Nuclear Decay Spectroscopy in the Actinide Region
@
the JYFL gas-filled recoil separator RITU

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Periodic Table

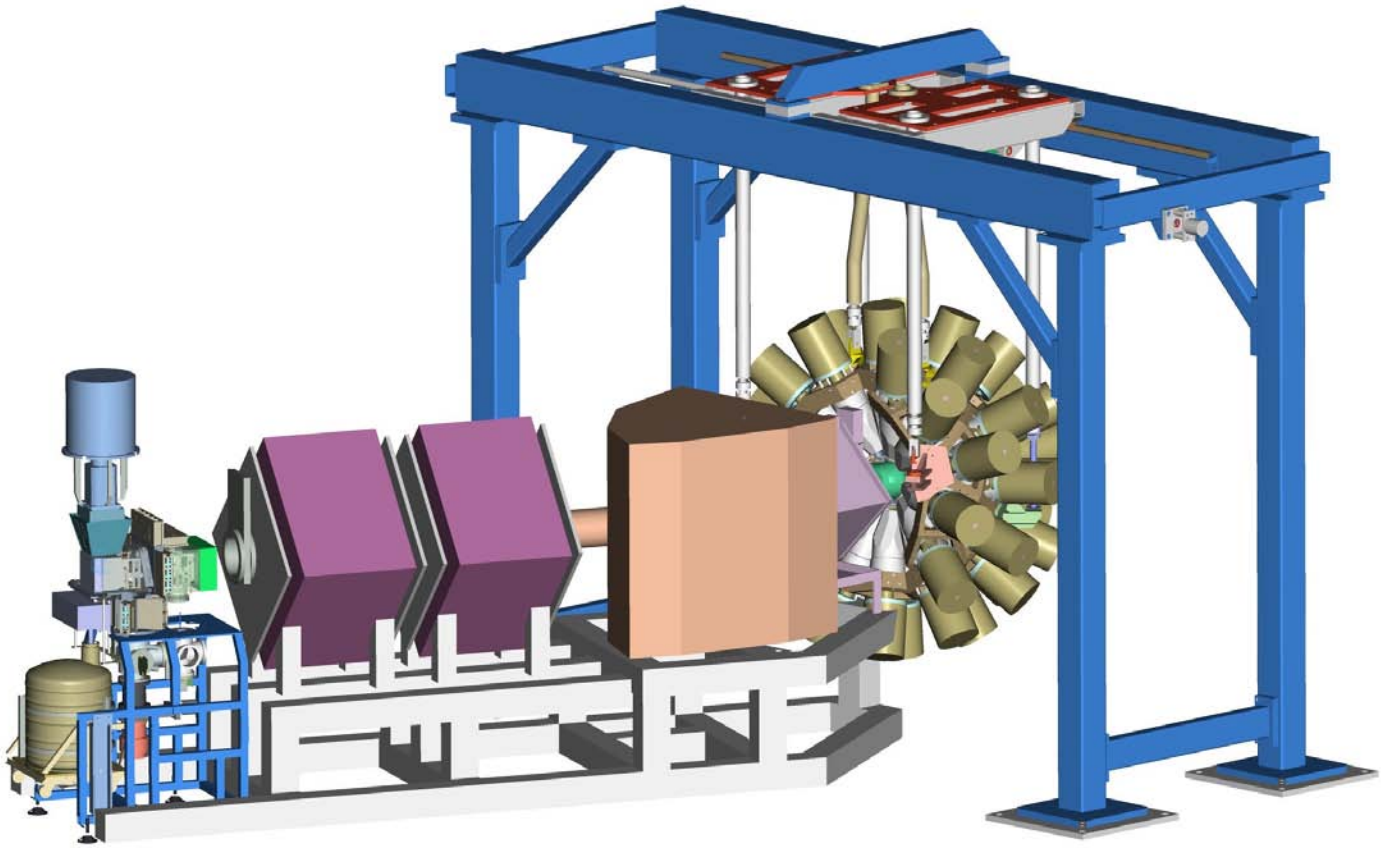
1998 Dr. Michael Blaber

	1/IA	2/IIA	3/IIIB	4/IVB	5/VB	6/VIB	7/VIIB	8 (VIII)	9 (VIII)	10 (VIII)	11/IB	12/IIB	13/IIIA	14/IVA	15/VA	16/VIA	17/VIIA	18/VIIIA
1	1 H 1.008																	2 He 4.003
2	3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.30											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.05	18 Ar 39.95
4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc 98.91	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
6	55 Cs 123.9	56 Ba 137.3	La-Lu	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po 210.0	85 At 210.0	86 Rn 222.0
7	87 Fr 223.0	88 Ra 226.0	Ac-Lr	104 Db	105 Jl	106 Rf	107 Bh	108 Hn	109 Mt	110 Uun	111 Uuu							

