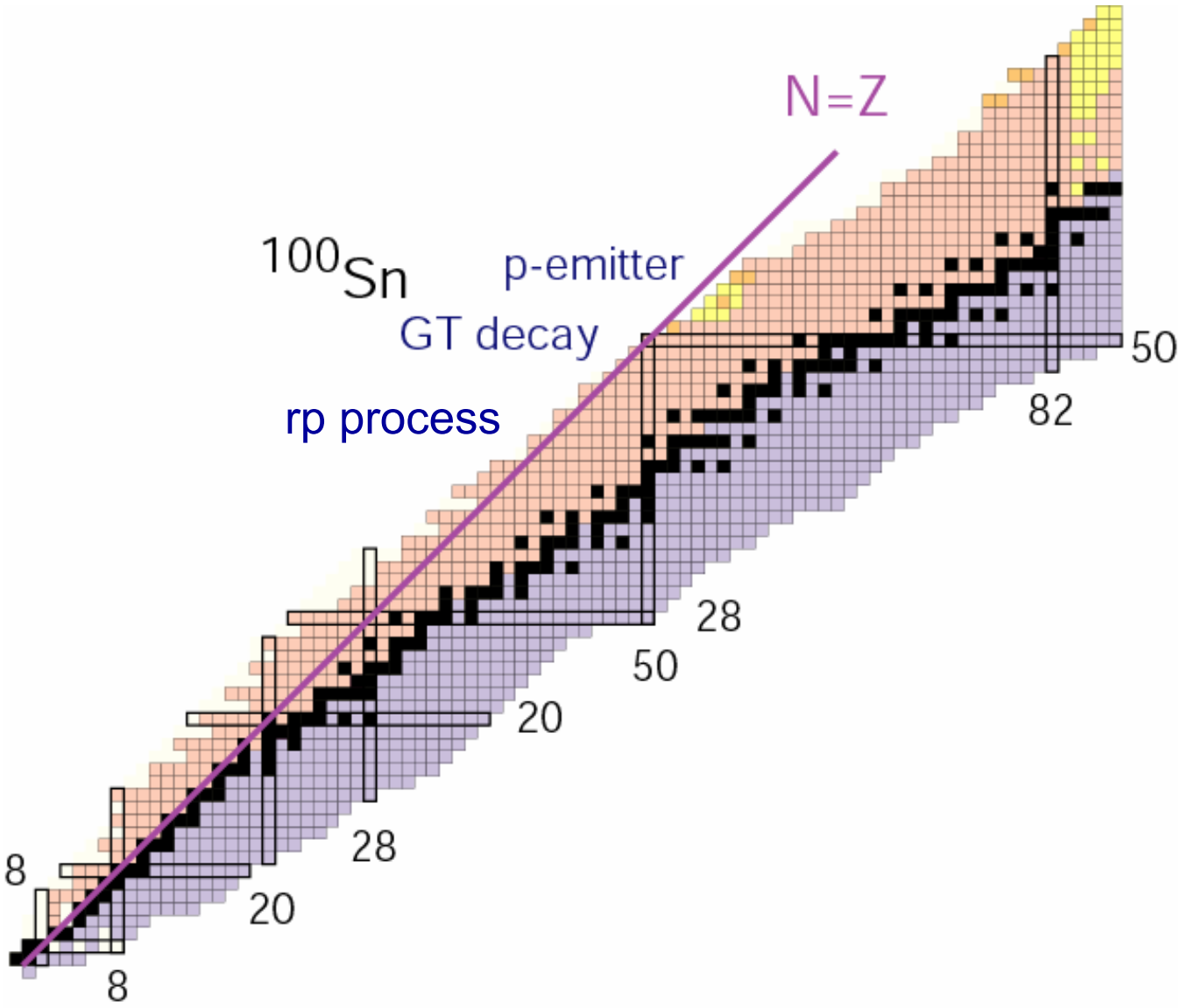
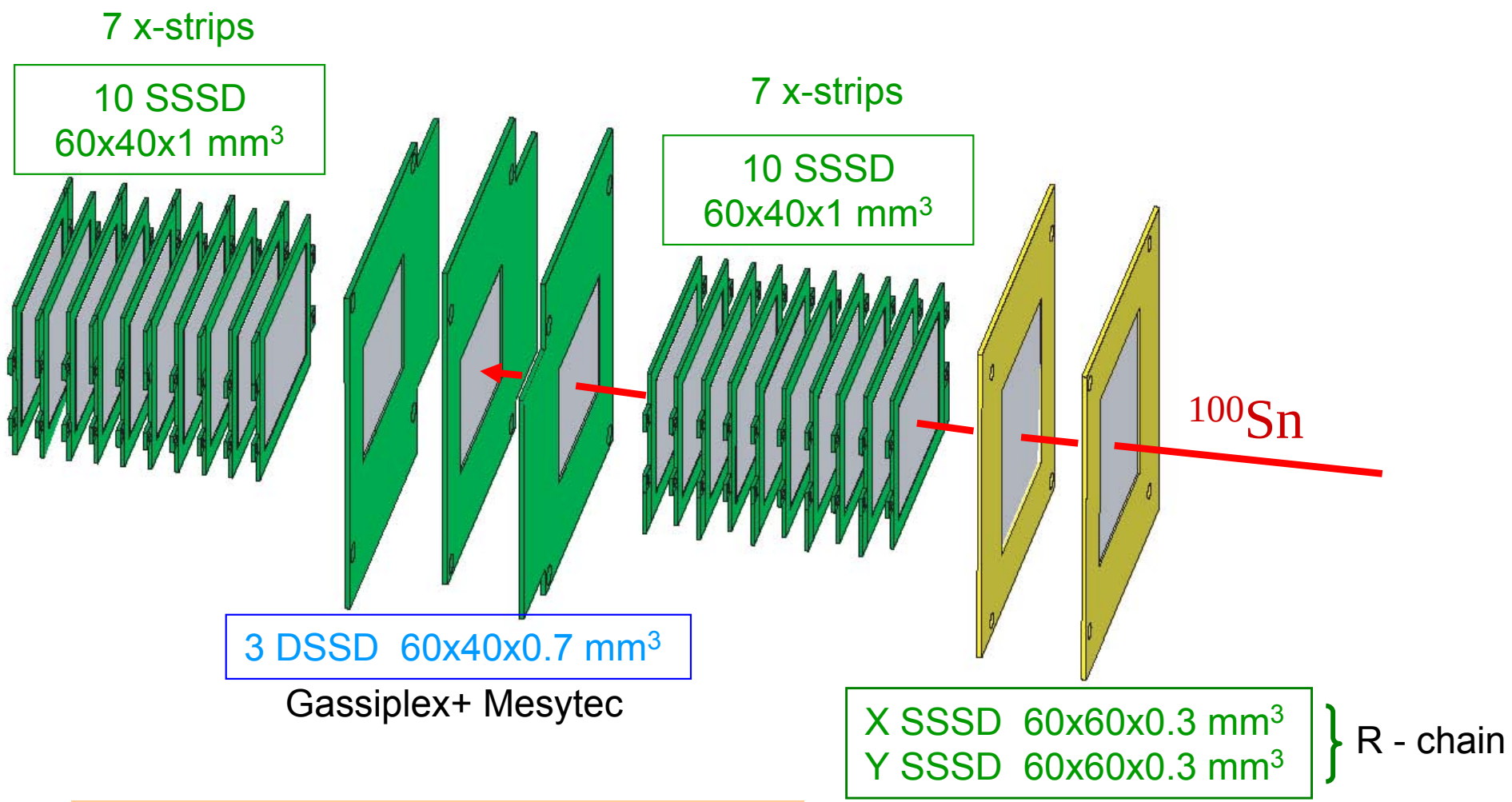
S330

