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COMPILATION OF EXPERIMENTAL E_α VALUES IN THE REGION ABOVE Z=81 AND BELOW N=128

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August 1967

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Submitted to 3rd International Conference
on Atomic Masses

UCRL-17723
Preprint

UNIVERSITY OF CALIFORNIA

Lawrence Radiation Laboratory
Berkeley, California

AEC Contract No. W-7405-eng-48

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Experimental data concerning nuclides above thallium and below 128 neutron number published before 1964 have been compiled and discussed in a book by Hyde et al(27). The new Table of Isotopes by Lederer et al(32)covers the literature up to January 1966. However, since that time the number of known alpha activities in this region has increased by more than 50 and more accurate information has been collected on many others. It was felt that a summary of the recent results would be useful for several purposes.

Table I is intended to contain all known alpha-active isotopes of thorium, actinium, radium, francium, radon, bismuth (with the exception of ^{210}Bi), and lead containing less than 128 neutrons. Astatine isotopes lighter than ^{206}At (N=121), polonium isotopes lighter than ^{204}Po (N=120), and some recent results on ^{208}At and ^{209}At are also listed. For ^{206}At through ^{212}At, ^{204}Po through ^{211}Po, and ^{210}Bi see the Table of Isotopes (32). The compilation by Eskola (17) is also useful.

Because of the limited space only alpha-particle energies (E_α), alpha-decay energies (Q_α), alpha branches, half lives ($T_{1/2}$), and references are listed in Table I. The values are those given by the original authors. Because different alpha-energy standards have been used, small corrections are necessary to accurately compare the energies. In general, values published before 1961 are a few keV lower than those based on the present standards. The alpha branch is given in percentage where it is known; in general, the rest of the decay is electron capture. In those cases where alpha-fine structure has been observed, the relative intensities are given in the last column. Results that are not listed in the Table of Isotopes are indicated by an asterisk (*) in Table I.

Alpha energies versus neutron number are shown in Fig. 1 for the isotopes of the different elements.

Lead isotopes. The only experimental study of the alpha-active lead isotopes is that of Siivola (42).

Bismuth isotopes. The most comprehensive investigation of the alpha-active bismuth isotopes is that of Siivola (42). As a secondary result of a study of light astatine isotopes Treytl et al (53) observed four of the bismuth activities but the excitation functions tended to indicate different assignments. In later studies of the isotopes of elements francium through thorium it has been observed that direct production can considerably affect the excitation functions of the alpha-decay daughters. With the assumption that direct production of the bismuth isotopes is important in the reactions of $^{185}Re + ^{20}Ne$ the results of Treytl et al can be interpreted such that at least the ground state assignments agree with those of Siivola. Additional experiments are in progress to resolve the problem.

Polonium isotopes. As the polonium isotopes are the last alpha-active members of most of the decay chains in this region, they provide a basis for numerous further assignments. Previous investigators generally agree on the alpha-decay properties of ^{202}Po through ^{211}Po. Recent studies have revealed isomerism in ^{201}Po, ^{199}Po, ^{197}Po, and ^{195}Po. Most of the older data can be made consistent with these results by reassigning some of the activities to the isomers as shown in Table II. Only the results of Forsling et al (19) remain somewhat unexplained.

Systematic trends in the alpha energy versus mass number (Fig. 1) indicate that the alpha energy 5.48 MeV assigned to ^{203}Po by Atterling et al (2) and by Forsling et al (19) would better be explained if it were due to an isomer ^{203m}Po; the value expected for ^{203}Po is about 5.40 MeV.

Astatine isotopes. The alpha-decay properties of ^{203}At through ^{212}At are relatively well-known from several previous studies. In some of the earliest investigations (6,46) isomerism was reported in ^{204}At, ^{206}At, and ^{208}At. In a later careful study of these isotopes by Thoresen et al (49) no evidence of isomerism was observed. Accordingly, they are not listed in Table I. Most of the recent astatine results concern the isotopes ^{196}At through ^{202}At. Hoff et al (25) suspected that one of the two alpha groups attributed to ^{202}At was an isomer because no alpha-gamma coincidences could be observed. Treytl et al (53) observed a

small difference in the half-lives of the two groups and assigned them to ^{202m}At and ^{202}At. This assignment fits well into the pattern of the systematic occurrence of isomerism in this region. Isomerism was observed also in ^{200}At and ^{198}At and one alpha-fine structure peak was observed in ^{200}At (N=115, compare with ^{201}Rn).