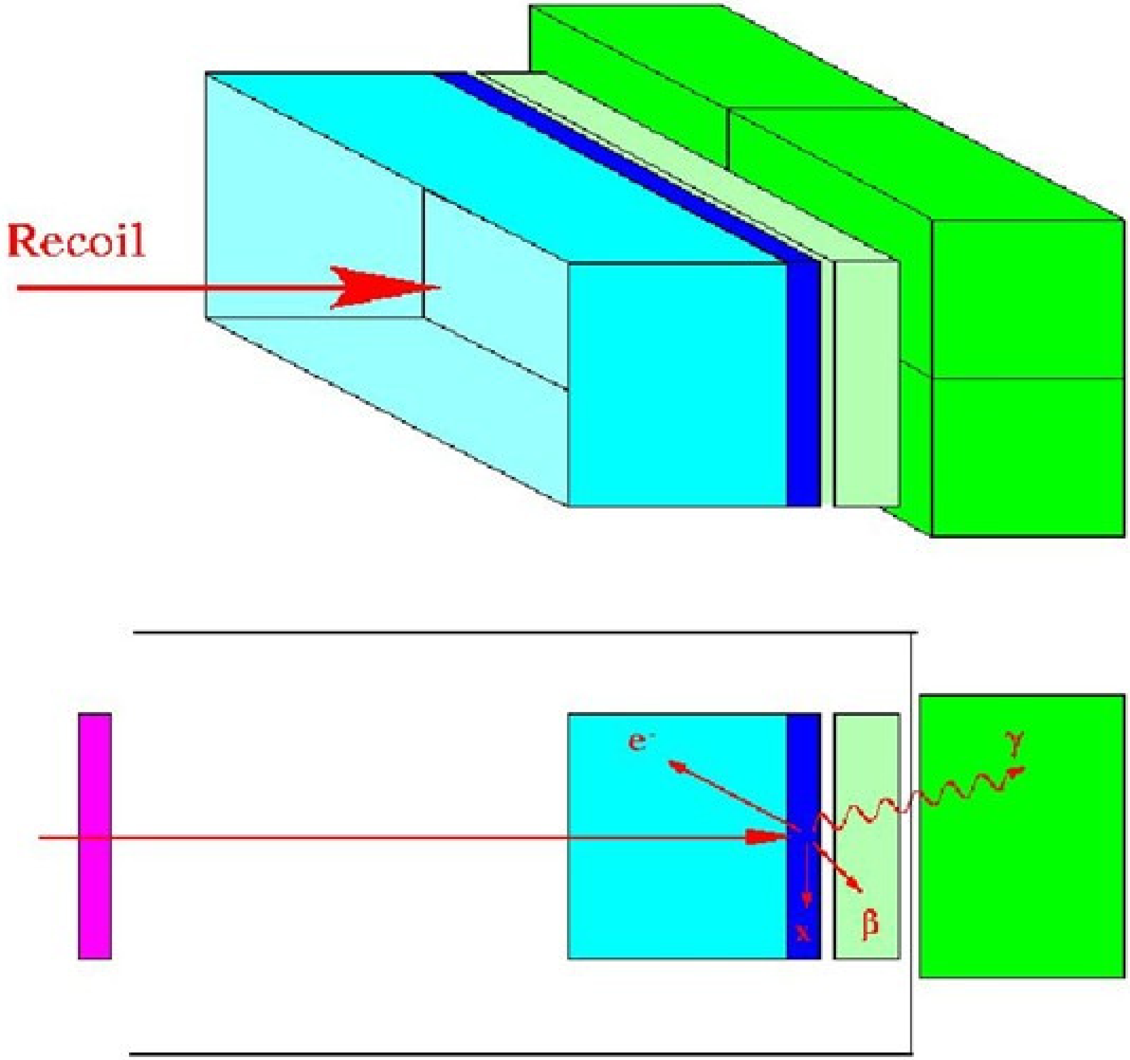
← *s* → ← *d* → ← *p* →

	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
Lanthanides	57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm 146.9	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
Actinides	89 Ac 227.0	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237.0	94 Pu 239.1	95 Am 241.1	96 Cm 244.1	97 Bk 249.1	98 Cf 252.1	99 Es 252.1	100 Fm 257.1	101 Md 258.1	102 No 259.1	103 Lr 262.1