^{100}Sn: Gamov-Teller Strength in its Decay Search for its Isomer Particle Stability of Neighbours

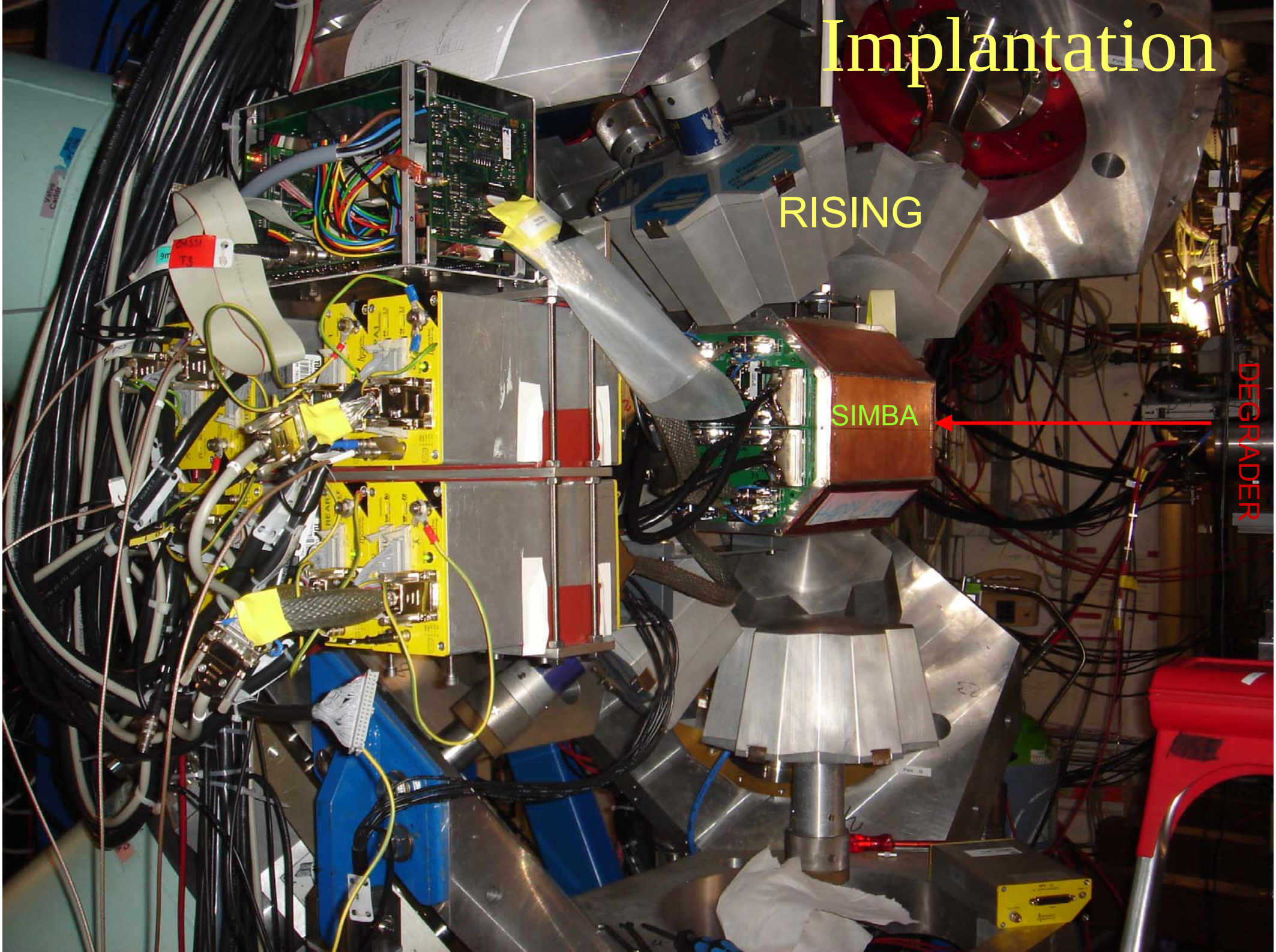
TUM
GSI
Edinburgh
Ankara
Belgrade
Bratislava
GANIL
Groningen
Köln
Krakow
MSU
RIKEN
Surrey
Uppsala
Warsaw
+
RISING



