

Mines Branch Information Circular IC 226  
LiF(220) CONVERSION TABLES FOR X-RAY SPECTROGRAPHY

by

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ABSTRACT

Tables are presented of the  $2\theta$  angles for the principal X-ray lines of elements diffracted by the 220 plane of a lithium fluoride crystal.

RÉSUMÉ

Les auteurs présentent des tableaux des angles  $2\theta$  des principales raies X d'éléments diffractés par le plan 220 d'un cristal de fluorure de lithium.

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## AUTHORS' PREFACE

The following tables were prepared for use by us in the Spectrochemical Laboratory of the Mineral Sciences Division, Mines Branch, because no conversion tables for  $\text{LiF}(220)$  extensive enough for our purposes were available. To place these tables at the disposal of other workers in the field of X-ray fluorescence analysis, permission was obtained to publish them as a Mines Branch Information Circular, and we wish to record our debt to Dr. A.H. Gillieson, our Section Head, and Mr. V.A. Haw, Division Chief, respectively, for their assistance in this respect.

The two-theta angle values were calculated from the Bragg formula

$$n\lambda = 2d \sin \theta$$

where  $n$  = order of spectrum  
 $\lambda$  = wavelength of line  
 $d$  = crystal spacing

For convenience the circular is divided into three parts:

- Section 1 - Two-theta values for the principal lines of the elements
- Section 2 - Two-theta values in ascending numerical order
- Section 3 - Two-theta positions of extra reflections

Absorption edges of the elements have been included as well as the characteristic lines of analytical interest. Radiation of four orders is included in Section 1 and of five in Section 2.

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Ottawa, September 1969

SECTION 1

Two-Theta Values for the Principal Lines of the Elements

<u>Element</u>	<u>K edge</u>	<u>K<math>\alpha</math>1</u>	<u>K<math>\alpha</math>2</u>	<u>K<math>\beta</math>1</u>	<u>N</u>
22 Ti	122.53	149.61		123.93	1
23 V	105.63	123.05	123.37	106.66	1
24 Cr	93.25	107.02	107.28	94.11	1
25 Mn	83.50	95.12	95.35	84.24	1
26 Fe	75.49	85.65	85.87	76.16	1
27 Co	68.76	77.82	78.02	69.37	1
28 Ni	63.00	71.20	71.39	63.57	1
29 Cu	57.99	65.49	65.67	58.53	1
30 Zn	53.56	60.52	60.70	54.10 130.89	1 2
31 Ga	49.65	56.14 140.45	56.31 141.39	50.19 116.04	1 2
32 Ge	46.16	52.25 123.44	52.42 124.11	46.70 104.89	1 2
33 As	43.05	48.73 111.32	48.94 111.89	43.58 95.88	1 2
34 Se	40.24	45.65 101.75	45.82 102.27	40.77 88.33	1 2
35 Br	37.69	42.82 93.79	43.00 94.27	38.23 81.84	1 2
36 Kr	35.38	40.26 86.98	40.43 87.43	35.93 76.18 135.44	1 2 3
37 Rb	33.28	37.93 81.07	38.10 81.51	33.83 71.17 121.58	1 2 3
38 Sr	31.36	35.79 75.85 134.42	35.97 76.28 135.74	31.91 66.70 111.11	1 2 3

<u>Element</u>	<u>K edge</u>	<u>K<math>\alpha</math>1</u>	<u>K<math>\alpha</math>2</u>	<u>K<math>\beta</math>1</u>	<u>N</u>
39 Y	29.60	33.84	34.01	30.15	1
		71.18	71.60	62.68	2
		121.62	122.68	102.56	3
40 Zr	27.99	32.04	32.21	28.53	1
		66.99	67.40	59.04	2
		111.75	112.66	95.32	3
41 Nb	26.51	30.38	30.55	27.04	1
		63.20	63.60	55.74	2
		103.62	104.46	89.06	3
				138.46	4
42 Mo	25.14	28.84	29.02	25.65	1
		59.75	60.14	52.72	2
		96.68	97.46	83.52	3
				125.25	4
44 Ru	22.70	26.10	26.28	23.19	1
		53.69	54.08	47.41	2
		85.28	85.99	74.17	3
		129.15	130.80	107.03	4
45 Rh	21.60	24.87	25.05	22.09	1
		51.02	51.41	45.06	2
		80.48	81.17	70.16	3
		118.93	120.32	100.04	4
46 Pd	20.60	23.72	23.90	21.06	1
		48.55	48.94	42.88	2
		76.14	76.82	66.50	3
		110.61	111.86	93.95	4
47 Ag	19.64	22.65	22.83	20.10	1
		46.26	46.64	40.86	2
		72.20	72.86	63.14	3
		103.56	104.71	88.54	4
48 Cd	18.76	21.65	21.84	19.20	1
		44.13	44.52	38.98	2
		68.60	69.25	60.06	3
		97.42	98.50	83.71	4
49 In	17.93	20.72	20.90	18.37	1
		42.15	42.54	37.23	2
		65.29	65.92	57.21	3
		91.98	93.01	79.34	4
50 Sn	17.15	19.84	20.02	17.58	1
		40.30	40.68	35.59	2
		62.23	62.86	54.57	3
		87.10	88.09	75.36	4

<u>Element</u>	<u>K edge</u>	<u>K<math>\alpha</math>1</u>	<u>K<math>\alpha</math>2</u>	<u>K<math>\beta</math>1</u>	<u>N</u>
51 Sb	16.42	19.01	19.19	16.84	1
		38.57	38.95	34.06	2
		59.40	60.02	52.12	3
		82.69	83.65	71.71	4
52 Te	15.73	18.23	18.42	16.15	1
		36.95	37.33	32.62	2
		56.76	57.38	49.84	3
		78.66	79.60	68.36	4
53 I	15.08	17.50	17.69	15.49	1
		35.43	35.81	31.28	2
		54.31	54.92	47.70	3
		74.97	75.89	65.25	4
54 Xe	14.46	16.80	16.98	14.87	1
		33.97	34.34	29.99	2
		51.97	52.57	45.68	3
		71.49	72.38	62.33	4

Element	K $\alpha$ 1	K $\alpha$ 2	K $\beta$ 1	L $\alpha$ 1	L $\alpha$ 2	L $\beta$ 1	L $\beta$ 2	L $\beta$ 3	L $\gamma$ 1	L $\eta$	N	
55 Cs	16.16	16.34	14.30			140.85	123.73	134.68	111.04		1	
	32.65	33.03	28.82								2	
	49.88	50.48	43.83								3	
	68.41	69.30	59.69								4	
	Edges:	K 13.90	LI 99.09	LII 108.66	LIII 120.60							
56 Ba	15.54	15.73	13.74			128.70	115.17	124.12	103.80		1	
	31.38	31.64	27.69								2	
	47.86	48.46	42.08								3	
	65.48	66.18	57.19								4	
	Edges:	K 13.36	LI 93.11	LII 101.44	LIII 112.12							
57 La	14.96	15.14	13.22	138.71	139.77	119.34	107.90	115.61	97.52	147.27	1	
	30.18	30.56	26.63								2	
	45.97	46.57	40.42								3	
	62.75	63.62	54.85								4	
	Edges:	K 12.84	LI 87.69	LII 95.20	LIII 104.92							
58 Ce	14.40	14.59	12.73	128.13	128.98	111.62	101.74	108.44	91.98	133.84	1	
	29.04	29.43	25.62								2	
	44.19	44.79	38.86								3	
	60.20	61.06	52.66								4	
	Edges:	K 12.36	LI 83.12	LII 89.82	LIII 98.89							
59 Pr	13.88	14.07	12.26	119.70	120.50	104.93	96.16	102.23	87.02	123.78	1	
	27.97	28.35	24.67								2	
	42.51	43.10	37.38								3	
	57.80	58.65	50.59								4	
	Edges:	K 11.90	LI 78.96	LII 84.99	LIII 93.65							
60 Nd	13.38	13.57	11.82	112.65	113.40	99.06	91.24	96.60	82.49	139.94	115.53	1
	26.95	27.33	23.77									2
	40.92	41.51	35.99									3
	55.56	56.40	48.65									4
	Edges:	K 11.47	LI 75.07	LII 80.64	LIII 88.92							

Element	K $\alpha$ 1	K $\alpha$ 2	K $\beta$ 1	L $\alpha$ 1	L $\alpha$ 2	L $\beta$ 1	L $\beta$ 2	L $\beta$ 3	L $\gamma$ 1	L $\delta$	L $\eta$	N
61 Pm	12.93	13.10	11.37	106.55	107.23	93.90	86.75	91.62	78.33			1
	26.03	26.37	22.85									2
	39.49	40.02	34.57									3
	53.55	54.29	46.60									4
	Edges:	K 11.05	LI 71.53	LII 76.67	LIII 84.63							
62 Sm	12.46	12.65	11.00	101.12	101.80	89.08	82.72	87.08	74.64	121.10	102.33	1
	25.06	25.45	22.11									2
	37.98	38.58	33.43									3
	51.43	52.27	45.10									4
	Edges:	K 10.66	LI 68.29	LII 73.42	LIII 80.73							
63 Eu	12.03	12.22	10.62	96.25	96.91	84.79	79.02	82.98	71.19	114.49	96.90	1
	24.20	24.59	21.34									2
	36.65	37.26	32.24									3
	49.57	50.42	43.46									4
	Edges:	K 10.30	LI 65.30	LII 69.63	LIII 77.12							
64 Gd	11.62	11.82	10.25	91.85	92.47	80.82	75.59	79.16	67.96	108.53	92.04	1
	23.37	23.76	20.59									2
	35.37	35.98	31.09									3
	47.79	48.64	41.88									4
	Edges:	K 9.94	LI 62.48	LII 66.49	LIII 73.77							
65 Tb	11.23	11.42	9.91	87.84	88.44	77.17	72.42	75.62	64.97	103.30	87.69	1
	22.58	22.96	19.90									2
	34.15	34.74	30.04									3
	46.10	46.92	40.43									4
	Edges:	K 9.60	LI 59.86	LII 63.62	LIII 70.74							
66 Dy	10.86	11.05	9.57	84.17	84.77	73.80	69.49	72.35	62.28	98.55	83.55	1
	21.83	22.21	19.21									2
	32.99	33.59	28.99									3
	44.50	45.32	38.98									4
	Edges:	K 9.28	LI 57.27	LII 60.65	LIII 67.35							



Element	K $\alpha$ 1	K $\alpha$ 2	K $\beta$ 1	L $\alpha$ 1	L $\alpha$ 2	L $\beta$ 1	L $\beta$ 2	L $\beta$ 3	L $\gamma$ 1	L $\eta$	L $\zeta$	N
67 Ho	10.51	10.70	9.27	80.74	81.33	70.65	66.76	69.30	59.68	94.20	79.74	1
	21.11	21.49	18.60									2
	31.89	32.47	28.07									3
	42.98	43.79	37.72									4
	Edges: K 8.98 LI 55.10 LII 58.41 LIII 65.24											
68 Er	10.17	10.36	8.97	77.58	78.17	67.74	64.23	66.50	57.22	90.30	76.16	1
	20.42	20.81	17.99						146.58			2
	30.85	31.43	27.12									3
	41.54	42.34	36.44									4
	Edges: K 8.68 LI 52.88 LII 56.06 LIII 62.72											
69 Tm	9.84	10.04	8.67	74.62	75.18	64.98	61.83	63.82	55.01	86.70	73.08	1
	19.76	20.15	17.39						134.95			2
	29.83	30.43	26.22									3
	40.14	40.96	35.20									4
	Edges: K 8.41 LI 50.82 LII 53.75 LIII 60.41											
70 Yb	9.57	9.73	8.41	71.89	72.43	62.41	59.60	61.32	52.86	83.37	70.10	1
	19.14	19.53	16.86						125.78			2
	28.88	29.47	25.41									3
	38.84	39.65	34.10									4
	Edges: K 8.14 LI 49.03 LII 51.74 LIII 58.25											
71 Lu	9.24	9.43	8.14	69.31	69.84	59.98	57.51	58.96	50.83	80.29	62.50	1
	18.53	18.92	16.32				147.35		118.25			2
	27.95	28.55	24.58									3
	37.57	38.38	32.98									4
	Edges: K 7.89 LI 47.20 LII 49.77 LIII 56.20											
72 Hf	8.95	9.14	7.87	66.89	67.41	57.69	55.51	56.72	48.91	77.43	64.66	1
	17.95	18.34	15.79			149.55	137.31	143.64	111.77			2
	27.07	27.67	23.77									3
	36.37	37.18	31.88									4
	Edges: K 7.64 LI 45.42 LII 47.84 LIII 54.19											

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Element	K $\alpha$ 1	K $\alpha$ 2	K $\beta$ 1	L $\alpha$ 1	L $\alpha$ 2	L $\beta$ 1	L $\beta$ 2	L $\beta$ 3	L $\gamma$ 1	L $\eta$	L $\eta$	N
73 Ta	8.68	8.87	7.65	64.60	65.12	55.54	53.62	54.62	47.10	74.72	62.20	1
	17.41	17.80	15.34			137.45	128.85	133.17	106.09			2
	26.24	26.84	23.10									3
	35.23	36.05	30.97									4
	Edges: K 7.40 LI 43.74 LII 46.04 LIII 52.30											
74 W	8.42	8.61	7.42	62.45	62.97	53.50	51.82	52.64	45.32	72.20	59.87	1
	16.88	17.27	14.88			128.35	121.85	124.96	100.97			2
	25.44	26.03	22.40									3
	34.14	34.95	30.01									4
	Edges: K 7.18 LI 42.17 LII 44.33 LIII 50.53											
75 Re	8.17	8.36	7.20	60.41	60.93	51.56	50.13	50.74	43.74	69.85	57.66	1
	16.37	16.77	14.43			120.83	115.84	117.95	96.33		149.35	2
	24.67	25.26	21.72									3
	33.09	33.90	29.10									4
	Edges: K 6.97 LI 40.66 LII 42.70 LIII 48.80											
76 Os	7.92	8.12	6.99	58.48	58.99	49.72	48.50	48.93	42.19	67.63	55.58	1
	15.89	16.28	14.00			114.44	110.46	111.85	92.07		137.63	2
	23.93	24.52	21.07									3
	32.09	32.90	28.22									4
	Edges: K 6.76 LI 39.21 LII 41.16 LIII 47.21											
77 Ir	7.69	7.89	6.78	56.65	57.16	47.98	46.99	47.23	40.72	65.51	53.62	1
	15.42	15.81	13.59	143.23	146.20	108.80	105.74	106.48	88.19		128.86	2
	23.22	23.82	20.45									3
	31.13	31.94	27.38									4
	Edges: K 6.56 LI 37.82 LII 39.70 LIII 45.69											
78 Pt	7.47	7.66	6.59	54.91	55.42	46.31	45.53	45.61	39.31	63.53	51.74	1
	14.97	15.37	13.20	134.45	136.88	103.70	101.40	101.64	84.55		121.55	2
	22.54	23.14	19.86									3
	30.20	31.02	26.58									4
	Edges: K 6.37 LI 36.56 LII 38.30 LIII 44.24											

