

Th, Ra, Rn, Po, Pb, Bi, & Tl K x-rays

^{227}Ac (21 yr.)
 8/29/2000
 HPGe: 50 mm dia. x 20 mm
 no external absorber
 embedded in 1.6 μm plastic
 20 cm
 A209070001
 low energy portion

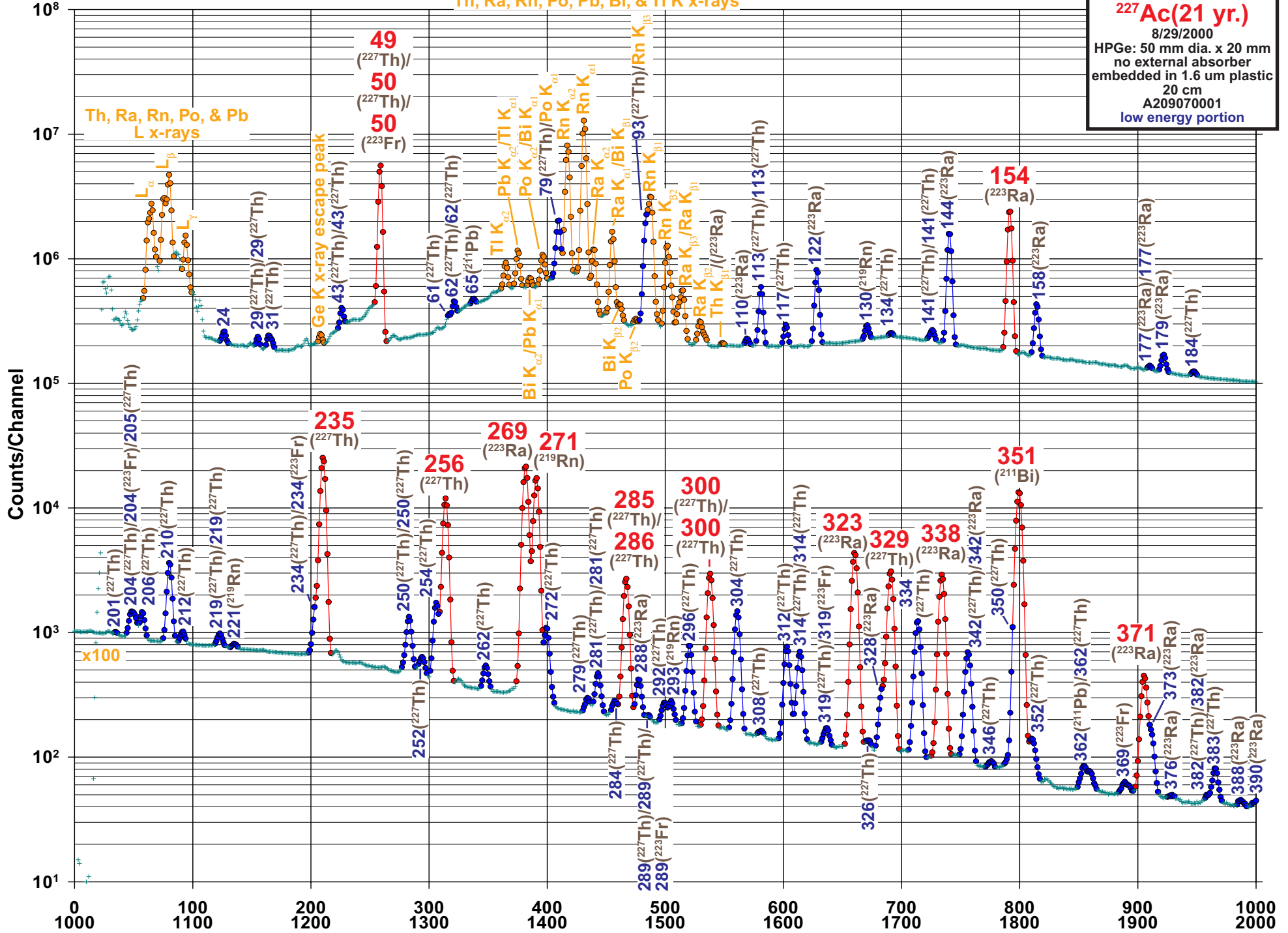
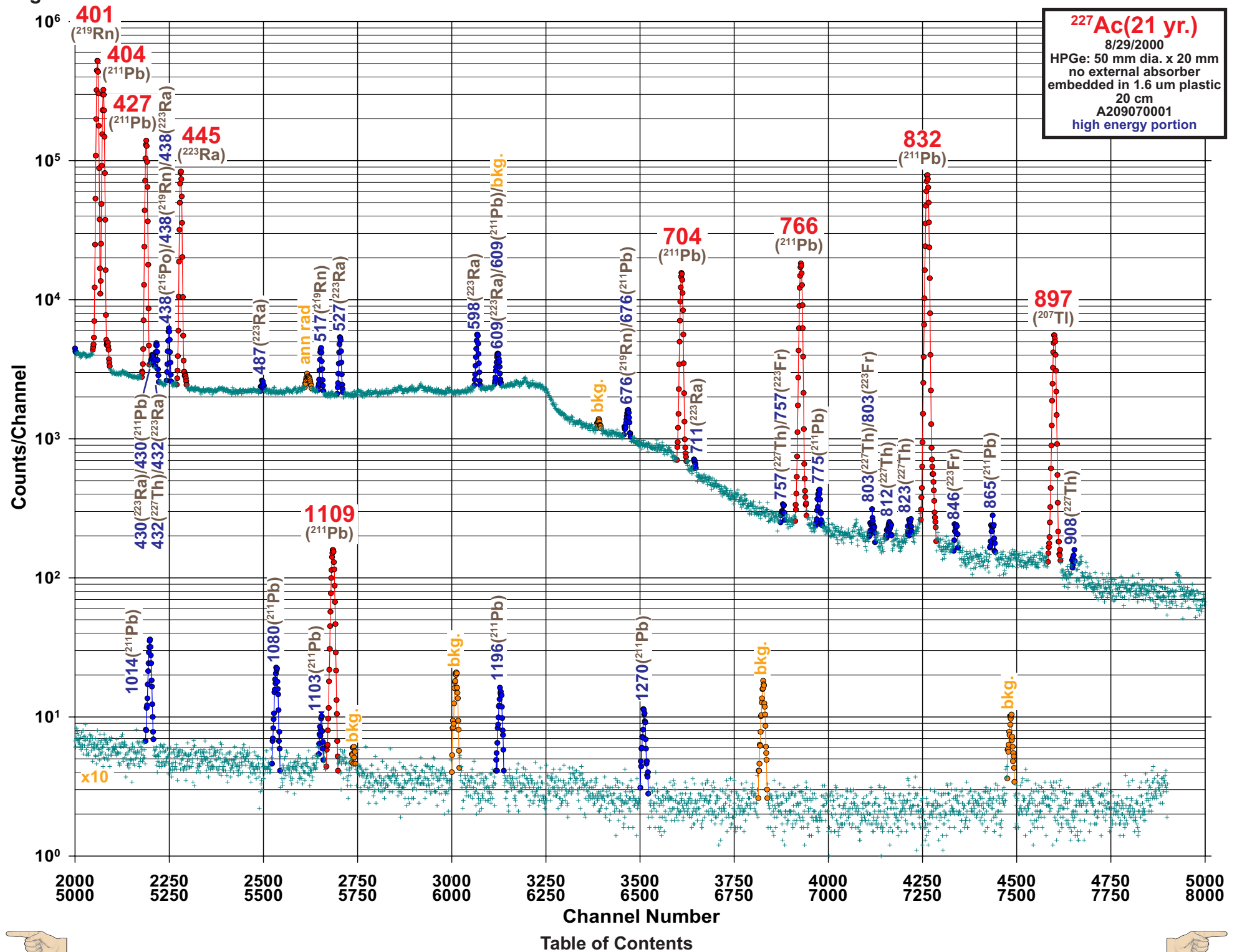


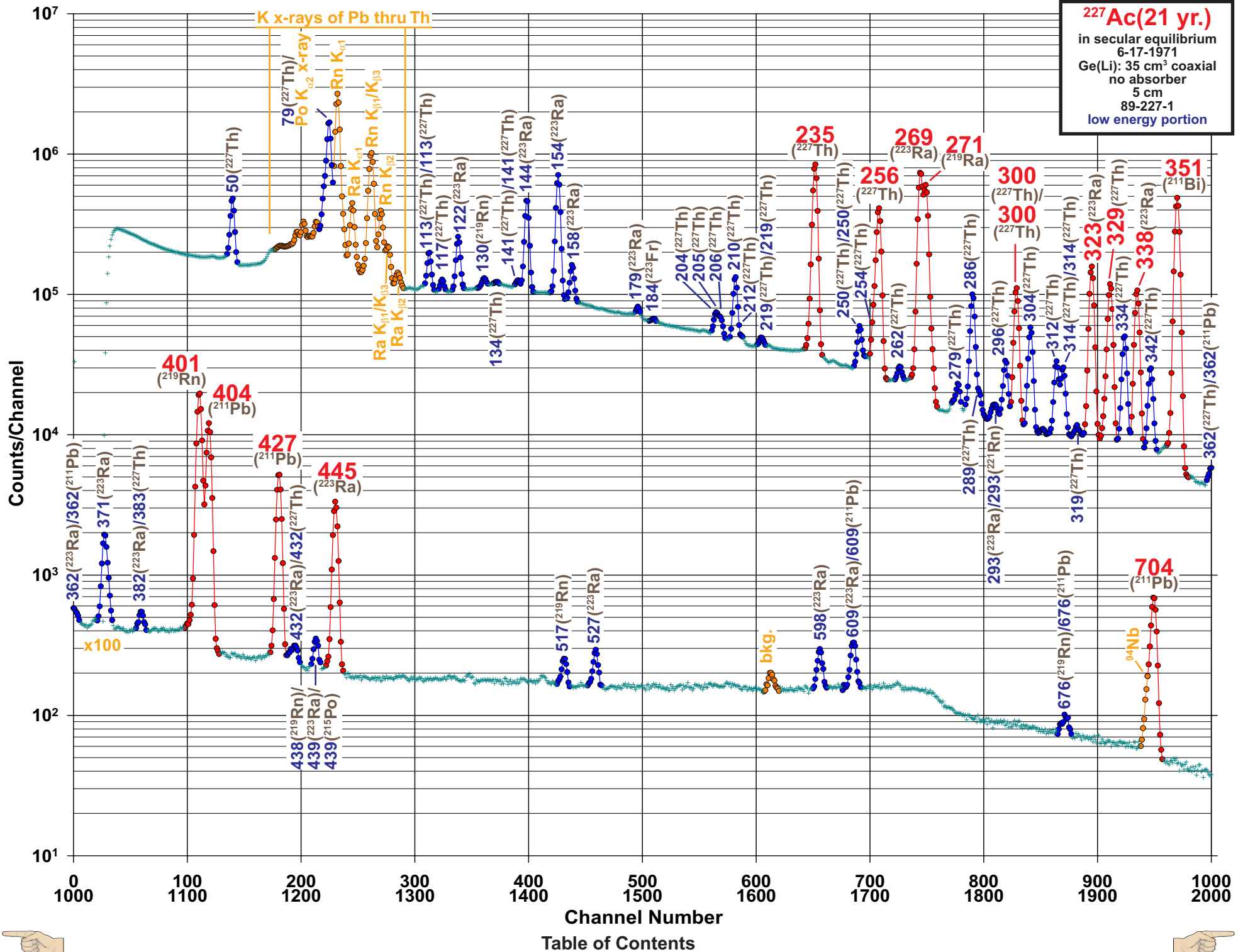
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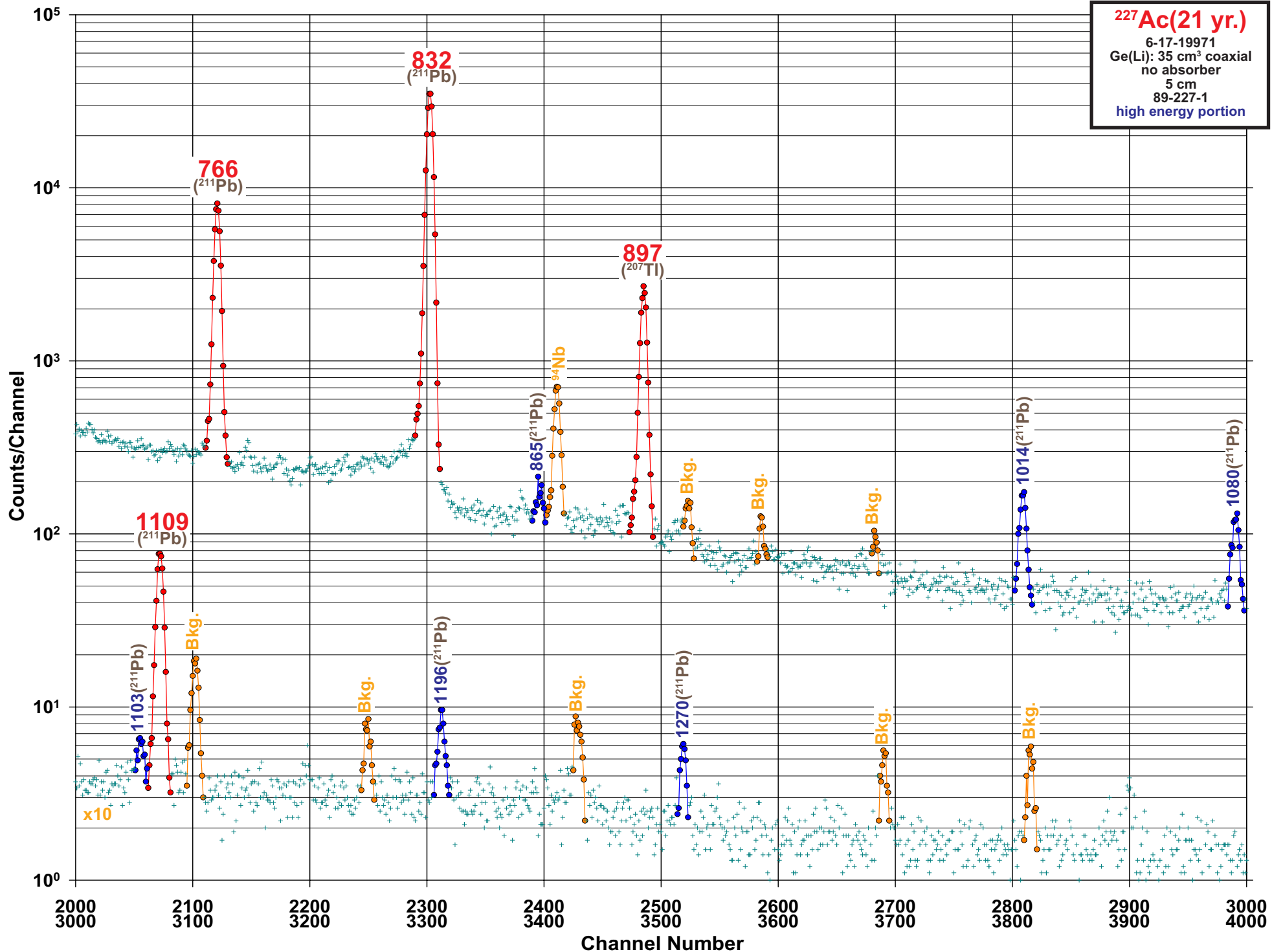