Silicon Implantation Detector and Beta Absorber SIMBA



pixels in implantation zone:
3x60x40 = 7200


Implantation
RISING
SIMBA
DEGRADER

RISING

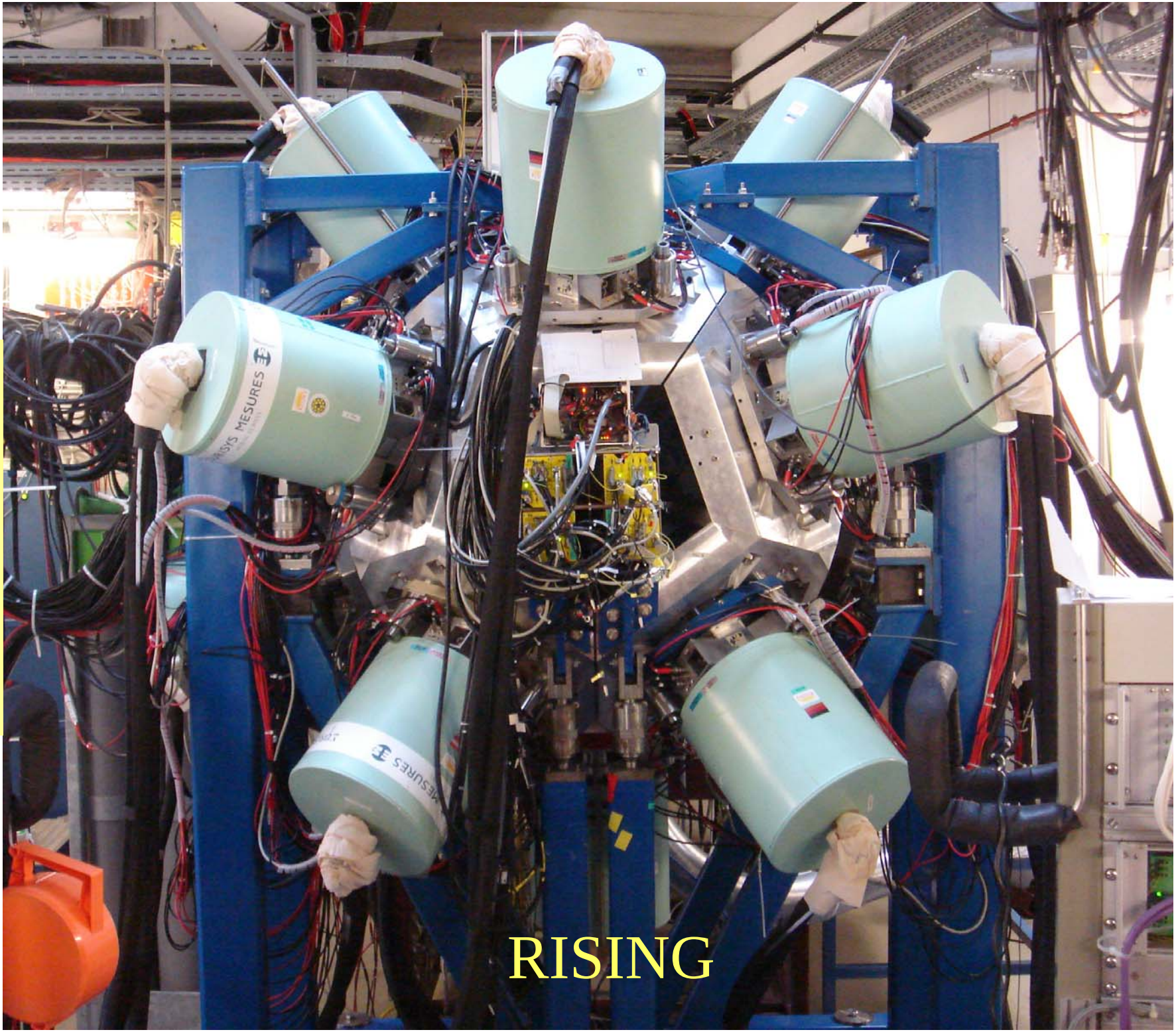
+

15 x 7

Germanium detectors

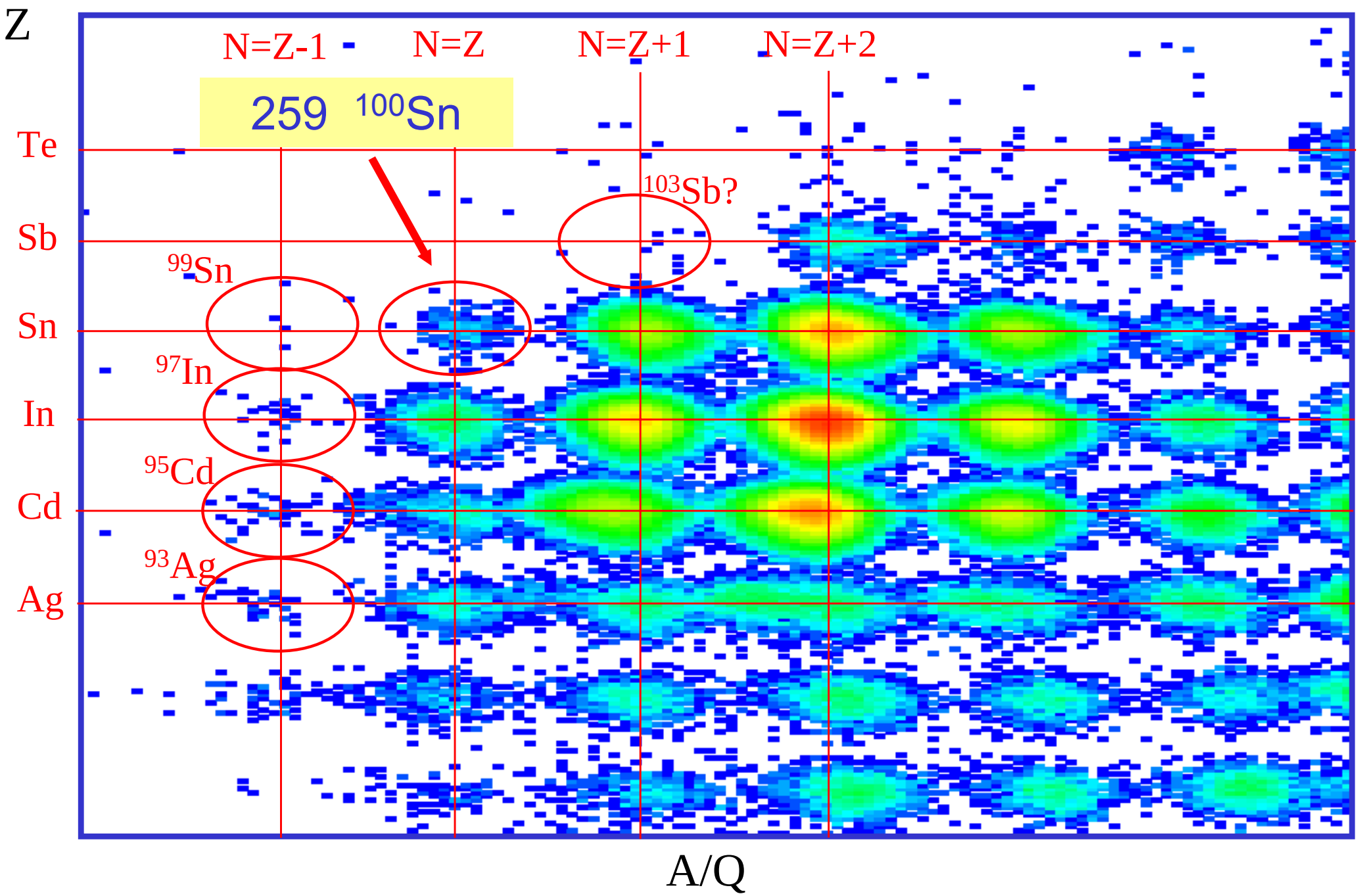
ε_{Photo}~ 11%

@ 662 keV

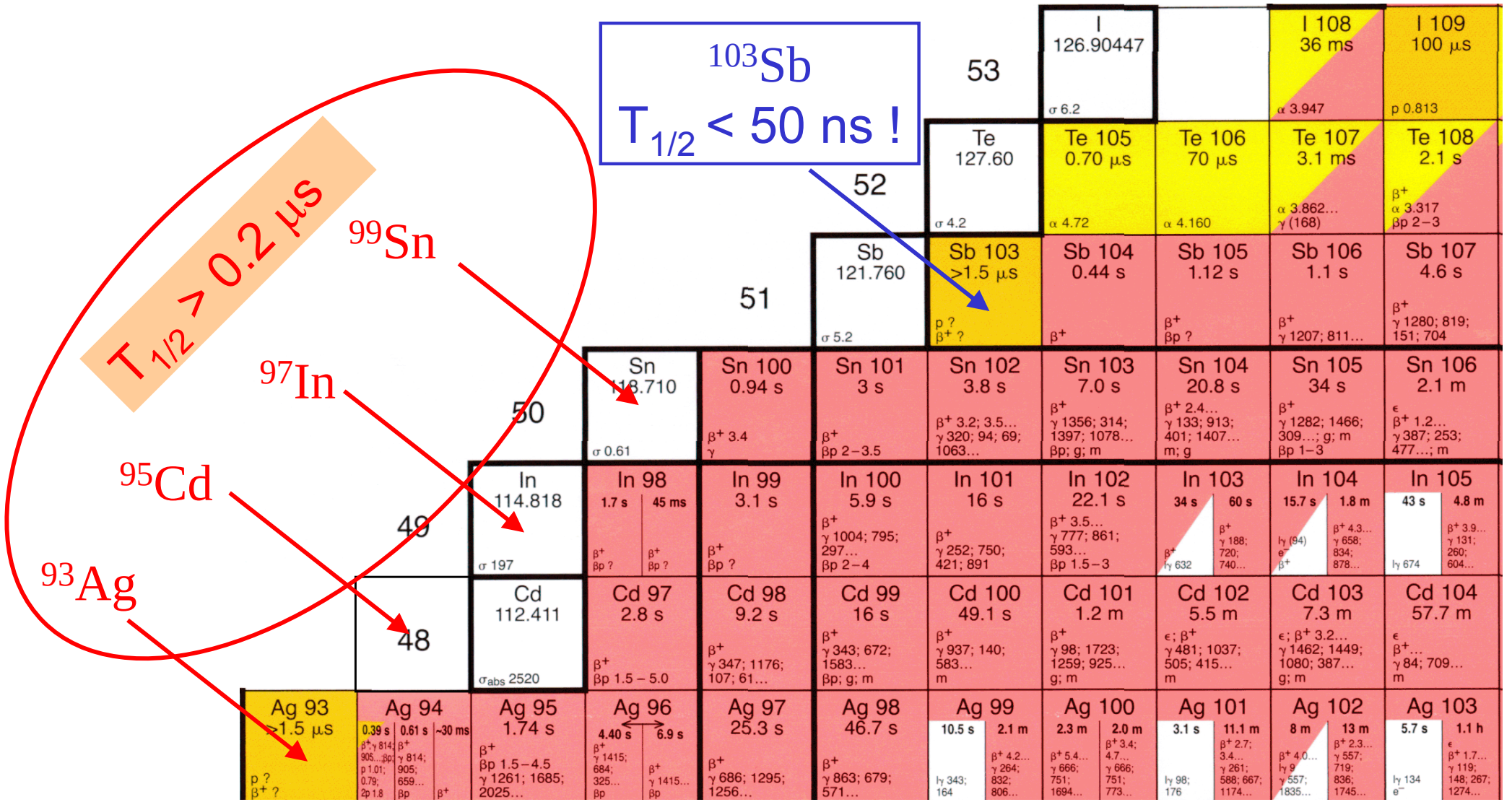


RISING

^{100}Sn setting (full statistics, 15 days)



what‘s new?


^{103}Sb
$T_{1/2}$ < 50 ns !
$T_{1/2}$ > 0.2 µs
^{99}Sn
^{97}In
^{95}Cd
^{93}Ag
53
52
51
50
49
48
I 126.90447 σ 6.2
I 108 36 ms α 3.947
I 109 100 µs p 0.813
Te 127.60 σ 4.2
Te 105 0.70 µs α 4.72
Te 106 70 µs α 4.160
Te 107 3.1 ms α 3.862… γ (168)
Te 108 2.1 s β+ α 3.317 βp 2–3
Sb 121.760 σ 5.2
Sb 103 >1.5 µs p ? β+ ?
Sb 104 0.44 s β+
Sb 105 1.12 s β+ βp ?
Sb 106 1.1 s β+ γ 1207; 811…
Sb 107 4.6 s β+ γ 1280; 819; 151; 704
Sn 118.710 σ 0.61
Sn 100 0.94 s β+ 3.4 γ
Sn 101 3 s β+ βp 2–3.5
Sn 102 3.8 s β+ 3.2; 3.5… γ 320; 94; 69; 1063…
Sn 103 7.0 s β+ γ 1356; 314; 1397; 1078… βp; g; m
Sn 104 20.8 s β+ 2.4… γ 133; 913; 401; 1407… m; g
Sn 105 34 s β+ γ 1282; 1466; 309…; g; m βp 1–3
Sn 106 2.1 m ε β+ 1.2… γ 387; 253; 477…; m
In 114.818 σ 197
In 98 1.7 s 45 ms β+ βp ? β+ βp ?
In 99 3.1 s β+ βp ?
In 100 5.9 s β+ γ 1004; 795; 297… βp 2–4
In 101 16 s β+ γ 252; 750; 421; 891
In 102 22.1 s β+ 3.5… γ 777; 861; 593… βp 1.5–3
In 103 34 s 60 s β+ γ 632 β+ γ 188; 720; 740…
In 104 15.7 s 1.8 m Iγ (94) e⁻ β+ β+ 4.3… γ 658; 834; 878…
In 105 43 s 4.8 m Iγ 674 β+ 3.9… γ 131; 260; 604…
Cd 112.411 σabs 2520