Element	K $\alpha$ 1	K $\alpha$ 2	K $\beta$ 1	L $\alpha$ 1	L $\alpha$ 2	L $\beta$ 1	L $\beta$ 2	L $\beta$ 3	L $\gamma$ 1	L $\gamma$	L $\eta$	N
79 Au	7.26	7.45	6.40	53.25	53.77	44.72	44.14	44.04	37.97	61.66	49.96	1
	14.54	14.94	12.82	127.36	129.47	99.09	97.45	97.16	81.18		115.26	2
	21.88	22.48	19.28									3
	29.32	30.13	25.80									4
	Edges:	K 6.18	LI 35.29	LII 36.95	LIII 42.83							
80 Hg	7.05	7.24	6.22	51.67	52.18	43.21	42.82	42.56	36.69	59.89	48.24	1
	14.13	14.52	12.46	121.29	123.19	94.85	93.79	93.07	78.03			2
	21.26	21.86	18.74						141.56			3
	28.47	29.29	25.06									4
	Edges:	K 6.02	LI 34.11	LII 35.67	LIII 41.50							
81 Tl	6.85	7.05	6.04	50.17	50.68	41.77	41.56	41.14	35.47	58.19	46.65	1
	13.72	14.12	12.10	115.96	117.72	90.94	90.39	89.29	75.07		104.73	2
	20.65	21.25	18.20						132.09			3
	27.65	28.46	24.35									4
	Edges:	K 5.82	LI 32.96	LII 34.45	LIII 40.22							
82 Pb	6.66	6.86	5.88	48.73	49.24	40.35	40.38	39.78	34.30	56.58	45.11	1
	13.34	13.74	11.77	111.21	112.85	87.22	87.31	85.77	72.27	142.85	100.20	2
	20.06	20.67	17.69						124.39			3
	26.86	27.67	23.66									4
	Edges:	K 5.67	LI 31.85	LII 33.26	LIII 38.98							
83 Bi	6.47	6.67	5.71	47.36	47.86	39.06	39.19	38.48	33.18	55.05	43.64	1
	12.96	13.36	11.44	106.88	108.45	83.91	84.25	82.46	69.64	135.10	96.04	2
	19.50	20.10	17.20						117.86			3
	26.10	26.92	23.00									4
	Edges:	K 5.52	LI 30.82	LII 32.15	LIII 37.84							
90 Th	5.35	5.55	4.72	39.23	39.73	31.17	32.36	30.73	26.52	46.10	34.92	1
	10.70	11.11	9.46	84.34	85.62	65.01	67.73	64.02	53.62	103.08	73.75	2
	16.08	16.70	14.21			107.42	113.41	105.33	86.95		128.33	3
	21.50	22.32	18.98									4
	Edges:	K 4.54	LI 24.56	LII 25.55	LIII 30.98							
92 U	5.07	5.27	4.48	37.29	37.80	29.29	30.73	28.88	24.93	44.01	32.85	1
	10.15	10.55	8.97	79.50	80.75	60.74	64.01	59.84	51.15	97.07	68.87	2
	15.25	15.86	13.48	147.12		98.65	105.30	96.86	80.71		116.03	3
	20.38	21.20	18.00						119.40			4
	Edges:	K 4.30	LI 23.07	LII 23.99	LIII 29.38							

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SECTION 2

Two-Theta Values in Ascending Numerical Order

2θ	Element	Line	N	2θ	Element	Line	N
4.30	92 U	K	abs	6.66	82 Pb	Kα1	1
4.48	92 U	KB1	1	6.67	83 Bi	Kα2	1
4.52	92 U	KB3	1	6.74	77 Ir	KB5	1
4.54	90 Th	K	abs	6.76	76 Os	K	abs
4.59	90 Th	KB2	1	6.78	77 Ir	KB1	1
4.70	90 Th	KB5	1	6.80	76 Os	KB2	1
4.72	90 Th	KB1	1	6.84	77 Ir	KB3	1
4.76	90 Th	KB3	1	6.85	81 Tl	Kα1	1
5.07	92 U	Kα1	1	6.86	82 Pb	Kα2	1
5.27	92 U	Kα2	1	6.97	75 Re	K	abs
5.35	90 Th	Kα1	1	6.99	76 Os	KB1	1
5.52	83 Bi	K	abs	7.01	75 Re	KB2	1
5.55	90 Th	Kα2	1	7.04	76 Os	KB3	1
5.55	83 Bi	KB2	1	7.05	80 Hg	Kα1	1
5.67	82 Pb	K	abs	7.05	81 Tl	Kα2	1
5.70	82 Pb	KB4	1	7.18	74 W	K	abs
5.71	82 Pb	KB2	1	7.20	75 Re	KB1	1
5.71	83 Bi	KB1	1	7.20	74 W	KB4	1
5.75	83 Bi	KB3	1	7.22	74 W	KB2	1
5.82	81 Tl	K	abs	7.24	75 Re	KB3	1
5.83	82 Pb	KB5	1	7.24	80 Hg	Kα2	1
5.87	81 Tl	KB2	1	7.26	79 Au	Kα1	1
5.88	82 Pb	KB1	1	7.37	74 W	KB5	1
5.91	82 Pb	KB2	1	7.40	73 Ta	K	abs
6.02	80 Hg	K	abs	7.42	74 W	KB1	1
6.04	81 Tl	KB1	1	7.43	73 Ta	KB4	1
6.05	80 Hg	KB2	1	7.45	73 Ta	KB2	1
6.08	81 Tl	KB3	1	7.45	79 Au	Kα2	1
6.18	79 Au	K	abs	7.46	74 W	KB3	1
6.21	79 Au	KB4	1	7.47	78 Pt	Kα1	1
6.22	79 Au	KB2	1	7.60	73 Ta	KB5	1
6.22	80 Hg	KB1	1	7.64	72 Hf	K	abs
6.24	80 Hg	KB3	1	7.65	73 Ta	KB1	1
6.36	79 Au	KB5	1	7.66	78 Pt	Kα2	1
6.37	78 Pt	K	abs	7.68	72 Hf	KB2	1
6.39	78 Pt	KB4	1	7.69	73 Ta	KB3	1
6.40	79 Au	KB1	1	7.69	77 Ir	Kα1	1
6.41	78 Pt	KB2	1	7.87	72 Hf	KB1	1
6.43	79 Au	KB3	1	7.89	71 Lu	K	abs
6.47	83 Bi	Kα1	1	7.89	77 Ir	Kα2	1
6.54	78 Pt	KB5	1	7.90	72 Hf	KB3	1
6.56	77 Ir	K	abs	7.92	76 Os	Kα1	1
6.58	77 Ir	KB4	1	7.93	71 Lu	KB2	1
6.59	78 Pt	KB1	1	8.12	76 Os	Kα2	1
6.60	77 Ir	KB2	1	8.14	71 Lu	KB1	1
6.62	78 Pt	KB3	1	8.14	70 Yb	K	abs

2θ	Element	Line	N	2θ	Element	Line	N
8.17	75 Re	Kα1	1	10.35	63 Eu	KB2	1
8.17	71 Lu	KB3	1	10.36	68 Fr	Kα2	1
8.20	70 Yb	KB2	1	10.51	67 Ho	Kα1	1
8.36	75 Re	Kα2	1	10.55	92 U	Kα2	2
8.41	70 Yb	KB1	1	10.62	63 Eu	KB1	1
8.41	69 Tm	K	abs	10.65	63 Eu	KB3	1
8.42	74 W	Kα1	1	10.66	62 Sm	K	abs
8.44	70 Yb	KB3	1	10.70	67 Ho	Kα2	1
8.61	74 W	Kα2	1	10.70	90 Th	Kα1	2
8.67	69 Tm	KB1	1	10.73	62 Sm	KB2	1
8.68	73 Ta	Kα1	1	10.86	66 Dy	Kα1	1
8.68	68 Er	K	abs	11.00	62 Sm	KB1	1
8.70	69 Tm	KB3	1	11.05	61 Pm	K	abs
8.75	68 Er	KB2	1	11.05	62 Sm	KB3	1
8.75	92 U	KB2	2	11.05	66 Dy	Kα2	1
8.87	73 Ta	Kα2	1	11.11	90 Th	Kα2	2
8.95	72 Hf	Kα1	1	11.12	83 Bi	KB2	2
8.97	68 Er	KB1	1	11.12	61 Pm	KB2	1
8.97	92 U	KB1	2	11.23	65 Tb	Kα1	1
8.98	67 Ho	K	abs	11.37	61 Pm	KB1	1
9.00	68 Er	KB3	1	11.41	82 Pb	KB4	2
9.03	67 Ho	KB2	1	11.42	65 Tb	Kα2	1
9.05	92 U	KB3	2	11.43	61 Pm	KB3	1
9.14	72 Hf	Kα2	1	11.44	82 Pb	KB2	2
9.19	90 Th	KB2	2	11.44	83 Bi	KB1	2
9.24	71 Lu	Kα1	1	11.47	60 Nd	K	abs
9.27	67 Ho	KB1	1	11.51	83 Bi	KB3	2
9.28	66 Dy	K	abs	11.54	60 Nd	KB2	1
9.30	67 Ho	KB3	1	11.62	64 Gd	Kα1	1
9.34	66 Dy	KB2	1	11.68	82 Pb	KB5	2
9.40	90 Th	KB5	2	11.74	81 Tl	KB2	2
9.43	71 Lu	Kα2	1	11.77	82 Pb	KB1	2
9.46	90 Th	KB1	2	11.82	64 Gd	Kα2	1
9.53	90 Th	KB3	2	11.82	60 Nd	KB1	1
9.54	70 Yb	Kα1	1	11.83	82 Pb	KB3	2
9.57	66 Dy	KB1	1	11.85	60 Nd	KB3	1
9.60	66 Dy	KB3	1	11.90	59 Pr	K	abs
9.60	65 Tb	K	abs	11.96	59 Pr	KB2	1
9.65	65 Tb	KB2	1	12.03	63 Eu	Kα1	1
9.73	66 Yb	Kα2	1	12.10	81 Tl	KB1	2
9.84	69 Tm	Kα1	1	12.12	80 Hg	KB2	2
9.91	65 Tb	KB1	1	12.17	81 Tl	KB3	2
9.94	65 Tb	KB3	1	12.22	63 Eu	Kα2	1
9.94	64 Gd	K	abs	12.26	59 Pr	KB1	1
10.00	64 Gd	KB2	1	12.29	59 Pr	KB3	1
10.04	69 Tm	Kα2	1	12.36	58 Ce	K	abs
10.15	92 U	Kα1	2	12.39	58 Ce	KB4	1
10.17	68 Er	Kα1	1	12.42	58 Ce	KB2	1
10.25	64 Gd	KB1	1	12.43	79 Au	KB4	2
10.28	64 Gd	KB3	1	12.46	62 Sm	Kα1	1
10.30	63 Eu	K	abs	12.46	80 Hg	KB1	2

