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406

X-Ray Wavelength Conversion Tables and Graphs For Qualitative Electron Probe Microanalysis

Kurt F. J. Heinrich and Mary Ann M. Giles

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards

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X-RAY WAVELENGTH CONVERSION TABLES AND GRAPHS FOR QUALITATIVE ELECTRON PROBE MICROANALYSIS

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ABSTRACT

Tables and graphs have been constructed for electron probe x-ray spectrometers equipped with crystal changers and calibrated for LiF crystals in angstroms. These tables indicate the equivalent reading for the lines which can be normally expected to appear in wavelength scans using the following crystals: LiF, EDDT, ADP, KAP, and Pb stearate (LSD). The readings were extracted from the tables of E. W. White, et al.[1]. The tables are arranged by the atomic numbers of the emitting elements; the graphs show the readings for observable lines as a function of atomic number for each of the aforementioned crystals. A suggested method for using the tables and graphs is included.

Keywords:

X-ray spectrometers, wavelengths, electron probe microanalyzer, x-ray emission.

INTRODUCTION

Notwithstanding the complexity of some techniques used in microprobe analysis, the making and interpreting of simple x-ray wavelength scans for qualitative elemental analysis is, in our experience, one of the most tedious tasks. Frequently, it is necessary to perform several wavelength scans on the same specimen; in the long wavelength region, numerous lines in higher orders may appear. A further complication arises from the fact that the spectrometers of our instrument are provided with crystal changers. Consequently, with the exception of the readings corresponding to LiF crystals, which give the wavelength in angstrom units, the readings corresponding to an observed peak must be multiplied by factors characteristic of each crystal in order to be transformed into wavelengths.

The only tables including these factors for the crystals employed in our instrument (LiF, EDDT, ADP, KAP, and Pb stearate) are those of E. W. White, et al.[1]. These tables, although excellent as a reference compilation, are somewhat cumbersome for the particular purpose of wavelength scans; in the section in which the lines appear in the sequence of the atomic number of the emitting elements, higher orders of reflection are not indicated; in the section arranged by wavelength readings, the great number of satellite lines included complicates its use. We have employed values extracted from these tables to construct a simplified table adapted to the specific purpose of qualitative elemental analysis.

The tables list the elements of the periodic table in increasing order of atomic number and the wavelength readings at which lines of these elements appear when the aforementioned crystals are used. The wavelength ranges (for the first order) covered by these crystals in our spectrometer are tabulated in table I. Several pure elements were scanned at various acceleration voltages from 15 to 40 keV, employing a beam current of 10^{-7} A. Only the lines and orders observable under these conditions were included. The order of reflection is indicated in the heading by the numbers 1 to 8. Orders higher than the eighth, observable with the lead stearate, were not included, as they are easy to identify due to their periodicity. Similarly, the resolution of the $K_{\alpha_{1,2}}$ doublet at higher orders was not taken into account, as these doublets are easily identified as such. The satellite lines, which are seldom observed, are not included in these tables, but may be identified using the tables of White, et al.

The tables are complemented by graphs showing the position of the more prominent line reflections for the crystals under consideration. It is suggested that these graphs be used to tentatively determine the major components of the analyte. By means of the tables, these elements are confirmed, and all their lines, in the first and higher order reflections, marked. By alternating use of the tables and the graphs, all lines can be identified in a few minutes.

Table I

Ranges of first order lines covered in tables and graphs.

	Å
LiF	1.00 – 3.75
EDDT	2.20 – 8.20
ADP	2.65 – 10.00
KAP	7.90 – 24.8
LSD	29.9 – 93.4

NOTE: All our spectrometer scales are calibrated so that the true wavelengths are read when a LiF crystal is used. On the other crystals, the true wavelengths can be obtained by multiplying the number read on the spectrometer by the ratio of the spacings of the respective crystal to that of lithium fluoride and dividing by the order of reflection. These d-spacings of the various crystals are given by White[1].