²²⁷Ac(21 yr.)
 8/29/2000
 HPGe: 50 mm dia. x 20 mm
 no external absorber
 embedded in 1.6 um plastic
 20 cm
 A209070001
 high energy portion







^{227}Ac Decay Chain

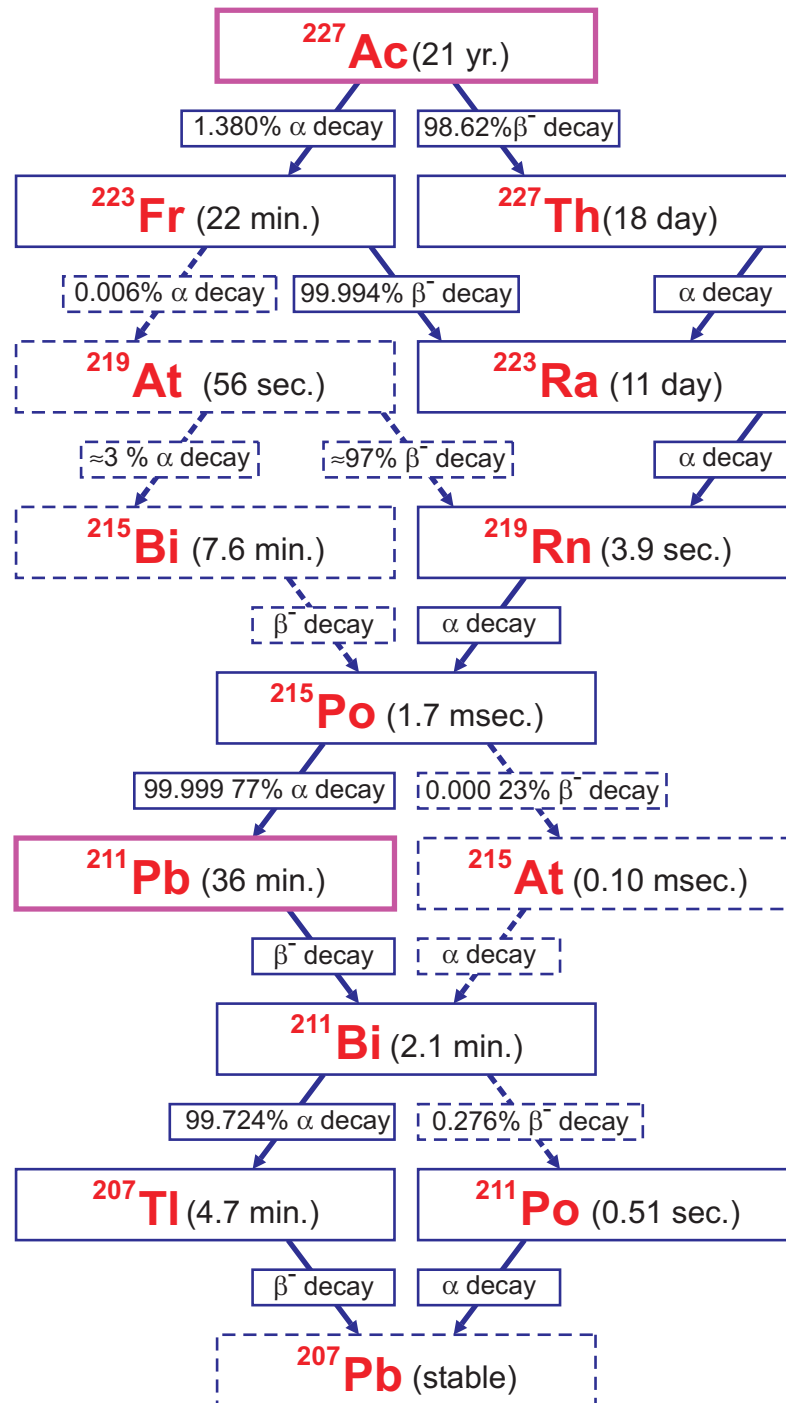


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GAMMA-RAY ENERGIES AND INTENSITIES

Nuclide: **²²⁷Ac**

Half Life: 21.773(3) yr.

E_γ (keV)	σE_γ	$^{\textcircled{1}} I_\gamma$	$^{\textcircled{2}} \sigma I_\gamma$	Level	
9.3	0.1			9.3	β^-
12.7				12.78	α
15.2	0.1			24.5	β^-
24.5	0.2			24.5	β^-
55.03		0.000 98	\approx	55.5	α
69.21	0.04	0.006 6	0.000 6	81.99	α
82	\approx	0.001 26	\approx	81.99	α
100	\approx	0.009 2	\approx	100	α
106.79	0.06	0.001 34	0.000 14	188.78	α
121.53	0.04	0.002 16	0.000 22	134.31	α
134	\approx			134.31	α
147.48	0.04	0.003 1	0.000 3	160.26	α
160.26	0.05	0.005 9	0.000 6	160.26	α
171.90	0.08	0.001 29	0.000 14	171.90	α
241.7	0.2	0.001 65	\approx	241.7	α

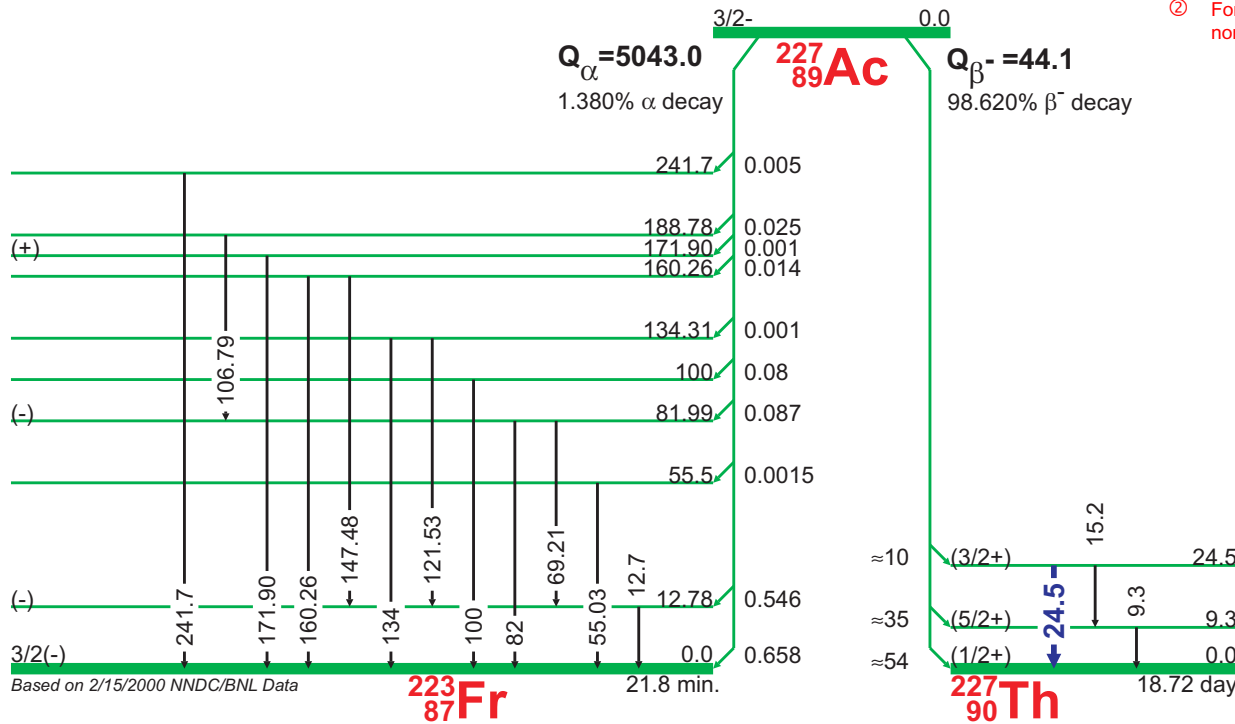
$E_\gamma, \sigma E_\gamma, I_\gamma, \sigma I_\gamma, \text{Levels}$ from ENSDF Database as of August 5, 1999

$\textcircled{1}$ These I_γ are per 100 Decays of ²²⁷Ac

$\textcircled{2}$ For α decay total uncertainty add 28% systematic component in quadrature, using normalization factor 0.00028(8).