Radon isotopes. Special techniques are required in the study of the gaseous radon activities. Results from a few investigations agree on the alpha-decay properties of ^{212}Rn through ^{206}Rn. A recent study by Valli et al (55) covers principally the isotopes ^{207}Rn through ^{201}Rn. Isomerism was discovered in ^{203}Rn and probably in ^{201}Rn; in addition, ^{201}Rn (N=115, compare with ^{200}At) seems to have one fine structure peak. Since this work was reported, more data has been obtained on ^{201}Rn, ^{200}Rn, and ^{199}Rn with an improved apparatus. However, the results on the three lightest isotopes are still tentative.

There is a difference in alpha energy between the reports on ^{213}Rn. As the ^{213}Rn activity was produced directly in the two earlier studies (41, 23) and through the electron-capture decay of ^{213}Fr in the case of Valli et al (56), there is the possibility that one of the energies belongs to ^{213}Rn and the other one to ^{213m}Rn (compare ^{214}Fr and also ^{212}At, ^{211}Po, and ^{210}Bi).

Francium isotopes. The alpha-decay properties of the light francium isotopes are well established by three independent studies, two of them very recent. In the latest work by Gough et al (51) the few disagreements in half-lives between the two earlier studies were investigated. There was also a notable difference in the alpha energy of ^{214}Fr between the earlier studies. Recently Torgerson et al (51) using a very fast collection system showed two alpha groups which they have assigned to the ground state and an isomeric level of ^{214}Fr.

Radium and actinium isotopes. A study of light radium isotopes by Valli et al (57) will be published shortly. An investigation of light actinium isotopes by Treytl et al (54) has also been recently completed.

Thorium isotopes. The only experimental data concerning light thorium isotopes comes from a work that is still in progress (58). The assignments are based on excitation

functions (of the thorium isotopes themselves and of the daughters). The energies were determined by means of the known daughter peaks. The listed values are tentative.

Isomers. When two activities with different half-lives and alpha energies are attributed to one nuclide the assignment is usually made on the basis of excitation functions, parent-daughter relationships, and other evidence. However, the assignment of the group associated with the ground-state decay is made in most cases on the basis of energy versus mass number systematics (Fig. 1). The isomers occur in three groups:

a) Odd-neutron isotopes of elements above bismuth with 117 or less neutrons. In the even-proton elements, e.g., polonium and radon, the isomeric level can be assigned to a 13/2+ state (53,55); in the odd-proton elements, e.g., astatine and francium, coupling between the odd nucleons takes place. The half-lives of these isomers are of the same order of magnitude as those of the corresponding ground states and they occur in a regular pattern on both sides of the lead shell including the lead isotopes themselves.

b) Even-neutron isotopes of bismuth. If the assignments of the bismuth isomers by Siivola (42) are correct, the odd-neutron isomerism discussed above disappears in bismuth and another type of isomerism involving different single particle states occurs in the even-neutron isotopes.

c) Isotopes of different elements with 127 neutrons (^{214}Fr, ^{212}At, ^{211}Po, and ^{210}Bi). See the Table of Isotopes or Ref. (32) for detailed information.

Alpha energy versus mass number systematics. The alpha energy versus neutron number curves shown in Fig. 1 have a typical steplike behavior with relatively low overall slope. The curves for different elements are not equally spaced but rather grouped together two and two. These phenomena indicate that there is a systematic difference in the paring energy between parent and daughter nuclei. The steplike behavior can be explained as a result of the weakening of the neutron pairing energy as the 126-neutron shell is approached and the grouping as a result of the weakening of the proton pairing energy as the 82-proton shell is approached (57).

TABLE I

	E_α (MeV)	$T_{1/2}$	α branch(%)	Ref.	Q_α (MeV)		
^{213}Th?	7.700±0.010			ValliK67c	7.847	*	
^{214}Th	7.685±0.010			ValliK67c	7.831	*	
^{215}Th	7.520±0.010	1.2 ±0.2 s		ValliK67c	7.663	*	~50%
	7.397±0.010	1.2 ±0.2 s					~50%
^{216}Th	7.918±0.010			ValliK67c	8.067	*	
^{209}Ac	7.585±0.015	0.10±0.05 s		TreyW67a	7.733	*	
^{210}Ac	7.462±0.008	0.35±0.05 s		TreyW67a	7.607	*	
^{211}Ac	7.480±0.008	0.25±0.05 s		TreyW67a	7.625	*	
^{212}Ac	7.377±0.008	0.93±0.05 s		TreyW67a	7.519	*	
^{213}Ac	7.362±0.008	0.80±0.05 s		TreyW67a	7.503	*	
	7.42	~1 s		GrifR61		*	
^{214}Ac	7.212±0.005	8.2 ±0.2 s	89±2	TreyW67a	7.349	*	52±2%
	7.080±0.005	8.2 ±0.2 s					44±2%
	7.000±0.015	8.2 ±0.5 s					4±1%
	7.24	12 s		GrifR61		*	~33%
	7.18	12 s					~33%
	7.12	12 s					~33%