Crystal	hkl	d–spacing (Å)
LiF	200	2.0136
EDDT	020	4.4040
ADP	101	5.3200
KAP	$10\bar{1}0$	13.316
LSD	soap film	50.15

The line designation is that used by White[1] and is quoted in the following table:

KA1,2 = the unresolved $K\alpha_{1,2}$ doublet
KB1 = $K\beta_1$
KBA+ = $K\beta'_a$ (+ = ' one being understood)
SKA3 = satellite $K\alpha_3$
LA1,2 = $L\alpha_{1,2}$
LB1 = $L\beta_1$
LG1 = $L\gamma_1$
LL = $L\ell$
LN = $L\eta$
L2–O2 = L line with transition between the L_{II} and O_{II} levels

ACKNOWLEDGEMENT

We give our thanks to Dr. White for permission to use his numbers.

REFERENCE

(1) White, E. W., Gibbs, G. V., Johnson, G. G., Jr., and Zechman, G. R., Jr., "X-ray Wavelengths and Crystal Interchange Settings for Wavelength Geared Curved Crystal Spectrometers", 2nd Edition, Mineral Industries Experiment Station Special Publication No. 3–64, The Pennsylvania State University, 1965.

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
5 Boron	KA1,2	LSD	2.6901							
6 Carbon	KA1,2	LSD	1.7666	3.4332						
7 Nitrogen	KA1,2	LSD	1.2689	2.5378						
8 Oxygen	KA1,2	KAP	3.5850							
		LSD		1.9038	2.8557					
9 Fluorine	KA1,2	KAP	2.7683							
		LSD		1.4700	2.2050	2.9400	3.6750			
10 Neon	KA1,2	KAP	2.2100							
		LSD			1.7604	2.3472	2.9340	3.5208		
	KB	KAP	2.1865							
		LSD			1.7415	2.3220	2.9025	3.4830		
11 Sodium	KA1,2	KAP	1.8008	3.6016						
		LSD			1.4343	1.9124	2.3905	2.8686	3.3467	
	KB1	KAP	1.7567	3.5134						
		LSD			1.3992	1.8656	2.3320	2.7984	3.2648	3.7312
	SKA+	KAP	1.7899							
	SKA3	KAP	1.7851							
	SKA4	KAP	1.7822							
12 Magnesium	KA1,2	ADP	3.7429							
		KAP	1.4953	2.9906						
		LSD			1.1910	1.5880	1.9850	2.3820	2.7790	3.1760
	SKA+	ADP	3.7273							
		KAP	1.4891							
	SKA3	ADP	3.7182							
		KAP	1.4855							
	SKA4	ADP	3.7122							
		KAP	1.4830							
	KB1	ADP	3.6221							
		KAP	1.4471	2.8942						
		LSD			1.1526	1.5368	1.9210	2.3052	2.6894	3.0736

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
13 Aluminum	KA1,2	ADP	3.1562							
		KAP	1.2609	2.5218						
		LSD				1.3392	1.6740	2.0088	2.3436	2.6784
	SKA+	ADP	3.1433							
		KAP	1.2558							
	SKA3	ADP	3.1364							
		KAP	1.2530							
	SKA4	ADP	3.1304							
		KAP	1.2506							
	SKA5	ADP	3.1144							
		KAP	1.2442							
	KB1	EDDT	3.6494							
		ADP	3.0211							
		KAP	1.2069	2.4138	3.6207					
		LSD				1.2816	1.6020	1.9224	2.2428	2.5632
14 Silicon	KA1,2	EDDT	3.2582							
		ADP	2.6972							
		KAP	1.0775	2.1550	3.2325					
		LSD					1.4305	1.7166	2.0027	2.2888
	SKA+	EDDT	3.2436							
		ADP	2.6851							
	SKA3	EDDT	3.2356							
		ADP	2.6785							
	SKA4	EDDT	3.2317							
		ADP	2.6753							
	KB1	EDDT	3.0990							
		ADP	2.5654							
		KAP		2.0498	3.0747					
		LSD					1.3605	1.6326	1.9047	2.1768
15 Phosphorus	KA1,2	EDDT	2.8141							
		ADP	2.3296							
		KAP		1.8614	2.7921	3.7228				
	SKA+	EDDT	2.8032							
		ADP	2.3205							
	SKA3	EDDT	2.7966							
		ADP	2.3151							
	SKA4	EDDT	2.7930							
		ADP	2.3121							
	KB1	EDDT	2.6536							
		ADP	2.1967							
		KAP		1.7552	2.6328	3.5104				