²²⁷Ac (21.773 yr.) Decay Scheme

21.773 yr.



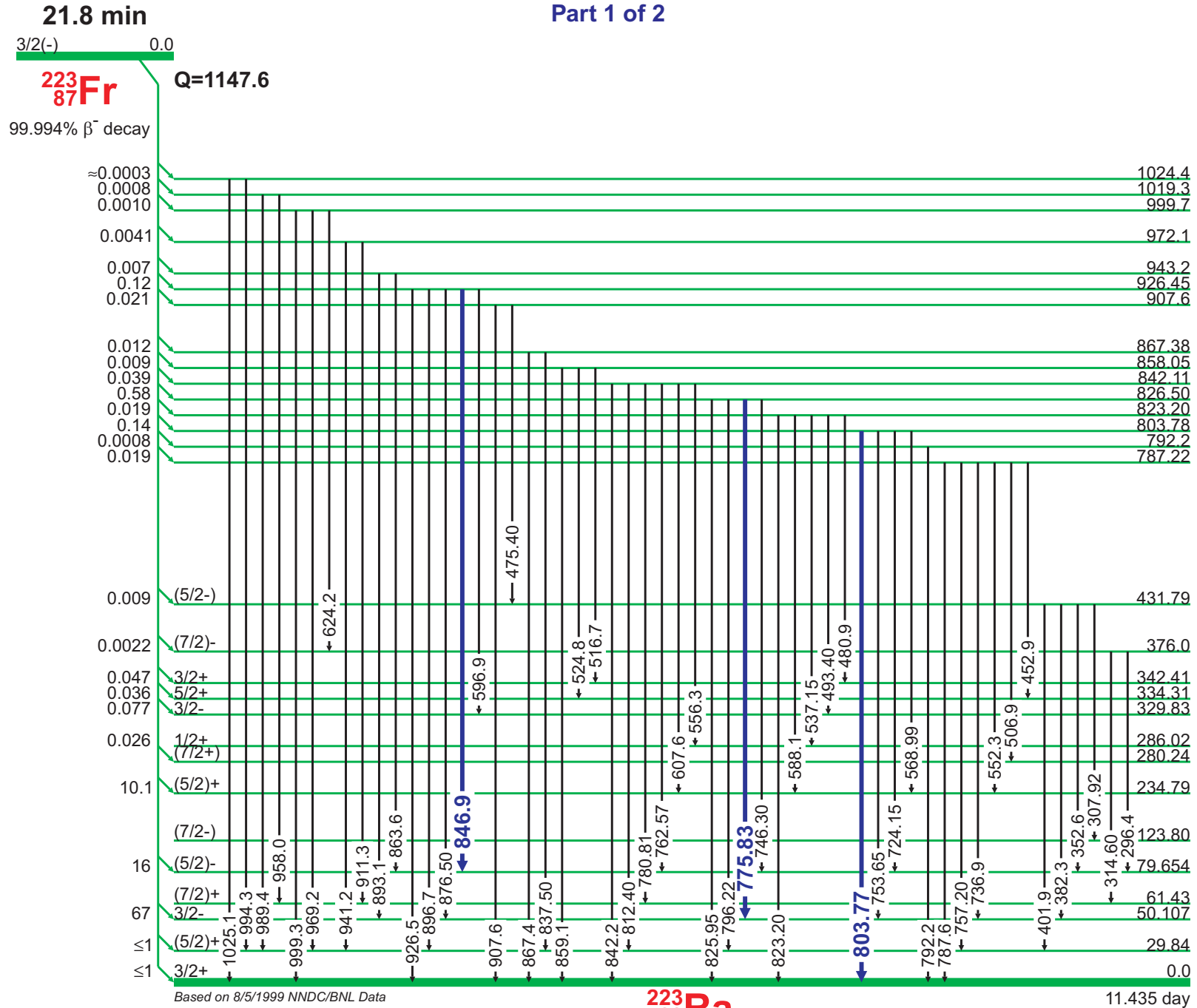
Based on 2/15/2000 NNDC/BNL Data

Based on 8/5/1999 NNDC/BNL Data



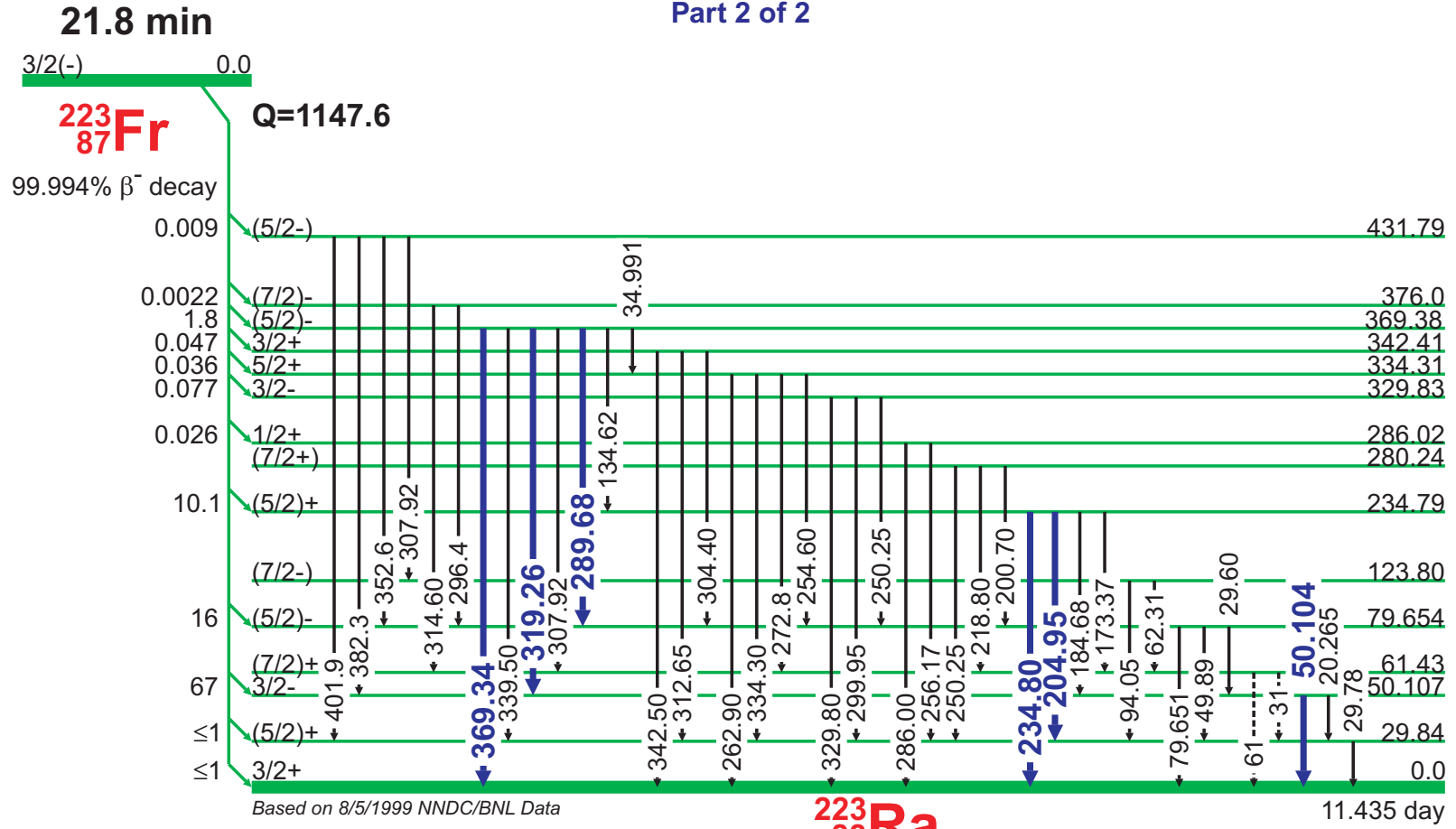
²²³Fr (21.8 min.) Decay Scheme

Part 1 of 2



²²³Fr (21.8 min.) Decay Scheme

Part 2 of 2



GAMMA-RAY ENERGIES AND INTENSITIES (page 1 of 3)

Nuclide: **²²³Fr**E_γ, σE_γ, I_γ, σI_γ, Levels- from ENSDF Database as of August 25, 1999

Half Life: 21.8(4) min.

E _γ (keV)	σ E _γ	① I _γ	② σ I _γ	Level	
15	3				β-
19.102	0.015	0.111	0.018		β-
20.265	0.016	0.8	0.3	50.107	β-
24.136	0.023	0.29	0.04		β-
27.268	0.030	0.066	0.012		β-
29.60	0.03	0.024	≈	79.654	β-
29.78	0.03	0.054	0.012	29.84	β-
31				61.43	β-
34.991	0.055	0.004 5	0.002 1	369.38	β-
37.90	0.02	0.007 5	0.001 8		β-
49.89	0.07	2.7	0.9	79.654	β-
50.104	0.005	36.0	2.1	50.107	β-
57.07	0.06	0.007 2	0.002 1		β-
59.36	0.06	0.006 3	0.002 1		β-
61				61.43	β-
62.31	0.06	0.018	0.006	123.80	β-
65.12	0.06	0.039	0.006		β-
79.651	0.005	9.1	0.4	79.654	β-
94.05	0.05	0.039	0.006	123.80	β-
111.05	0.03	0.005 7	0.000 6		β-
134.62	0.02	0.501	0.015	369.38	β-
144.1	0.1	0.001 68	0.000 21		β-
150.6	0.4	0.002 16	0.000 15		β-
173.37	0.03	0.111 0	0.000 9	234.79	β-
184.68	0.03	0.219 6	0.001 8	234.79	β-
200.70	0.05	0.005 4	0.000 9	280.24	β-
204.95	0.02	0.948	0.012	234.79	β-
210.60	0.05	0.009 3	0.000 3		β-
214.3	0.1	0.001 8	0.000 3		β-
218.80	0.05	0.009 6	0.000 6	280.24	β-
222.9	0.1	0.004 5	0.001 5		β-
234.80	0.01	3.00		234.79	β-
245.60	0.05	0.021 0	0.001 5		β-
250.25	0.06	0.020 4	0.000 9	280.24	β-
250.25	0.06	0.020 4	0.001 2	329.83	β-

E _γ (keV)	σ E _γ	① I _γ	② σ I _γ	Level	
254.60	0.05	0.006 3	0.000 9	334.31	β-
256.17	0.05	0.022 5	0.001 2	286.02	β-
262.90	0.15	0.004 5	0.001 2	342.41	β-
269.6	0.2	0.002 0	0.000 4		β-
272.8	0.1	0.004 5	0.000 9	334.31	β-
286.00	0.05	0.004 5	0.000 9	286.02	β-
289.68	0.05	0.228	0.009	369.38	β-
293.15	0.05	0.003 3	0.000 3		β-
296.4	1.9	0.000 48	0.000 06	376.0	β-
299.95	0.05	0.022 5	0.001 5	329.83	β-
304.40	0.05	0.009 6	0.000 9	334.31	β-
307.92	0.05	0.013 8	0.000 9	369.38	β-
307.92	0.05	0.013 8	0.000 9	431.79	β-
312.65	0.05	0.017 7	0.001 2	342.41	β-
314.60	0.10	0.001 8	0.000 3	376.0	β-
319.26	0.02	0.501	0.015	369.38	β-
329.80	0.05	0.027 0	0.002 1	329.83	β-
334.30	0.06	0.009 9	0.000 9	334.31	β-
339.50	0.06	0.070	0.005	369.38	β-
342.50	0.07	0.013 5	0.001 2	342.41	β-
352.6	0.2	0.000 21	0.000 12	431.79	β-
369.34	0.05	0.103	0.005	369.38	β-
382.3	0.2	0.000 51	0.000 09	431.79	β-
401.9	0.1	0.000 69	0.000 09	431.79	β-
434.4	0.1	0.002 4	0.000 4		β-
439.6	0.3	0.000 33	0.000 15		β-
444.5	0.3	0.000 54	0.000 15		β-
452.9	0.2	0.001 98	0.000 18	787.22	β-
469.33	0.08	0.002 2	0.000 4		β-
475.40	0.07	0.006 3	0.000 3	907.6	β-
480.9	0.1	0.001 35	0.000 18	823.20	β-
493.40	0.15	0.002 7	0.000 3	823.20	β-
506.9	0.1	0.002 4	0.000 9	787.22	β-
516.7	0.1	0.003 6	0.000 6	858.05	β-
524.8	0.1	0.005 1	0.000 9	858.05	β-

① These I_γ are per 100 Decays of ²²³Fr. For ²²⁷Ac parent, multiply these values by 0.0138

② For total uncertainty add systematic component of 20% in quadrature, based on the normalization factor 0.030(6)

GAMMA-RAY ENERGIES AND INTENSITIES (page 2 of 3)

Nuclide: **²²³Fr**E_γ, σE_γ, I_γ, σI_γ, Levels- from ENSDF Database as of August 25, 1999

Half Life: 21.8(4) min.

