, R. D. Page§, M. Taylor§, H. Kettunen‖, M. Leino‖, A. Lavrentiev¶, R. Wyss# & K. Heyde☆

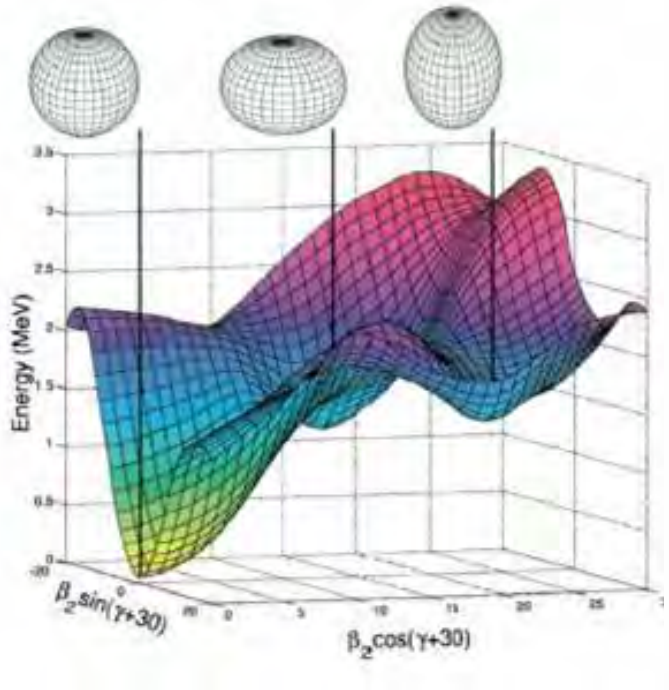
Eur. Phys. J. A 17, 167–171 (2003)
DOI 10.1140/epja/i2003-10002-x

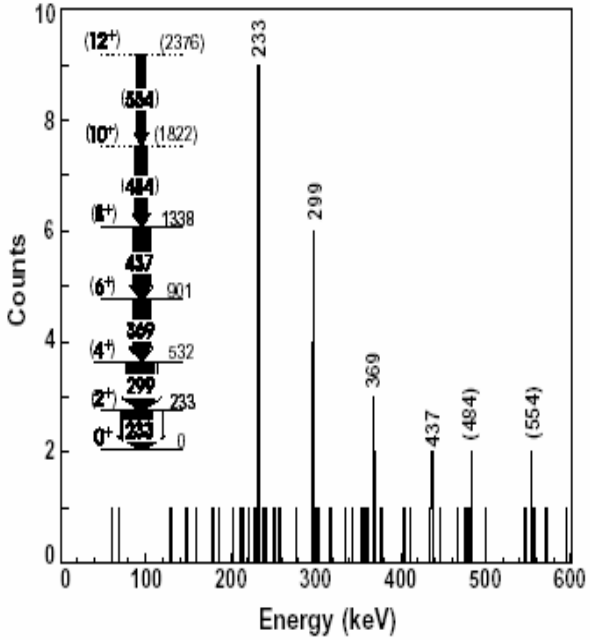
THE EUROPEAN PHYSICAL JOURNAL A

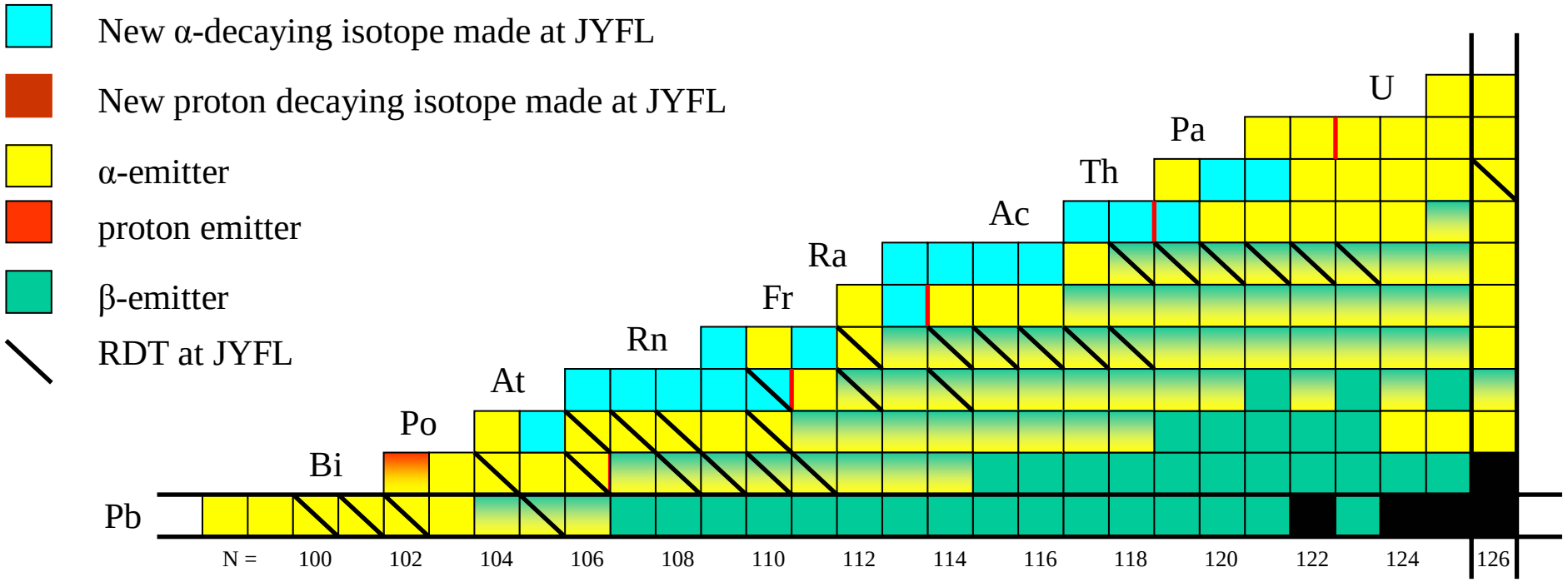
In-beam γ-ray spectroscopy of ^{190}Po: First observation of a low-lying prolate band in Po isotopes