Cd 97 2.8 s β+ βp 1.5 – 5.0
Cd 98 9.2 s β+ γ 347; 1176; 107; 61…
Cd 99 16 s β+ γ 343; 672; 1583… βp; g; m
Cd 100 49.1 s β+ γ 937; 140; 583… m
Cd 101 1.2 m β+ γ 98; 1723; 1259; 925… g; m
Cd 102 5.5 m ε; β+ γ 481; 1037; 505; 415… m
Cd 103 7.3 m ε; β+ 3.2… γ 1462; 1449; 1080; 387… g; m
Cd 104 57.7 m ε β+… γ 84; 709… m
Ag 93 >1.5 µs p ? β+ ?
Ag 94 0.39 s 0.61 s ~30 ms β+ γ 814; 905…; βp; p 1.01; 0.79; 2p 1.8 β+ γ 814; 905; 659… βp β+
Ag 95 1.74 s β+ βp 1.5–4.5 γ 1261; 1685; 2025…
Ag 96 4.40 s 6.9 s β+ γ 1415; 684; 325… βp β+ γ 1415… βp
Ag 97 25.3 s β+ γ 686; 1295; 1256…
Ag 98 46.7 s β+ γ 863; 679; 571…
Ag 99 10.5 s 2.1 m Iγ 343; 164 β+ 4.2… γ 264; 832; 806…
Ag 100 2.3 m 2.0 m β+ 5.4… γ 666; 751; 1694… β+ 3.4; 4.7… γ 666; 751; 773…
Ag 101 3.1 s 11.1 m Iγ 98; 176 β+ 2.7; 3.4… γ 261; 588; 667; 1174…
Ag 102 8 m 13 m β+ 4.0… Iγ 9 γ 557; 1835… β+ 2.3… γ 557; 719; 836; 1745…
Ag 103 5.7 s 1.1 h Iγ 134 e⁻ ε β+ 1.7… γ 119; 148; 267; 1274…

Proton decay Q-value for ^{97}In and ^{93}Ag

with $T_{1/2}$ > 0.2 μs and L=4 transitions

we get (using Delion et al. PRL96(2006)):

the Q_p values:

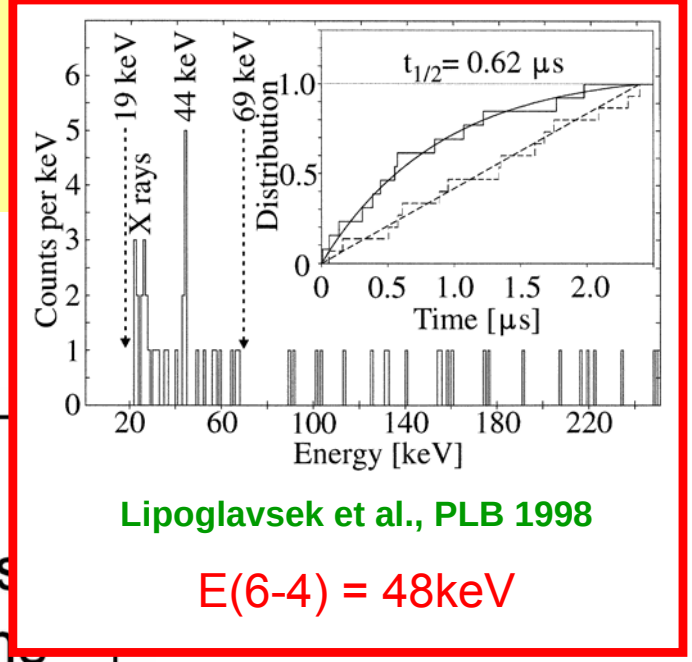
	our limit	Lalazissis et al.	Herndl, Brown	Audi et al.
		NPA 679 (2001)	NPA 627 (1997)	NPA 729 (2003)
		rel. H B	shell model	extrapolation
^{93}Ag	< 1.1MeV	0.11	0.95	1.43(78)
^{97}In	< 1.2MeV	0.37	1.28	1.81(78)

^{97}In: 1 decay after 38ms => $T_{1/2} = 26^{+125}_{-12}\,ms$ => log ft = 3.7

=> $T_{1/2}$ (proton) > 40ms => Q_p < 0.7MeV

Isomers?