20	Element	Line	N	20	Element	Line	N
12.47	79 Au	K $\beta$ 2	2	14.12	81 Tl	K $\alpha$ 2	2
12.49	80 Hg	K $\beta$ 3	2	14.13	80 Hg	K $\alpha$ 1	2
12.64	58 Ce	K $\beta$ 5	1	14.21	90 Th	K $\beta$ 1	3
12.65	62 Sm	K $\alpha$ 2	1	14.30	55 Cs	K $\beta$ 1	1
12.73	79 Au	K $\beta$ 5	2	14.31	90 Th	K $\beta$ 3	3
12.73	58 Ce	K $\beta$ 1	1	14.32	55 Cs	K $\beta$ 3	1
12.76	58 Ce	K $\beta$ 3	1	14.40	58 Ce	K $\alpha$ 1	1
12.76	78 Pt	K $\beta$ 4	2	14.43	75 Re	K $\beta$ 1	2
12.82	79 Au	K $\beta$ 1	2	14.44	74 W	K $\beta$ 4	2
12.84	78 Pt	K $\beta$ 2	2	14.46	54 Xe	K	abs
12.84	57 La	K	abs	14.48	74 W	K $\beta$ 2	2
12.87	57 La	K $\beta$ 4	1	14.50	75 Re	K $\beta$ 3	2
12.88	79 Au	K $\beta$ 3	2	14.52	80 Hg	K $\alpha$ 2	2
12.91	57 La	K $\beta$ 2	1	14.52	54 Xe	K $\beta$ 2	1
12.93	61 Pm	K $\alpha$ 1	1	14.54	79 Au	K $\alpha$ 1	2
12.96	83 Bi	K $\alpha$ 1	2	14.59	58 Ce	K $\alpha$ 2	1
13.10	61 Pm	K $\alpha$ 2	1	14.77	74 W	K $\beta$ 5	2
13.11	78 Pt	K $\beta$ 5	2	14.87	54 Xe	K $\beta$ 1	2
13.12	57 La	K $\beta$ 5	1	14.88	74 W	K $\beta$ 1	2
13.14	92 U	K $\beta$ 2	3	14.89	73 Ta	K $\beta$ 4	2
13.19	77 Ir	K $\beta$ 4	2	14.90	54 Xe	K $\beta$ 3	1
13.20	78 Pt	K $\beta$ 1	2	14.93	73 Ta	K $\beta$ 2	2
13.22	77 Ir	K $\beta$ 2	2	14.94	79 Au	K $\alpha$ 2	2
13.22	57 La	K $\beta$ 1	1	14.94	74 W	K $\beta$ 3	2
13.25	57 La	K $\beta$ 3	1	14.96	57 La	K $\alpha$ 1	1
13.27	78 Pt	K $\beta$ 3	2	14.97	78 Pt	K $\alpha$ 1	2
13.34	82 Pb	K $\alpha$ 1	2	15.08	53 I	K	abs
13.36	56 Ba	K	abs	15.14	57 La	K $\alpha$ 2	1
13.36	83 Bi	K $\alpha$ 2	2	15.15	53 I	K $\beta$ 2	1
13.38	60 Nd	K $\alpha$ 1	1	15.23	73 Ta	K $\beta$ 5	2
13.42	56 Ba	K $\beta$ 2	1	15.25	92 U	K $\alpha$ 1	3
13.48	92 U	K $\beta$ 1	3	15.34	73 Ta	K $\beta$ 1	2
13.50	77 Ir	K $\beta$ 5	2	15.37	78 Pt	K $\alpha$ 2	2
13.51	60 Nd	K $\alpha$ 2	1	15.40	72 Hf	K $\beta$ 2	2
13.59	92 U	K $\beta$ 3	3	15.41	73 Ta	K $\beta$ 3	2
13.59	77 Ir	K $\beta$ 1	2	15.42	77 Ir	K $\alpha$ 1	2
13.62	76 Os	K $\beta$ 2	2	15.49	53 I	K $\beta$ 1	1
13.64	56 Ba	K $\beta$ 5	1	15.52	53 I	K $\beta$ 3	1
13.66	77 Ir	K $\beta$ 3	2	15.54	56 Ba	K $\alpha$ 1	1
13.72	81 Tl	K $\alpha$ 1	2	15.73	56 Ba	K $\alpha$ 2	1
13.74	82 Pb	K $\alpha$ 2	2	15.73	52 Te	K	abs
13.74	56 Ba	K $\beta$ 1	1	15.79	52 Te	K $\beta$ 2	1
13.77	56 Ba	K $\beta$ 3	1	15.79	72 Hf	K $\beta$ 1	2
13.80	90 Th	K $\beta$ 2	3	15.81	77 Ir	K $\alpha$ 2	2
13.88	59 Pr	K $\alpha$ 1	1	15.84	72 Hf	K $\beta$ 3	2
13.90	55 Cs	K	abs	15.86	92 U	K $\alpha$ 2	3
13.96	55 Cs	K $\beta$ 2	1	15.89	76 Os	K $\alpha$ 1	2
14.00	76 Os	K $\beta$ 1	2	15.89	71 Lu	K $\beta$ 2	2
14.04	75 Re	K $\beta$ 2	2	16.08	90 Th	K $\alpha$ 1	3
14.07	59 Pr	K $\alpha$ 2	1	16.15	52 Te	K $\beta$ 1	1
14.07	76 Os	K $\beta$ 3	2	16.16	55 Cs	K $\alpha$ 1	1
14.12	90 Th	K $\beta$ 5	3	16.17	52 Te	K $\beta$ 3	1

20	Element	Line	N	20	Element	Line	N
16.28	76 Os	K $\alpha$ 2	2	18.15	92 U	KB3	4
16.32	71 Lu	KB1	2	18.20	81 Tl	KB1	3
16.34	55 Cs	K $\alpha$ 2	1	18.21	80 Hg	KB2	3
16.37	75 Re	K $\alpha$ 1	2	18.22	49 In	KB5	1
16.39	71 Lu	KB3	2	18.23	52 Te	K $\alpha$ 1	1
16.42	51 Sb	K	abs	18.30	81 Tl	KB3	3
16.43	51 Sb	KB4	1	18.34	72 Hf	K $\alpha$ 2	2
16.44	70 Yb	KB2	2	18.37	49 In	KB1	1
16.47	51 Sb	KB2	1	18.39	49 In	KB3	1
16.70	90 Th	K $\alpha$ 2	3	18.42	52 Te	K $\alpha$ 2	1
16.71	51 Sb	KB5	1	18.43	90 Th	KB2	4
16.71	83 Bi	KB2	3	18.53	71 Lu	K $\alpha$ 1	2
16.77	75 Re	K $\alpha$ 2	2	18.60	67 Ho	KB1	2
16.80	54 Xe	K $\alpha$ 1	1	18.67	67 Ho	KB3	2
16.84	51 Sb	KB1	1	18.70	79 Au	KB4	3
16.86	70 Yb	KB1	2	18.73	66 Dy	KB2	2
16.87	51 Sb	KB3	1	18.74	80 Hg	KB1	3
16.88	74 W	K $\alpha$ 1	2	18.75	79 Au	KB2	3
16.93	70 Yb	KB3	2	18.76	48 Cd	K	abs
16.98	54 Xe	K $\alpha$ 2	1	18.78	80 Hg	KB3	3
17.15	82 Pb	KB4	3	18.81	48 Cd	KB2	1
17.15	50 Sn	K	abs	18.86	90 Th	KB5	4
17.16	50 Sn	KB4	1	18.92	71 Lu	K $\alpha$ 2	2
17.19	82 Pb	KB2	3	18.98	90 Th	KB1	4
17.20	83 Bi	KB1	3	19.01	51 Sb	K $\alpha$ 1	1
17.20	50 Sn	KB2	1	19.12	90 Th	KB3	4
17.27	74 W	K $\alpha$ 2	2	19.14	70 Yb	K $\alpha$ 1	2
17.30	83 Bi	KB3	3	19.15	79 Au	KB5	3
17.39	69 Tm	KB1	2	19.19	51 Sb	K $\alpha$ 2	1
17.41	73 Ta	K $\alpha$ 1	2	19.20	48 Cd	KB1	1
17.44	50 Sn	KB5	1	19.21	66 Dy	KB1	2
17.45	69 Tm	KB3	2	19.23	48 Cd	KB3	1
17.50	53 I	K $\alpha$ 1	1	19.26	78 Pt	KB4	3
17.54	68 Er	KB2	2	19.27	66 Dy	KB3	2
17.55	92 U	KB2	4	19.28	79 Au	KB1	3
17.56	82 Pb	KB5	3	19.30	78 Pt	KB2	3
17.58	50 Sn	KB1	1	19.37	65 Tb	KB2	2
17.61	50 Sn	KB3	1	19.38	79 Au	KB3	3
17.66	81 Tl	KB2	3	19.50	83 Bi	K $\alpha$ 1	3
17.69	53 I	K $\alpha$ 2	1	19.53	70 Yb	K $\alpha$ 2	2
17.69	82 Pb	KB1	3	19.64	47 Ag	K	abs
17.79	82 Pb	KB3	3	19.65	47 Ag	KB4	1
17.80	73 Ta	K $\alpha$ 2	2	19.69	47 Ag	KB2	1
17.93	49 In	K	abs	19.72	78 Pt	KB5	3
17.94	49 In	KB4	1	19.76	69 Tm	K $\alpha$ 1	2
17.95	72 Hf	K $\alpha$ 1	2	19.84	77 Ir	KB4	3
17.98	49 In	KB2	1	19.84	50 Sn	K $\alpha$ 1	1
17.99	68 Er	KB1	2	19.86	78 Pt	KB1	3
18.00	92 U	KB1	4	19.89	77 Ir	KB2	3
18.06	68 Er	KB3	2	19.90	65 Tb	KB1	2
18.13	67 Ho	KB2	2	19.94	47 Ag	KB5	1

2θ	Element	Line	N	2θ	Element	Line	N
19.96	78 Pt	KB3	3	21.88	79 Au	Kα1	3
19.96	65 Tb	KB3	2	21.90	45 Rh	KB5	1
20.02	50 Sn	Kα2	1	21.99	92 U	KB2	5
20.06	82 Pb	Kα1	3	22.09	45 Rh	KB1	1
20.07	64 Gd	KB2	2	22.11	62 Sm	KB1	2
20.10	47 Ag	KB1	1	22.11	45 Rh	KB3	1
20.10	83 Bi	Kα2	3	22.17	62 Sm	KB3	2
20.13	47 Ag	KB3	1	22.21	66 Dy	Kα2	2
20.15	69 Tm	Kα2	2	22.24	74 W	KB5	3
20.31	77 Ir	KB5	3	22.32	90 Th	Kα2	4
20.38	92 U	Kα1	4	22.32	61 Pm	KB2	2
20.42	68 Er	Kα1	2	22.35	83 Bi	KB2	4
20.45	77 Ir	KB1	3	22.40	74 W	KB1	3
20.50	76 Os	KB2	3	22.41	73 Ta	KB4	3
20.55	77 Ir	KB3	3	22.47	73 Ta	KB2	3
20.59	64 Gd	KB1	2	22.48	79 Au	Kα2	3
20.60	46 Pd	K	abs	22.50	74 W	KB3	3
20.64	46 Pd	KB2	1	22.54	78 Pt	Kα1	3
20.65	81 Tl	Kα1	3	22.55	92 U	KB1	5
20.65	64 Gd	KB3	2	22.58	65 Tb	Kα1	2
20.67	82 Pb	Kα2	3	22.65	47 Ag	Kα1	1
20.72	49 In	Kα1	1	22.70	44 Ru	K	abs
20.79	63 Eu	KB2	2	22.72	44 Ru	KB4	1
20.81	68 Er	Kα2	2	22.74	92 U	KB3	5
20.90	49 In	Kα2	1	22.75	44 Ru	KB2	1
20.90	46 Pd	KB5	1	22.84	47 Ag	Kα2	1
21.06	46 Pd	KB1	1	22.85	61 Pm	KB1	2
21.07	76 Os	KB1	3	22.93	82 Pb	KB4	4
21.09	46 Pd	KB3	1	22.94	73 Ta	KB5	3
21.11	67 Ho	Kα1	2	22.96	65 Tb	Kα2	2
21.13	75 Re	KB2	3	22.98	61 Pm	KB3	2
21.17	76 Os	KB3	3	22.99	82 Pb	KB2	4
21.20	92 U	Kα2	4	23.00	83 Bi	KB1	4
21.25	81 Tl	Kα2	3	23.00	44 Ru	KB5	1
21.26	80 Hg	Kα1	3	23.07	92 U	LI	abs
21.34	63 Eu	KB1	2	23.10	90 Th	KB2	5
21.40	63 Eu	KB3	2	23.10	73 Ta	KB1	3
21.49	67 Ho	Kα2	2	23.14	83 Bi	KB3	4
21.50	90 Th	Kα1	4	23.14	78 Pt	Kα2	3
21.56	62 Sm	KB2	2	23.19	72 Hf	KB2	3
21.60	45 Rh	K	abs	23.19	44 Ru	KB1	1
21.62	45 Rh	KB4	1	23.20	60 Nd	KB2	2
21.65	48 Cd	Kα1	1	23.20	73 Ta	KB3	3
21.66	45 Rh	KB2	1	23.22	44 Ru	KB3	1
21.72	75 Re	KB1	3	23.22	77 Ir	Kα1	3
21.73	74 W	KB4	3	23.30	92 U	Ly4	1
21.79	74 W	KB2	3	23.37	64 Gd	Kα1	2
21.82	75 Re	KB3	3	23.49	82 Pb	KB5	4
21.83	66 Dy	Kα1	2	23.62	81 Tl	KB2	4
21.84	48 Cd	Kα2	1	23.66	82 Pb	KB1	4
21.86	80 Hg	Kα2	3	23.72	46 Pd	Kα1	1
				23.76	64 Gd	Kα2	2



2θ	Element	Line	N	2θ	Element	Line	N
23.77	60 Nd	KB1	2	25.55	90 Th	LII	abs
23.77	72 Hf	KB1	3	25.62	79 Au	KB5	4
23.79	90 Th	KB1	5	25.62	58 Ce	KB1	2
23.80	82 Pb	KB3	4	25.65	42 Mo	KB1	1
23.82	77 Ir	Kα2	3	25.67	90 Th	Ly6	1
23.83	60 Nd	KB3	2	25.68	42 Mo	KB3	1
23.86	72 Hf	KB3	3	25.68	58 Ce	KB3	2
23.90	46 Pd	Kα2	1	25.77	78 Pt	KB4	4
23.93	76 Os	Kα1	3	25.79	90 Th	Ly3	1
23.94	71 Lu	KB2	3	25.80	79 Au	KB1	4
23.97	90 Th	KB3	5	25.84	78 Pt	KB2	4
23.99	92 U	LII	abs	25.91	57 La	KB4	2
24.06	59 Pr	KB2	2	25.94	79 Au	KB3	4
24.11	92 U	Ly6	1	25.98	57 La	KB2	2
24.20	63 Eu	Kα1	2	26.03	74 W	Kα2	3
24.26	92 U	Ly3	1	26.03	61 Pm	Kα1	2
24.35	81 Tl	KB1	4	26.06	90 Th	Ly2	1
24.36	80 Hg	KB2	4	26.10	44 Ru	Kα1	1
24.48	81 Tl	KB3	4	26.10	83 Bi	Kα1	4
24.52	76 Os	Kα2	3	26.22	69 Tm	KB1	3
24.54	92 U	Ly2	1	26.24	73 Ta	Kα1	3
24.56	90 Th	LI	abs	26.28	44 Ru	Kα2	1
24.58	71 Lu	KB1	3	26.31	69 Tm	KB3	3
24.59	63 Eu	Kα2	2	26.37	61 Pm	Kα2	2
24.67	75 Re	Kα1	3	26.39	78 Pt	KB5	4
24.67	59 Pr	KB1	2	26.42	57 La	KB5	2
24.69	71 Lu	KB3	3	26.45	68 Er	KB2	3
24.73	59 Pr	KB3	2	26.51	41 Nb	K	abs
24.77	70 Yb	KB2	3	26.52	41 Nb	KB4	1
24.78	90 Th	Ly4	1	26.52	90 Th	Ly1	1
24.87	45 Rh	Kα1	1	26.55	77 Ir	KB4	4
24.93	58 Ce	KB4	2	26.56	41 Nb	KB2	1
24.93	92 U	Ly1	1	26.58	78 Pt	KB1	4
24.99	58 Ce	KB2	2	26.58	92 U	Kα2	5
25.02	79 Au	KB4	4	26.62	77 Ir	KB2	4
25.05	45 Rh	Kα2	1	26.63	57 La	KB1	2
25.06	80 Hg	KB1	4	26.69	57 La	KB3	2
25.06	62 Sm	Kα1	2	26.72	78 Pt	KB3	4
25.08	79 Au	KB2	4	26.80	41 Nb	KB5	1
25.13	80 Hg	KB3	4	26.84	73 Ta	Kα2	3
25.14	42 Mo	K	abs	26.86	82 Pb	Kα1	4
25.15	42 Mo	KB4	1	26.92	83 Bi	Kα2	4
25.19	42 Mo	KB2	1	26.95	60 Nd	Kα1	2
25.26	75 Re	Kα2	3	26.98	67 Ho	KB2	5
25.41	70 Yb	KB1	3	27.00	90 Th	Kα1	5
25.43	58 Ce	KB5	2	27.03	56 Ba	KB2	2
25.43	42 Mo	KB5	1	27.04	41 Nb	KB1	1
25.44	74 W	Kα1	3	27.06	41 Nb	KB3	1
25.45	62 Sm	Kα2	2	27.07	72 Hf	Kα1	3
25.51	70 Yb	KB3	3	27.12	68 Er	KB1	3
25.55	92 U	Kα1	5	27.19	77 Ir	KB5	4