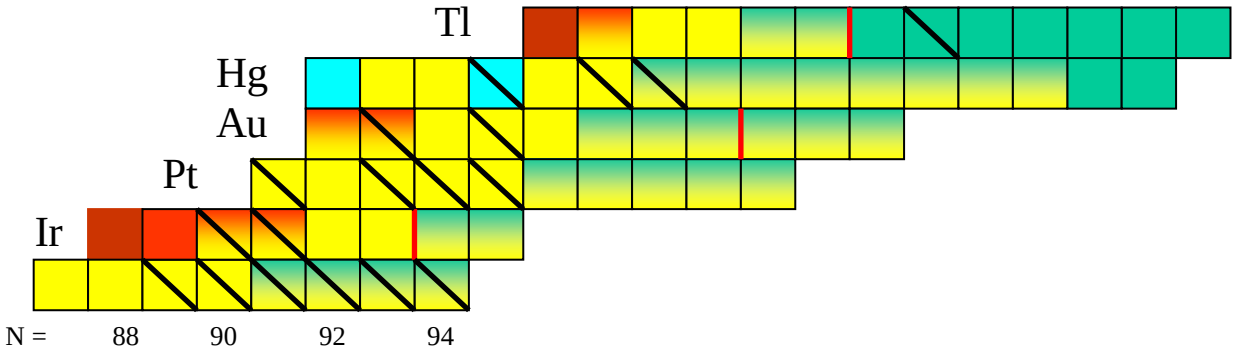
K. Van de Vel[1,a], A.N. Andreyev[1,2], R.D. Page[2], H. Kettunen[3], P.T. Greenlees[3], P. Jones[3], R. Julin[3], S. Juutinen[3], H. Kankaanpää[3], A. Keenan[3], P. Kuusiniemi[3], M. Leino[3], M. Muikku[3,b], P. Nieminen[3], P. Rahkila[3], J. Uusitalo[3], K. Eskola[4], A. Hürstel[5], M. Huyse[1], Y. Le Coz[5], M.B. Smith[6,c], P. Van Duppen[1], and R. Wyss[7]








New α-decaying isotope made at JYFL
New proton decaying isotope made at JYFL
α-emitter
proton emitter
β-emitter
RDT at JYFL
U
Pa
Th
Ac
Ra
Fr
Rn
At
Po
Bi
Pb
N =
100
102
104
106
108
110
112
114
116
118
120
122
124
126