	E_α (MeV)	$T_{1/2}$	α branch(%)	Ref.	Q_α (MeV)		(TABLE I, cont'd)
^{215}Ac	7.602±0.005	0.17±0.01 s	~100	TreyW67a	7.746	*	EC=0.09%
^{216}Ac	9.14 ±0.03	0.39±0.03 ms		RotH66	9.31	*	
^{206}Ra	7.270±0.005	0.4 ±0.2 s		ValliK67b	7.414	*	
^{207}Ra	7.131±0.005	1.3 ±0.2 s		ValliK67b	7.272	*	
^{208}Ra	7.131±0.005	1.2 ±0.2 s		ValliK67b	7.271	*	
^{209}Ra	7.008±0.005	4.7 ±0.2 s		ValliK67b	7.145	*	
^{210}Ra	7.018±0.005	3.8 ±0.2 s		ValliK67b	7.154	*	
^{211}Ra	6.910±0.005	15 ±2 s		ValliK67b	7.044	*	
^{212}Ra	6.896±0.005	13 ±2 s		ValliK67b	7.029	*	
	6.9	18 s		GrifR61		*	
^{213}Ra	6.730±0.005	2.75±0.15 m	80±5	ValliK67b	6.858	*	45±2%
	6.323±0.005	2.75±0.15 m					49±2%
	6.520±0.005	2.75±0.15 m					6±1%
	6.408±0.005?						0.4±0.2%
	6.74	2.7 m		GrifR61		*	~50%
	6.61	2.7 m					~50%
	6.90 ±0.04	2.7 ±0.3 m		MomF55a			

	E_α (MeV)	$T_{1/2}$	α branch(%)	Ref.	Q_α (MeV)		(TABLE I, cont'd)
^{214}Ra	7.136±0.005	2.6±0.2 s	~100	ValliK67b	7.272	*	EC=0.09%
	7.17	2.6 s		GrifR61		*	
^{215}Ra	8.70 ±0.02		100	TreyW67a	8.865	*	
	8.73			RotH66		*	
	8.7	1.6 ms		GrifR61		*	
^{203}Fr	7.130±0.005	0.7±0.3 s		ValliK67a	7.273	*	
^{204m}Fr	7.028±0.005	2.2±0.2 s		ValliK67a	7.169	*	
	7.02 ±0.03	2.0±0.5 s		GrifR64			original assign ^{204}Fr
^{204}Fr	6.973±0.005	3.3±0.2 s		ValliK67a	7.112	*	
^{205}Fr	6.917±0.005	3.7±0.2 s		ValliK67a	7.055	*	
	6.91 ±0.02	3.7±0.4 s		GrifR64			
^{206}Fr	6.792±0.005	15.7±0.3 s		ValliK67a	6.926	*	
		15.3±0.3 s		TorgD67		*	
	6.79 ±0.02	15.8±0.4 s		GrifR64			
^{207}Fr	6.773±0.005	14.7±0.3 s		ValliK67a	6.906	*	
		15.4±0.3 s		TorgD67		*	
	6.77 ±0.02	18.7±0.8 s		GrifR64			

	E_α (MeV)	$T_{1/2}$	α branch(%)	Ref.	Q_α (MeV)		(TABLE I, cont'd)
^{208}Fr	6.647±0.005	59 ±2 s		ValliK67a	6.777	*	
		57.4±0.5 s		TorgD67		*	
	6.65 ±0.02	37.5±2.0 s		GrifR64			
^{209}Fr	6.647±0.005	52 ±2 s		ValliK67a	6.777	*	
		52.2±0.9 s		TorgD67		*	
	6.65 ±0.02	54.7±1.0 s		GrifR64			
^{210}Fr	6.542±0.005	3.18±0.06 m		ValliK67a	6.669	*	
		3.20±0.07 m		TorgD67		*	
	6.55 ±0.02	2.65±0.08 m		GrifR64			
^{211}Fr	6.533±0.005	3.06±0.06 m		ValliK67a	6.659	*	
	6.55 ±0.02	3.10±0.07 m		GrifR64			
^{212}Fr	6.407±0.003			ValliK66	6.530		20.7±2.0%
	6.383±0.003						23.3±2.0%
	6.338±0.003						12.3±1.0%
	6.261±0.003						40.0±4.0%
	6.179±0.003						2.1±0.3%
	6.127±0.003						1.0±0.2%
	6.077±0.005						0.4±0.2%
	5.983±0.005						0.10±0.05%
	5.828±0.008						0.05±0.03%