E _γ (keV)	σ E _γ	① I _γ	② σ I _γ	Level	
533.1	0.1	0.002 1	0.000 3		β-
537.15	0.08	0.005 4	0.000 9	823.20	β-
539.80	0.08	0.006 0	0.000 6		β-
545.4	0.4	0.000 33	0.000 15		β-
552.3	0.1	0.003 3	0.000 3	787.22	β-
556.3	0.2	0.001 56	0.000 18	842.11	β-
568.99	0.07	0.051	0.003	803.78	β-
576.1	0.4	0.001 2	0.000 3		β-
581.3	0.4	0.001 5	0.000 3		β-
588.1	0.2	0.000 75	0.000 18	823.20	β-
592.30	0.15	0.003 0	0.000 6		β-
596.9	0.2	0.000 99	0.000 15	926.45	β-
600.7	0.3	0.000 60	0.000 15		β-
607.6	0.3	0.003 3	0.001 5	842.11	β-
613.6	0.3	0.002 1	0.000 6		β-
624.2	0.3	0.000 51	0.000 12	999.7	β-
632.65	0.15	0.002 1	0.000 5		β-
663.7	0.3	0.001 5	0.000 3		β-
671.9	0.3	0.000 9	0.000 3		β-
682.30	0.25	0.000 54	0.000 09		β-
694.6	0.3	0.000 54	0.000 09		β-
708.3	0.3	0.001 5	0.000 3		β-
722.65	0.05	0.038 7	0.002 7		β-
724.15	0.05	0.016 2	0.000 6	803.78	β-
736.9	0.2	0.000 60	0.000 09	787.22	β-
738.7	0.2	0.000 60	0.000 12		β-
742.37	0.08	0.001 20	0.000 15		β-
746.30	0.05	0.021 9	0.001 8	826.50	β-
753.65	0.05	0.010 5	0.000 6	803.78	β-
753.65	0.05	0.010 5	0.000 6		β-
757.20	0.05	0.008 4	0.000 9	787.22	β-
762.57	0.05	0.002 7	0.000 3	842.11	β-
766.64	0.05	0.023 7	0.001 8		β-
775.83	0.05	0.477	0.024	826.50	β-
780.81	0.06	0.003 0	0.000 3	842.11	β-

E _γ (keV)	σ E _γ	① I _γ	② σ I _γ	Level	
784.93	0.05	0.009 3	0.000 3		β-
787.6	0.1	0.002 7	0.000 3	787.22	β-
792.2	0.1	0.000 75	0.000 15	792.2	β-
796.22	0.05	0.011 4	0.001 5	826.50	β-
803.77	0.05	0.063	0.003	803.78	β-
812.40	0.06	0.022 5	0.000 3	842.11	β-
816.54	0.08	0.001 59	0.000 18		β-
823.20	0.07	0.008 7	0.000 9	823.20	β-
825.95	0.07	0.057	0.003	826.50	β-
833.9	0.1	0.001 41	0.000 15		β-
837.50	0.10	0.010 2	0.001 8	867.38	β-
842.2	0.1	0.005 7	0.000 9	842.11	β-
846.9	0.1	0.057	0.003	926.45	β-
859.1	0.2	0.000 15	0.000 00	858.05	β-
863.6	0.1	0.003 9	0.000 3	943.2	β-
867.4	0.1	0.001 80	0.000 21	867.38	β-
876.50	0.07	0.042	0.003	926.45	β-
893.1	0.2	0.002 7	0.000 6	943.2	β-
896.7	0.2	0.017 1	0.002 4	926.45	β-
907.6	0.2	0.014 7	0.000 9	907.6	β-
911.3	0.2	0.000 81	0.000 18	972.1	β-
913.6	0.3	0.000 45	0.000 06		β-
926.5	0.3	0.001 65	0.000 12	926.45	β-
941.2	0.3	0.003 3	0.000 3	972.1	β-
949.3	0.3	0.000 36	0.000 06		β-
958.0	0.7	0.000 60	0.000 15	1,019.3	β-
969.2	0.4	0.000 24	0.000 12	999.7	β-
975.2	0.5	0.000 18	0.000 03		β-
978.7	0.4	0.000 81	0.000 09		β-
989.4	0.5	0.000 15	0.000 09	1,019.3	β-
994.3	0.3	0.000 12	≈	1,024.4	β-
999.3	0.5	0.000 21	0.000 12	999.7	β-
1,025.1	0.5	0.000 15	≈	1,024.4	β-

① These I_γ are per 100 Decays of ²²³Fr. For ²²⁷Ac parent, multiply these values by 0.0138

② For total uncertainty add systematic component of 20% in quadrature, based on the normalization factor 0.030(6)