Tl
Hg
Au
Pt
Ir
N =
88
90
92
94

Excited states studied using RG or RDT at JYFL

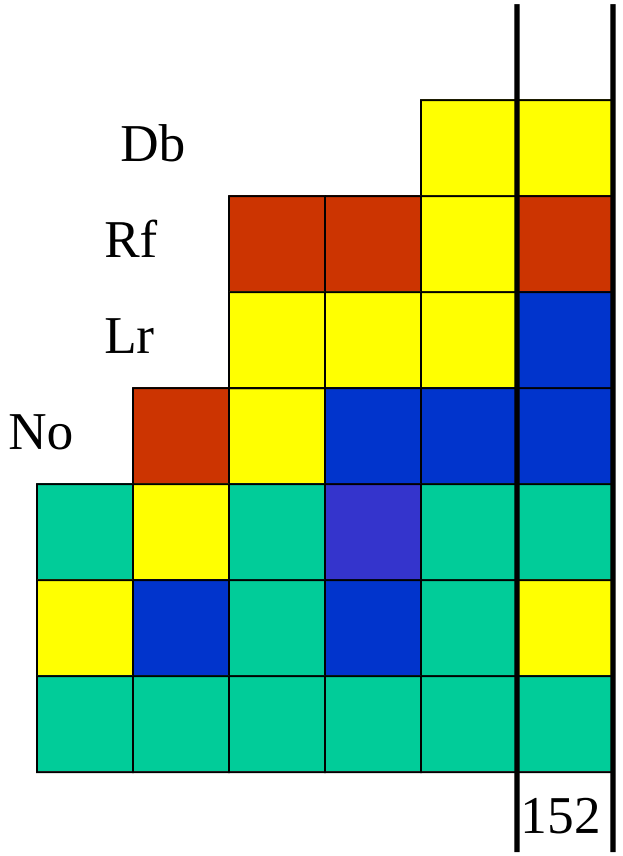
$^{48}Ca + {}^{209}Bi \longrightarrow {}^{255}Lr$, 200 nb

$^{48}Ca + {}^{206\text{-}208}Pb \longrightarrow {}^{252\text{-}254}No$, 300 nb, 1 µb and 3 µb

$^{48}Ca + {}^{205}Tl \longrightarrow {}^{251}Md$, 1 µb

$^{48}Ca + {}^{204}Hg \longrightarrow {}^{250}Fm$, 1 µb

($^{48}Ca + {}^{202}Hg \longrightarrow {}^{248}Fm$)



GREAT

•**Double Sided Silicon Strip Detectors** into which the reaction products are implanted and used to measure subsequent alpha particle, beta particle or proton emission.

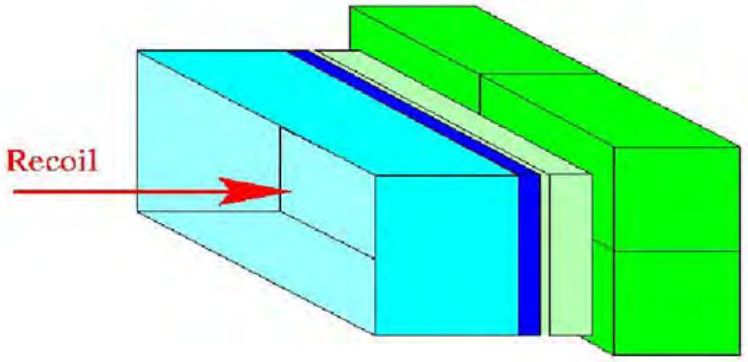
•**An Array of Silicon PIN photodiode Detectors** to measure conversion electron energies.

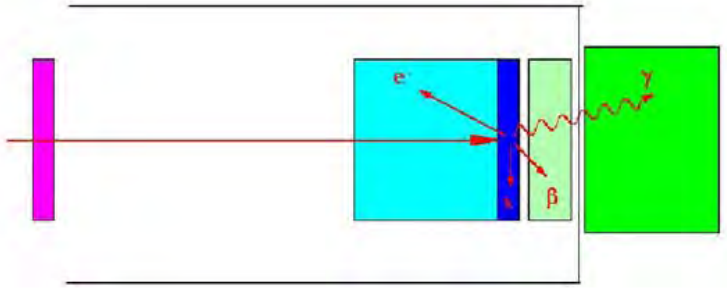
•**A Double-sided planar Germanium strip Detector** to measure the energies of X-rays, low energy gamma rays and beta particles.