(TABLE I, cont'd)

	E_α (MeV)	$T_{1/2}$	α branch(%)	Ref.	Q_α (MeV)		
^{212}Fr	6.411±0.009			MomF55	6.534		37%
	6.387±0.009						39%
	6.342±0.007						24%
	6.25 ±0.03	19.3±0.5 m	44	HydeE50			
^{213}Fr	6.773±0.005	34.7±0.3 s	99.4±0.3	ValliK67a	6.903	*	
	6.77 ±0.01	33.7±1.5 s	99.5	GrifR64			
^{214m}Fr	8.549±0.005	3.36±0.01 ms		TorgD67	8.711	*	
	8.53			RotH66		*	original assign ^{214}Fr
	8.55	3.9 ms		GrifR64			original assign ^{214}Fr
^{214}Fr	8.482±0.005	3.42±0.04 ms		TorgD67	8.643	*	
	8.430±0.008			ValliK67b	8.591	*	
^{199m}Rn?	7.04 ±0.02			ValliK67c	7.184	*	
^{200}Rn	6.88 ±0.01			ValliK67c	7.020	*	
^{201m}Rn	6.768±0.005	3.0 ±1.5 s		ValliK67	6.905		
^{201}Rn	6.735±0.010			ValliK67c	6.872	*	
	6.703±0.010						
^{202}Rn	6.636±0.003	13±2 s		ValliK67	6.770		

	E_α (MeV)	$T_{1/2}$	α branch(%)	Ref.	Q_α (MeV)	(TABLE I, cont'd)
^{203m}Rn	6.547±0.003	28 ±2 s		ValliK67	6.679	
^{203}Rn	6.497±0.005	45 ±5 s		ValliK67	6.628	
^{204}Rn	6.416±0.003	75 ±2 s	42±10	ValliK67	6.544	
^{205}Rn	6.262±0.003	1.8±0.5 m		ValliK67	6.387	
	6.28 ±0.05	3 ±1 m		StonA57	6.405	original assign ^{204}Rn
^{206}Rn	6.258±0.003	6.5±1.0 m		ValliK67	6.382	
	6.25 ±0.05	6.2±0.5 m	65	StonA57		
		6.5±0.1 m	22	BarabS57		
	6.25 ±0.05	6.5±0.5 m		BurcW54		
^{207}Rn	6.135±0.003			ValliK67	6.256	
	6.14 ±0.05	10 ±2 m	4	StonA57		
	6.09 ±0.05	11.0±1.0 m		BurcW54		
^{208}Rn	6.141±0.004	23 ±2 m	20	MomF55	6.261	
	6.14 ±0.05	21 ±3 m	20	StonA57		
^{209}Rn	6.037±0.010	30 ±2 m	17	MomF55	6.155	
^{210}Rn	6.037±0.010	2.7±0.2 h	46±1	MomF55	6.155	see also ValliK67
	6.04	2.42±0.05 h		CrofP64		

	E_α (MeV)	$T_{1/2}$	α branch(%)	Ref.	Q_α (MeV)		(TABLE I, cont'd)
^{211}Rn	5.874±0.002	16 ±1 h	26	MomF55	5.987		33.5% see also ValliK67
	5.779±0.003						64.5%
	5.613±0.007						2.0%
	5.86	14.6±0.6 h	28	CrofP64			
^{212}Rn	6.264±0.005	23 m	100	MomF55	6.384		
	6.26	25.5±1.0 m		CrofP64			
	6.17 ±0.03	23 m		HydeE50			
^{213}Rn	8.090±0.008			ValliK67a	8.245	*	
	8.14			RotH66		*	
	8.13	19 ms		GrifR62		*	
^{196}At	7.055±0.007	0.3±0.1 s		TreyW67	7.202	*	
^{197}At	6.957±0.005	0.4±0.1 s		TreyW67	7.101	*	
^{198m}At	6.847±0.005	1.5±0.3 s		TreyW67	6.988	*	
^{198}At	6.747±0.005	4.9±0.5 s		TreyW67	6.886	*	
^{199}At	6.638±0.005	7.2±0.5 s		TreyW67	6.744	*	
^{200m}At	6.536±0.005	4.3±0.3 s		TreyW67	6.669	*	