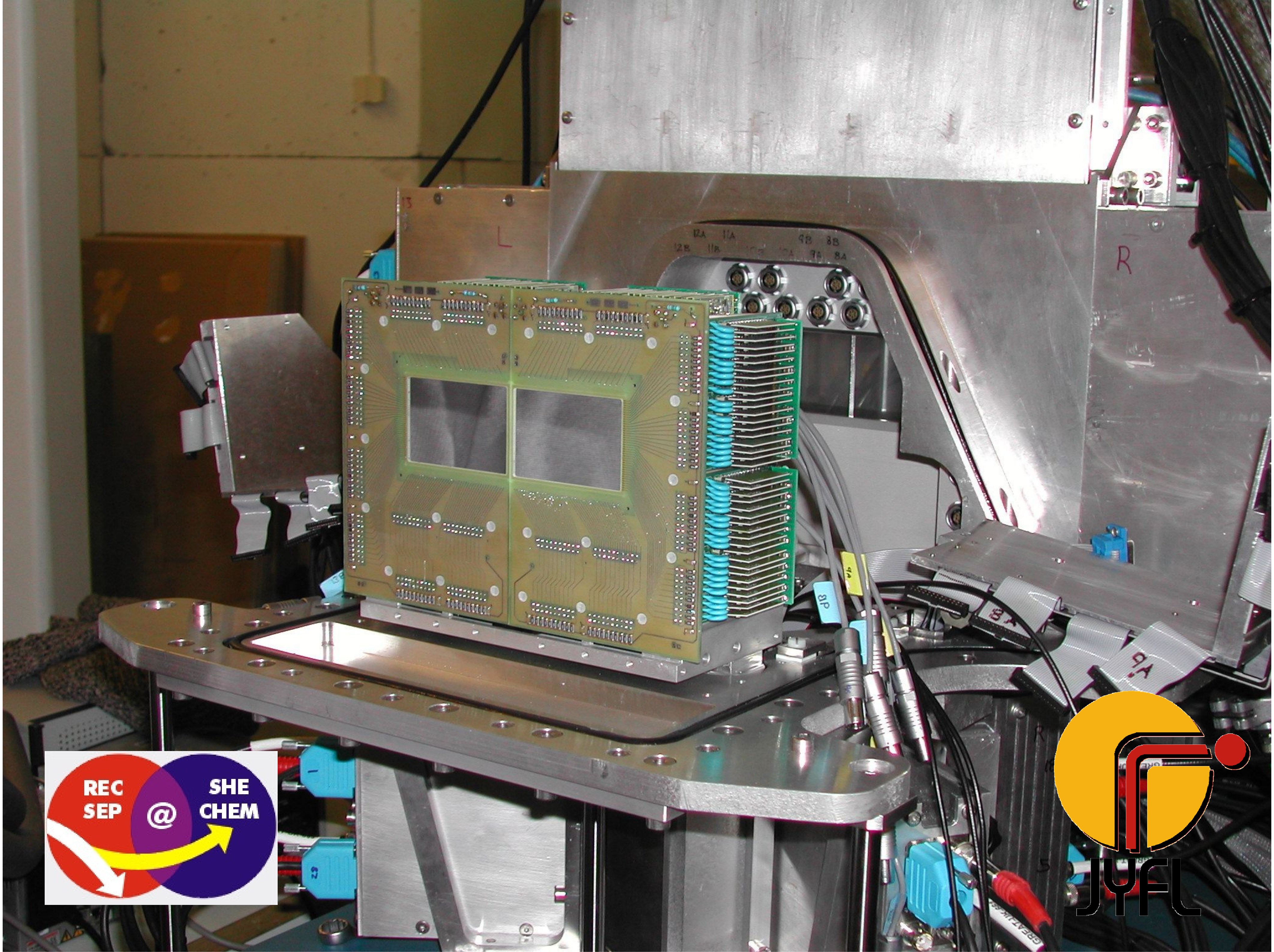
← *f* →



GREAT & RITU & JUROGAM



MWPC
PIN-diodes
DSSSD
Planar-Ge
Clover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Isomer Spectroscopy in $^{216}_{90}Th_{126}$ and the Magicity of $^{218}_{92}U_{126}$

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Excited states in ^{216}Th were investigated via prompt and delayed γ decays and the recoil-decay tagging method. The decay schemes of the $I^\pi = (8^+)$, $t_{1/2} = 128(8)$ μs, the $I^\pi = (11^-)$, $t_{1/2} = 615(55)$ ns, and the $I^\pi = (14^+)$, $t_{1/2} \geq 130$ ns isomers were established. The configuration $\pi h_{9/2} f_{7/2}$ is assigned to the $I^\pi = (8^+)$ isomer, which implies that the $h_{9/2}$ and $f_{7/2}$ states are nearly degenerate. This is ascribed to increased binding of the $f_{7/2}$ orbital by its coupling to a low-lying $I^\pi = (3^-)$ state at $E_x = 1687$ keV. The role of octupole and pairing correlations for a $Z = 92$ shell closure prediction is discussed on the basis of shell model calculations.

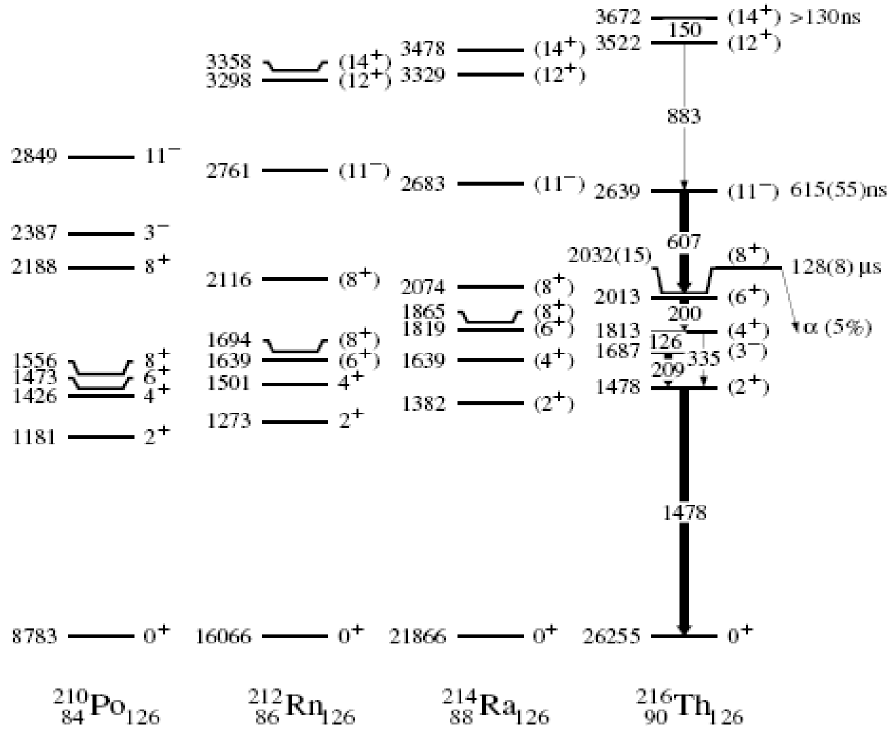

FIG. 2. Level scheme for ^{216}Th, deduced from the delayed γ rays observed in the present work, compared with other $N = 126$ isotones. Excitation and ground state binding energies relative to ^{208}Pb are given in keV.