2θ	Element	Line	N	2θ	Element	Line	N
27.23	68 Er	KB3	3	29.29	92 U	LB1	1
27.33	60 Nd	Kα2	2	29.32	79 Au	Kα1	4
27.38	77 Ir	KB1	4	29.38	92 U	LIII	abs
27.44	76 Os	KB2	4	29.43	58 Ce	Kα2	2
27.47	56 Ba	KB5	2	29.47	70 Yb	Kα2	3
27.52	77 Ir	KB3	4	29.55	92 U	LB5	1
27.65	81 Tl	Kα1	4	29.60	39 Y	K	abs
27.67	72 Hf	Kα2	3	29.61	39 Y	KB4	1
27.67	82 Pb	Kα2	4	29.64	81 Tl	KB2	5
27.69	56 Ba	KB1	2	29.65	39 Y	KB2	1
27.75	56 Ba	KB3	2	29.70	82 Pb	KB1	5
27.95	71 Lu	Kα1	3	29.80	74 W	KB5	4
27.97	59 Pr	Kα1	2	29.83	69 Tm	Kα1	3
27.99	40 Zr	K	abs	29.87	82 Pb	KB3	5
28.00	40 Zr	KB4	1	29.89	39 Y	KB5	1
28.01	90 Th	Kα2	5	29.99	54 Xe	KB1	2
28.04	83 Bi	KB2	5	30.01	74 W	KB1	4
28.04	40 Zr	KB2	1	30.04	73 Ta	KB4	4
28.07	67 Ho	KB1	3	30.04	65 Tb	KB1	3
28.13	67 Ho	KB3	3	30.07	54 Xe	KB3	2
28.13	55 Cs	KB2	2	30.12	73 Ta	KB2	4
28.22	76 Os	KB1	4	30.13	79 Au	Kα2	4
28.26	66 Dy	KB2	3	30.14	65 Tb	KB3	3
28.29	40 Zr	KB5	1	30.15	74 W	KB3	4
28.30	75 Re	KB2	4	30.15	39 Y	KB1	1
28.35	59 Pr	Kα2	2	30.17	39 Y	KB3	1
28.36	76 Os	KB3	4	30.18	57 La	Kα1	2
28.46	81 Tl	Kα2	4	30.20	78 Pt	Kα1	4
28.47	80 Hg	Kα1	4	30.30	64 Gd	KB2	3
28.53	40 Zr	KB1	1	30.38	41 Nb	Kα1	1
28.55	71 Lu	Kα2	3	30.43	69 Tm	Kα2	3
28.55	40 Zr	KB3	1	30.45	92 U	LB4	1
28.82	55 Cs	KB1	2	30.55	41 Nb	Kα2	1
28.84	42 Mo	Kα1	1	30.56	57 La	Kα2	2
28.85	82 Pb	KB2	5	30.57	81 Tl	KB1	5
28.86	83 Bi	KB1	5	30.58	53 I	KB2	2
28.88	55 Cs	KB3	2	30.73	92 U	LB2	1
28.88	92 U	LB3	1	30.73	90 Th	LB3	1
28.88	70 Yb	Kα1	3	30.74	73 Ta	KB5	4
28.99	66 Dy	KB1	3	30.82	83 Bi	LI	abs
29.02	42 Mo	Kα2	1	30.85	68 Er	Kα1	3
29.03	83 Bi	KB3	5	30.97	73 Ta	KB1	4
29.04	58 Ce	Kα1	2	30.98	90 Th	LIII	abs
29.08	66 Dy	KB3	3	30.99	83 Bi	Ly4	1
29.10	75 Re	KB1	4	31.02	78 Pt	Kα2	4
29.10	74 W	KB4	4	31.09	72 Hf	KB2	4
29.19	74 W	KB2	4	31.09	64 Gd	KB1	3
29.19	75 Re	KB3	4	31.10	73 Ta	KB3	4
29.24	65 Tb	KB2	3	31.13	77 Ir	Kα1	4
29.28	54 Xe	KB2	2	31.15	90 Th	LB5	1
29.29	80 Hg	Kα2	4	31.17	90 Th	LB1	1

2θ	Element	Line	N	2θ	Element	Line	N
31.19	64 Gd	KB3	3	33.18	83 Bi	Ly1	1
31.28	53 I	KB1	2	33.22	51 Sb	KB4	2
31.33	53 I	KB3	2	33.24	70 Yb	KB2	4
31.36	38 Sr	K	abs	33.25	82 Pb	Ly3	1
31.36	38 Sr	KB4	1	33.26	82 Pb	LII	abs
31.38	56 Ba	Kα1	2	33.28	37 Rb	K	abs
31.40	38 Sr	KB2	1	33.30	51 Sb	KB2	2
31.41	63 Eu	KB2	3	33.32	37 Rb	KB2	1
31.43	68 Er	Kα2	3	33.34	82 Pb	Ly6	1
31.50	79 Au	KB2	5	33.40	78 Pt	KB1	5
31.64	38 Sr	KB5	1	33.43	62 Sm	KB1	3
31.64	56 Ba	Kα2	2	33.46	77 Ir	KB2	5
31.85	82 Pb	LI	abs	33.52	82 Pb	Ly2	1
31.88	52 Te	KB2	2	33.53	62 Sm	KB3	3
31.88	72 Hf	KB1	4	33.54	37 Rb	KB5	1
31.89	67 Ho	Kα1	3	33.57	78 Pt	KB3	5
31.91	38 Sr	KB1	1	33.59	66 Dy	Kα2	3
31.93	38 Sr	KB3	1	33.75	82 Pb	Kα1	5
31.94	77 Ir	Kα2	4	33.78	51 Sb	KB5	2
32.00	72 Hf	KB3	4	33.80	61 Pm	KB2	3
32.04	40 Zr	Kα1	1	33.82	83 Bi	Kα2	5
32.04	82 Pb	Ly4	1	33.83	37 Rb	KB1	1
32.09	76 Os	Kα1	4	33.84	39 Y	Kα1	1
32.11	71 Lu	KB2	4	33.85	37 Rb	KB3	1
32.15	83 Bi	LII	abs	33.90	75 Re	Kα2	4
32.18	83 Bi	Ly3	1	33.97	54 Xe	Kα1	2
32.21	40 Zr	Kα2	1	34.01	39 Y	Kα2	1
32.23	83 Bi	Ly6	1	34.06	51 Sb	KB1	2
32.24	63 Eu	KB1	3	34.10	70 Yb	KB1	4
32.32	90 Th	LB4	1	34.11	80 Hg	LI	abs
32.34	63 Eu	KB3	3	34.12	51 Sb	KB3	2
32.36	90 Th	LB2	1	34.14	74 W	Kα1	4
32.41	79 Au	KB1	5	34.15	65 Tb	Kα1	3
32.44	83 Bi	Ly2	1	34.24	70 Yb	KB3	4
32.46	78 Pt	KB2	5	34.26	80 Hg	Ly4	1
32.47	67 Ho	Kα2	3	34.30	82 Pb	Ly1	1
32.58	62 Sm	KB2	3	34.34	54 Xe	Kα2	2
32.59	79 Au	KB3	5	34.36	81 Tl	Ly3	1
32.62	52 Te	KB1	2	34.42	77 Ir	KB1	5
32.65	55 Cs	Kα1	2	34.45	81 Tl	LII	abs
32.68	52 Te	KB3	2	34.50	81 Tl	Ly6	1
32.79	83 Bi	Kα1	5	34.50	76 Os	KB2	5
32.85	92 U	Lη	1	34.57	61 Pm	KB1	3
32.90	76 Os	Kα2	4	34.60	77 Ir	KB3	5
32.96	81 Tl	LI	abs	34.64	81 Tl	Ly2	1
32.98	71 Lu	KB1	4	34.72	50 Sn	KB4	2
32.99	66 Dy	Kα1	3	34.74	65 Tb	Kα2	3
33.03	55 Cs	Kα2	2	34.76	81 Tl	Kα1	5
33.09	75 Re	Kα1	4	34.79	61 Pm	KB3	3
33.12	71 Lu	KB3	4	34.79	82 Pb	Kα2	5
33.13	81 Tl	Ly4	1	34.81	50 Sn	KB2	2

20	Element	Line	N	20	Element	Line	N
34.92	90 Th	L $\eta$	1	36.95	52 Te	K $\alpha$ 1	2
34.95	74 W	K $\alpha$ 2	4	36.95	79 Au	LII	abs
35.11	60 Nd	K $\beta$ 2	3	36.97	79 Au	L $\gamma$ 6	1
35.20	69 Tm	K $\beta$ 1	4	37.03	79 Au	L $\gamma$ 2	1
35.23	73 Ta	K $\alpha$ 1	4	37.18	72 Hf	K $\alpha$ 2	4
35.29	79 Au	LI	abs	37.23	49 In	K $\beta$ 1	2
35.30	50 Sn	K $\beta$ 5	2	37.26	63 Eu	K $\alpha$ 2	3
35.32	69 Tm	K $\beta$ 3	4	37.28	49 In	K $\beta$ 3	2
35.37	64 Gd	K $\alpha$ 1	3	37.29	92 U	L $\alpha$ 1	1
35.38	36 Kr	K	abs	37.33	52 Te	K $\alpha$ 2	2
35.41	36 Kr	K $\beta$ 2	1	37.38	59 Pr	K $\beta$ 1	3
35.43	53 I	K $\alpha$ 1	2	37.48	59 Pr	K $\beta$ 3	3
35.45	79 Au	L $\gamma$ 4	1	37.57	71 Lu	K $\alpha$ 1	4
35.47	81 Tl	L $\gamma$ 1	1	37.69	35 Br	K	abs
35.49	76 Os	K $\beta$ 1	5	37.72	35 Br	K $\beta$ 2	1
35.51	68 Er	K $\beta$ 2	4	37.72	67 Ho	K $\beta$ 1	4
35.54	80 Hg	L $\gamma$ 3	1	37.75	74 W	K $\beta$ 1	5
35.58	75 Re	K $\beta$ 2	5	37.78	58 Ce	K $\beta$ 4	3
35.59	50 Sn	K $\beta$ 1	2	37.80	92 U	L $\alpha$ 2	1
35.61	36 Kr	K $\beta$ 5	1	37.82	77 Ir	LI	abs
35.65	50 Sn	K $\beta$ 3	2	37.83	67 Ho	K $\beta$ 3	4
35.66	76 Os	K $\beta$ 3	5	37.84	83 Bi	LIII	abs
35.67	80 Hg	LII	abs	37.88	58 Ce	K $\beta$ 2	3
35.71	80 Hg	L $\gamma$ 6	1	37.91	73 Ta	K $\beta$ 2	5
35.79	81 Tl	K $\alpha$ 2	5	37.92	79 Au	K $\alpha$ 2	5
35.79	38 Sr	K $\alpha$ 1	1	37.93	35 Br	K $\beta$ 5	1
35.80	80 Hg	L $\gamma$ 2	1	37.93	37 Rb	K $\alpha$ 1	1
35.81	53 I	K $\alpha$ 2	2	37.93	83 Bi	L $\beta$ 5	1
35.93	36 Kr	K $\beta$ 1	1	37.94	74 W	K $\beta$ 3	5
35.95	36 Kr	K $\beta$ 3	1	37.97	79 Au	L $\gamma$ 1	1
35.97	38 Sr	K $\alpha$ 2	1	37.98	62 Sm	K $\alpha$ 1	3
35.98	64 Gd	K $\alpha$ 2	3	37.99	66 Dy	K $\beta$ 2	4
35.99	60 Nd	K $\beta$ 1	3	38.01	77 Ir	L $\gamma$ 4	1
36.05	73 Ta	K $\alpha$ 2	4	38.01	78 Pt	K $\alpha$ 1	5
36.08	60 Nd	K $\beta$ 3	3	38.03	78 Pt	L $\gamma$ 3	1
36.33	49 In	K $\beta$ 4	2	38.10	37 Rb	K $\alpha$ 2	1
36.37	72 Hf	K $\alpha$ 1	4	38.14	48 Cd	K $\beta$ 2	2
36.42	49 In	K $\beta$ 2	2	38.23	35 Br	K $\beta$ 1	1
36.43	59 Pr	K $\beta$ 2	3	38.26	35 Br	K $\beta$ 3	1
36.44	68 Er	K $\beta$ 1	4	38.30	78 Pt	L $\gamma$ 6	1
36.56	78 Pt	LI	abs	38.30	78 Pt	L $\gamma$ 2	1
36.58	68 Er	K $\beta$ 3	4	38.30	78 Pt	LII	abs
36.60	75 Re	K $\beta$ 1	5	38.38	71 Lu	K $\alpha$ 2	4
36.65	63 Eu	K $\alpha$ 1	3	38.48	83 Bi	L $\beta$ 3	1
36.69	80 Hg	L $\gamma$ 1	1	38.55	58 Ce	K $\beta$ 5	3
36.70	78 Pt	L $\gamma$ 4	1	38.57	51 Sb	K $\alpha$ 1	2
36.72	74 W	K $\beta$ 2	5	38.58	62 Sm	K $\alpha$ 2	3
36.73	67 Ho	K $\beta$ 2	4	38.84	70 Yb	K $\alpha$ 1	4
36.75	79 Au	L $\gamma$ 3	1	38.86	58 Ce	K $\beta$ 1	3
36.78	75 Re	K $\beta$ 3	5	38.95	58 Ce	K $\beta$ 3	3
36.88	79 Au	K $\alpha$ 1	5	38.95	51 Sb	K $\alpha$ 2	2
36.92	49 In	K $\beta$ 5	2	38.98	48 Cd	K $\beta$ 1	2