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
16 Sulfur	KA1,2	EDDT	2.4565							
		ADP	2.0335							
		KAP		1.6248	2.4372	3.2496				
	SKA+	EDDT	2.4476							
		ADP	2.0261							
	SKA3	EDDT	2.4419							
		ADP	2.0214							
	SKA4	EDDT	2.4388							
		ADP	2.0189							
	KB1	EDDT	2.3006							
		ADP	1.9044							
		KAP		1.5216	2.2824	3.0432				
17 Chlorine	KA1,2	EDDT	2.1619							
		ADP	1.7897	3.5794						
		KAP		1.4300	2.1450	2.8600	3.5750			
	SKA+	EDDT	2.1542							
		ADP	1.7833							
	SKA3	EDDT	2.1539							
		ADP	1.7830							
	SKA4	EDDT	2.1469							
		ADP	1.7772							
	KB1	EDDT	2.0131							
		ADP	1.6665	3.3330						
		KAP		1.3316	1.9974	2.6632	3.3290			
18 Argon	KA1,2	EDDT	1.9169							
		ADP	1.5868	3.1736						
		KAP		1.2678	1.9017	2.5356	3.1695			
	KB1	EDDT	1.7767	3.5534						
		ADP	1.4708	2.9416						
		KAP			1.7628	2.3504	2.9380	3.5256		

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
19 Potassium	KA1,2	LIF	3.7424							
		EDDT	1.7111	3.4222						
		ADP	1.4164	2.8328						
		KAP			1.6977	2.2636	2.8295	3.3954		
	SKA+	LIF	3.7281							
		EDDT	1.7045							
		ADP	1.4110							
	SKA3	LIF	3.7206							
		EDDT	1.7011							
		ADP	1.4082							
	SKA4	LIF	3.7164							
		EDDT	1.6992							
		ADP	1.4066							
	KB1,3	LIF	3.4539							
		EDDT	1.5791	3.1582						
		ADP	1.3072	2.6144						
		KAP			1.5666	2.0888	2.6110	3.1332	3.6554	
20 Calcium	KA1,2	LIF	3.3596							
		EDDT	1.5361	3.0722						
		ADP	1.2716	2.5432	3.8148					
		KAP			1.5240	2.0320	2.5400	3.0480	3.5560	
	SKA+	LIF	3.3468							
		EDDT	1.5302							
		ADP	1.2667							
	SKA3	LIF	3.3401							
		EDDT	1.5271							
		ADP	1.2642							
	SKA4	LIF	3.3368							
		EDDT	1.5256							
		ADP	1.2629							
	KB1	LIF	3.0896							
		EDDT	1.4126	2.8252						
		ADP	1.1694	2.3388	3.5082					
		KAP			1.4016	1.8688	2.3360	2.8032	3.2704	3.7376
	LA1	LSD	1.4612	2.9224						
	LB1	LSD	1.4463	2.8926						
21 Scandium	KA1,2	LIF	3.0322							
		EDDT	1.3863	2.7726						
		ADP	1.1471	2.2952	3.4428					
		KAP			1.3755	1.8340	2.2925	2.7510	3.2095	3.6680
	KB1	LIF	2.7795							
		EDDT	1.2708	2.5416						
		ADP	1.0520	2.1040	3.1560					
		KAP			1.2609	1.6812	2.1015	2.5218	2.9421	3.3628
	LA1,2	LSD	1.2604	2.5208	3.7812					
	LB1	LSD	1.2476	2.4952	3.7428					