	E_α (MeV)	$T_{1/2}$	α branch(%)	Ref.	Q_α (MeV)		(TABLE I, cont'd)
^{200}At	6.463±0.005	42 ±2 s		TreyW67	6.592	*	41±2%
	6.412±0.005	42 ±2 s				*	59±2%
	6.465±0.005	0.9±0.2 m		HoffR63	6.597		~40%
	6.412±0.009	0.9±0.2 m					~60%
	6.50	43 s		BartoG51			original assign <^{202}At
^{201}At	6.342±0.003	90 ±4 s		TreyW67	6.471	*	
	6.342±0.006	1.5±0.1 m		HoffR63	6.471		
	6.35	1.7 m		BartoG51			original assign <^{203}At
^{202m}At	6.226±0.003	2.6±0.3 m		TreyW67	6.352	*	
	6.227±0.003	3.0±0.2 m		HoffR63	6.353		original assign ^{202}At
	6.25 ±0.05	3 ±1 m		ForW61			original assign ^{202}At
^{202}At	6.133±0.003	3.0±0.3 m		TreyW67	6.257	*	
	6.133±0.002	3.0±0.2 m		HoffR63	6.257		
	6.13 ±0.03	3 ±1 m		ForW61			
^{203}At	6.086±0.003			TreyW67	6.208	*	
	6.085±0.001	7.4±0.3 m		HoffR63	6.207		
		7.4±0.3 m	13.8±0.6	LatR61			
	6.09 ±0.03	7 ±2 m		ForW61			

	E_α (MeV)	$T_{1/2}$	α branch(%)	Ref.	Q_α (MeV)	(TABLE I, cont'd)
^{203}At	6.09 ±0.03	7.1±1.5 m		BurcW56		
	6.10	7 m		BartoG51		
		7 m		MillJF50		
^{204}At	5.947±0.003			TreyW67	6.066	*
		8.9 m		ThorP64		
	5.948±0.003	9.3±0.2 m		HoffR63	6.067	
		9.3±0.3 m	4.5±0.4	LatR61		
	5.95 ±0.03	9 ±3 m		ForW61		
^{205}At	5.896±0.004	26.2±0.5 m		HoffR63	6.013	
		26.2±0.5 m	18.4±1.6	LatR61		
	5.90 ±0.03	28 ±3 m		ForW61		
	5.94 ±0.03	23 ±4 m		BurcW56		
	5.90 ±0.04	25 ±2 m		BurcW54		
	5.90	25 m		BartoG51		
		24 m		MillJF50		

For ^{206}At through ^{212}At see the Table of Isotopes (32).

	E_α (MeV)	$T_{1/2}$	α branch(%)	Ref.	Q_α (MeV)		(TABLE I, cont'd)
^{193}Po	7.0			SiiA65	7.148		
^{194}Po	6.845±0.007			TreyW67	6.989	*	
	6.85	0.5 s		SiiA65			
^{195m}Po	6.697±0.005			TreyW67	6.837	*	
	6.72	1.4 s		SiiA65			
^{195}Po	6.608±0.005			TreyW67	6.746	*	
	6.63	3 s		SiiA65			
	6.58 ±0.04	0.5±0.1 s		TovP58			original assign ^{192}Po
^{196}Po	6.517±0.005			TreyW67	6.653	*	
	6.53	5.9 s		SiiA65			
	6.47 ±0.04	4 ±1 s		TovP58			original assign ^{193}Po
^{197m}Po	6.378±0.005			TreyW67	6.510	*	
	6.37 ±0.03	29 s		BrunC65a			
	6.39	25 s		SiiA65			
	6.38 ±0.04	13 ±2 s		TovP58			original assign ^{194}Po
^{197}Po	6.280±0.005			TreyW67	6.410	*	
	6.27 ±0.03	58 s		BrunC65a			
	6.30	54		SiiA65			

	E_α (MeV)	$T_{1/2}$	α branch(%)	Ref.	Q_α (MeV)		(TABLE I, cont'd)
^{197}Po	6.23 ±0.04	~0.5 m		AttH59a			original assign ^{195}Po
	6.26 ±0.04	30 ±4 s		TovP58			original assign ^{195}Po
^{198}Po	6.178±0.005			TreyW67	6.305	*	
	6.16 ±0.02	1.7 m	>34	BrunC65a			
	6.18	1.75 m		SiiA65			
	6.13 ±0.03	1.8±0.2 m		AttH59			original assign ^{196}Po
^{199m}Po	6.053±0.005			TreyW67	6.177	*	
	6.04 ±0.01	4.1 m	25.7	BrunC65a			
	6.05 ±0.02	4.1±0.1 m		TieE65			
	6.06	4.24 m		SiiA65			original assign ^{199}Po
	6.03 ±0.03	4.0±0.4 m		AttH59			original assign ^{197}Po
	6.040±0.010	4 m		RosS54b			original assign ^{197}Po
^{199}Po	5.950±0.005			TreyW67	6.072	*	
	5.93 ±0.02	5.2 m	2.74	BrunC65a			
	5.95 ±0.02	5.0±0.2 m		TieE65			
	5.93 ±0.03	~7 m		AttH59			original assign ^{198}Po
	5.935±0.010	6 m		RosS54b			original assign ^{198}Po