227Th (18.72 day) Decay Scheme

Part 1 of 6

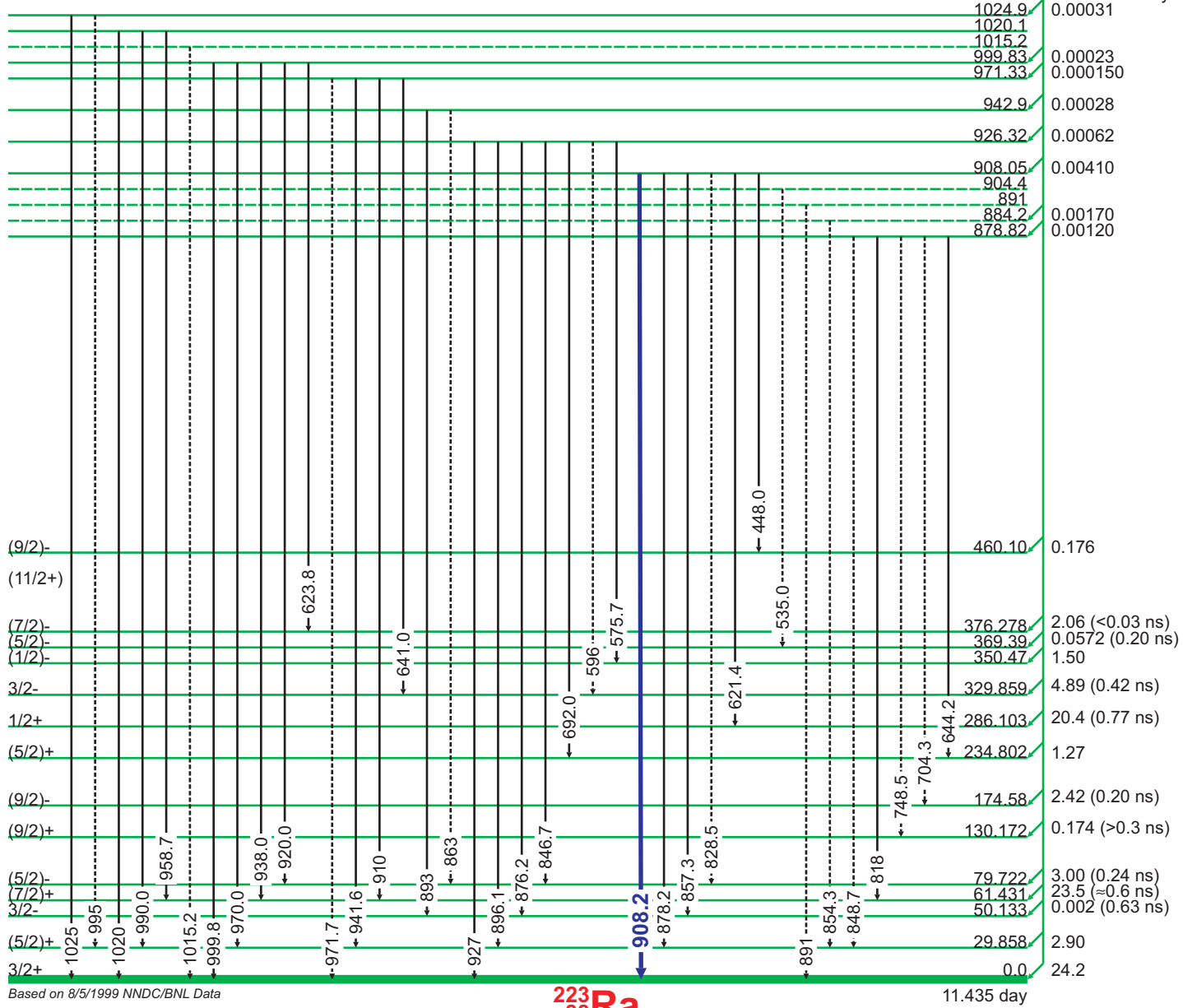
18.72 day

(1/2+) 0.0

$Q_{\alpha} = 6146.49$

227
90Th

100% α decay



Based on 8/5/1999 NNDC/BNL Data

223
88Ra

11.435 day



²²⁷Th (18.72 day) Decay Scheme

Part 2 of 6

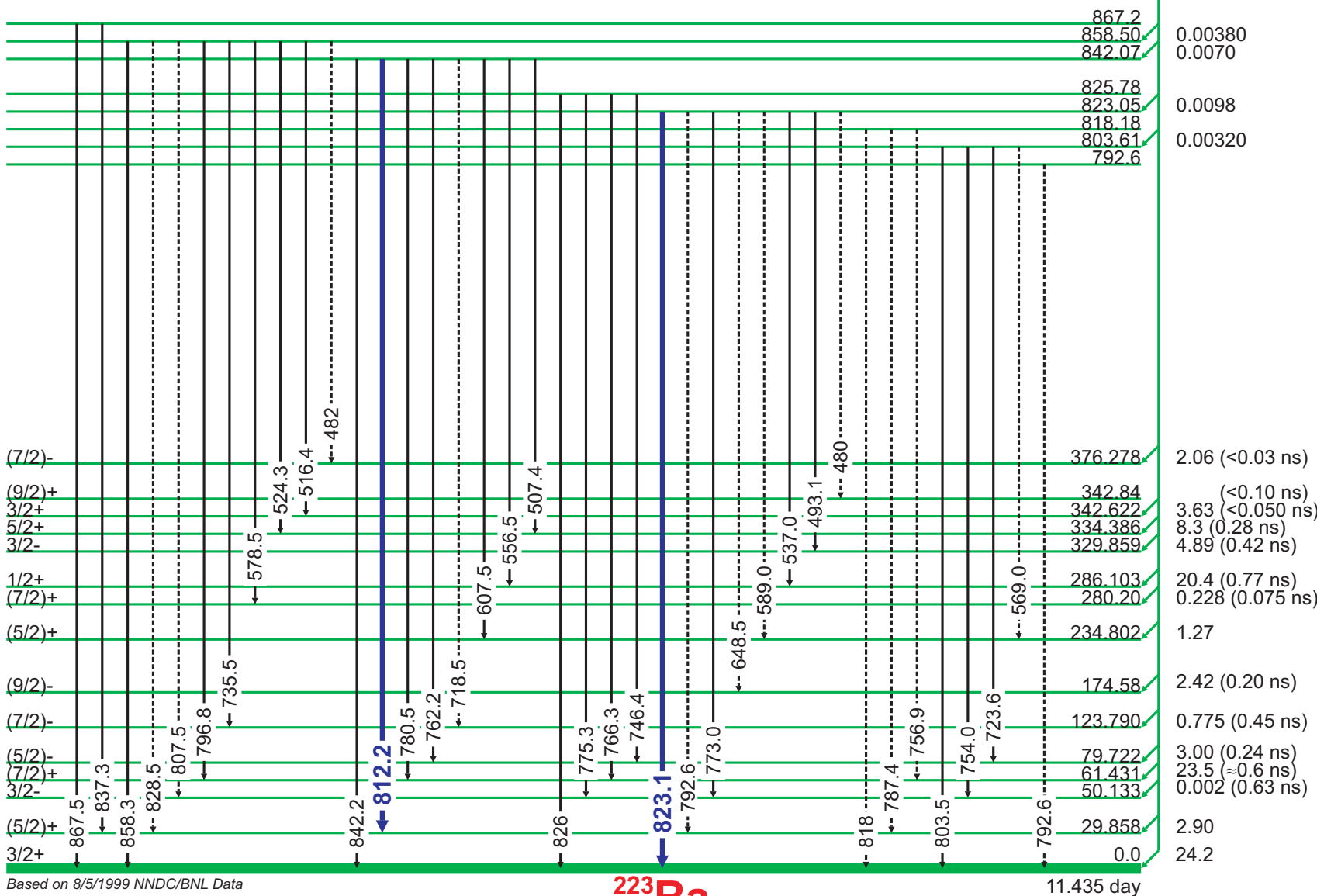
18.72 day

(1/2+) 0.0

²²⁷₉₀Th

100% α decay

Q_α = 6146.49



²²³₈₈Ra

11.435 day

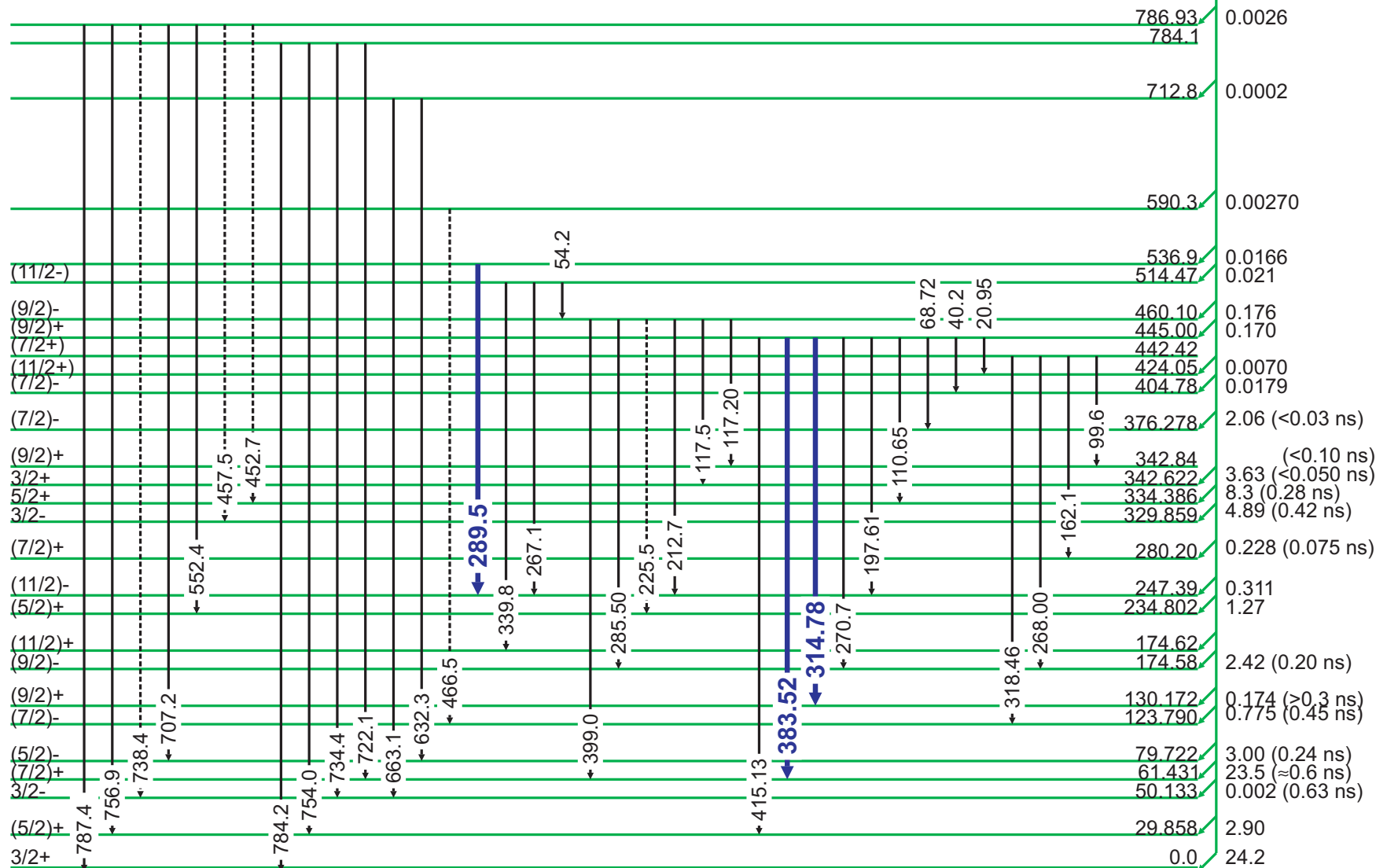


²²⁷Th (18.72 day) Decay Scheme

Part 3 of 6

18.72 day
(1/2+) 0.0

²²⁷Th
100% α decay
 $Q_{\alpha} = 6146.49$



Based on 8/5/1999 NNDC/BNL Data

²²³Ra

11.432 day



²²⁷Th (18.72 day) Decay Scheme

Part 4 of 6

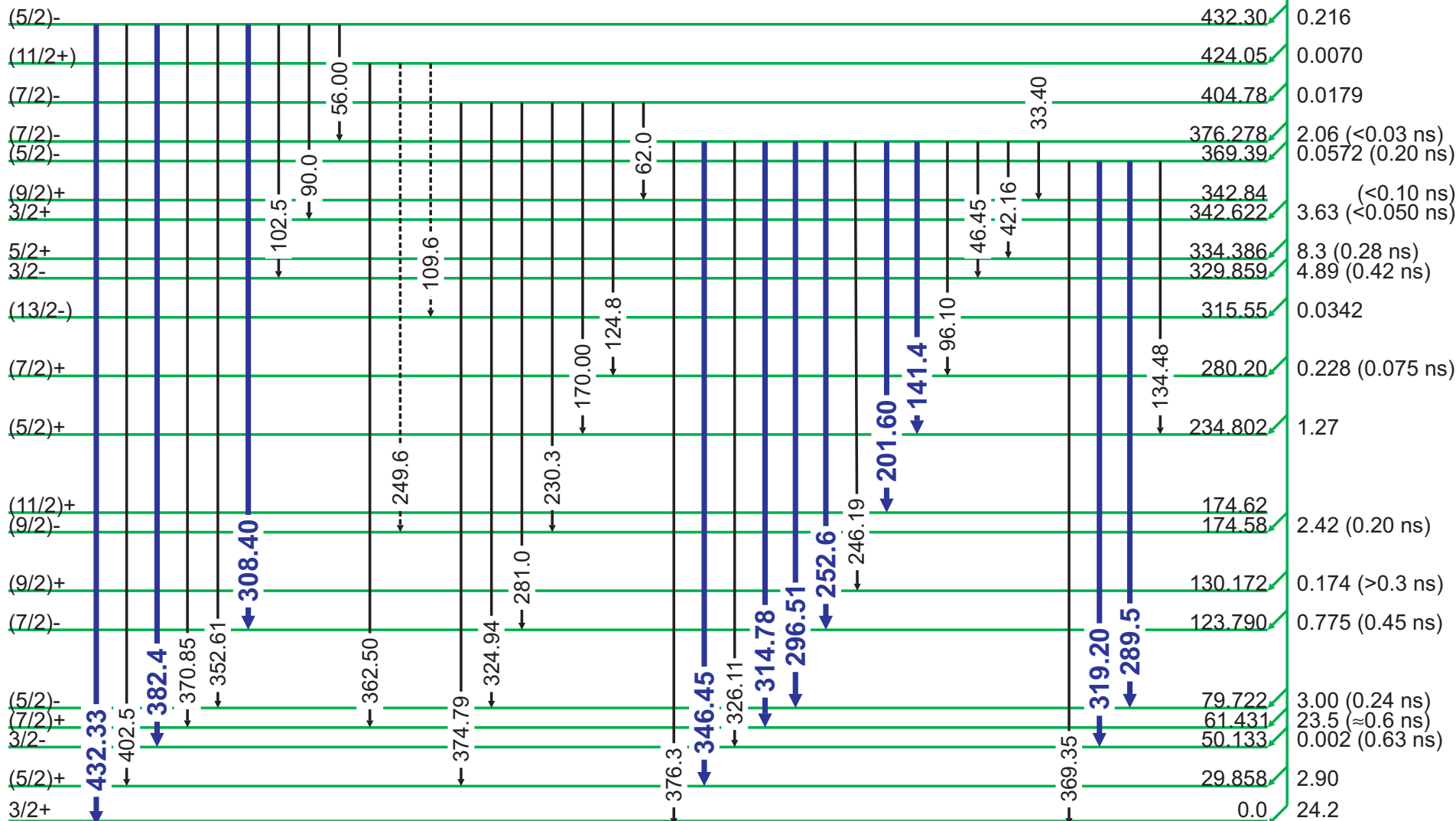
18.72 day

(1/2+) 0.0

²²⁷₉₀Th

100% α decay

$Q_{\alpha} = 6146.49$



Based on 8/5/1999 NNDC/BNL Data

²²³₈₈Ra

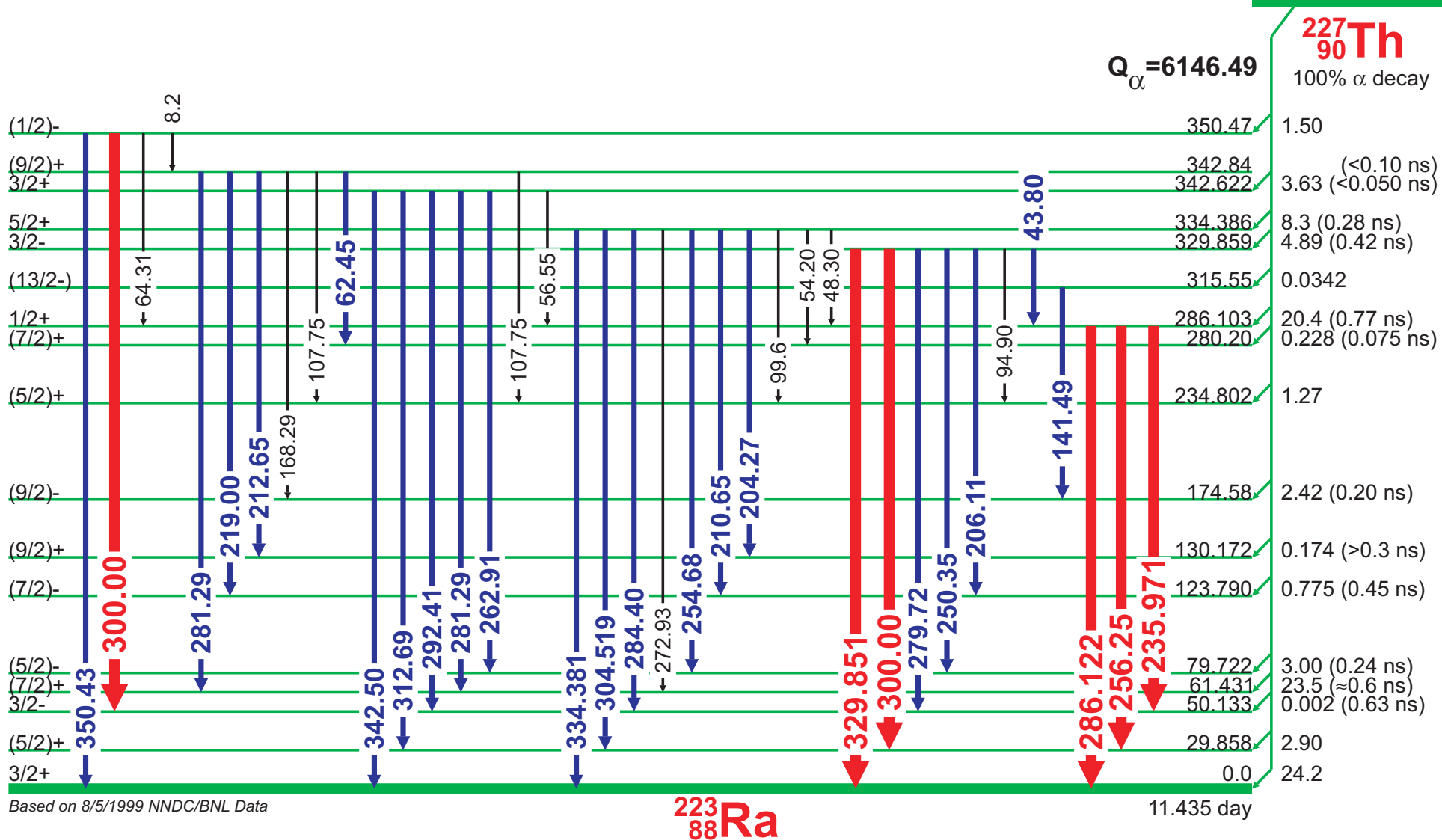
11.435 day



²²⁷Th (18.72 day) Decay Scheme

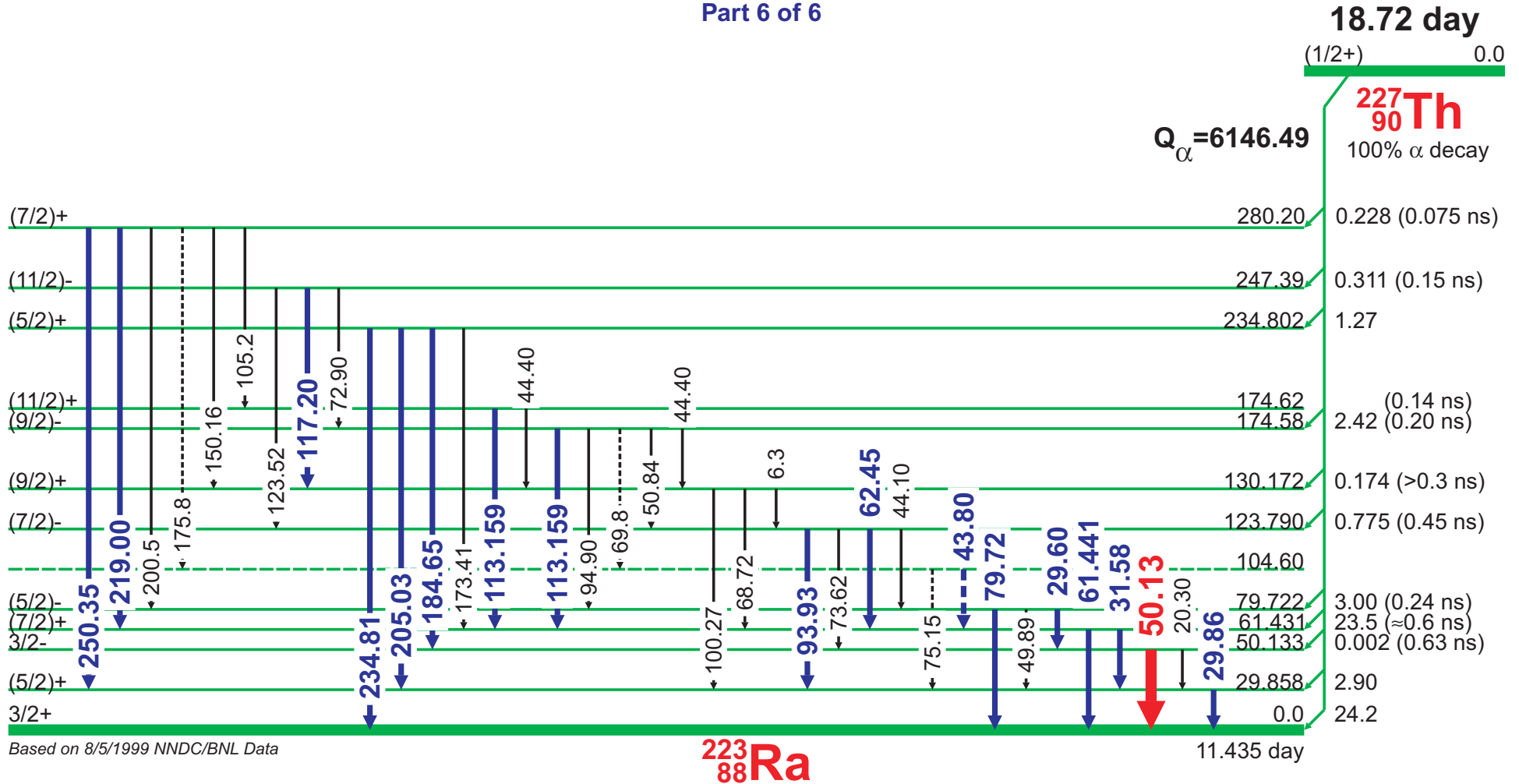
Part 5 of 6

18.72 day
(1/2+) 0.0



²²⁷Th (18.72 day) Decay Scheme

Part 6 of 6



GAMMA-RAY ENERGIES AND INTENSITIES (page 1 of 4)

Nuclide: **²²⁷Th**E_γ, σE_γ, I_γ, σI_γ, Levels- from ENSDF Database as of August 5, 1999

Half Life: 18.72(2) day

E _γ (keV)	σ E _γ	① I _γ	② σ I _γ	Level	α	E _γ (keV)	σ E _γ	① I _γ	② σ I _γ	Level	α
6.3	0.3			130.172	α	68.72	0.09	0.054	0.011	445.00	α
8.2	0.1			350.47	α	69.8	0.5	0.010	0.004	174.58	α
20.30	0.05	0.18	0.06	50.133	α	72.90	0.10	0.027	0.006	247.39	α
20.95	0.05			445.00	α	73.62	0.05	0.018 9	0.002 8	123.790	α
29.60	0.03	0.005	≈	79.722	α	75.15	0.25	0.022	0.006	104.60	α
29.86	0.01	0.095	0.030	29.858	α	79.72	0.01	1.89	0.18	79.722	α
31.58	0.01	0.076	0.018	61.431	α	90.0	0.3			432.30	α
33.40	0.08	0.01	≈	376.278	α	93.93	0.08	1.37	0.11	123.790	α
40.2	0.1	0.02		445.00	α	94.90	0.05	0.011 3	0.001 8	174.58	α