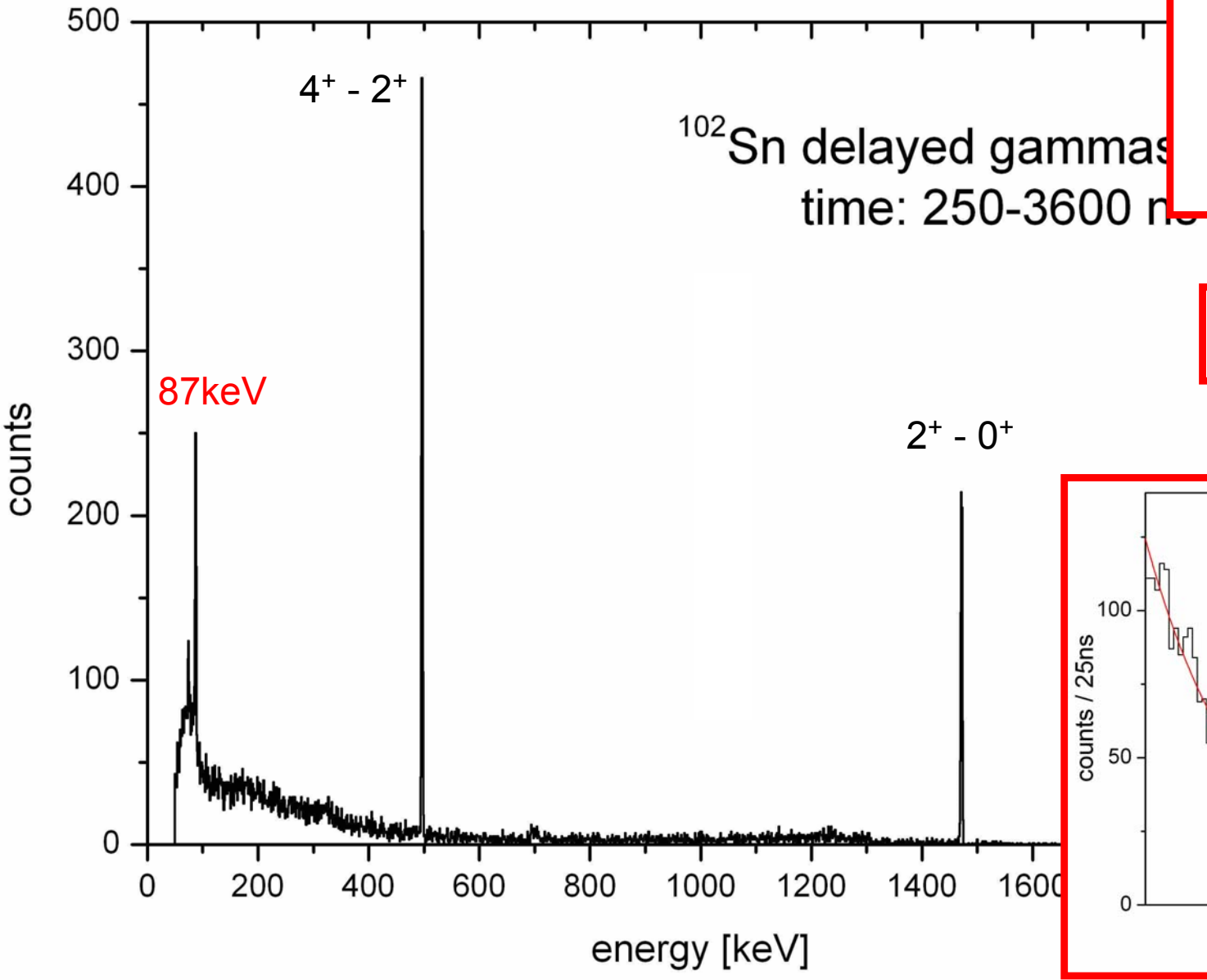
6^+ Isomer in ^{102}Sn

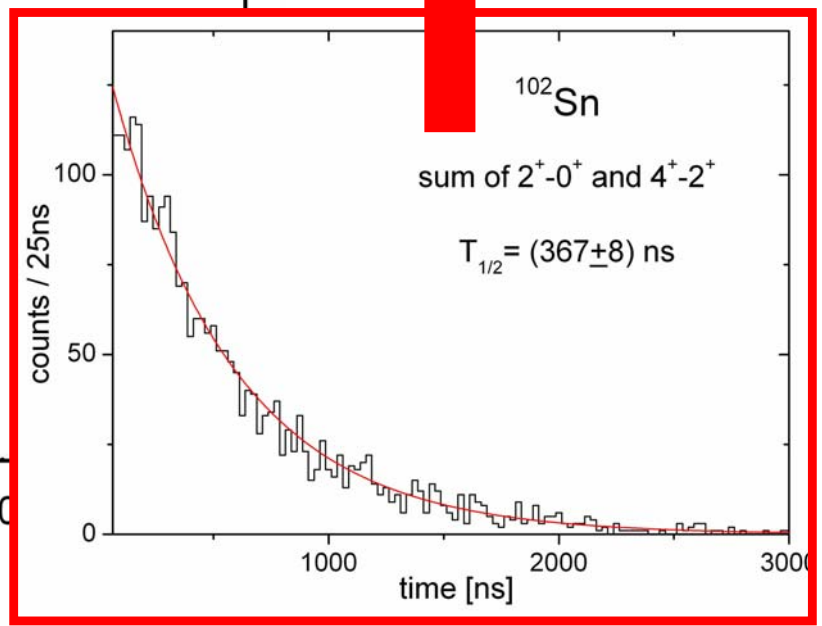


Lipoglavsek et al., PLB 1998

E(6-4) = 48keV

B(E2)=3.2(1) W.u.