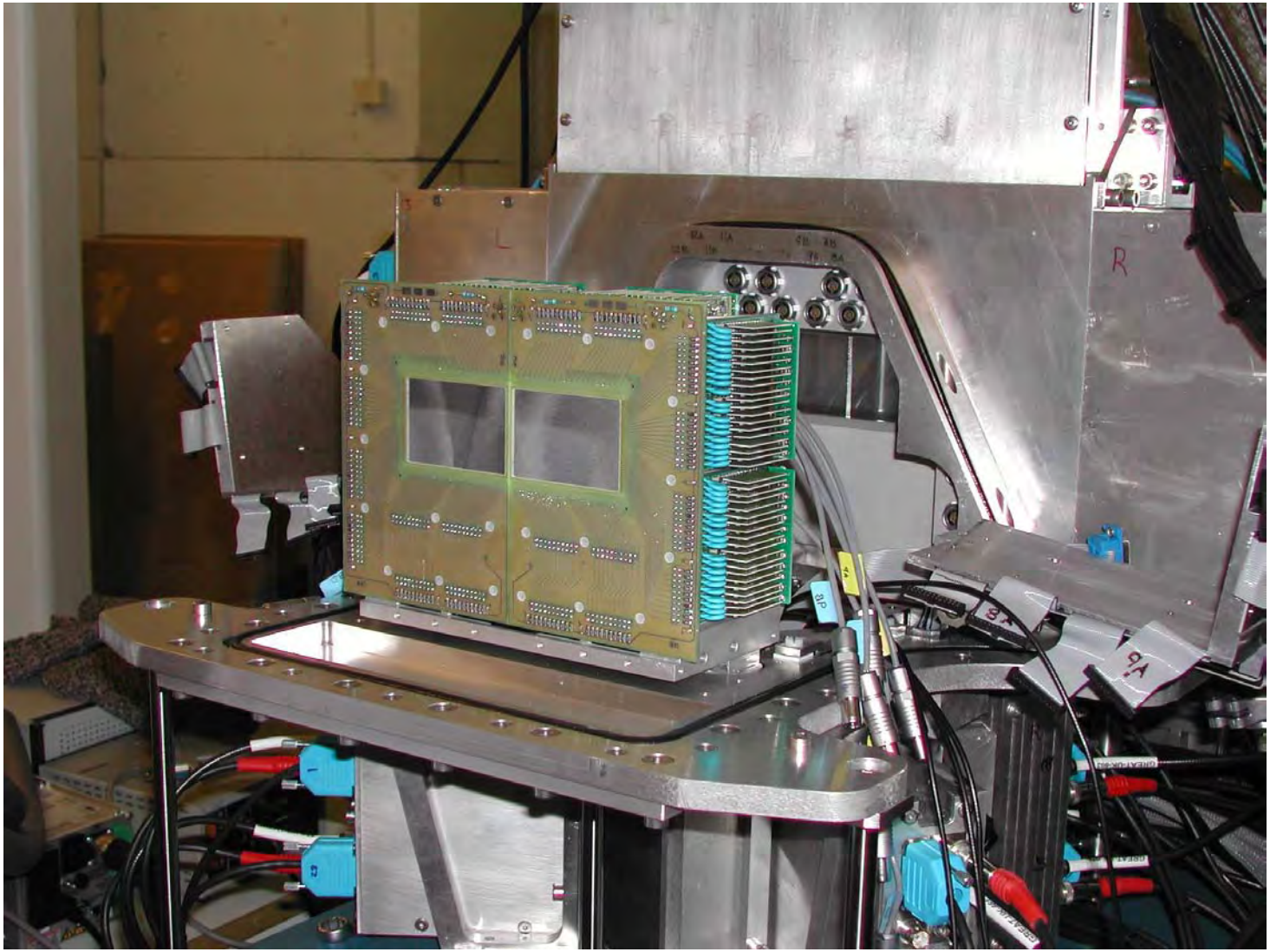
•**A High efficiency segmented Germanium CLOVER Detector** to measure the energies of higher energy gamma rays.