2θ	Element	Line	N	2θ	Element	Line	N
38.98	82 Pb	LIII	abs	40.56	65 Tb	KB3	4
38.98	66 Dy	KB1	4	40.66	75 Re	LI	abs
38.99	73 Ta	KB1	5	40.68	50 Sn	Kα2	2
39.03	48 Cd	KB3	2	40.72	77 Ir	Ly1	1
39.05	78 Pt	Kα2	5	40.76	76 Os	Ly3	1
39.06	83 Bi	LB1	1	40.77	34 Se	KB1	1
39.08	82 Pb	LB5	1	40.79	75 Re	Ly4	1
39.12	66 Dy	KB3	4	40.79	64 Gd	KB2	4
39.14	72 Hf	KB2	5	40.79	34 Se	KB3	1
39.16	73 Ta	KB3	5	40.86	47 Ag	KB1	2
39.19	83 Bi	LB2	1	40.91	47 Ag	KB3	2
39.19	77 Ir	Kα1	5	40.92	60 Nd	Kα1	3
39.21	76 Os	LI	abs	40.96	69 Tm	Kα2	4
39.23	90 Th	La1	1	41.03	76 Os	Ly2	1
39.31	57 La	KB4	3	41.04	56 Ba	KB2	3
39.31	78 Pt	Ly1	1	41.14	81 Tl	LB3	1
39.33	65 Tb	KB2	4	41.16	76 Os	LII	abs
39.37	76 Os	Ly4	1	41.16	76 Os	Ly6	1
39.37	77 Ir	Ly3	1	41.43	82 Pb	LB4	1
39.41	57 La	KB2	3	41.45	76 Os	Kα2	5
39.49	61 Pm	Kα1	3	41.50	80 Hg	LIII	abs
39.63	77 Ir	Ly2	1	41.51	60 Nd	Kα2	3
39.65	70 Yb	Kα2	4	41.54	80 Hg	LB5	1
39.70	77 Ir	LII	abs	41.54	68 Er	Kα1	4
39.70	77 Ir	Ly6	1	41.56	81 Tl	KB2	1
39.73	90 Th	La2	1	41.57	71 Lu	KB1	5
39.78	82 Pb	LB3	1	41.71	75 Re	Kα1	5
39.91	47 Ag	KB4	2	41.73	56 Ba	KB5	3
40.00	47 Ag	KB2	2	41.74	71 Lu	KB3	5
40.02	61 Pm	Kα2	3	41.77	81 Tl	LB1	1
40.10	57 La	KB5	3	41.88	64 Gd	KB1	4
40.12	83 Bi	LB4	1	41.89	70 Yb	KB2	5
40.14	69 Tm	Kα1	4	41.99	46 Pd	KB2	2
40.16	72 Hf	KB1	5	42.01	64 Gd	KB3	4
40.22	81 Tl	LIII	abs	42.08	56 Ba	KB1	3
40.23	77 Ir	Kα2	5	42.15	49 In	Kα1	2
40.24	34 Se	K	abs	42.16	56 Ba	KB3	3
40.25	34 Se	KB2	1	42.17	74 W	LI	abs
40.26	36 Kr	Kα1	1	42.19	76 Os	Ly1	1
40.28	81 Tl	LB5	1	42.19	76 Os	Ly1	1
40.28	81 Tl	LB5	1	42.24	75 Re	Ly3	1
40.30	50 Sn	Kα1	2	42.31	74 W	Ly4	1
40.30	72 Hf	KB2	5	42.31	63 Eu	KB2	4
40.35	82 Pb	LB1	1	42.34	68 Er	Kα2	4
40.38	82 Pb	LB2	1	42.50	75 Re	Ly2	1
40.42	57 La	KB1	3	42.51	59 Pr	Kα1	3
40.42	76 Os	Kα1	5	42.54	49 In	Kα2	2
40.43	65 Tb	KB1	4	42.55	46 Pd	KB5	2
40.43	36 Kr	Kα2	1	42.56	80 Hg	LB3	1
40.44	34 Se	KB5	1	42.56	80 Hg	LB3	1
40.44	71 Lu	KB2	5	42.70	75 Re	LII	abs
40.51	57 La	KB3	3	42.71	75 Re	Ly6	1
40.51	47 Ag	KB5	2	42.75	75 Re	Kα2	5
				42.76	55 Cs	KB2	3

2θ	Element	Line	N	2θ	Element	Line	N
42.80	81 Tl	Lβ4	1	44.72	79 Au	Lβ1	1
42.82	80 Hg	Lβ2	1	44.79	58 Ce	Kα2	3
42.82	35 Br	Kα1	1	44.82	68 Er	KB2	5
42.83	79 Au	LIII	abs	45.06	45 Rh	KB1	2
42.85	79 Au	Lβ5	1	45.10	62 Sm	KB1	4
42.88	46 Pd	KB1	2	45.11	45 Rh	KB3	2
42.94	46 Pd	KB3	2	45.11	82 Pb	Lη	1
42.98	67 Ho	Kα1	4	45.17	75 Re	Ly5	1
43.00	35 Br	Kα2	1	45.23	62 Sm	KB3	4
43.00	70 Yb	KB1	5	45.32	66 Dy	Kα2	4
43.05	74 W	Kα1	5	45.32	74 W	Ly1	1
43.05	33 As	K	abs	45.41	73 Ta	Ly3	1
43.05	33 As	KB2	1	45.42	72 Hf	LI	abs
43.10	59 Pr	Kα2	3	45.50	73 Ta	Kα2	5
43.18	70 Yb	KB3	5	45.53	78 Pt	Lβ2	1
43.21	80 Hg	Lβ1	1	45.57	72 Hf	Ly4	1
43.21	33 As	KB5	1	45.61	78 Pt	Lβ3	1
43.22	61 Pm	KB2	4	45.65	34 Se	Kα1	1
43.46	63 Eu	KB1	4	45.68	73 Ta	Ly2	1
43.58	33 As	KB1	1	45.68	54 Xe	KB1	3
43.60	63 Eu	KB3	4	45.69	77 Ir	LIII	abs
43.60	33 As	KB3	1	45.70	77 Ir	Lβ5	1
43.64	83 Bi	Lη	1	45.72	79 Au	KB4	1
43.74	75 Re	Ly1	1	45.80	54 Xe	KB3	3
43.74	73 Ta	LI	abs	45.82	34 Se	Kα2	1
43.78	74 W	Ly3	1	45.92	72 Hf	Kα1	5
43.79	67 Ho	Kα2	4	45.97	57 La	Kα1	3
43.83	55 Cs	KB1	3	46.01	68 Er	KB1	5
43.90	73 Ta	Ly4	1	46.03	73 Ta	LII	abs
43.92	55 Cs	KB3	3	46.04	73 Ta	Ly6	1
43.92	62 Sm	KB2	4	46.10	65 Tb	Kα1	4
44.01	92 U	LI	1	46.10	90 Th	LI	1
44.04	79 Au	Lβ3	1	46.16	32 Ge	K	abs
44.05	45 Rh	KB4	2	46.18	32 Ge	KB2	1
44.05	74 W	Ly2	1	46.19	68 Er	KB3	5
44.10	74 W	Kα2	5	46.26	47 Ag	Kα1	2
44.13	48 Cd	Kα1	2	46.29	32 Ge	KB5	1
44.14	45 Rh	KB2	2	46.31	78 Pt	Lβ1	1
44.14	79 Au	Lβ2	1	46.39	44 Ru	KB4	2
44.19	58 Ce	Kα1	3	46.46	44 Ru	KB2	2
44.23	80 Hg	Lβ4	1	46.57	57 La	Kα2	3
44.24	78 Pt	Lβ5	1	46.60	53 I	KB2	3
44.24	78 Pt	LIII	abs	46.64	47 Ag	Kα2	2
44.33	74 W	Ly6	1	46.65	81 Tl	Lη	1
44.33	74 W	LII	abs	46.68	61 Pm	KB1	4
44.42	69 Tm	KB1	5	46.70	32 Ge	KB1	1
44.46	73 Ta	Kα1	5	46.72	32 Ge	KB3	1
44.50	66 Dy	Kα1	4	46.92	65 Tb	Kα2	4
44.52	48 Cd	Kα2	2	46.95	61 Pm	KB3	4
44.56	54 Xe	KB2	3	46.98	72 Hf	Kα2	5
44.57	69 Tm	KB3	5	46.99	77 Ir	Lβ2	1
44.66	45 Rh	KB5	2				

2θ	Element	Line	N	2θ	Element	Line	N
47.00	44 Ru	KB5	2	49.47	66 Dy	KB3	5
47.10	72 Hf	Ly3	1	49.57	63 Eu	Kα1	4
47.10	73 Ta	Ly1	1	49.65	31 Ga	K	abs
47.20	71 Lu	LI	abs	49.66	31 Ga	KB2	1
47.21	76 Os	LIII	abs	49.71	92 U	Ly3	2
47.21	76 Os	LB5	1	49.72	76 Os	LB1	1
47.23	77 Ir	LB3	1	49.74	31 Ga	KB5	1
47.29	78 Pt	LB4	1	49.75	65 Tb	KB2	5
47.34	71 Lu	Ly4	1	49.77	71 Lu	LII	abs
47.36	83 Bi	La1	1	49.78	71 Lu	Ly6	1
47.38	72 Hf	Ly2	1	49.84	52 Te	KB1	3
47.41	44 Ru	KB1	2	49.88	55 Cs	Kα1	3
47.42	60 Nd	KB2	4	49.92	52 Te	KB3	3
47.46	44 Ru	KB3	2	49.96	79 Au	Lη	1
47.47	71 Lu	Kα1	5	50.13	75 Re	LB2	1
47.64	92 U	Ly4	2	50.17	70 Yb	Kα2	5
47.70	53 I	KB1	3	50.17	81 Tl	La1	1
47.79	64 Gd	Kα1	4	50.19	31 Ga	KB1	1
47.79	53 I	KB3	3	50.21	31 Ga	KB3	1
47.84	72 Hf	LII	abs	50.21	31 Ga	KB3	1
47.86	72 Hf	Ly6	1	50.30	92 U	Ly2	2
47.86	56 Ba	Kα1	3	50.42	63 Eu	Kα2	4
47.86	83 Bi	La2	1	50.48	55 Cs	Kα2	3
47.98	77 Ir	LB1	1	50.53	74 W	LB5	1
48.02	66 Dy	KB2	5	50.53	74 W	LIII	abs
48.24	80 Hg	Lη	1	50.59	59 Pr	KB1	4
48.46	56 Ba	Kα2	3	50.66	76 Os	LB4	1
48.50	76 Os	LB2	1	50.68	81 Tl	La2	1
48.52	71 Lu	Kα2	5	50.72	59 Pr	KB3	4
48.55	46 Pd	Kα1	2	50.74	75 Re	LB3	1
48.64	64 Gd	Kα2	4	50.77	51 Sb	KB4	3
48.65	60 Nd	KB1	4	50.81	69 Tm	Kα1	5
48.66	52 Te	KB2	3	50.82	90 Th	Ly4	2
48.73	82 Pb	La1	1	50.82	69 Tm	LI	abs
48.73	33 As	Kα1	1	50.83	71 Lu	Ly1	1
48.78	60 Nd	KB3	4	50.83	70 Yb	Ly3	1
48.80	75 Re	LIII	abs	50.90	51 Sb	KB2	3
48.83	75 Re	LB5	1	51.02	45 Rh	Kα1	2
48.91	72 Hf	Ly1	1	51.12	70 Yb	Ly2	1
48.93	71 Lu	Ly3	1	51.12	69 Tm	Ly4	1
48.93	76 Os	LB3	1	51.15	58 Ce	KB4	4
48.93	77 Ir	LB4	1	51.15	92 U	Ly1	2
48.94	46 Pd	Kα2	2	51.18	65 Tb	KB1	5
48.94	33 As	Kα2	1	51.29	58 Ce	KB2	4
49.03	70 Yb	LI	abs	51.35	65 Tb	KB3	5
49.12	70 Yb	Kα1	5	51.41	45 Rh	Kα2	2
49.17	71 Lu	Ly2	1	51.43	62 Sm	Kα1	4
49.17	70 Yb	Ly4	1	51.56	75 Re	LB1	1
49.24	82 Pb	La2	1	51.62	42 Mo	KB4	2
49.26	59 Pr	KB2	4	51.65	64 Gd	KB2	5
49.30	66 Dy	KB1	5	51.67	80 Hg	La1	1
49.38	92 U	Ly6	2	51.68	51 Sb	KB5	3
				51.71	42 Mo	KB2	2