	E_α (MeV)	$T_{1/2}$	α branch(%)	Ref.	Q_α (MeV)		(TABLE I, cont'd)
^{200}Po	5.860±0.005		14±5	TreyW67	6.980	*	see also ValliK67
	5.85 ±0.01	11.4 m	12.2	BrunC65a			
	5.85 ±0.02	11.4±0.4 m		TieE65			
	5.86	11.4 m		SiiA65			
	5.860±0.006	10.5±1.0 m		HoffR63	5.980		
	5.87 ±0.03	13 ±3 m		ForW61a			original assign ^{199}Po
		11.2±0.3 m		BelyB61			original assign ^{199}Po
	5.86 ±0.03	12 ±1 m		AttH59			original assign ^{199}Po
	5.846±0.010	11 m		RosS54b			original assign ^{199}Po
	5.84 ±0.03	11 m		KarrD51a			
^{201m}Po	5.780±0.005			TreyW67	5.897	*	
	5.77 ±0.01	9.0±0.2 m	2.9	BrunC65a			
	5.77 ±0.02	8.9±0.4 m		TieE65			
	5.780±0.005	8.5±1.0 m		HoffR63	5.897		
	5.86 ±0.03	12 ±4 m		ForW61a			original assign ^{200}Po
	5.75 ±0.03						
	5.77 ±0.03	10 ±1 m		AttH59			original assign ^{200}Po
	5.770±0.010	8 m		RosS54b			original assign ^{200}Po

(TABLE I, cont'd)

	E_α (MeV)	$T_{1/2}$	α branch(%)	Ref.	Q_α (MeV)	
^{201}Po	5.677±0.005			TreyW67	5.792	*
	5.67 ±0.01	15.8±0.4 m	1.15	BrunC65a		
	5.67 ±0.02	15.1±0.3 m		TieE65		
	5.674±0.009	19.5±2.0 m		HoffR63	5.789	
	5.77 ±0.05 5.67 ±0.03 5.57 ±0.03	16 ±3 m		ForW61a		
		17.5±1.5 m	0.8±0.3	BelyB61		
	5.68 ±0.03	18 ±2 m		AttH59		
	5.671±0.010	17 m		RosS54b		
	5.70 ±0.03	18 m		KarrD51a		
^{202}Po	5.578±0.005			TreyW67	5.691	*
	5.57	44 ±2 m	2.0	BrunC65a		
	5.57 ±0.02	45 ±1.5 m		TieE65		
	5.581	43 ±4 m		AnJ65		*
	5.580±0.010	44 ±7 m		HoffR63	5.693	
	5.57	50 ±10 m		ForW61a		
		44.5±1.5 m		BelyB61		

	E_α (MeV)	$T_{1/2}$	α branch(%)	Ref.	Q_α (MeV)		(TABLE I, cont'd)
^{202}Po	5.58 ±0.03	43 ±4 m		AttH59			
	5.57 ±0.05	51 ±3 m	2.0	StonA57			
	5.575±0.010	55 m		RosS54b			
	5.61 ±0.05	56 ±5 m		BurcW54			
	5.59 ±0.03	52 ±5 m		KarrD51a			
^{203}Po	5.48 ±0.03			ForW61a	5.590		
			0.02	BelyB61			
	5148 ±0.03	45 ±10 m		AttH59			
		42 m		BellRE56			
		47 ±5 m		KarrD51			
^{208}Po	5.110±0.005		~100	HagG66	5.210	*	~100%
	4.22 ±0.015						$(2.4\pm0.7)\cdot10^{-4}$%
^{209}Po	4.877±0.005		99.74	HagG66	4.972	*	99.26%
	4.617±0.005						0.48±0.02%
	4.31 ±0.015						$(1.5\pm0.4)\cdot10^{-4}$%
	4.11 ±0.015						$(5.56\pm0.42)\cdot10^{-4}$%

For ^{204}Po through ^{211}Po see the Table of Isotopes (32).