42.16	0.20	0.039	0.015	376.278	α	94.90	0.05			329.859	α
43.80	0.19	0.05	0.01	104.60	α	96.10	0.14	0.066	0.018	376.278	α
43.80	0.05	0.218	0.028	329.859	α	99.6	0.1			334.386	α
44.10	0.05	0.007	0.002	123.790	α	99.6	0.2			442.42	α
44.40	0.05	0.004	0.004	174.58	α	100.27	0.03	0.076	0.015	130.172	α
44.40	0.05	0.012	0.009	174.62	α	102.5	0.1			432.30	α
46.45	0.05			376.278	α	105.2	0.4			280.20	α
48.30	0.03	0.009 5	0.001 0	334.386	α	107.75	0.07	0.008 5	0.002 8	342.622	α
48.5	0.5	0.048	0.012		α	107.75	0.07			342.84	α
49.89	0.07	0.57	0.18	79.722	α	109.6	0.5	0.006	≈	424.05	α
50.13	0.01	8.0	0.4	50.133	α	110.65	0.05			445.00	α
50.84	0.05			174.58	α	112.6	0.5	0.009	≈		α
54.20	0.04			334.386	α	113.159	0.020	0.15		174.62	α
54.2	1.0			514.47	α	113.159	0.020	0.52		174.58	α
56.00	0.06	0.009 5	0.001 8	432.30	α	117.20	0.05			460.10	α
56.55	0.03	0.10	0.05	342.622	α	117.20	0.05	0.170	0.018	247.39	α
59.6	0.5	0.010	0.004		α	117.5	0.5	0.012	0.002	460.10	α
61.441	0.020	0.085	0.018	61.431	α	123.52	0.18	0.010	0.005	247.39	α
62.0	0.5			404.78	α	124.8	0.3	0.002	≈	404.78	α
62.45	0.05	0.191	0.028	123.790	α	134.48	0.15	0.028	0.006	369.39	α
62.45	0.05	0.191	0.028	342.84	α	141.49	0.05	0.12	0.07	315.55	α
64.31	0.10	0.04	0.01	350.47	α	141.49	0.05			376.278	α
66.2	0.5	0.006	0.004		α	150.16	0.17	0.014	0.011	280.20	α
66.4	0.5	0.007	0.004		α	162.1	0.3	0.009	≈	442.42	α
68.72	0.09	0.054	0.011	130.172	α	168.29	0.13	0.014 3	0.002 8	342.84	α

① These I_γ are per 100 Decays of ²²⁷Th. For ²²⁷Ac parent, multiply these values by 0.9862

② For total uncertainty add systematic component of 10.6% in quadrature, based on the normalization factor 0.123(13)

GAMMA-RAY ENERGIES AND INTENSITIES (page 2 of 4)

Nuclide: **²²⁷Th**E_γ, σE_γ, I_γ, σI_γ, Levels- from ENSDF Database as of August 5, 1999