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Decay studies of $^{215-217}$Th using ER-γ-α-γ coincidences

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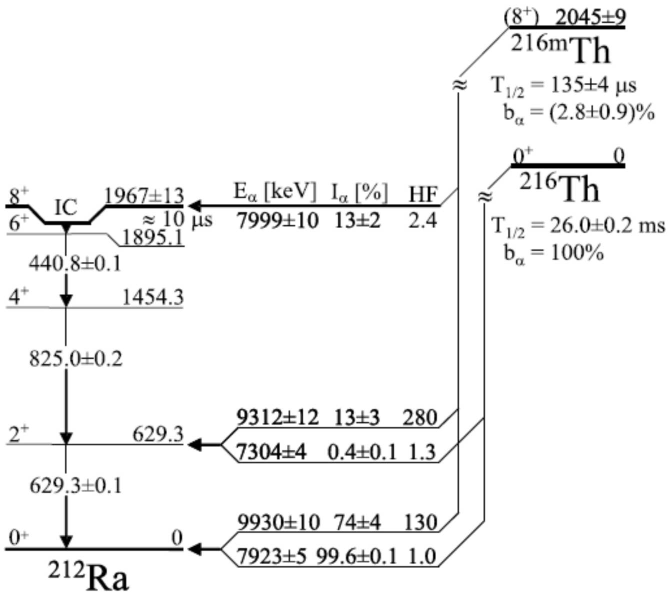

Fig. 3. Decay scheme of ^{216}Th observed in the present work. Ordering of the $6^+ \to 4^+ \to 2^+$ transitions is from [15] where the level energy of 1958.4 ± 0.5 keV for the isomeric 8^+ state with a half-life of 10.9 ± 0.4 μs and connected by a 63.3 keV transition to the 6^+ state at 1895.1 keV is reported. The α-decay hindrance factors (HF) were calculated according to [11] assuming a spin difference of $\Delta I^\pi = |I^\pi_{\text{initial}} - I^\pi_{\text{final}}|$.

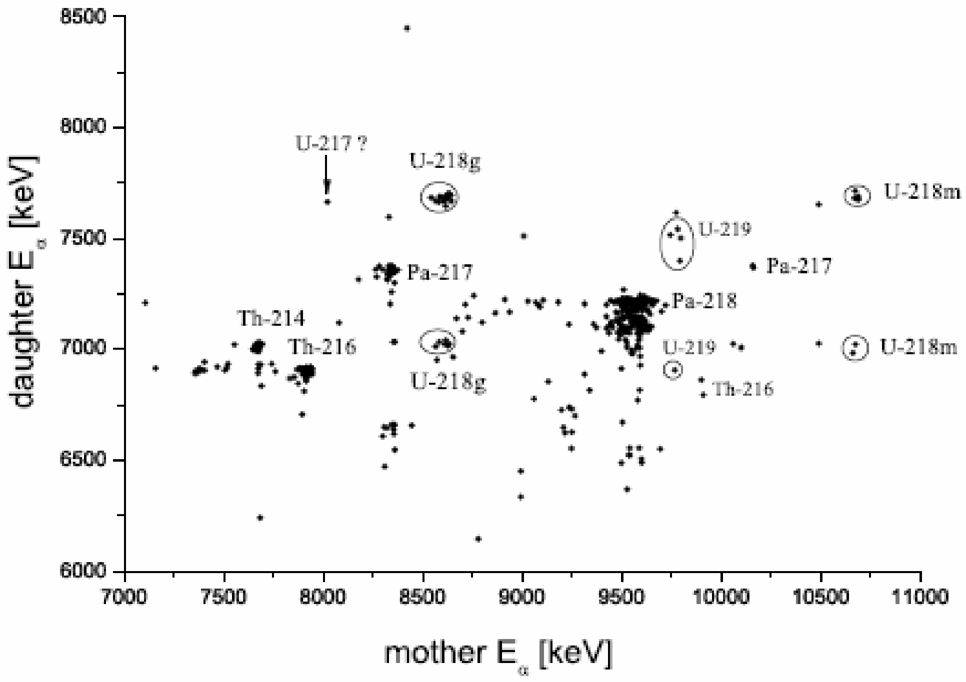

Table **5.2**: Summary of the results

nucleus	E [keV]	half-life [ms]	cross section [nb]	number of chains	state
^{217}U	8024(14)	$0.19^{+1.13}_{-0.10}$	0.05	1	$(\frac{1}{2}^-)$
^{218g}U	8612(9)	$0.51^{+0.17}_{-0.10}$	0.9	20	0^+
^{218m}U	10 678(17)	$0.56^{+0.26}_{-0.14}$	0.5	12	8^+
^{219}U	9774(18)	$0.08^{+0.10}_{-0.03}$	0.2	5	$\frac{9}{2}^+$