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
22 Titanium	KA1,2	LIF	2.7490							
		EDDT	1.2571	2.5142	3.7713					
		ADP	1.0407	2.0814	3.1221					
		KAP			1.2471	1.6628	2.0785	2.4942	2.9099	3.3256
	KB1,3	LIF	2.5137							
		EDDT	1.1493	2.2986	3.4479					
		ADP		1.9028	2.8542					
		KAP				1.5204	1.9005	2.2806	2.6607	3.0408
	LA1,2	LSD		2.2038	3.3057					
	LB1	LSD		2.1740	3.2610					
	LL	LSD	1.2616							
	LN	LSD	1.2423							
23 Vanadium	KA1,2	LIF	2.5047							
		EDDT	1.1452	2.2904	3.4356					
		ADP		1.8960	2.8440					
		KAP				1.5148	1.8935	2.2722	2.6509	3.0296
	KB1,3	LIF	2.2843							
		EDDT	1.0444	2.0888	3.1332					
		ADP		1.7292	2.5938	3.4584				
		KAP				1.3816	1.7270	2.0724	2.4178	2.7632
	LA1,2	KAP	3.6759							
		LSD		1.9520	2.9280					
	LB1	KAP	3.6138							
		LSD		1.9190	2.8785					
24 Chromium	KA1,2	LIF	2.2909							
		EDDT	1.0474	2.0948	3.1422					
		ADP		1.7342	2.6013	3.4684				
		KAP				1.3856	1.7320	2.0784	2.4248	2.7712
	KB1,3	LIF	2.0848							
		EDDT		1.9064	2.8596					
		ADP		1.5780	2.3670	3.1560				
		KAP				1.2608	1.5760	1.8912	2.2064	2.5216
	LA1,2	KAP	3.2834							
		LSD		1.7436	2.6154	3.4872				
	LB1	KAP	3.2243							
		LSD		1.7122	2.5683	3.4244				
	LB3,4	KAP	2.9380							
		LSD		1.5602	2.3403	3.1204				
	LL	KAP	3.7562							
	LN	KAP	3.6804							