2θ	Element	Line	N	2θ	Element	Line	N
51.74	70 Yb	Ly6	1	54.10	30 Zn	KB1	1
51.74	70 Yb	LII	abs	54.10	50 Sn	KB5	3
51.74	78 Pt	Lη	1	54.19	72 Hf	LIII	abs
51.82	74 W	LB2	1	54.21	72 Hf	LB5	1
51.87	69 Tm	Kα2	5	54.29	61 Pm	Kα2	4
51.97	54 Xe	Kα1	3	54.31	53 I	Kα1	3
52.12	51 Sb	KB1	3	54.40	57 La	KB5	4
52.18	80 Hg	Lα2	1	54.40	74 W	LB4	1
52.21	51 Sb	KB3	3	54.51	67 Ho	Kα1	5
52.23	58 Ce	KB5	4	54.57	50 Sn	KB1	3
52.24	42 Mo	KB5	2	54.60	41 Nb	KB4	2
52.25	32 Ge	Kα1	1	54.60	90 Th	Ly1	2
52.27	62 Sm	Kα2	4	54.62	73 Ta	LB3	1
52.30	73 Ta	LIII	abs	54.66	50 Sn	KB3	3
52.31	73 Ta	LB5	1	54.69	41 Nb	KB2	2
52.42	32 Ge	Kα2	1	54.85	57 La	KB1	4
52.48	75 Re	LB4	1	54.91	78 Pt	Lα1	1
52.57	54 Xe	Kα2	3	54.92	53 I	Kα2	3
52.62	68 Er	Kα1	5	54.98	68 Er	Ly3	1
52.64	74 W	LB3	1	54.98	57 La	KB3	4
52.66	58 Ce	KB1	4	55.01	69 Tm	Ly1	1
52.72	42 Mo	KB1	2	55.05	83 Bi	LI	1
52.75	90 Th	Ly6	2	55.10	67 Ho	LI	abs
52.77	42 Mo	KB3	2	55.22	41 Nb	KB5	2
52.78	58 Ce	KB3	4	55.27	68 Er	Ly2	1
52.86	70 Yb	Ly1	1	55.31	63 Eu	KB3	5
52.87	69 Tm	Ly3	1	55.33	67 Ho	Ly4	1
52.88	68 Er	LI	abs	55.42	78 Pt	Lα2	1
53.02	90 Th	Ly3	2	55.51	72 Hf	LB2	1
53.07	64 Gd	KB1	5	55.54	73 Ta	LB1	1
53.14	69 Tm	Ly2	1	55.56	60 Nd	Kα1	4
53.18	50 Sn	KB4	3	55.57	67 Ho	Kα2	5
53.22	68 Er	Ly4	1	55.58	76 Os	Lη	1
53.24	64 Gd	KB3	5	55.72	56 Ba	KB2	4
53.25	79 Au	Lα1	1	55.74	41 Nb	KB1	2
53.29	57 La	KB4	4	55.74	62 Sm	KB2	5
53.31	50 Sn	KB2	3	55.76	49 In	KB4	3
53.43	57 La	KB2	4	55.80	41 Nb	KB3	2
53.50	74 W	LB1	1	55.90	49 In	KB2	3
53.55	61 Pm	Kα1	4	56.06	68 Er	LII	abs
53.56	30 Zn	K	abs	56.14	31 Ga	Kα1	1
53.58	30 Zn	KB2	1	56.20	71 Lu	LIII	abs
53.62	90 Th	Ly2	2	56.21	71 Lu	LB5	1
53.62	73 Ta	LB2	1	56.31	31 Ga	Kα2	1
53.62	30 Zn	KB5	1	56.39	73 Ta	LB4	1
53.62	77 Ir	Lη	1	56.40	60 Nd	Kα2	4
53.62	63 Eu	KB2	5	56.49	66 Dy	Kα1	5
53.63	68 Er	Kα2	5	56.58	82 Pb	LI	1
53.69	44 Ru	Kα1	2	56.65	77 Ir	Lα1	1
53.75	69 Tm	LII	abs	56.70	56 Ba	KB5	4
53.77	79 Au	Lα2	1	56.71	49 In	KB5	3
54.08	44 Ru	Kα2	2	56.72	72 Hf	LB3	1



20	Element	Line	N	20	Element	Line	N
56.76	52 Te	K $\alpha$ 1	3	59.82	55 Cs	KB3	4
57.16	77 Ir	L $\alpha$ 2	1	59.84	92 U	LB3	2
57.19	56 Ba	KB1	4	59.86	65 Tb	LI	abs
57.21	49 In	KB1	3	59.87	74 W	L $\eta$	1
57.22	68 Er	L $\gamma$ 1	1	59.89	80 Hg	LI	1
57.23	67 Ho	L $\gamma$ 3	1	59.96	66 Dy	L $\gamma$ 2	1
57.27	66 Dy	LI	abs	59.98	71 Lu	LB1	1
57.29	62 Sm	KB1	5	60.02	51 Sb	K $\alpha$ 2	3
57.30	49 In	KB3	3	60.06	48 Cd	KB1	3
57.32	56 Ba	KB3	4	60.13	65 Tb	L $\gamma$ 4	1
57.38	52 Te	K $\alpha$ 2	3	60.14	42 Mo	K $\alpha$ 2	2
57.46	62 Sm	KB3	5	60.14	48 Cd	KB3	3
57.51	71 Lu	LB2	1	60.20	58 Ce	K $\alpha$ 1	4
57.53	67 Ho	L $\gamma$ 2	1	60.35	60 Nd	KB2	5
57.58	66 Dy	K $\alpha$ 2	5	60.41	69 Tm	LIII	abs
57.66	75 Re	L $\eta$	1	60.41	75 Re	L $\alpha$ 1	1
57.69	72 Hf	LB1	1	60.52	30 Zn	K $\alpha$ 1	1
57.70	66 Dy	L $\gamma$ 4	1	60.65	66 Dy	LII	abs
57.80	59 Pr	K $\alpha$ 1	4	60.70	30 Zn	K $\alpha$ 2	1
57.82	61 Pm	KB2	5	60.72	54 Xe	KB2	4
57.87	40 Zr	KB4	2	60.74	92 U	LB1	2
57.96	40 Zr	KB2	2	60.79	71 Lu	LB4	1
57.99	29 Cu	K	abs	60.84	64 Gd	K $\alpha$ 1	5
58.01	29 Cu	KB2	1	60.93	75 Re	L $\alpha$ 2	1
58.02	29 Cu	KB5	1	61.06	58 Ce	K $\alpha$ 2	4
58.16	55 Cs	KB2	4	61.32	70 Yb	LB3	1
58.19	81 Tl	LI	1	61.33	92 U	LB5	2
58.25	70 Yb	LIII	abs	61.46	39 Y	LB4	2
58.28	70 Yb	LB5	1	61.56	39 Y	KB2	2
58.41	67 Ho	LII	abs	61.58	47 Ag	KB4	3
58.48	76 Os	L $\alpha$ 1	1	61.66	79 Au	LI	1
58.51	40 Zr	KB5	2	61.73	47 Ag	KB2	3
58.52	72 Hf	LB4	1	61.83	69 Tm	LB2	1
58.53	29 Cu	KB1	1	61.96	64 Gd	K $\alpha$ 2	5
58.54	29 Cu	KB3	1	61.98	60 Nd	KB1	5
58.60	65 Tb	K $\alpha$ 1	5	62.10	39 Y	KB5	2
58.65	59 Pr	K $\alpha$ 2	4	62.15	60 Nd	KB3	5
58.70	48 Cd	KB2	3	62.20	73 Ta	L $\eta$	1
58.96	71 Lu	LB3	1	62.21	65 Tb	L $\gamma$ 3	1
58.99	76 Os	L $\alpha$ 2	1	62.23	50 Sn	K $\alpha$ 1	3
59.04	40 Zr	KB1	2	62.28	66 Dy	L $\gamma$ 1	1
59.10	40 Zr	KB3	2	62.33	54 Xe	KB1	4
59.37	61 Pm	KB1	5	62.41	70 Yb	LB1	1
59.40	51 Sb $\beta$	K $\alpha$ 1	3	62.45	74 W	L $\alpha$ 1	1
59.60	70 Yb	LB2	1	62.47	65 Tb	L $\gamma$ 2	1
59.66	66 Dy	L $\gamma$ 3	1	62.48	64 Gd	LI	abs
59.68	67 Ho	L $\gamma$ 1	1	62.50	71 Lu	L $\eta$	1
59.68	65 Tb	K $\alpha$ 2	5	62.51	54 Xe	KB3	4
59.69	55 Cs	KB1	4	62.55	47 Ag	KB5	3
59.75	42 Mo	K $\alpha$ 1	2	62.68	39 Y	KB1	2
59.75	71 Lu	LB6	1	62.72	68 Er	LIII	abs

2θ	Element	Line	N	2θ	Element	Line	N
62.73	39 Y	KB3	2	65.67	29 Cu	Kα2	1
62.75	57 La	Kα1	4	65.70	62 Sm	Kα1	5
62.75	59 Pr	KB2	5	65.92	49 In	Kα2	3
62.84	64 Gd	Ly4	1	65.95	46 Pd	KB5	3
62.86	50 Sn	Kα2	3	66.08	38 Sr	KB5	2
62.97	74 W	Lα2	1	66.18	56 Ba	Kα2	4
63.00	28 Ni	K	abs	66.49	64 Gd	LII	abs
63.02	28 Ni	KB5	1	66.50	68 Er	LB3	1
63.03	28 Ni	KB2	1	66.50	46 Pd	KB1	3
63.14	47 Ag	KB1	3	66.59	46 Pd	KB3	3
63.15	70 Yb	KB4	1	66.63	52 Te	KB2	4
63.20	41 Nb	Kα1	2	66.70	38 Sr	KB1	2
63.21	63 Eu	Kα1	5	66.76	38 Sr	KB3	2
63.23	47 Ag	KB3	3	66.76	67 Ho	LB2	1
63.36	92 U	LB4	2	66.82	62 Sm	Kα2	5
63.53	78 Pt	LI	1	66.89	72 Hf	Lα1	1
63.57	28 Ni	KB1	1	66.99	40 Zr	Kα1	2
63.60	41 Nb	Kα2	2	66.99	82 Pb	Ly4	2
63.62	57 La	Kα2	4	67.26	65 Tb	LB5	1
63.62	65 Tb	LII	abs	67.32	83 Bi	Ly3	2
63.65	53 I	KB2	4	67.34	58 Ce	KB1	5
63.82	69 Tm	LB3	1	67.35	66 Dy	LIII	abs
64.01	92 U	LB2	2	67.40	40 Zr	Kα2	2
64.02	90 Th	LB3	2	67.41	72 Hf	Lα2	1
64.23	68 Er	LB2	1	67.43	83 Bi	Ly6	2
64.34	63 Eu	Kα2	5	67.51	58 Ce	KB3	5
64.57	59 Pr	KB1	5	67.63	76 Os	LI	1
64.60	83 Bi	Ly4	2	67.64	90 Th	LB4	2
64.60	73 Ta	Lα1	1	67.73	90 Th	LB2	2
64.66	72 Hf	Lη	1	67.74	68 Er	LB1	1
64.74	59 Pr	KB3	5	67.92	63 Eu	Ly3	1
64.94	64 Gd	Ly3	1	67.94	83 Bi	Ly2	2
64.96	90 Th	LB5	2	67.96	64 Gd	Ly1	1
64.97	65 Tb	Ly1	1	68.22	63 Eu	Ly2	1
64.98	69 Tm	LB1	1	68.29	62 Sm	LI	abs
65.01	90 Th	LB1	2	68.36	52 Te	KB1	4
65.02	46 Pd	KB2	3	68.38	57 La	KB2	5
65.12	73 Ta	Lα2	1	68.40	68 Er	LB4	1
65.18	64 Gd	Ly2	1	68.41	55 Cs	Kα1	4
65.24	67 Ho	LIII	abs	68.46	45 Rh	KB4	3
65.25	53 I	KB1	4	68.48	52 Te	KB3	4
65.29	49 In	Kα1	3	68.54	61 Pm	Kα1	5
65.30	63 Eu	LI	abs	68.60	48 Cd	Kα1	3
65.38	53 I	KB3	4	68.61	45 Rh	KB2	3
65.45	38 Sr	KB4	2	68.68	62 Sm	Ly4	1
65.48	56 Ba	Kα1	4	68.76	27 Co	K	abs
65.49	29 Cu	Kα1	1	68.79	27 Co	KB5	1
65.50	58 Ce	KB2	5	68.87	92 U	Lη	2
65.51	77 Ir	LI	1	69.25	48 Cd	Kα2	3
65.54	38 Sr	LB2	2	69.30	55 Cs	Kα2	4
65.65	63 Eu	Ly4	1	69.30	67 Ho	LB3	1
65.67	69 Tm	LB4	1	69.31	71 Lu	Lα1	1