	E_α (MeV)	$T_{1/2}$	α branch(%)	Ref.	Q_α (MeV)		(TABLE I, cont'd)
^{190}Bi	6.46			SiiA66	6.60	*	
^{191m}Bi	6.90			SiiA66	7.05	*	
^{191}Bi	6.33	15.4 s		SiiA66	6.47	*	
	6.305±0.005	14±2 s		TreyW67	6.440	*	original assign ^{190}Bi or ^{194}Bi
^{192}Bi	6.07	48 s		SiiA66	6.20	*	
	6.050±0.005	38±5 s		TreyW67	6.179	*	original assign ^{191}Bi or ^{195}Bi
^{193m}Bi	6.50	3.2 s		SiiA66	6.64	*	
^{193}Bi	5.91	60 s		SiiA66	6.04	*	
	5.892±0.005	74±5 s		TreyW67	6.017	*	original assign ^{192}Bi or ^{196}Bi
^{194}Bi	5.61	85 s		SiiA66	5.73	*	
^{195m}Bi	6.13	85 s		SiiA66	6.26	*	
	6.100±0.005	55±10 s		TreyW67	6.228	*	original assign ^{191}Bi or ^{195}Bi
	6.2 ±0.1	1.7 m		NeumH50			original assign <^{198}Bi
^{195}Bi	5.42	2.5 m		SiiA66	5.53	*	
^{197m}Bi	5.81 ±0.03	8.0±0.5 m		SiiA64	5.90		original no assign
	5.81	8.0 m		SiiA66	5.90	*	
	5.83 ±0.06	7±1 m	0.05	NeumH50	5.92		original assign ^{198}Bi
	5.5 ±0.3	9 m		TemD48			original assign ^{198}Bi

	E_α (MeV)	$T_{1/2}$	α branch(%)	Ref.	Q_α (MeV)		(TABLE I, cont'd)
^{199m}Bi	5.481±0.006	24.70±0.15 m		MahI66	5.593	*	
	5.52 ±0.02	24.4 ±0.5 m		SiiA64	5.63		
	5.47 ±0.06	25 ±5 m	0.01	NeumH50	5.58		original assign ^{199}Bi
	5.5 ±0.3	27 m		TemD48			original assign ^{199}Bi
^{201m}Bi	5.240±0.006	59.1 ±0.6 m		MahI66	5.346	*	
	5.27 ±0.02	52 ±2 m		SiiA64	5.38		
	5.15 ±0.06	62 m	0.003	NeumH50	5.26		original assign ^{201}Bi
	5.5 ±0.3	1-2 h		TemD48			original assign ^{201}Bi
^{203}Bi	4.85	~12 h	$\sim 10^{-5}$	DunlD52a			

For ^{210m}Bi and ^{210}Bi see the Table of Isotopes (32).

^{188}Pb	5.99	26 s		SiiA66	6.12	*
^{189}Pb	5.73	50 s		SiiA66	5.85	*
^{190}Pb	5.55	1.1 m		SiiA66	5.67	*
^{191}Pb	5.30	1.4 m		SiiA66	5.41	*
^{192}Pb	5.11	2.2 m		SiiA66	5.22	*
^{204}Pb	2.6	$1.4 \cdot 10^{17}$ y		RieW58	2.65	

TABLE II

Po	TreyW67	SiiA65	BrunC65a	TieE65	HoffR63
192					
193		7.0			
194	6.845	6.85 0.5s			
195m	6.698	6.72 1.4s			
195	6.608	6.63 3 s			
196	6.517	6.53 5.9s			
197m	6.378	6.39 25 s	6.37 29 s		
197	6.280	6.30 54 s	6.27 58 s		
198	6.178	6.18 1.75m	6.16 1.7m		
199m	6.053		6.04 4.1m	6.05 4.1m	
199	5.950	6.06 4.24m	5.93 5.2m	5.95 5.0m	
200	5.860	5.86 11.4 m	5.85 11.4m	5.85 11.4m	5.860 9.4m
201m	5.780		5.77 9 m	5.77 8.9m	5.780 8.5m
201	5.677		5.67 16 m	5.67 15.1m	5.674 19.5m
202	5.578		5.57 44 m	5.57 45 m	5.580 44 m
203					
204					
205					

Po	TovP58		AttH59		RosS54b		KarrD51a	
192	6.58	0.5s						
193	6.47	4 s						
194	6.38	13 s						
195m								
195	6.26	30 s						
196			6.13	1.8m				
197m								
197			6.03	4 m	6.040	4 m		
198			5.93	7 m	5.935	6 m		
199m								
199			5.86	12 m	5.846	11 m		
200			5.77	10 m	5.770	8 m	5.84	11 m
201m								
201			5.68	18 m	5.671	17 m	5.70	18 m
202			5.58	43 m	5.575	55 m	5.59	52 m
203			5.48	45 m				47 m
204			5.38	3-4 h	5.370	3.8h	5.37	3.8h
205							5.2	1.5h