Z–ELEMENT	LINE	CRYSTAL	i	2	3	4	5	6	7	8
25 Manganese	KA1,2	LIF	2.1030							
		EDDT		1.9230	2.8845					
		ADP		1.5918	2.3877	3.1836				
		KAP				1.2720	1.5900	1.9080	2.2260	2.5440
	KB1	LIF	1.9101							
		EDDT		1.7466	2.6199	3.4932				
		ADP		1.4458	2.1687	2.8916	3.6145			
		KAP					1.4440	1.7328	2.0216	2.3104
	LA1,2	KAP	2.9471							
		LSD		1.5650	2.3475	3.1300				
	LB1	KAP	2.8971							
		LSD		1.5384	2.3076	3.0768				
	LB3,4	KAP	2.6576							
		LSD		1.4112	2.1168	2.8224				
	LL	KAP	3.3743							
	LN	KAP	3.3062							
26 Iron	KA1,2	LIF	1.9373							
		EDDT		1.7714	2.6571	3.5428				
		ADP		1.4664	2.1996	2.9328	3.6660			
		KAP					1.4645	1.7574	2.0503	2.3432
	KB1	LIF	1.7565	3.5130						
		EDDT		1.6062	2.4093	3.2124				
		ADP		1.3296	1.9944	2.6592	3.3240			
		KAP					1.3280	1.5936	1.8592	2.1248
	LA1,2	KAP	2.6617							
		LSD		1.4134	2.1201	2.8268	3.5335			
	LB1	KAP	2.6145							
		LSD		1.3884	2.0826	2.7768	3.4710			
	LB3,4	KAP	2.3756							
		LSD		1.2614	1.8921	2.5228				
	LL	KAP	3.0548							
	LN	KAP	2.9835							
27 Cobalt	KA1,2	LIF	1.7902	3.5804						
		EDDT		1.6370	2.4555	3.2740				
		ADP		1.3540	2.0310	2.7080	3.3850			
		KAP					1.3535	1.6242	1.8949	2.1656
	KB1	LIF	1.6207	3.2414						
		EDDT		1.4820	2.2230	2.9640	3.7050			
		ADP		1.2268	1.8402	2.4536	3.0670	3.6804		
	LA1,2	KAP	2.4105							
		LSD		1.2848	1.9272	2.5696	3.2120			
	LB1	KAP	2.3738							
		LSD		1.2606	1.8909	2.5212	3.1515			
	LB3,4	KAP	2.1533							
		LSD			1.7151	2.2868				
	LL	KAP	2.7760							
	LN	KAP	2.7007							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
28 Nickel	KA1,2	LIF	1.6591	3.3182						
		EDDT		1.5170	2.2755	3.0340				
		ADP		1.2558	1.8837	2.5116	3.1395	3.7674		
		KAP					1.2540	1.5048	1.7556	2.0064
	KB1	LIF		1.5001	3.0002					
		EDDT		1.3716	2.0574	2.7432	3.4290			
		ADP		1.1354	1.7031	2.2708	2.8385	3.4062		
	LA1,2	KAP	2.2070							
		LSD			1.7580	2.3440	2.9300	3.5160		
	LB1	KAP	2.1635							
		LSD			1.7232	2.2976	2.8720	3.4464		
	LB3,4	KAP	1.9879							
		LSD			1.5834	2.1112				
	LL	KAP	2.5243							
	LN	KAP	2.4654							
29 Copper	KA1,2	LIF	1.5418	3.0836						
		EDDT		1.4098	2.1147	2.8196	3.5245			
		ADP		1.1670	1.7505	2.3340	2.9175	3.5010		
	KB1	LIF	1.3922	2.7844						
		EDDT		1.2730	1.9095	2.5460	3.1825			
		ADP		1.0538	1.5807	2.1076	2.6345	3.1614	3.6883	
	LA1,2	KAP	2.0197							
		LSD			1.6089	2.1452	2.6815	3.2178	3.7541	
	LB1	KAP	1.9778							
		LSD			1.5753	2.1004	2.6255	3.1506	3.6757	
	LB3,4	KAP	1.8320	3.6640						
		LSD			1.4592	1.9456				
	LL	KAP	2.3131							
	LN	KAP	2.2591							
30 Zinc	KA1,2	LIF	1.4363	2.8726						
		EDDT		1.3134	1.9701	2.6268	3.2835			
		ADP		1.0872	1.6308	2.1744	2.7180	3.2616		
	KB1	LIF	1.2952	2.5904						
		EDDT		1.1842	1.7763	2.3684	2.9605	3.5526		
		ADP			1.4706	1.9608	2.4510	2.9412	3.4314	
	LA1,2	KAP	1.8572	3.7144						
		LSD			1.4793	1.9724	2.4655	2.9586	3.4517	