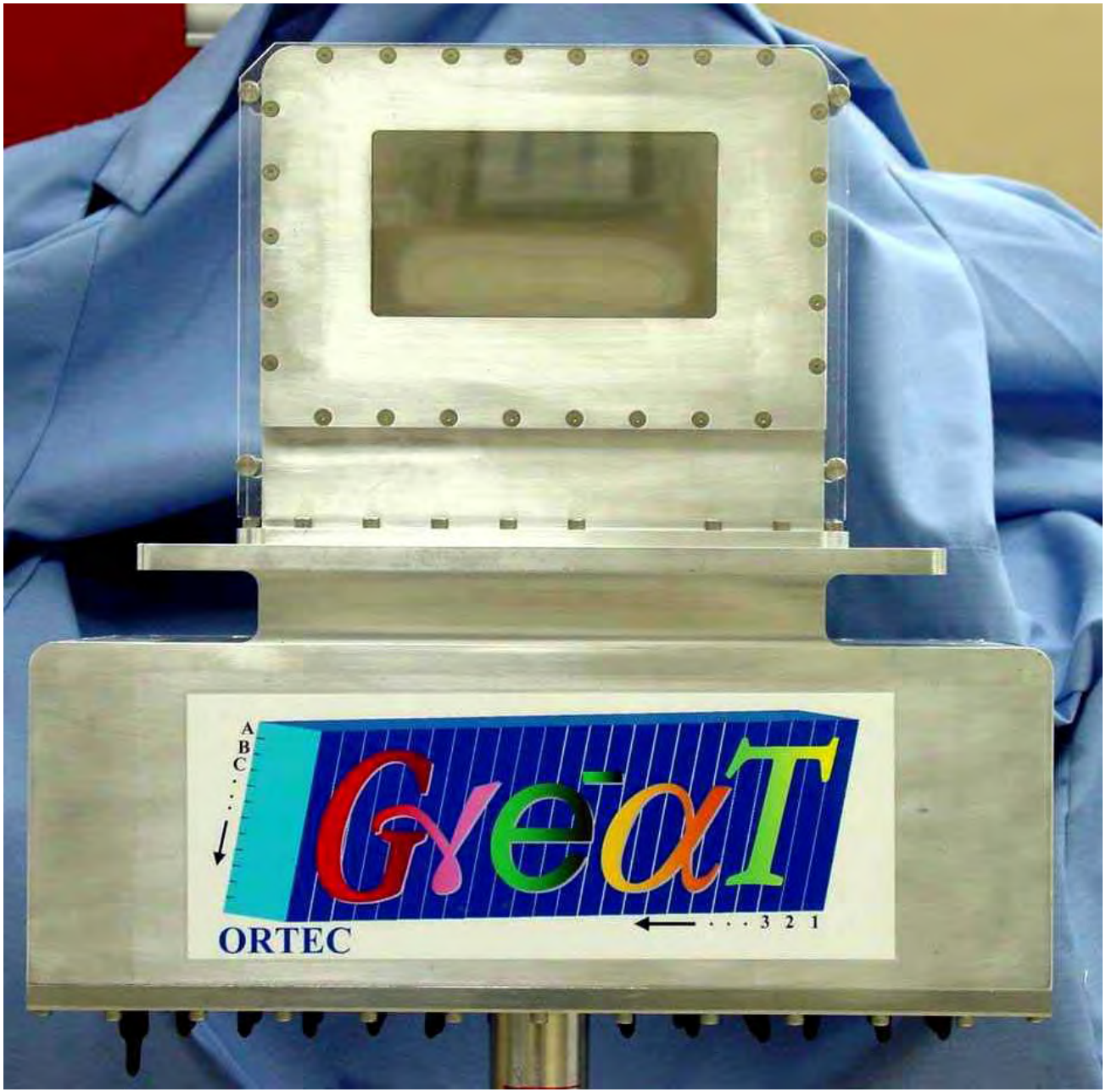
•**A Multiwire proportional counter** this is placed in front of the silicon strip detectors to act as an active recoil discriminator.

•**Total Data Readout** This is a new concept that dramatically decreases the dead time of the DAQ allowing more data to be taken.