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PHYSICAL REVIEW C 67, 054310 (2003)

Large-scale shell model calculations for the $N=126$ isotones Po–Pu

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Large-scale shell model calculations were performed in the full $Z=82$–126 proton model space $\pi(0h_{9/2}, 1f_{7/2}, 0i_{13/2}, 2p_{3/2}, 1f_{5/2}, 2p_{1/2})$ employing the code NATHAN. The modified Kuo-Herling interaction was used, no truncation was applied up to protactinium ($Z=91$) and seniority truncation beyond. The results are compared to experimental data including binding energies, level schemes, and electromagnetic transition rates. An overall excellent agreement is obtained for states that can be described in this model space. Limitations of the approach with respect to excitations across the $Z=82$ and $N=126$ shells and deficiencies of the interaction are discussed.

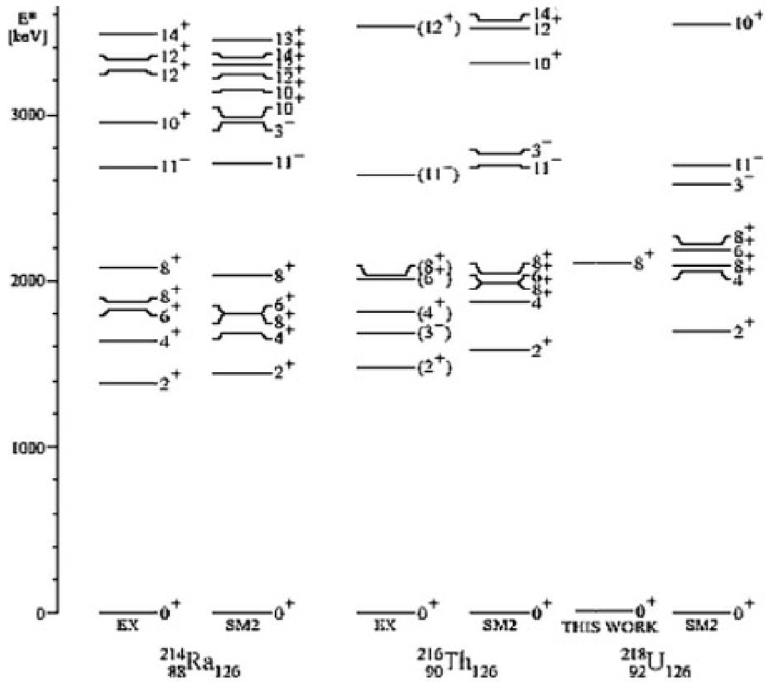
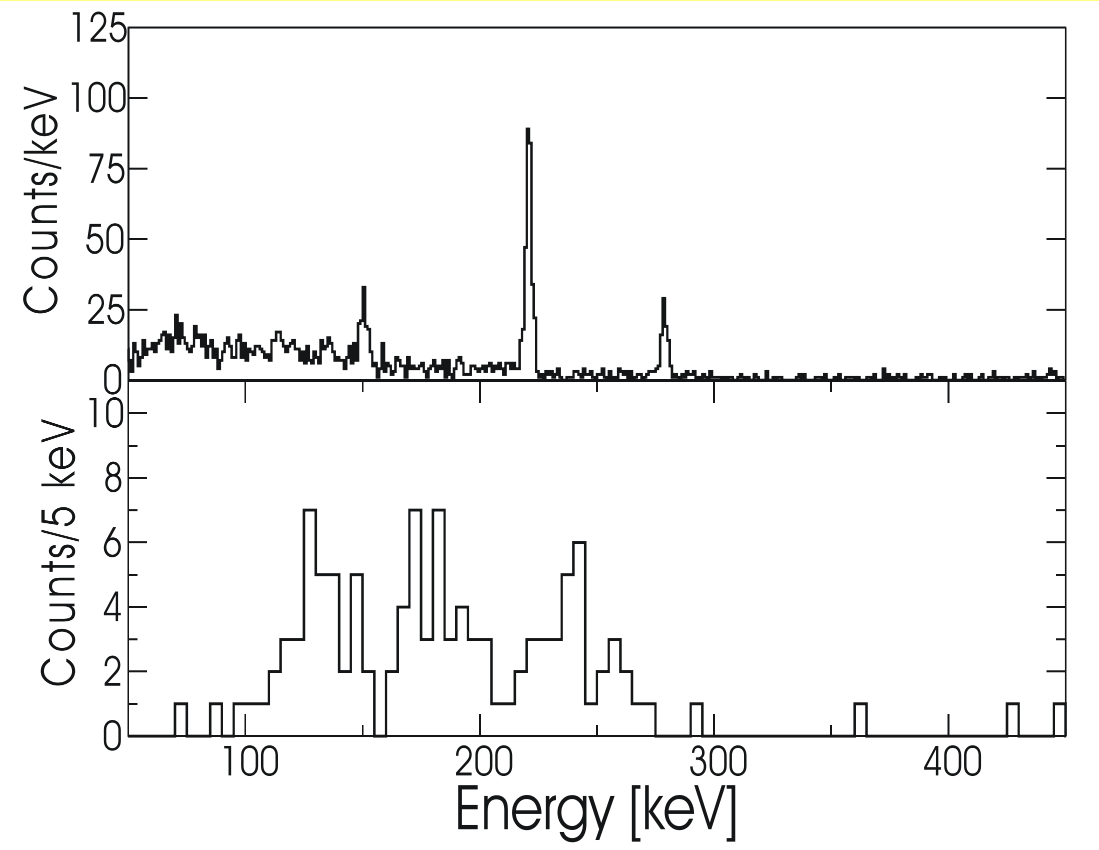
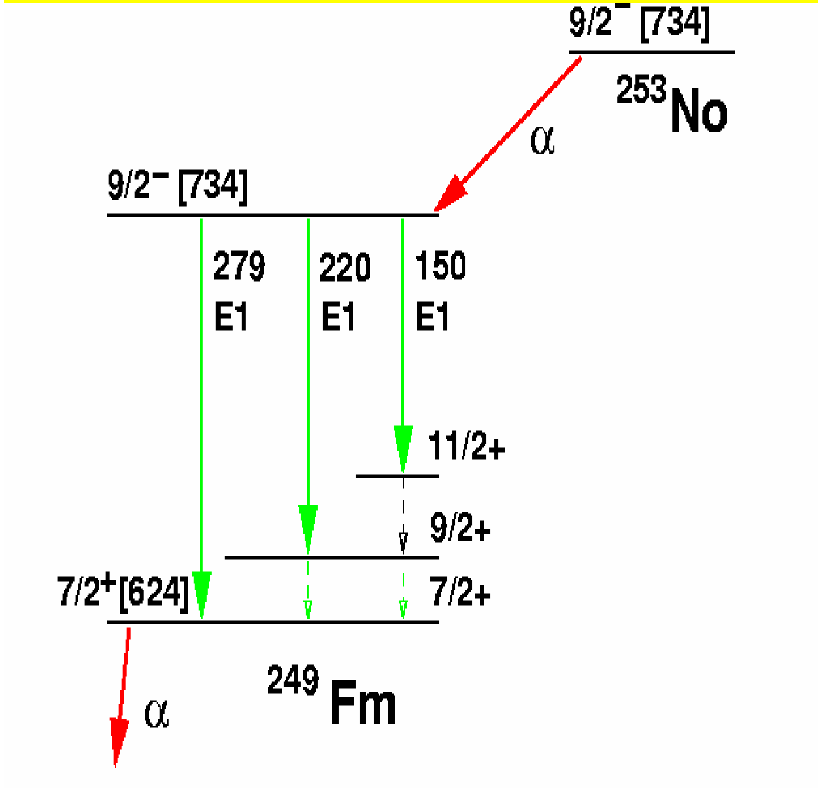