2θ	Element	Line	N	2θ	Element	Line	N
69.37	27 Co	KB1	1	72.43	81 Tl	Ly3	2
69.48	45 Rh	KB5	3	72.54	44 Ru	KB2	3
69.49	66 Dy	LB2	1	72.74	81 Tl	Ly6	2
69.52	81 Tl	Ly4	2	72.86	47 Ag	Ka2	3
69.54	61 Pm	Ka2	5	73.08	81 Tl	Ly2	2
69.63	63 Eu	LII	abs	73.08	69 Tm	L $\eta$	1
69.64	83 Bi	Ly1	2	73.28	50 Sn	KB4	4
69.69	57 La	KB5	5	73.42	62 Sm	LII	abs
69.73	51 Sb	KB4	4	73.47	44 Ru	KB5	3
69.81	82 Pb	Ly3	2	73.48	50 Sn	KB2	4
69.84	71 Lu	La2	1	73.50	56 Ba	KB1	5
69.85	75 Re	L $\eta$	1	73.67	56 Ba	KB3	3
69.91	51 Sb	KB2	4	73.75	90 Th	L $\eta$	2
69.96	37 Rb	KB2	2	73.77	64 Gd	LIII	abs
70.01	82 Pb	Ly6	2	73.80	66 Dy	LB1	1
70.10	70 Yb	L $\eta$	1	74.17	44 Ru	KB1	3
70.16	45 Rh	KB1	3	74.27	44 Ru	KB3	3
70.25	45 Rh	KB3	3	74.31	66 Dy	LB4	1
70.31	57 La	KB1	5	74.35	59 Pr	Ka1	5
70.44	82 Pb	Ly2	2	74.57	92 U	Ly4	3
70.48	57 La	KB3	5	74.62	69 Tm	La1	1
70.50	37 Rb	KB5	2	74.64	62 Sm	Ly1	1
70.65	67 Ho	LB1	1	74.66	50 Sn	KB5	4
70.74	65 Tb	LIII	abs	74.72	73 Ta	L $\eta$	1
71.06	51 Sb	KB5	4	74.83	55 Cs	KB2	5
71.06	62 Sm	Ly3	1	74.92	36 Kr	KB2	2
71.17	37 Rb	KB1	2	74.97	53 I	Ka1	4
71.18	39 Y	Ka1	2	75.02	79 Au	Ly4	2
71.19	63 Eu	Ly1	1	75.07	81 Tl	Ly1	2
71.20	28 Ni	Ka1	1	75.07	60 Nd	LI	abs
71.22	37 Rb	KB3	2	75.18	69 Tm	La2	1
71.24	67 Ho	LB4	1	75.23	80 Hg	Ly3	2
71.26	60 Nd	Ka1	5	75.36	50 Sn	KB1	4
71.27	62 Sm	Ly2	1	75.40	36 Kr	KB5	2
71.39	28 Ni	Ka2	1	75.49	26 Fe	K	abs
71.49	56 Ba	KB2	5	75.49	50 Sn	KB3	4
71.49	54 Xe	Ka1	4	75.50	59 Pr	Ka2	5
71.53	61 Pm	LI	abs	75.52	26 Fe	KB5	1
71.60	39 Y	Ka2	2	75.54	60 Nd	Ly4	1
71.71	51 Sb	KB1	4	75.59	64 Gd	LB2	1
71.84	51 Sb	KB3	4	75.62	65 Tb	LB3	1
71.89	70 Yb	La1	1	75.64	80 Hg	Ly6	2
72.19	80 Hg	Ly4	2	75.85	38 Sr	Ka1	2
72.20	47 Ag	Ka1	3	75.87	80 Hg	Ly2	2
72.20	74 W	L $\eta$	1	75.89	53 I	Ka2	4
72.27	82 Pb	Ly1	2	76.14	46 Pd	Ka1	3
72.35	66 Dy	LB3	1	76.16	68 Er	L $\eta$	1
72.38	54 Xe	Ka2	4	76.16	26 Fe	KB1	1
72.41	60 Nd	Ka2	5	76.18	36 Kr	KB1	2
72.42	65 Tb $\beta$	LB2	1	76.23	36 Kr	KB3	2
72.43	44 Ru	KB4	3	76.28	38 Sr	Ka2	2
72.43	70 Yb	La2	1	76.67	61 Pm	LII	abs

2θ	Element	Line	N	2θ	Element	Line	N
76.82	46 Pd	Kα2	3	81.07	35 Br	KB5	2
76.94	55 Cs	KB1	5	81.07	37 Rb	Kα1	2
77.12	55 Cs	KB3	5	81.08	83 Bi	LB5	2
77.12	63 Eu	LIII	abs	81.17	45 Rh	Kα2	3
77.14	49 In	KB4	4	81.18	79 Au	Ly1	2
77.17	65 Tb	LB1	1	81.18	64 Gd	LB4	1
77.30	62 Sm	LB5	1	81.21	57 La	Kα1	5
77.36	49 In	KB2	4	81.28	77 Ir	Ly4	2
77.43	72 Hf	L1	1	81.32	78 Pt	Ly3	2
77.58	68 Er	Lα1	1	81.33	67 Ho	Lα2	1
77.59	92 U	Ly6	3	81.51	37 Rb	Kα2	2
77.62	65 Tb	LB4	1	81.55	42 Mo	KB4	3
77.64	58 Ce	Kα1	5	81.62	48 Cd	KB2	4
77.82	27 Co	Kα1	1	81.70	42 Mo	KB2	3
77.89	81 Tl	Ly5	2	81.84	35 Br	KB1	2
78.02	27 Co	Kα2	1	81.89	35 Br	KB3	2
78.03	80 Hg	Ly1	2	81.89	78 Pt	Ly6	2
78.05	78 Pt	Ly4	2	82.00	78 Pt	Ly2	2
78.17	92 U	Ly3	3	82.00	78 Pt	Ly2	2
78.17	68 Er	Lα2	1	82.28	59 Pr	Ly3	1
78.18	79 Au	Ly3	2	82.42	57 La	Kα2	5
78.20	60 Nd	Ly3	1	82.46	83 Bi	LB3	2
78.33	61 Pm	Ly1	1	82.48	53 I	KB2	5
78.37	54 Xe	KB2	5	82.49	60 Nd	Ly1	1
78.45	60 Nd	Ly2	1	82.55	59 Pr	Ly2	1
78.57	49 In	KB5	4	82.65	42 Mo	KB5	3
78.66	52 Te	Kα1	4	82.69	51 Sb	Kα1	4
78.71	79 Au	Ly6	2	82.72	62 Sm	LB2	1
78.83	58 Ce	Kα2	5	82.98	63 Eu	LB3	1
78.85	79 Au	Ly2	2	83.12	58 Ce	LI	abs
78.96	59 Pr	LI	abs	83.37	70 Yb	L1	1
79.02	63 Eu	LB2	1	83.50	25 Mn	K	abs
79.16	64 Gd	LB3	1	83.52	42 Mo	KB1	3
79.21	92 U	Ly2	3	83.53	25 Mn	KB5	1
79.34	49 In	KB1	4	83.55	66 Dy	Lη	1
79.39	59 Pr	Ly4	1	83.58	90 Th	Ly6	3
79.47	49 In	KB3	4	83.61	42 Mo	KB3	3
79.50	92 U	Lα1	2	83.64	58 Ce	Ly4	1
79.60	52 Te	Kα2	4	83.65	51 Sb	Kα2	4
79.74	67 Ho	Lη	1	83.71	48 Cd	KB1	4
80.12	90 Th	Ly4	3	83.85	48 Cd	KB3	4
80.29	71 Lu	L1	1	83.91	83 Bi	LB1	2
80.48	45 Rh	Kα1	3	83.96	82 Pb	LB5	2
80.56	35 Br	KB2	2	84.06	90 Th	Ly3	3
80.61	54 Xe	KB1	5	84.17	66 Dy	Lα1	1
80.64	60 Nd	LII	abs	84.24	25 Mn	KB1	1
80.71	92 U	Ly1	3	84.25	83 Bi	LB2	2
80.73	62 Sm	LIII	abs	84.34	90 Th	Lα1	2
80.74	67 Ho	Lα1	1	84.55	78 Pt	Ly1	2
80.75	92 U	Lα2	2	84.63	61 Pm	LIII	abs
80.82	64 Gd	LB1	1	84.70	76 Os	Ly4	?
80.86	54 Xe	KB3	5	84.71	77 Ir	Ly3	2
				84.75	53 I	KB1	5

2θ	Element	Line	N	2θ	Element	Line	N
84.77	66 Dy	La2	1	88.69	47 Ag	KB3	4
84.79	63 Eu	LB1	1	88.92	60 Nd	LIII	abs
84.92	53 I	KB3	5	88.99	76 Os	Ly2	2
84.99	59 Pr	LII	abs	89.06	41 Nb	KB1	3
85.08	56 Ba	Kα1	5	89.08	62 Sm	LB1	1
85.10	63 Fu	LB4	1	89.15	41 Nb	KB3	3
85.14	90 Th	Ly2	3	89.21	52 Te	KB1	5
85.28	44 Ru	Kα1	3	89.24	62 Sm	LB4	1
85.38	77 Ir	Ly2	2	89.29	81 Tl	LB3	2
85.55	77 Ir	Ly6	2	89.29	55 Cs	Kα1	5
85.62	90 Th	La2	2	89.34	76 Os	Ly6	2
85.65	26 Fe	Kα1	1	89.39	52 Te	KB3	5
85.77	82 Pb	LB3	2	89.82	58 Ce	LII	abs
85.87	26 Fe	Kα2	1	90.06	82 Pb	LB4	2
85.99	44 Ru	Kα2	3	90.30	68 Er	LI	1
86.08	47 Ag	KB4	4	90.33	80 Hg	LB5	2
86.32	47 Ag	KB2	4	90.39	81 Tl	LB2	2
86.32	56 Ba	Kα2	5	90.58	55 Cs	La2	5
86.63	83 Bi	LB4	2	90.94	81 Tl	LB1	2
86.69	58 Ce	Ly3	1	91.24	60 Nd	LB2	1
86.70	69 Tm	LI	1	91.48	51 Sb	KB2	5
86.73	52 Te	KB2	5	91.54	57 La	Ly3	1
86.75	61 Pm	LB2	1	91.55	46 Pd	KB2	4
86.95	41 Nb	KB4	3	91.62	61 Pm	LB3	1
86.95	90 Th	Ly1	3	91.83	57 La	Ly2	1
86.96	34 Se	KB2	2	91.85	64 Gd	La1	1
86.97	58 Ce	Ly2	1	91.98	49 In	Kα1	4
86.98	36 Kr	Kα1	2	91.98	58 Ce	Ly1	1
87.02	59 Pr	Ly1	1	92.04	64 Gd	Lη	1
87.04	81 Tl	LB5	2	92.07	76 Os	Ly1	2
87.08	63 Sm	LB3	1	92.21	75 Re	Ly3	2
87.10	50 Sn	Kα1	4	92.40	74 W	Ly4	2
87.11	41 Nb	KB2	3	92.47	64 Gd	La2	1
87.22	82 Pb	LB1	2	92.93	75 Re	Ly2	2
87.31	82 Pb	LB2	2	93.01	49 In	Kα2	4
87.43	36 Kr	Kα2	2	93.05	46 Pd	KB5	4
87.45	34 Se	KB5	2	93.06	40 Zr	KB4	3
87.64	47 Ag	KB5	4	93.07	80 Hg	LB3	2
87.69	65 Tb	Lη	1	93.11	56 Ba	LI	abs
87.69	57 La	LI	abs	93.22	40 Zr	KB2	3
87.84	65 Tb	La1	1	93.25	24 Cr	K	abs
88.09	41 Nb	KB5	3	93.28	24 Cr	KB5	1
88.09	50 Sn	Kα2	4	93.48	75 Re	Ly6	2
88.19	77 Ir	Ly1	2	93.54	56 Ba	Ly4	1
88.24	57 La	Ly4	1	93.65	59 Pr	LIII	abs
88.29	76 Os	Ly3	2	93.74	81 Tl	LB4	2
88.33	34 Se	KB1	2	93.79	80 Hg	LB2	2
88.37	75 Re	Ly4	2	93.79	35 Br	Kα1	2
88.38	34 Se	KB3	2	93.82	54 Xe	Kα1	5
88.44	65 Tb	La2	1	93.88	79 Au	LB5	2
88.54	47 Ag	KB1	4	93.90	61 Pm	LB1	1

2θ	Element	Line	N	2θ	Element	Line	N
93.95	46 Pd	KB1	4	99.06	60 Nd	LB1	1
94.10	46 Pd	KB3	4	99.06	60 Nd	LB4	1
94.11	24 Cr	KB1	1	99.09	79 Au	LB1	2
94.14	51 Sb	KB1	5	99.09	55 Cs	LI	abs
94.20	67 Ho	LI	1	99.52	55 Cs	Ly4	1
94.27	35 Br	Kα2	2	99.65	50 Sn	KB1	5
94.28	40 Zr	KB5	3	99.83	92 U	LB5	3
94.34	51 Sb	KB3	5	99.85	50 Sn	KB3	5
94.42	33 As	KB2	2	100.04	45 Rh	KB1	4
94.85	80 Hg	LB1	2	100.08	39 Y	KB4	3
94.86	33 As	KB5	2	100.19	45 Rh	KB3	4
95.12	25 Mn	Kα1	1	100.20	82 Pb	Lη	2
95.14	54 Xe	Kα2	5	100.28	39 Y	KB2	3
95.20	57 La	LII	abs	100.46	53 I	Kα2	5
95.32	40 Zr	KB1	3	100.97	74 W	Ly1	2
95.35	25 Mn	Kα2	1	101.07	73 Ta	Ly3	2
95.42	40 Zr	KB3	3	101.12	62 Sm	Lα1	1
95.88	33 As	KB1	2	101.22	39 Y	KB5	3
95.94	33 As	KB3	2	101.40	78 Pt	LB2	2
96.04	81 Bi	Lη	2	101.44	56 Ba	LIII	abs
96.16	59 Pr	LB2	1	101.53	72 Hf	Ly4	2
96.25	63 Eu	Lα1	1	101.64	78 Pt	LB3	2
96.33	75 Re	Ly1	2	101.74	58 Ce	LB2	1
96.44	74 W	Ly3	2	101.75	34 Se	Kα1	2
96.60	60 Nd	LB3	1	101.80	62 Sm	Lα2	1
96.68	42 Mo	Kα1	3	101.84	73 Ta	Ly2	2
96.77	73 Ta	Ly4	2	101.90	77 Ir	LB5	2
96.79	50 Sn	KB2	5	101.98	79 Au	LB4	2
96.86	92 U	LB3	3	102.23	59 Pr	LB3	1
96.91	63 Eu	Lα2	1	102.27	34 Se	Kα2	2
97.05	56 Ba	Ly3	1	102.33	62 Sm	Lη	1
97.07	92 U	LI	2	102.56	39 Y	KB1	3
97.16	79 Au	LB3	2	102.66	39 Y	KB3	3
97.18	45 Rh	KB4	4	102.74	49 In	KB2	5
97.19	74 W	Ly2	2	102.92	73 Ta	Ly6	2
97.33	56 Ba	Ly2	1	103.08	90 Th	LI	2
97.42	48 Cd	Kα1	4	103.23	55 Cs	Ly3	1
97.43	45 Rh	KB2	4	103.30	65 Tb	LI	1
97.45	79 Au	LB2	2	103.31	32 Ge	KB2	2
97.46	42 Mo	Kα2	3	103.52	55 Cs	Ly2	1
97.52	57 La	Ly1	1	103.56	47 Ag	Kα1	4
97.69	80 Hg	LB4	2	103.62	41 Nb	Kα1	3
97.71	78 Pt	LB5	2	103.64	32 Ge	KB5	2
97.96	74 W	Ly6	2	103.70	78 Pt	LB1	2
98.50	48 Cd	Kα2	4	103.80	56 Ba	Ly1	1
98.55	66 Dy	LI	1	103.95	44 Ru	KB4	4
98.57	50 Sn	KB2	5	103.96	92 U	LB4	3
98.65	92 U	LB1	3	104.15	44 Ru	KB2	4
98.89	58 Ce	LIII	abs	104.46	41 Nb	Kα2	3
98.90	45 Rh	KB5	4	104.68	59 Pr	LB4	1
99.05	53 I	Kα1	5	104.71	47 Ag	Kα2	4