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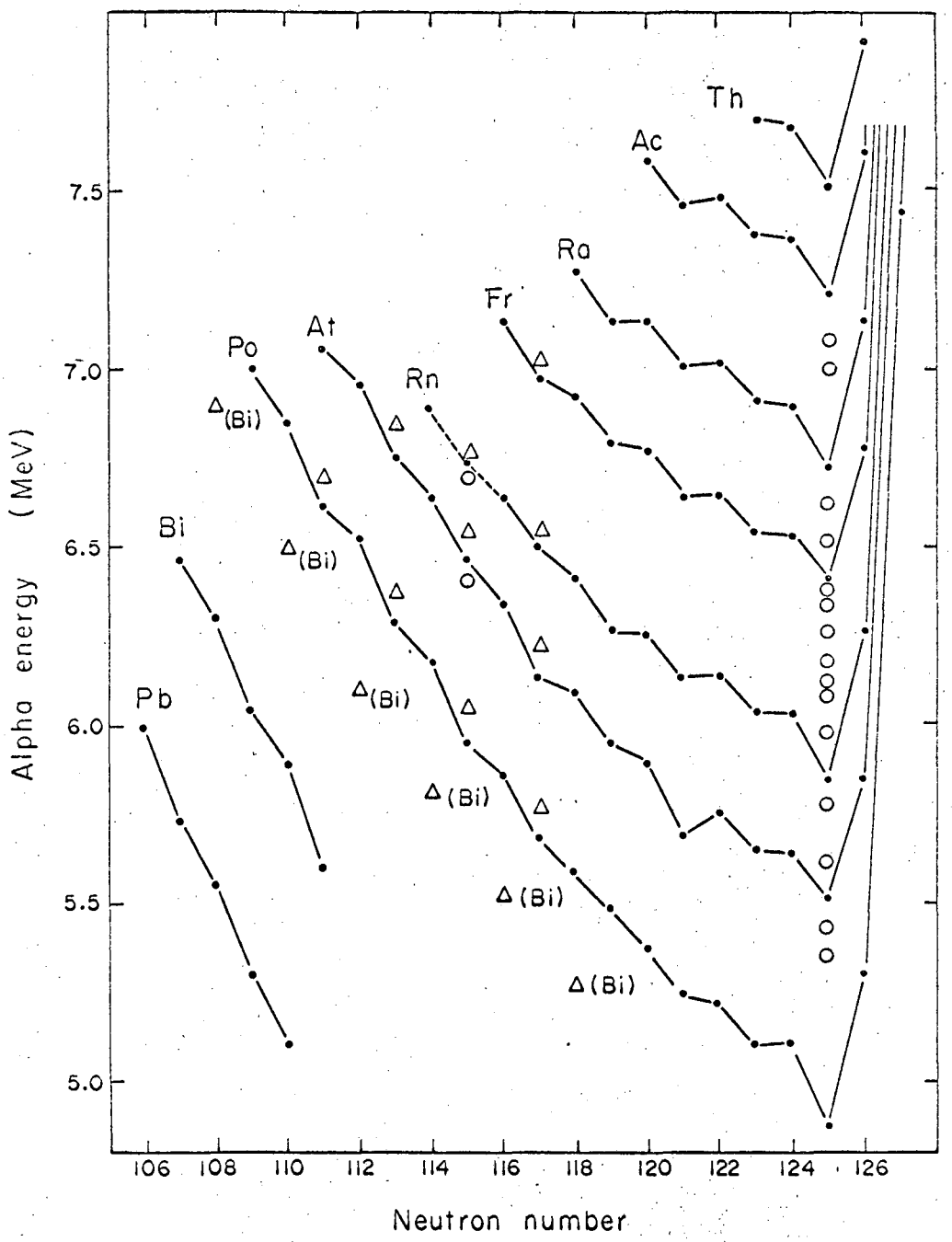
(Captions)

Fig. 1. Alpha energy versus neutron number for different elements in the area below 126-neutron shell and above 82-proton shell. The solid circles indicate energies assigned to ground-state alpha decay. The triangles represent alpha energies assigned to isomeric states. The open circles are alpha transitions to excited levels at the daughter nuclei (alpha-fine structure).



XBL678-3809

Fig. 1

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