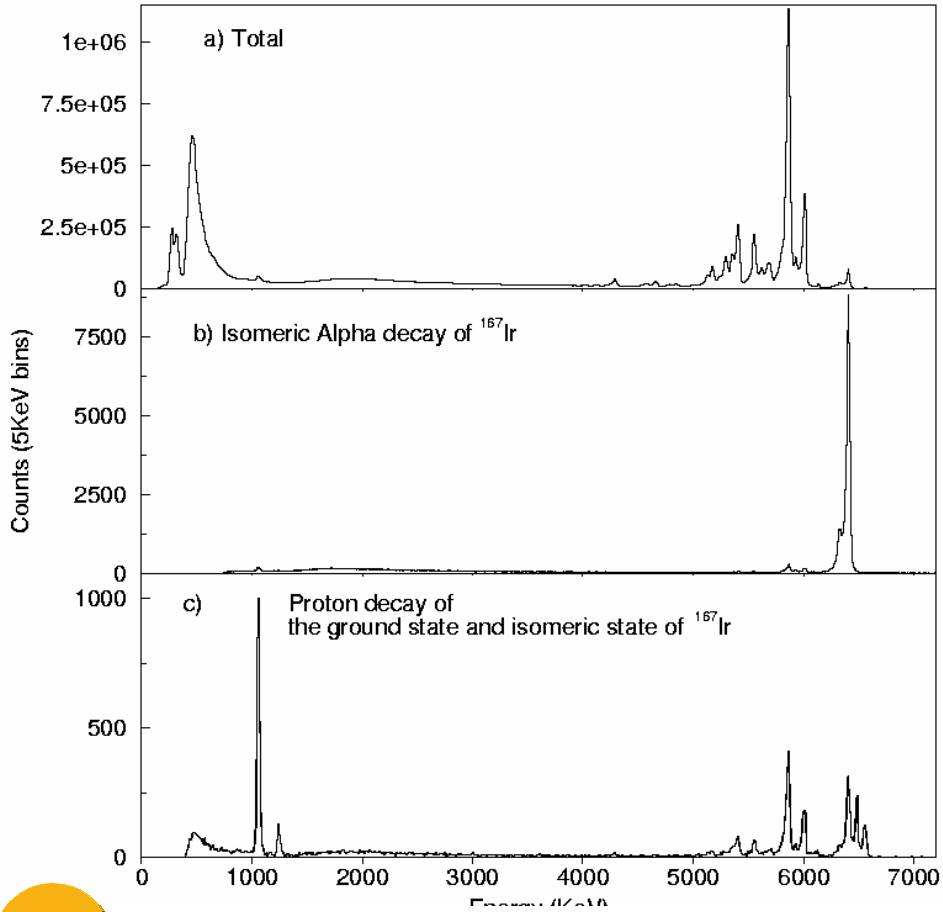


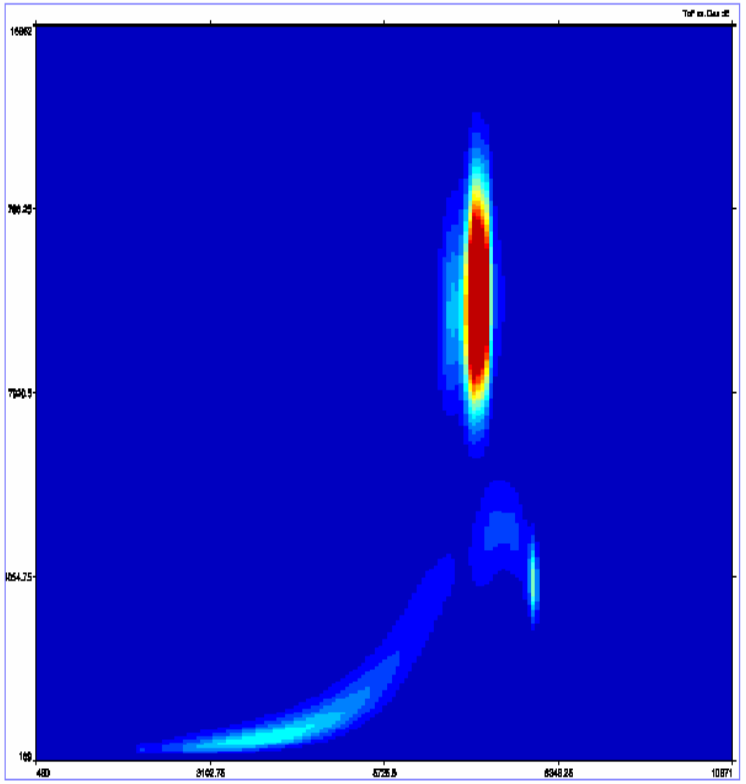

L
R
3P
8A
9A


A
B
C
GeαT
3 2 1
ORTEC