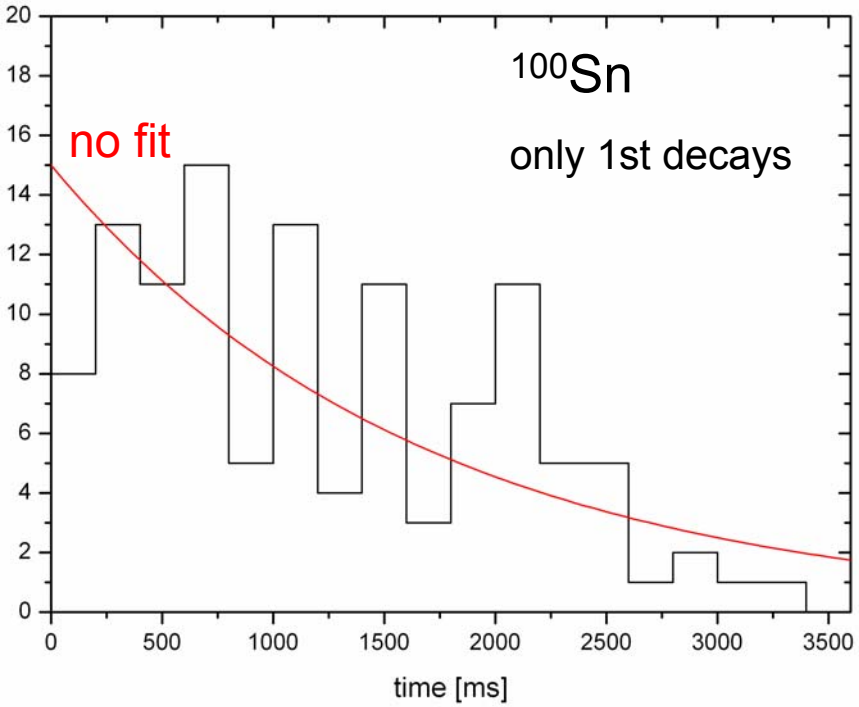
how does ^{100}Sn decay?

Correlation of Implantation and Decay

require same position within ± 1mm in x,y,z

record all decay triggers within 15 s
(β^+ of 3 generations)

Maximum Likelyhood analysis
varying the ^{100}Sn half-life
with known: daughter decays,
efficiencies, dead times, background



$T_{1/2}$ = 1.16 ± 0.20 s

preliminary

Comparison:

MSU 2007 $0.55^{+0.70}_{-0.31}$ s

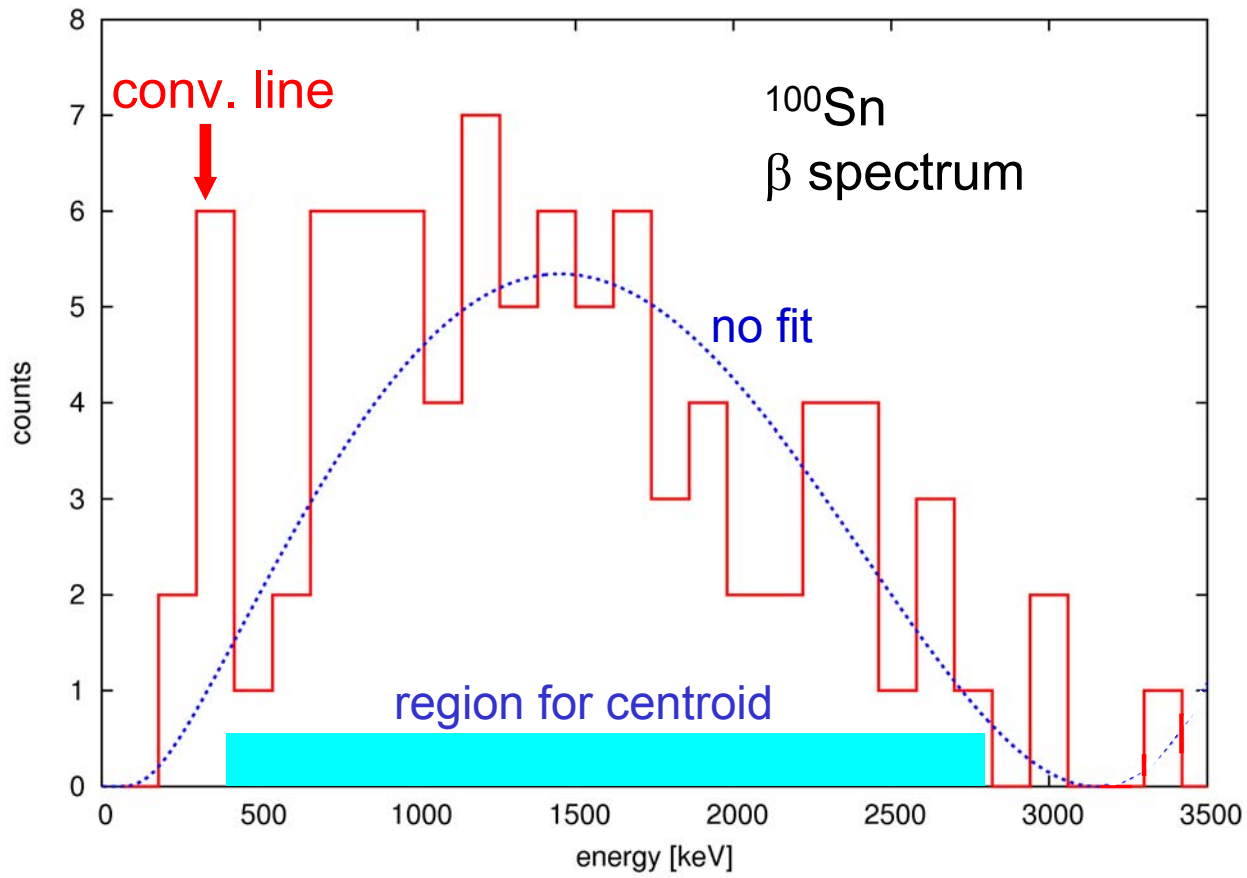
GSI 1997 $0.94^{+0.54}_{-0.26}$ s

Extraction of Beta Spectrum

Sum over total energy within 3 s after implantation

in implantation zone + calorimeter

not yet tested for uninterrupted tracks



from centroid

E_{max} = 3.15 ± 0.20 MeV

Q_{EC} = 4.17 ± 0.20 MeV

to excited state

preliminary

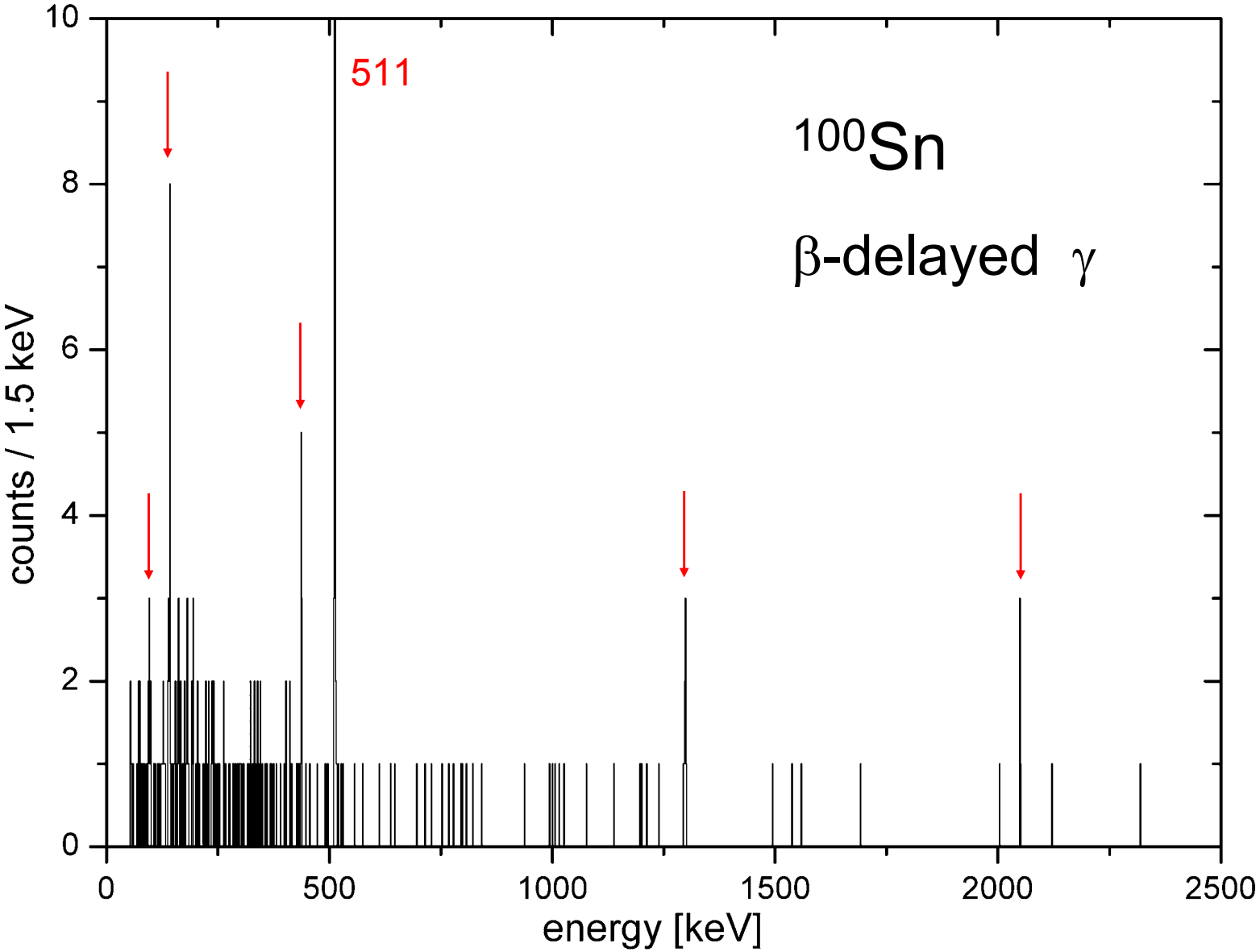
=> I_β = 85%

log ft = 2.54 ± 0.20

that‘s record

Gamma Spectrum after Beta Decay of ^{100}Sn

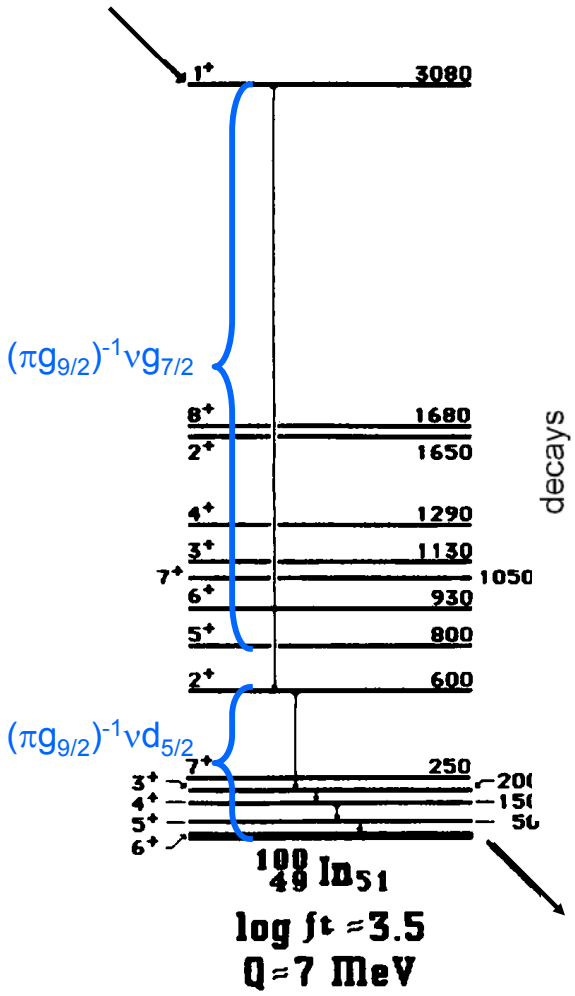
all events within 4 s after implantation

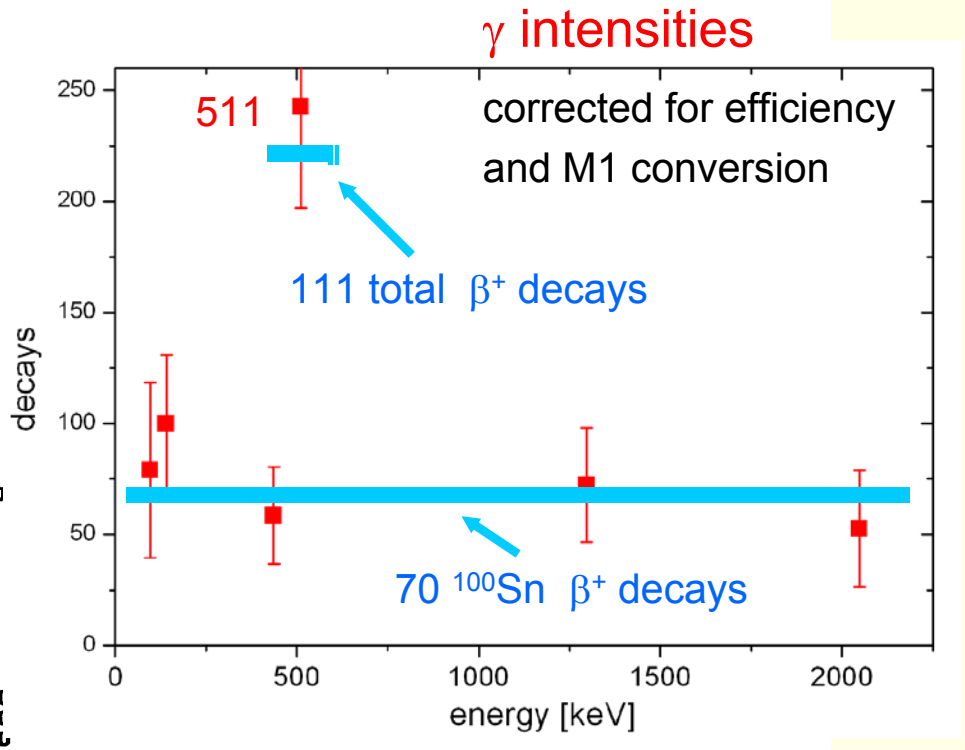


Gamma Intensities

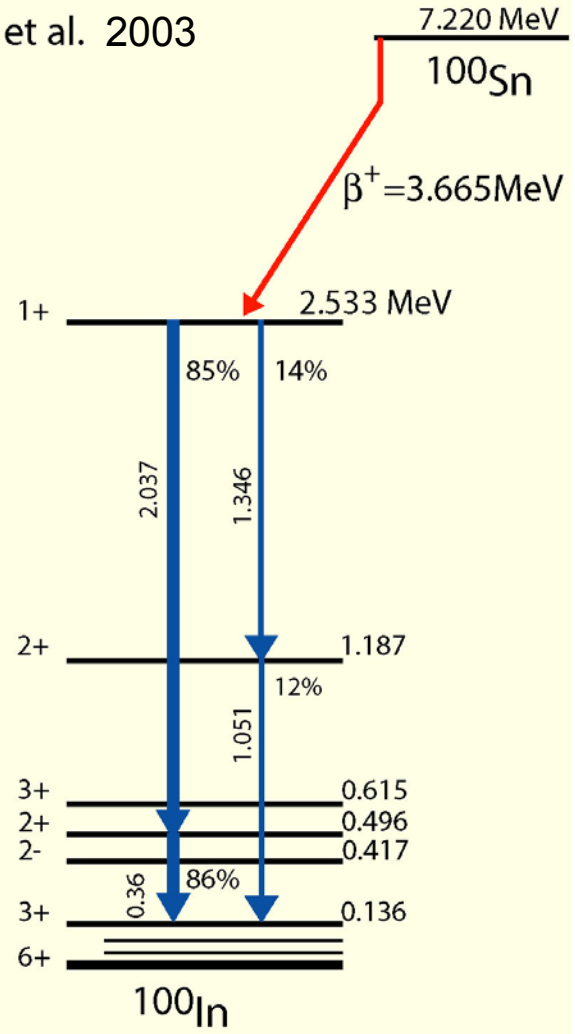
what do we expect?