2θ	Element	Line	N	2θ	Element	Line	N
104.73	81 Tl	L <sub>η</sub>	2	111.22	38 Sr	KB3	3
104.79	52 Te	Kα1	5	111.32	51 Sb	Kα1	5
104.89	32 Ge	KB1	2	111.32	33 As	Kα1	2
104.92	57 La	LIII	abs	111.52	75 Re	LB5	2
104.93	59 Pr	LB1	1	111.62	58 Ce	LB1	1
104.94	32 Ge	KB3	2	111.75	40 Zr	Kα1	3
105.30	92 U	LB2	3	111.75	82 Pb	L <sub>γ</sub> 4	3
105.33	90 Th	LB3	3	111.77	72 Hf	L <sub>γ</sub> 1	2
105.63	23 V	K	abs	111.85	71 Lu	L <sub>γ</sub> 3	2
105.66	23 V	KB5	1	111.85	76 Os	LB3	2
105.74	77 Ir	LB2	2	111.86	77 Ir	LB4	2
105.79	44 Ru	KB5	4	111.86	46 Pd	Kα2	4
105.87	49 In	Kα1	5	111.89	33 As	Kα2	2
106.08	47 I	KB3	5	112.12	56 Ba	LIII	abs
106.08	72 Hf	L <sub>γ</sub> 3	2	112.48	83 Bi	L <sub>γ</sub> 3	3
106.09	73 Ta	L <sub>γ</sub> 1	2	112.64	71 Lu	L <sub>γ</sub> 2	2
106.28	52 Te	Kα2	5	112.64	70 Yb	L <sub>γ</sub> 4	2
106.43	76 Os	LB5	2	112.65	60 Nd	Lα1	1
106.48	77 Ir	LB3	2	112.66	40 Zr	Kα2	3
106.54	83 Bi	L <sub>γ</sub> 4	3	112.74	83 Bi	L <sub>γ</sub> 6	3
106.55	61 Pm	Lα1	1	112.85	82 Pb	Lα2	2
106.66	78 Pt	LB4	2	112.93	51 Sb	Kα2	5
106.66	23 V	KB1	1	113.04	48 Cd	KB1	5
106.81	71 Lu	L <sub>γ</sub> 4	2	113.21	90 Th	LB4	3
106.88	83 Bi	Lα1	2	113.27	48 Cd	KB3	5
106.95	72 Hf	L <sub>γ</sub> 2	2	113.32	92 U	L <sub>γ</sub> 6	4
107.02	24 Cr	Kα1	1	113.40	60 Nd	Lα2	1
107.03	44 Ru	KB1	4	113.41	90 Th	LB2	3
107.20	44 Ru	KB3	4	113.88	83 Bi	L <sub>γ</sub> 2	3
107.23	61 Pm	Lα2	1	114.25	31 Gd	KB2	2
107.28	24 Cr	Kα2	1	114.41	92 U	L <sub>γ</sub> 3	4
107.32	90 Th	LB5	3	114.44	76 Os	LB1	2
107.42	90 Th	LB1	3	114.49	63 Eu	L1	1
107.90	57 La	LB2	1	114.52	31 Ga	LB5	2
108.38	38 Sr	KB4	3	114.64	71 Lu	L <sub>γ</sub> 6	2
108.42	72 Hf	L <sub>γ</sub> 6	2	115.17	56 Ba	LB2	1
108.44	58 Ce	LB3	1	115.26	79 Au	L <sub>η</sub>	2
108.45	83 Bi	Lα2	2	115.53	60 Nd	L <sub>η</sub>	1
108.53	64 Gd	L1	1	115.61	57 La	LB3	1
108.56	38 Sr	KB2	3	115.84	75 Re	LB2	2
108.66	55 Cs	LII	abs	115.96	81 Tl	Lα1	2
108.80	77 Ir	LB1	2	116.03	92 U	L <sub>η</sub>	3
109.55	48 Cd	KB2	5	116.04	31 Ga	KB1	2
109.65	80 Hg	L <sub>η</sub>	2	116.10	31 Ga	KB3	2
109.73	38 Sr	KB5	3	116.43	92 U	L <sub>γ</sub> 2	4
110.46	76 Os	LB2	2	117.20	74 W	LB5	2
110.61	46 Pd	Kα1	4	117.52	47 Ag	KB2	5
111.04	55 Cs	L <sub>γ</sub> 1	1	117.56	81 Tl	L <sub>γ</sub> 4	3
111.11	38 Sr	KB1	3	117.65	76 Os	LB4	2
111.13	58 Ce	LB4	1	117.72	81 Tl	Lα2	2
111.21	82 Pb	Lα1	2	117.86	83 Bi	L <sub>γ</sub> 1	3

20	Element	Line	N	20	Element	Line	N
117.95	75 Re	Lβ3	2	125.25	42 Mo	KB1	4
118.25	71 Lu	Ly1	2	125.37	90 Th	Ly6	4
118.25	70 Yb	Ly3	2	125.44	42 Mo	KB3	4
118.26	82 Pb	Ly3	3	125.62	81 Tl	Ly6	3
118.59	57 La	Lβ4	1	125.78	70 Yb	Ly1	2
118.63	37 Rb	KB2	3	125.84	69 Tm	Ly3	2
118.73	82 Pb	Ly6	3	125.43	90 Th	Ly3	4
118.91	50 Sn	Kα1	5	126.51	81 Tl	Ly2	3
118.93	45 Rh	Kα1	4	126.89	69 Tm	Ly2	2
119.27	70 Yb	Ly2	2	127.20	46 Pd	KB2	5
119.30	69 Tm	Ly4	2	127.25	68 Er	Ly4	2
119.34	57 La	Lβ1	1	127.36	79 Au	Lα1	2
119.40	92 U	Ly1	4	127.55	56 Ba	Lβ4	1
119.70	59 Pr	Lα1	1	128.06	49 In	Kα1	5
119.79	82 Pb	Ly2	3	128.13	58 Ce	Lα1	1
119.92	37 Rb	KB5	3	128.33	90 Th	Lη	3
120.32	45 Rh	Kα2	4	128.35	74 W	Lβ1	2
120.50	59 Pr	Lα2	1	128.70	30 Zn	KB2	2
120.60	55 Cs	LIII	abs	128.70	56 Ba	Lβ1	1
120.70	50 Sn	Kα2	5	128.84	90 Th	Ly2	4
120.83	75 Re	Lβ1	2	128.85	73 Ta	Lβ2	2
121.05	42 Mo	KB4	4	128.86	30 Zn	KB5	2
121.10	62 Sm	L1	1	128.86	77 Ir	Lη	?
121.29	80 Hg	Lα1	2	128.86	77 Ir	Lη	?
121.41	42 Mo	KB2	4	128.98	58 Ce	Lα2	1
121.52	47 Ag	KB1	5	129.15	44 Ru	Kα1	4
121.54	70 Yb	Ly6	2	129.47	79 Au	Lα2	2
121.55	78 Pt	Lη	2	130.14	49 In	Kα2	5
121.58	37 Rb	KB1	3	130.80	44 Ru	Kα2	4
121.62	39 Y	Kα1	3	130.89	30 Zn	KB1	2
121.72	37 Rb	KB3	3	131.34	72 Hf	Lβ5	?
121.78	47 Ag	KB3	5	131.65	36 Kr	KB2	3
121.85	74 W	Lβ2	2	131.94	79 Au	Ly4	3
122.53	22 Ti	K	abs	132.08	46 Pd	KB1	5
122.59	22 Ti	KB5	1	132.09	81 Tl	Ly1	3
122.68	39 Y	Kα2	3	132.17	74 W	Lβ4	2
123.05	23 V	Kα1	1	132.39	46 Pd	KB3	5
123.19	80 Hg	Lα2	2	132.55	80 Hg	Ly3	3
123.37	23 V	Kα2	1	133.06	36 Kr	KB5	3
123.40	42 Mo	KB5	4	133.09	41 Nb	KB4	4
123.44	32 Ge	Kα1	2	133.09	90 Th	Ly1	4
123.66	73 Ta	Lβ5	2	133.17	73 Ta	Lβ3	2
123.73	55 Cs	Lβ2	1	133.48	41 Nb	KB2	4
123.78	59 Pr	Lη	1	133.78	80 Hg	Ly6	3
123.93	22 Ti	KB1	1	133.84	58 Ce	Lη	1
124.11	32 Ge	Kα2	2	134.42	38 Sr	Kα1	3
124.12	56 Ba	Lβ3	1	134.45	78 Pt	Lα1	?
124.18	80 Hg	Ly4	3	134.48	80 Hg	Ly2	3
124.31	75 Re	Lβ4	2	134.68	55 Cs	Lβ3	1
124.39	82 Pb	Ly1	3	134.78	68 Er	Ly3	2
124.81	81 Tl	Ly3	3	134.95	69 Tm	Ly1	2
124.96	74 W	Lβ3	2	135.11	83 Bi	L1	2
				135.44	36 Kr	KB1	3



2θ	Element	Line	N
135.60	36 Kr	Kβ3	3
135.74	38 Sr	Kα2	3
135.94	41 Nb	Kβ5	4
136.16	68 Er	Lγ2	2
136.45	67 Ho	Lγ4	2
136.88	78 Pt	Lα2	2
137.31	72 Hf	LB2	2
137.45	73 Ta	LB1	2
137.63	76 Os	Lη	2
138.46	41 Nb	Kβ1	4
138.71	57 La	Lα1	1
138.72	41 Nb	Kβ3	4
138.86	55 Cs	LB4	1
139.77	57 La	Lα2	1
139.84	48 Cd	Kα1	5
139.94	60 Nd	Li	1
140.45	31 Ga	Kα1	2
140.85	55 Cs	LB1	1
140.86	71 Lu	LB5	2
141.05	81 Tl	Lγ5	3
141.39	31 Ga	Kα2	2
141.56	80 Hg	Lγ1	3
141.63	78 Pt	Lγ4	3
141.81	73 Ta	LB4	2
142.10	79 Au	Lγ3	3
142.52	48 Cd	Kα2	5
142.85	82 Pb	Li	2
143.23	77 Ir	Lα1	2
143.64	72 Hf	LB3	2
144.05	79 Au	Lγ6	3
144.59	79 Au	Lγ2	3
146.20	77 Ir	Lα2	2
146.58	68 Er	Lγ1	2
146.63	67 Ho	Lγ3	2
147.12	92 U	Lα1	3
147.27	57 La	Lη	1
147.35	71 Lu	LB2	2
147.48	67 Ho	Lγ2	2
149.35	75 Re	Lη	2
149.55	72 Hf	LB1	2
149.60	66 Dy	Lγ4	2
149.61	22 Ti	Kα1	1

### SECTION 3

#### Two-Theta Positions of Extra Reflections

When the characteristic radiation of an element possesses sufficient energy, it penetrates the analyzing crystal to such a depth that it is reflected from crystal planes not parallel to the surface. Such extra reflections have been observed with our LiF(220) crystal for the K radiation of silver and the heavier elements.

There are two extra reflections to the low-energy side of first-order  $K\alpha$  appearing approximately half-way between it and second-order  $K\beta$ . For identification they have been termed A at the higher  $2\theta$  and B at the lower  $2\theta$  position, because it has been observed that there is a linear relationship between their  $2\theta$  positions and the wavelengths of the  $K\alpha_1$  and  $K\beta_1$  lines of the element. Reflections have also been found between second-order  $K\alpha$  and third-order  $K\beta$  for cesium and the heavier elements.

The intensity of A in the first order varies from 0.2% of the corresponding  $K\alpha$  line for silver to 7% for mercury. The relationship between the intensities of B and  $K\beta$  is of the same magnitude.

The position of the extra reflections was determined experimentally for a number of the elements. Those of the others were determined by interpolation from the linear relationship between their positions and the  $K\alpha_1$  and  $K\beta_1$  wavelengths.

<u>Element</u>	<u>A</u>	<u>B</u>	<u>Element</u>	<u>A</u>	<u>B</u>
Ag 47	34.48	30.42	Ho 67	15.89 26.73	13.93 23.30
Cd 48	32.96	29.07	Er 68	15.37 25.86	13.46 22.73
In 49	31.54	27.80	Tm 69	14.86 25.01	13.01 21.98
Sn 50	30.20	26.61	Yb 70	14.39 24.21	12.60 21.31
Sb 51	28.94	25.48	Lu 71	13.92 23.42	12.20 20.63
Te 52	27.75	24.43	Hf 72	13.48 22.66	11.80 19.96
I 53	26.63	23.43	Ta 73	13.06 21.96	11.46 19.40
Xe 54	25.55	22.48	W 74	12.66 21.28	11.10 18.81
Cs 55	24.58 41.39	21.60 36.25	Re 75	12.27 20.64	10.76 18.25
Ba 56	23.63 39.79	20.77 34.87	Os 76	11.90 20.01	10.44 17.71
La 57	22.73 38.28	19.98 33.55	Ir 77	11.54 19.42	10.12 17.18
Ce 58	21.88 36.85	19.22 32.30	Pt 78	11.20 18.82	9.82 16.67
Pr 59	21.08 35.48	18.51 31.11	Au 79	10.87 18.26	9.53 16.20
Nd 60	20.32 34.20	17.83 29.99	Hg 80	10.55 17.73	9.26 15.74
Pm 61	19.62 33.02	17.19 28.92	Tl 81	10.24 17.20	8.98 15.29
Sm 62	18.88 31.79	16.59 27.92	Pb 82	9.94 16.70	8.73 14.87
Tu 63	18.23 30.69	16.00 26.94	Bi 83	9.66 16.22	8.48 14.45
Gd 64	17.60 29.63	15.43 26.00			
Tb 65	17.01 28.62	14.91 25.13			
Dy 66	16.43 27.64	14.39 24.27			