$^{78}Kr + {}^{92}Mo \longrightarrow {}^{170}Pt^*$

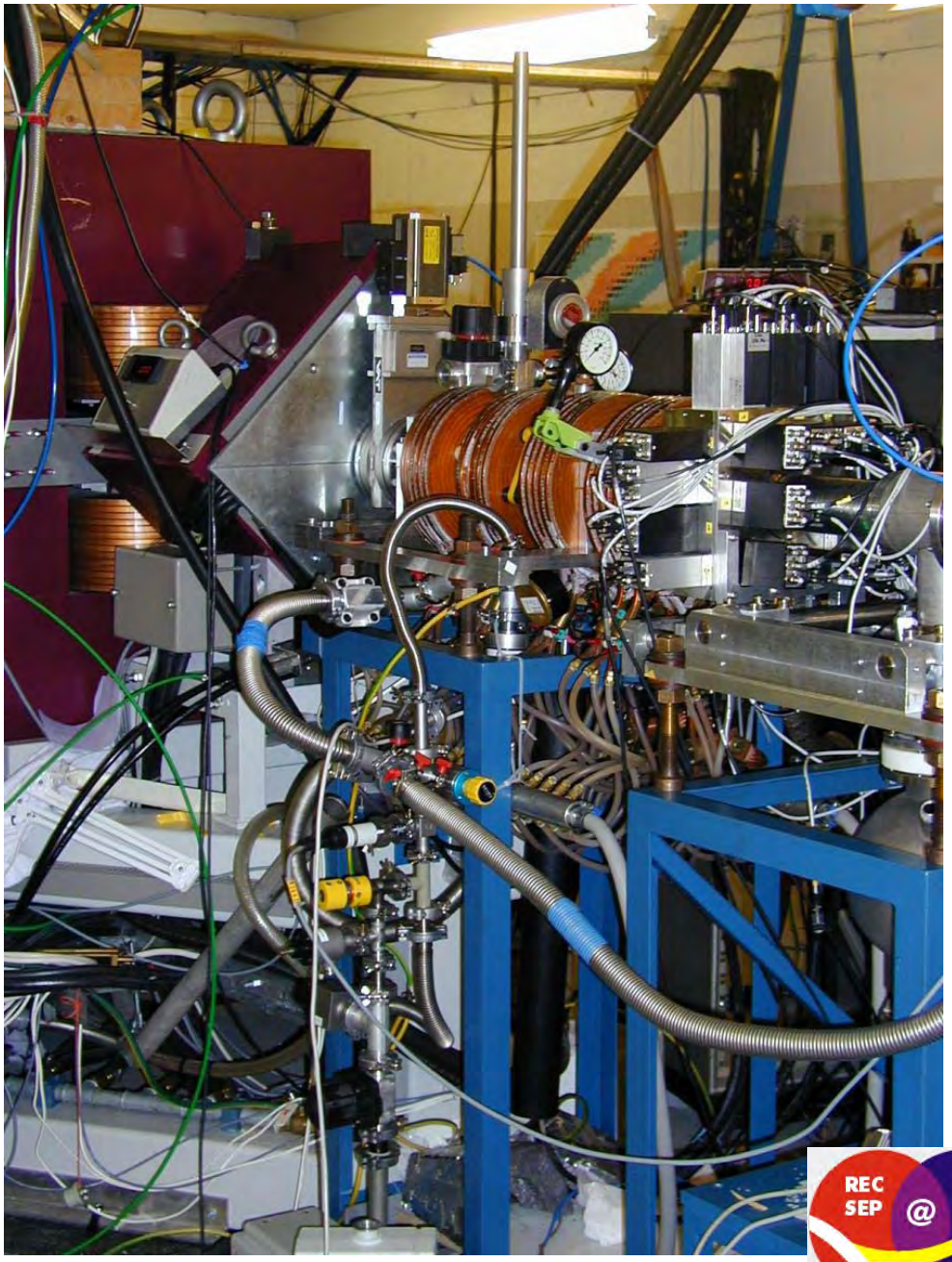
Catherine Scholey et al.