Half Life: 18.72(2) day

E _γ (keV)	σ E _γ	① I _γ	② σ I _γ	Level	α	E _γ (keV)	σ E _γ	① I _γ	② σ I _γ	Level	α
170.00	0.10	0.004	≈	404.78	α	281.29	0.14	0.16	0.04	342.622	α
173.41	0.09	0.015	0.004	234.802	α	281.29	0.14			342.84	α
175.8	0.3	0.020	0.025	280.20	α	284.40	0.20	0.02	0.01	334.386	α
184.65	0.05	0.038	0.006	234.802	α	285.50	0.09	0.048	0.010	460.10	α
197.61	0.10	0.014	0.004	445.00	α	286.122	0.020	1.54	0.12	286.103	α
200.5	0.2			280.20	α	289.5	0.3			369.39	α
201.60	0.09	0.031	0.007	376.278	α	289.5	0.3			536.9	α
202.5	0.5	0.006	0.002		α	292.41	0.09	0.066	0.018	342.622	α
204.27	0.17	0.20	0.05	334.386	α	296.51	0.05	0.46	0.06	376.278	α
205.03	0.09	0.15	0.04	234.802	α	300.00	0.03	0.34	0.05	350.47	α
206.11	0.05	0.21	0.06	329.859	α	300.00	0.03	2.32	0.17	329.859	α
210.65	0.05	1.11	0.21	334.386	α	304.519	0.020	1.2	0.4	334.386	α
212.65	0.04	0.06	0.04	342.84	α	308.40	0.09	0.014	0.004	432.30	α
212.7	0.3	0.018	0.006	460.10	α	312.69	0.09	0.48	0.07	342.622	α
219.00	0.13	0.103	0.010	280.20	α	314.78	0.09			376.278	α
219.00	0.13	0.103	0.010	342.84	α	314.78	0.09	0.44	0.06	445.00	α
225.5	1.0	0.004	≈	460.10	α	318.46	0.19	0.006	0.002	442.42	α
230.3	0.3			404.78	α	319.20	0.14	0.032	0.004	369.39	α
234.81	0.09	0.41	0.15	234.802	α	324.94	0.19	0.005	≈	404.78	α
235.971	0.020	12.3	0.9	286.103	α	326.11	0.10	0.02	≈	376.278	α
246.19	0.20	0.010	0.004	376.278	α	329.851	0.020	2.69	0.27	329.859	α
249.6	0.5	0.007	≈	424.05	α	334.381	0.020	1.05	0.10	334.386	α
250.35	0.05	0.09	0.02	280.20	α	339.8	1.0			514.47	α
250.35	0.05	0.34	0.05	329.859	α	342.50	0.09	0.39	0.09	342.622	α
252.6	0.3	0.096	0.028	376.278	α	346.45	0.10	0.010	0.004	376.278	α
254.68	0.09	0.7	0.5	334.386	α	348.5	0.5	0.006	0.002		α
256.25	0.02	7.0	0.4	286.103	α	350.43	0.09	0.113	0.018	350.47	α
262.91	0.09	0.095	0.010	342.622	α	352.61	0.09	0.012	0.004	432.30	α
267.1	0.2			514.47	α	362.50	0.14	0.004 7	0.001 0	424.05	α
268.00	0.19	0.005 7	0.001 8	442.42	α	369.35	0.05	0.006	≈	369.39	α
270.7	0.5	0.04	0.01	445.00	α	370.85	0.05			432.30	α
272.93	0.09	0.48	0.07	334.386	α	374.79	0.20	0.001 4	0.000 5	404.78	α
279.72	0.09	0.06	0.04	329.859	α	376.3	0.1			376.278	α
281.0	0.2			404.78	α	382.4	0.4	0.006	≈	432.30	α

① These I_γ are per 100 Decays of ²²⁷Th. For ²²⁷Ac parent, multiply these values by 0.9862

② For total uncertainty add systematic component of 10.6% in quadrature, based on the normalization factor 0.123(13)

GAMMA-RAY ENERGIES AND INTENSITIES (page 3 of 4)

Nuclide: **²²⁷Th**E_γ, σE_γ, I_γ, σI_γ, Levels- from ENSDF Database as of August 5, 1999

Half Life: 18.72(2) day

E _γ (keV)	σ E _γ	① I _γ	② σ I _γ	Level		E _γ (keV)	σ E _γ	① I _γ	② σ I _γ	Level	
383.52	0.09	0.047	0.010	445.00	α	704.3	0.5	0.000 076	0.000 018	878.82	α
392.4	0.5	0.010	0.002		α	707.2	0.7	0.000 038	0.000 010	786.93	α
399.0	0.4	0.002	≈	460.10	α	718.5	1.0	0.000 028	0.000 010	842.07	α
402.5	0.1			432.30	α	722.1	0.6	0.000 36	0.000 11	784.1	α
415.13	0.17	0.001 6	0.000 4	445.00	α	723.6	0.6	0.000 26	0.000 10	803.61	α
432.33	0.09	0.004 7	0.001 0	432.30	α	734.4	0.5	0.000 10	0.000 04	784.1	α
448.0	0.6	0.000 15	0.000 07	908.05	α	735.5	0.5	0.000 15	0.000 05	858.50	α
452.7	0.6	0.000 10	≈	786.93	α	738.4	1.0	0.000 066	0.000 018	786.93	α
457.5	1.0	0.000 06	≈	786.93	α	746.4	0.7	0.000 10	0.000 04	825.78	α
466.5	1.0	0.000 047	0.000 023	590.3	α	748.5	0.5	0.000 28	0.000 06	878.82	α
480	1	0.000 28	0.000 10	823.05	α	754.0	0.6	0.000 095	0.000 028	784.1	α
482	1	0.000 14	0.000 04	858.50	α	754.0	0.6	0.000 095	0.000 028	803.61	α
493.1	0.2	0.000 52	0.000 07	823.05	α	756.9	0.2	0.000 18	0.000 05	818.18	α
507.4	0.3	0.000 38	0.000 07	842.07	α	756.9	0.2	0.000 7	≈	786.93	α
516.4	0.3	0.000 17	0.000 04	858.50	α	762.2	0.5	0.000 25	0.000 05	842.07	α
524.3	0.4	0.000 141	0.000 028	858.50	α	766.3	0.5	0.000 28	0.000 06	825.78	α
535.0	1.2	0.000 095	0.000 028	904.4	α	773.0	0.8	0.000 12	0.000 05	823.05	α
537.0	0.3	0.001 05	0.000 18	823.05	α	775.3	0.2	0.001 41	0.000 18	825.78	α
552.4	0.5	0.000 28	0.000 06	786.93	α	780.5	0.3	0.000 31	0.000 06	842.07	α
556.5	0.5	0.000 21	0.000 04	842.07	α	784.2	0.5	0.000 095	0.000 028	784.1	α
569.0	0.3	0.000 57	0.000 10	803.61	α	787.4	0.5	0.000 095	0.000 018	786.93	α
575.7	0.7	0.000 123	0.000 028	926.32	α	787.4	0.5	0.000 095	0.000 018	818.18	α
578.5	0.7	0.000 123	0.000 028	858.50	α	792.6	0.6	0.000 066	0.000 010	792.6	α
589.0	0.6	0.000 057	0.000 018	823.05	α	792.6	0.6	0.000 066	0.000 010	823.05	α
596	1	0.000 010	0.000 005	926.32	α	796.8	0.2	0.000 76	0.000 10	858.50	α
607.5	0.4	0.000 17	0.000 04	842.07	α	803.5	0.2	0.000 92	0.000 10	803.61	α
621.4	0.5	0.000 057	0.000 018	908.05	α	807.5	1.0	0.000 047	0.000 023	858.50	α
623.8	0.5	0.000 15	0.000 04	999.83	α	812.2	0.2	0.002 56	0.000 28	842.07	α
632.3	0.7	0.000 14	0.000 04	712.8	α	818	1	0.000 123	0.000 028	818.18	α
641.0	0.5	0.000 018	0.000 006	971.33	α	818	1	0.000 123	0.000 028	878.82	α
644.2	0.5	0.000 047	0.000 018	878.82	α	823.1	0.2	0.002 36	0.000 28	823.05	α
648.5	0.5	0.000 018	0.000 006	823.05	α	826	1	0.000 18	0.000 06	825.78	α
663.1	0.5	0.000 057	0.000 018	712.8	α	828.5	0.5	0.000 18	0.000 05	858.50	α
692.0	0.7	0.000 038	0.000 010	926.32	α	828.5	0.5	0.000 18	0.000 05	908.05	α

① These I_γ are per 100 Decays of ²²⁷Th. For ²²⁷Ac parent, multiply these values by 0.9862

② For total uncertainty add systematic component of 10.6% in quadrature, based on the normalization factor 0.123(13)



GAMMA-RAY ENERGIES AND INTENSITIES (page 4 of 4)

Nuclide: **²²⁷Th**E_γ, σE_γ, I_γ, σI_γ, Levels- from ENSDF Database as of August 5, 1999

Half Life: 18.72(2) day

E _γ (keV)	σ E _γ	① I _γ	② σ I _γ	Level	
837.3	0.3	0.000 38	0.000 04	867.2	α
842.2	0.3	0.000 57	0.000 06	842.07	α
846.7	0.5	0.000 141	0.000 028	926.32	α
848.7	0.5	0.000 057	0.000 018	878.82	α
854.3	0.5	0.000 066	0.000 014	884.2	α
857.3	0.5	0.000 057	0.000 018	908.05	α
858.3	0.3	0.002 2	0.000 4	858.50	α
863	1	0.000 018	0.000 010	942.9	α
867.5	0.5	0.000 066	0.000 014	867.2	α
876.2	0.4	0.000 15	0.000 05	926.32	α
878.2	0.4	0.000 11	0.000 04	908.05	α
891	1	0.000 018	0.000 006	891	α
893	1	0.000 012	0.000 004	942.9	α
896.1	0.5	0.000 105	0.000 028	926.32	α
908.2	0.2	0.001 98	0.000 28	908.05	α

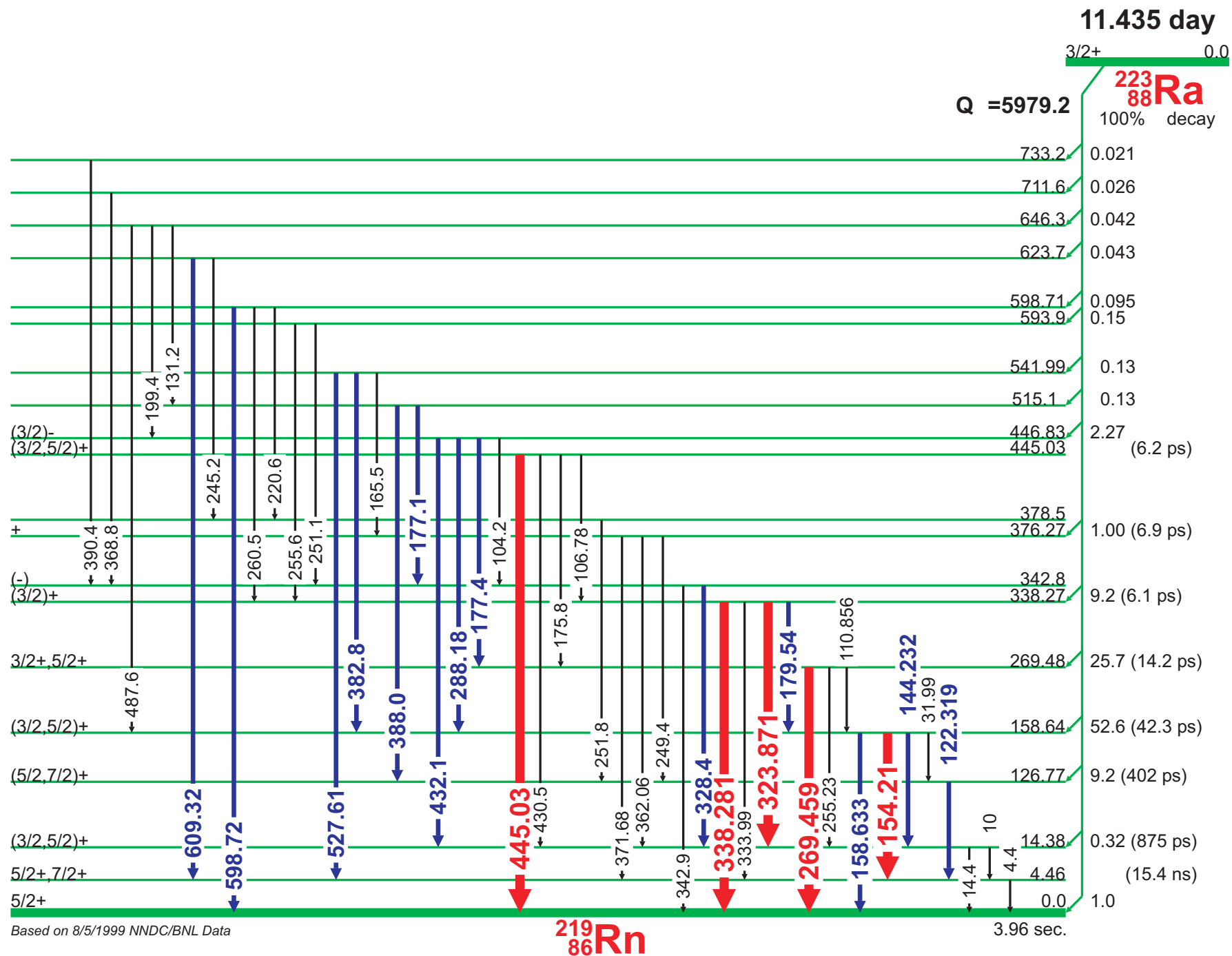
E _γ (keV)	σ E _γ	① I _γ	② σ I _γ	Level	
910	1	0.000 015	0.000 006	971.33	α
920.0	0.5	0.000 011	0.000 028	999.83	α
927	1	0.000 007	0.000 018	926.32	α
938.0	0.8	0.000 010	0.000 004	999.83	α
941.6	0.3	0.000 068	0.000 011	971.33	α
958.7	0.3	0.000 059	0.000 011	1,020.1	α
970.0	0.4	0.000 028	0.000 006	999.83	α
971.7	1.0	0.000 009	0.000 004	971.33	α
990.0	0.7	0.000 033	0.000 009	1,020.1	α
995	1	0.000 006	0.000 004	1,024.9	α
999.8	0.5	0.000 028	0.000 010	999.83	α
1,015.2	0.7	0.000 015	0.000 004	1,015.2	α
1,020	1	0.000 018	0.000 006	1,020.1	α
1,025	1	0.000 015	0.000 005	1,024.9	α