Figure **5.7**: Theoretical level schemes of different N=126 isotopes compared with experimental results. The new isomeric state found in ^{218}U has been added to the figure. Level scheme adopted from [Cau03].





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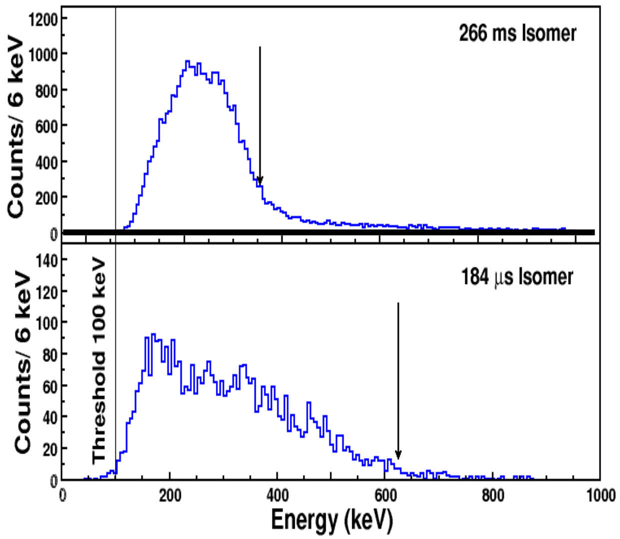
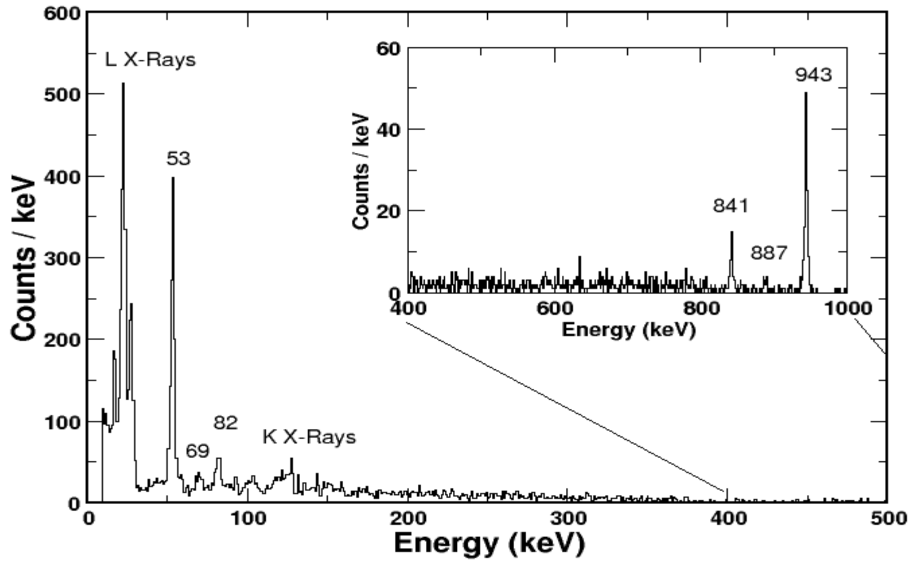
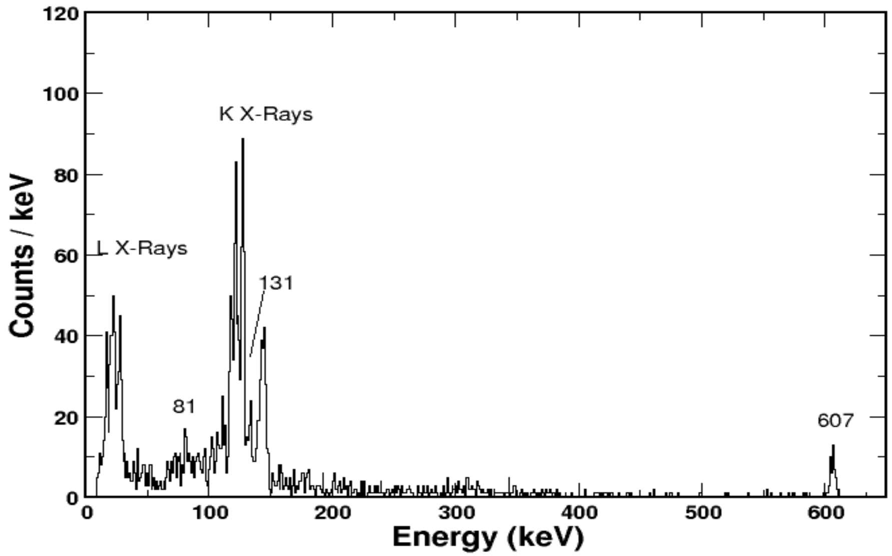
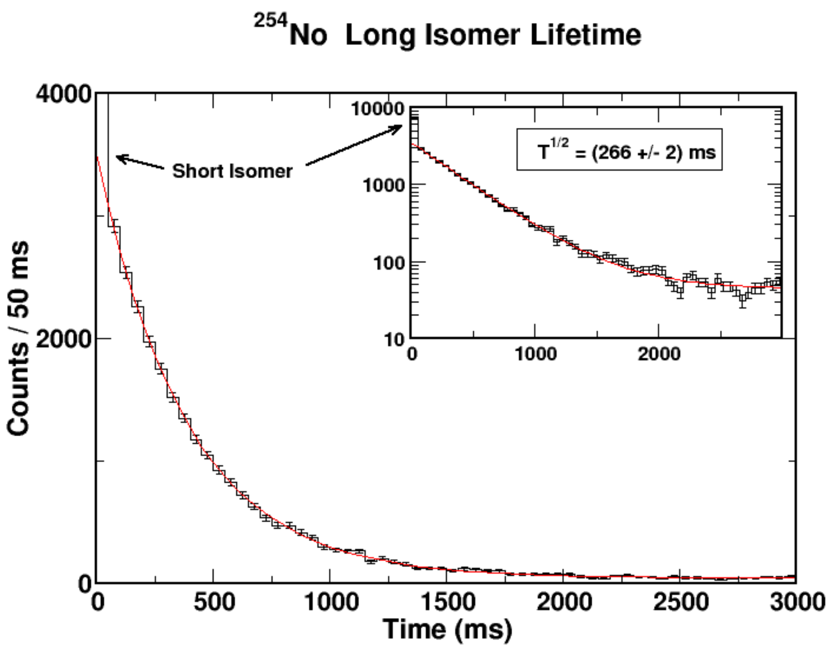
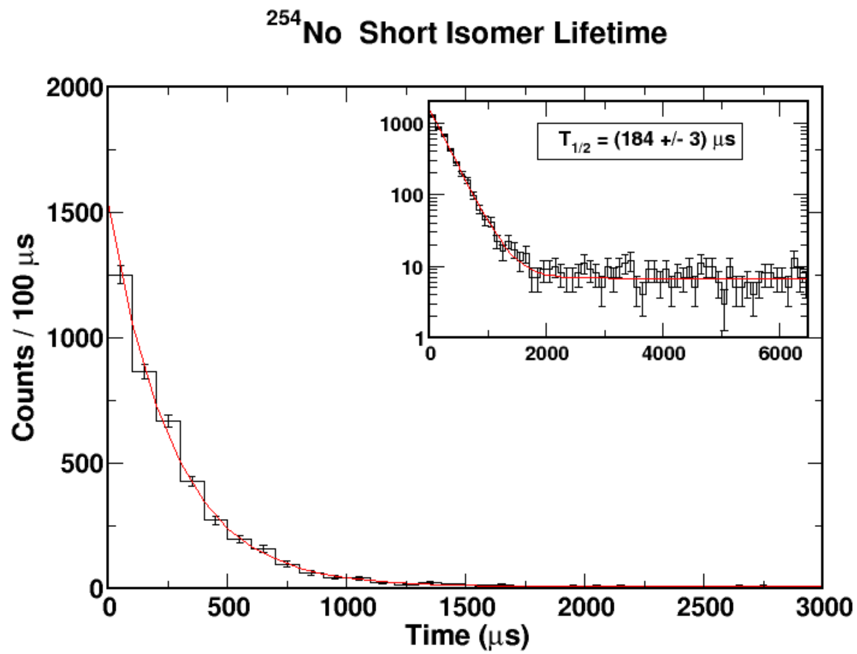