SACRED
@
RITU

Paul Greenlees et al.,

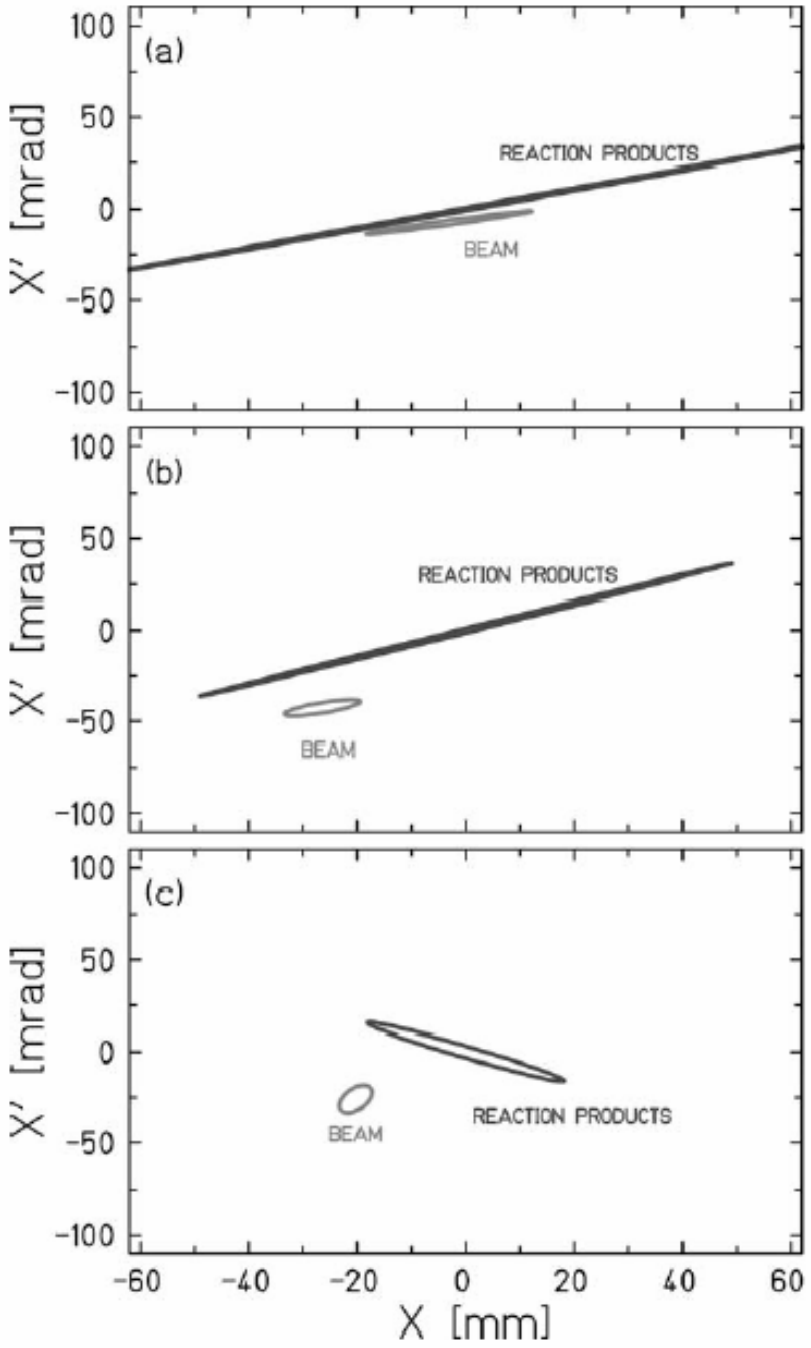


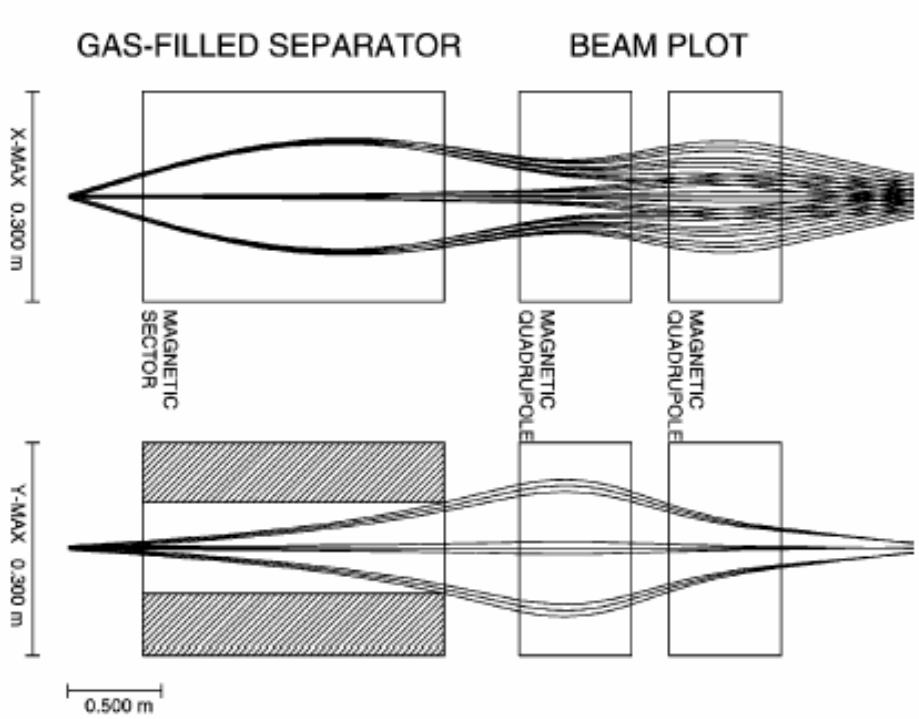
JYFL

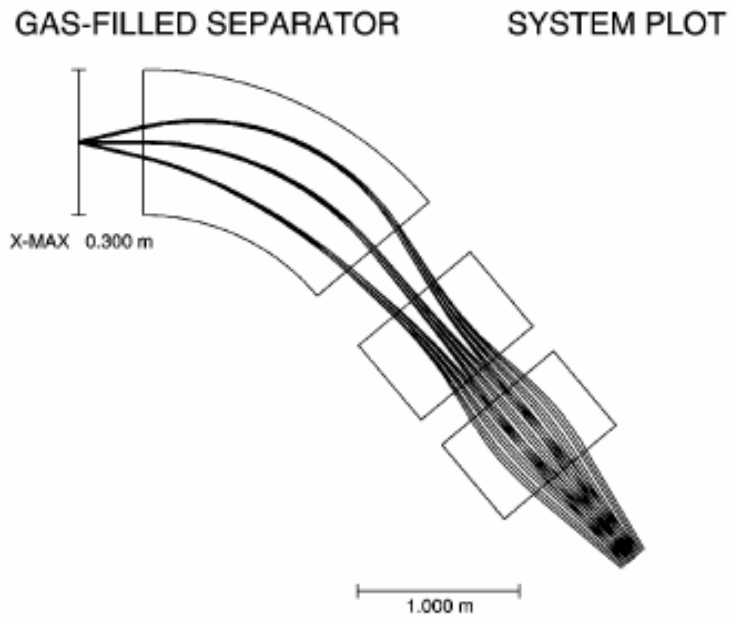
REC SEP @ SHE CHEM

Plunger @ RITU

A. Dewald et al.,


(a)
REACTION PRODUCTS
BEAM
(b)
REACTION PRODUCTS
BEAM
(c)
BEAM
REACTION PRODUCTS
X' [mrad]
X [mm]
100
50
0
-50
-100
-60
-40
-20
0
20
40
60


GAS-FILLED SEPARATOR
BEAM PLOT
X-MAX 0.300 m
MAGNETIC SECTOR
MAGNETIC QUADRUPOLE
MAGNETIC QUADRUPOLE
Y-MAX 0.300 m
0.500 m


GAS-FILLED SEPARATOR
SYSTEM PLOT
X-MAX 0.300 m
1.000 m