① These I_γ are per 100 Decays of ²²⁷Th. For ²²⁷Ac parent, multiply these values by 0.9862

② For total uncertainty add systematic component of 10.6% in quadrature, based on the normalization factor 0.123(13)



²²³Ra (11 day) Decay Scheme



²¹⁹₈₆Rn

3.96 sec.



GAMMA-RAY ENERGIES AND INTENSITIES

Nuclide: **²²³Ra**E_γ, σE_γ, I_γ, σI_γ, Levels- from ENSDF Database as of August 5, 1999

Half Life: 11.435(4) day

E _γ (keV)	σ E _γ	① I _γ	② σ I _γ	Level	
4.4	1.0			4.46	α
10	1	0.014	0.001	14.38	α
14.4	1.0	0.016	0.001	14.38	α
31.99	0.03	0.000 10	≈	158.64	α
33.6	0.5	0.10	0.03		α
63.2	0.5	0.055	0.015		α
104.2	0.1	0.019	0.003	446.83	α
106.78	0.03	0.023	0.001	445.03	α
110.856	0.010	0.058	0.004	269.48	α
114.5	0.5	0.009	0.005		α
122.319	0.010	1.19	0.01	126.77	α
131.2	0.5	0.005	0.003	646.3	α
136.1	0.2	0.027	0.003		α
143.1	0.8				α
144.232	0.010	3.22	0.07	158.64	α
154.21	0.01	5.6	0.1	158.64	α
158.633	0.010	0.69	0.01	158.64	α
165.5	0.5	0.005	0.003	541.99	α
175.8	0.2	0.019	0.004	445.03	α
177.1	0.5	0.004	0.003	515.1	α
177.4	0.2	0.047	0.004	446.83	α
179.54	0.05	0.15	0.01	338.27	α
193.0	1.0	0.010	≈		α
199.4	0.5	0.003	0.001	646.3	α
219.0	0.8	0.014	0.005		α
220.6	0.3	0.036	0.005	598.71	α
236.0	0.6	0.010	≈		α
245.2	0.3	0.010	0.003	623.70	α
249.4	0.3	0.038	0.010	376.27	α
251.1	0.3	0.04	0.01	593.9	α
251.8	0.1	0.067	0.008	378.5	α
255.23	0.15	0.052	0.007	269.48	α
255.6	0.5	0.005	0.003	593.9	α
260.5	0.5	0.007	0.003	598.71	α

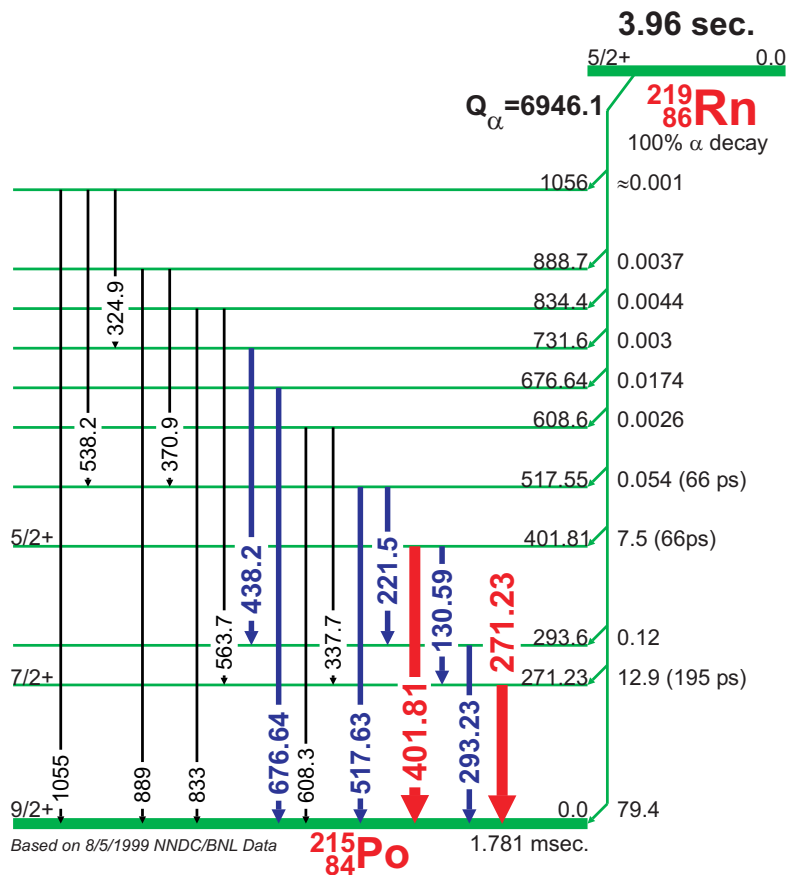
E _γ (keV)	σ E _γ	① I _γ	② σ I _γ	Level	
269.459	0.010	13.7	0.3	269.48	α
288.18	0.03	0.158	0.004	446.83	α
293.8	0.2	0.066			α
323.871	0.010	3.93	0.07	338.27	α
328.40	0.03	0.206	0.007	342.80	α
333.99	0.05	0.100	0.005	338.27	α
338.281	0.010	2.79	0.05	338.27	α
342.90	0.04	0.22	0.01	342.80	α
346.8	0.3	0.18	≈		α
362.06	0.02	0.045	0.003	376.27	α
368.8	0.2	0.008	0.004	711.6	α
369.5		0.021	≈		α
371.68	0.02	0.48	0.01	376.27	α
373.3		0.049	≈		α
376.0	0.3	0.012 1	0.004 0		α
382.8	0.3	0.014	0.004	541.99	α
388.0	0.5	0.015	0.005	515.1	α
390.4	0.5	0.007	0.003	733.2	α
393.5	0.5	0.011 1	0.004 0		α
430.5	0.5	0.019	0.005	445.03	α
432.1	0.1	0.034	0.003	446.83	α
439.3		0.081	0.014		α
445.03	0.01	1.27	0.04	445.03	α
465.2	0.1	0.004 0	0.001 0		α
481.6	0.5	0.021	0.005		α
487.6	0.3	0.011	0.001	646.3	α
527.61	0.01	0.070	0.004	541.99	α
580.4					α
598.72	0.02	0.093	0.004	598.71	α
609.32	0.04	0.056	0.003	623.70	α
623.4		0.008	0.004		α
632.0	1.0	0.030	0.010		α
711.2	0.7	0.003 6	0.001 0		α

① These I_γ are per 100 Decays of ²²³Ra.

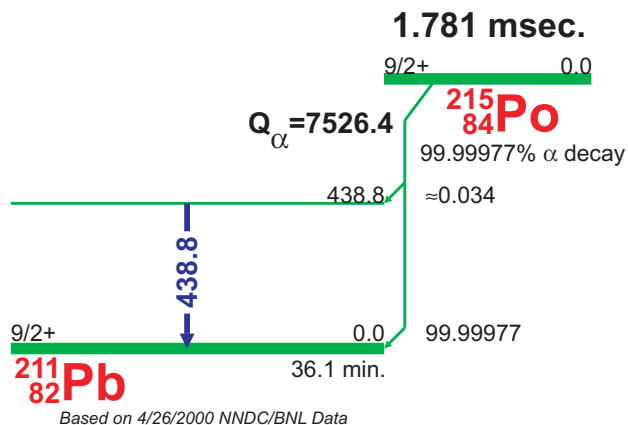
② For total uncertainty add systematic component of 1.45% in quadrature, based on the normalization factor 0.137(2)



²¹⁹Rn (3.96 sec.) Decay Scheme



²¹⁵Po (1.781 msec.) Decay Scheme



GAMMA-RAY ENERGIES AND INTENSITIES

Nuclide: **²¹⁹Rn**

Half Life: 3.96(1) sec.

E_{γ} (keV)	σE_{γ}	I_{γ}	σI_{γ}	Level	
130.59	0.03	0.12	0.01	401.81	α
221.5	0.3	0.030	0.004	517.55	α
271.23	0.01	10.8	0.3	271.23	α
293.54	0.04	0.073	0.004	293.60	α
324.9	1.0	0.006	<	1,056	α
337.7	1.0	0.009	0.002	608.6	α
370.9	1.5	0.01	<	888.7	α
380		0.000 03	\approx		α
401.81	0.01	6.4	0.2	401.81	α
438.2	0.6	0.030	<	731.6	α
517.63	0.06	0.044	0.002	517.55	α
538.2	1.5	0.006	0.003	1,056	α
563.7	1.5	0.003 2	<	834.4	α
608.3	1.0	0.004	0.002	608.6	α
676.64	0.07	0.021	0.002	676.64	α
833	\approx	0.001	\approx	834.4	α
889.0	1.5	0.001 6	0.000 8	888.7	α
1,055	2	0.000 6	0.000 3	1,056	α

E_{γ} σE_{γ} I_{γ} σI_{γ} Levels from ENSDF Database as of August 5, 1999

① These I_{γ} are per 100 Decays of ²¹⁹Rn.

② For total uncertainty add 5.5% systematic component in quadrature, based on the normalization factor 0.108 (6).

GAMMA-RAY ENERGIES AND INTENSITIES

Nuclide: **²¹⁵Po**

Half Life: 1.781(4) msec.

E_{γ} (keV)	σE_{γ}	I_{γ}	σI_{γ}	Level	
438.8	0.3	0.04	\approx	438.8	α

E_{γ} σE_{γ} I_{γ} σI_{γ} Levels from ENSDF Database as of April 26, 2000

① These I_{γ} are per 100 Decays of ²¹⁵Po.

② For total uncertainty add 2×10^{-5} % systematic component in quadrature, based on the normalization factor 0.99999774 (20)