Stone, Walters 1985





Grawe et al. 2003



5 lines add up to 4018 keV ???

The Team

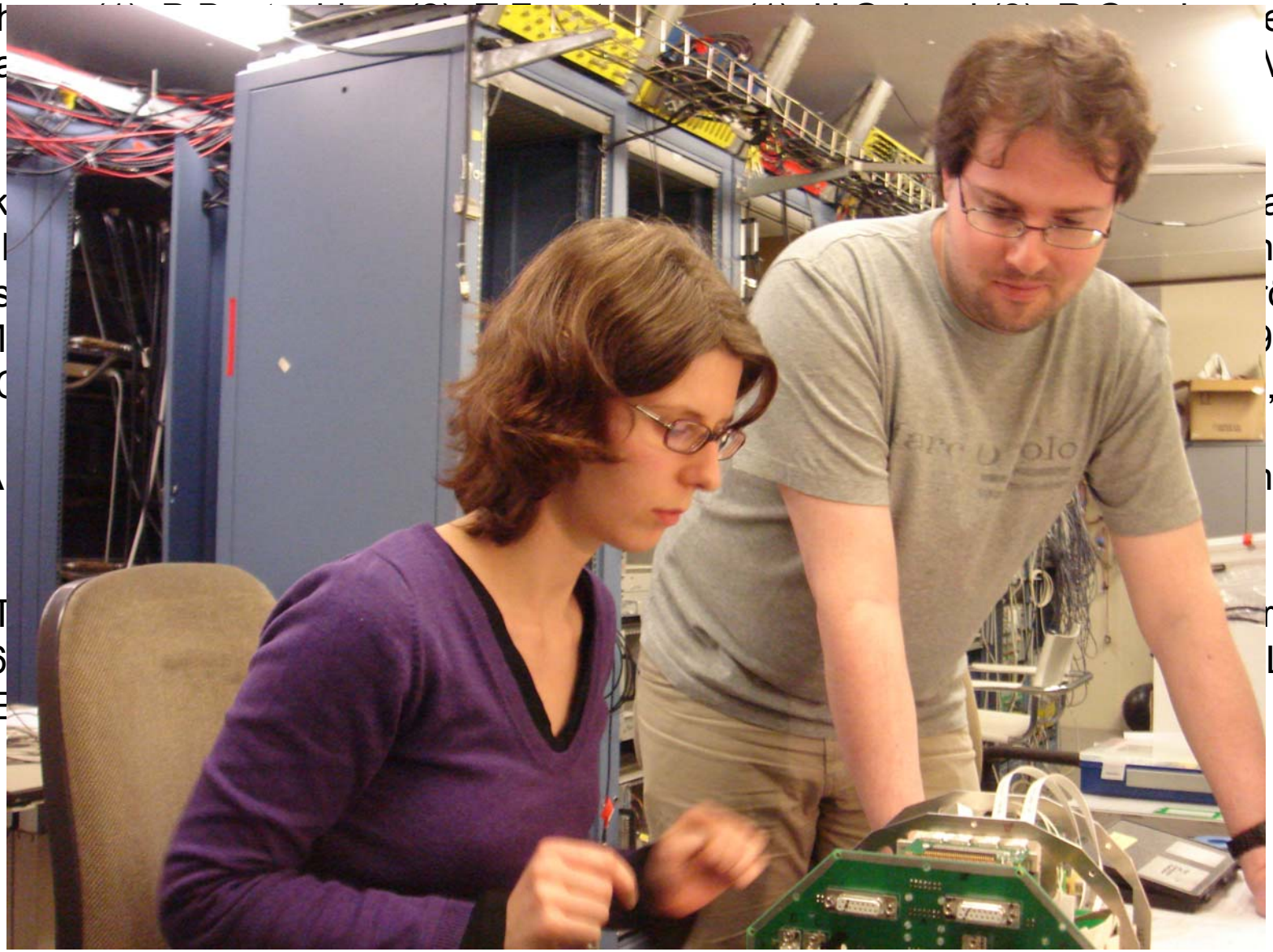
K.Eppinger (1), C.Hinke (1),
M.Böhmer (1), P.Boutachkov (2), T.Faestermann (1), H.Geissel (2), R.Gernhäuser (1),
M.Górska (2), A.Gottardo (3), J.Gręboszˊ (4), R.Krücken (1), N.Kurz (2), Z.Liu (3), L.Maier (1),
S.Pietri (2,5), Zs.Podolyák (5), K.Steiger (1), H.Weick (2), P.J.Woods (3),
N.Al-Dahan (5), N.Alkhomashi (5), A.Atac (6), A.Blazhev (7), N.Braun (7),
I.Čelikovićˊ (8), T.Davinson (3), I.Dillmann (1), C.Domingo-Pardo (2), P.Doornenbal (9),
G.de France (10), G.Farelli (5), F.Farinon (2), J.Gerl (2), N.Goel (2), T.Habermann (2),
R.Hoischen (2), R.Janik (11), M.Karny (12), A.Kaskas (6), I.Kojouharov (2), Th.Kröll (1),
M.Lewitowicz (10), Y.Litvinov (2), S.Myalski (4), F. Nebel (1), S.Nishimura (9),
C.Nociforo (2), J.Nyberg (13), A.Parikh (1), A.Procházka (2), P.H.Regan (4),
C.Rigollet (14), H.Schaffner (2), C.Scheidenberger (2), S.Schwertel (1),
P.-A.Söderström (13), S.Steer (4), A.Stolz (15), P.Strmeňˊ (11), H.J.Wollersheim (2),
and the RISING collaboration

(1) TU München, (2) GSI, (3) U of Edinburgh, (4) IFJ PAN Krakow, (5) U of Surrey,
(6) U of Ankara, (7) U of Köln (8) Inst. Vinca Belgrade, (9) RIKEN, (10) GANIL,
(11) U of Bratislava, (12) U of Warsaw, (13) U of Uppsala, (14) KVI - U of Groningen, (15) MSU

* supported by the MLL, BMBF, DFG (EXC153), EPSRC, STFC (UK), and EURONS

The Team

K.Eppinger (1), C.Hinke (1),
M.Böh er (1),
M.Górska Maier (1),
I.Čelik al (9),
G.de l nn (2),
R.Hois öll (1),
M),
C ,
P.-A n (2),
(1) T rrey,
(6 L,
(11) U of E (15) MSU



* supported by the MLL, BMBF, DFG (EXC153), EPSRC, STFC (UK), and EURONS

Lehrstuhl E12