266 ms Isomer
184 μs Isomer
Counts/ 6 keV
Counts/ 6 keV
Threshold 100 keV
Energy (keV)
0
200
400
600
800
1000
1200
0
20
40
60
80
100
120
140
0
200
400
600
800
1000


L X-Rays
53
69
82
K X-Rays
Counts / keV
Energy (keV)
0
100
200
300
400
500
600
0
100
200
300
400
500
943
841
887
Counts / keV
Energy (keV)
0
20
40
60
400
600
800
1000

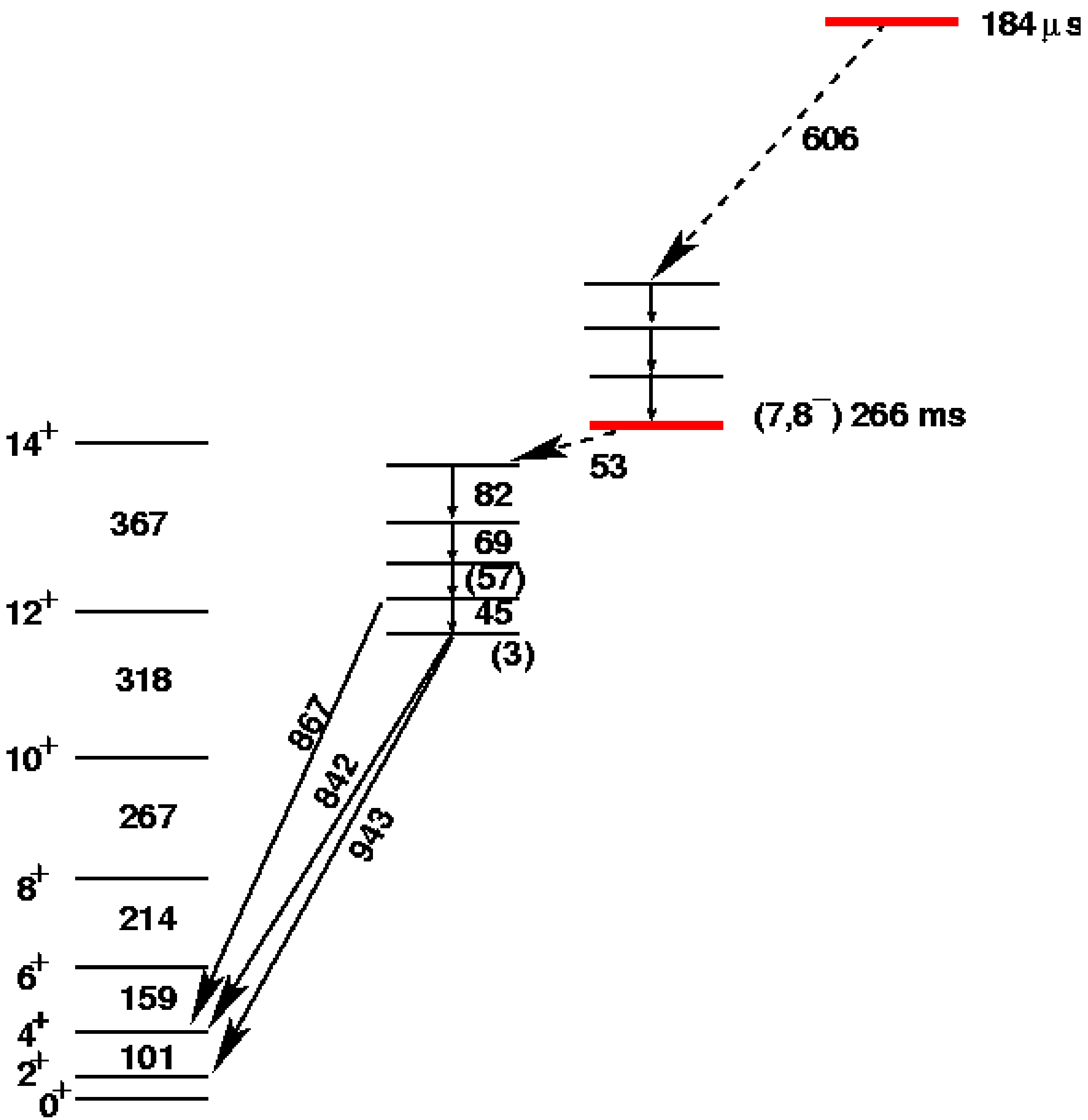

K X-Rays
L X-Rays
131
81
607
Counts / keV
Energy (keV)
0
20
40
60
80
100
120
0
100
200
300
400
500
600



^{254}No Long Isomer Lifetime
Short Isomer
$T^{1/2}$ = (266 +/- 2) ms
Counts / 50 ms
Time (ms)



^{254}No Short Isomer Lifetime
$T_{1/2}$ = (184 +/- 3) μs
Counts / 100 μs
Time (μs)


184 μs
606
(7,8⁻) 266 ms
53
82
69
(57)
45
(3)
14+
367
12+
318
10+
267
8+
214
6+
159
4+
101
2+
0+
867
842
943