	LB1	KAP	1.8159	3.6318						
		LSD			1.4463	1.9284	2.4105	2.8926	3.3747	
	LB3,4	KAP	1.6914	3.3828						
		LSD			1.3473	1.7964	2.2455	2.6946	3.1437	3.5928
	LL	KAP	2.1293							
	LN	KAP	2.0746							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
31 Gallium	KA1, 2	LIF	1.3413	2.6826						
		EDDT		1.2264	1.8396	2.4528	3.0660	3.6792		
		ADP			1.5228	2.0304	2.5380	3.0456	3.5532	
	KB1	LIF	1.2078	2.4156	3.6234					
		EDDT		1.1044	1.6566	2.2088	2.7610	3.3132		
		ADP			1.3713	1.8284	2.2855	2.7426	3.1997	3.6568
	LA1,2	KAP	1.7106	3.4212						
		LSD			1.3626	1.8168	2.2710	2.7252	3.1794	3.6336
	LB1	KAP	1.6702	3.3404						
		LSD			1.3302	1.7736	2.2170	2.6604	3.1038	3.5472
	LB3,4	KAP	1.5673	3.1346						
		LSD			1.2483	1.6644				
	LL	KAP	1.9622							
	LN	KAP	1.9084							
32 Germanium	KA1,2	LIF	1.2553	2.5106	3.7659					
		EDDT		1.1478	1.7217	2.2956	2.8695	3.4434		
		ADP			1.4253	1.9004	2.3755	2.8506	3.3257	
	KB1	LIF	1.1288	2.2576	3.3864					
		EDDT		1.0322	1.5483	2.0644	2.5805	3.0966	3.6127	
		ADP			1.2816	1.7088	2.1360	2.5632	2.9904	3.4176
	LA1,2	KAP	1.5811	3.1622						
		LSD			1.2594	1.6792	2.0990	2.5188	2.9386	3.3584
	LB1	KAP	1.5415	3.0830						
		LSD			1.2279	1.6372	2.0465	2.4558	2.8651	3.2744
	LB3	ADP	3.6263							
		KAP	1.4488	2.8976						
		LSD				1.5384	1.8230			
	LB4	ADP	3.6487							
		KAP	1.4577	2.9154						
		LSD	1.5480	1.9350						
	LL	KAP	1.8061							
	LN	KAP	1.7553							
33 Arsenic	KA1,2	LIF	1.1771	2.3542	3.5313					
		EDDT		1.0764	1.6146	2.1528	2.6910	3.2292	3.7674	
		ADP			1.3365	1.7820	2.2275	2.6730	3.1185	3.5640
	KB1	LIF	1.0572	2.1144	3.1716					
		EDDT			1.4499	1.9332	2.4165	2.8998	3.3831	
		ADP			1.2003	1.6004	2.0005	2.4006	2.8007	3.2008
	LA1,2	ADP	3.6606							
		KAP	1.4624	2.9248						
		LSD				1.5532	1.9415	2.3298	2.7181	3.1064
	LB1	ADP	3.5631							
		KAP	1.4235	2.8470						
		LSD				1.5116	1.8895	2.2674	2.6453	3.0232
	LB3,4	ADP	3.3799							
		KAP	1.3503	2.7006						
		LSD				1.4340	1.7925			
	LL	KAP	1.6738							
	LN	KAP	1.6229							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
34 Selenium	KA1,2	LIF	1.1060	2.2120	3.3180					
		EDDT		1.0114	1.5171	2.0228	2.5285	3.0342	3.5399	
		ADP			1.2558	1.6744	2.0930	2.5116	2.9302	3.3488
	KB1	LIF		1.9842	2.9763					
		EDDT			1.3608	1.8144	2.2680	2.7216	3.1752	3.6288
		ADP			1.1265	1.5020	1.8775	2.2530	2.6285	3.0040
	LA1,2	KAP	1.3594	2.7188						
		LSD				1.4436	1.8045	2.1654	2.5263	2.8872
		ADP	3.4027							
	LB1	ADP	3.3063							
		KAP	1.3209	2.6418						
		LSD				1.4028	1.7535	2.1042	2.4549	2.8056
	LB3,4	ADP	3.1494							
		KAP	1.2582	2.5164	3.7746					
		LSD				1.3364	1.6705			
	LL	KAP	1.5564							
	LN	KAP	1.5059							
		ADP	3.7694							
35 Bromine	KA1,2	LIF	1.0409	2.0818	3.1227					
		EDDT			1.4277	1.9036	2.3795	2.8554	3.3313	
		ADP			1.1712	1.5616	1.9520	2.3424	2.7328	3.1232
	KB1	LIF		1.8652	2.7978	3.7304				
		EDDT			1.2792	1.7056	2.1320	2.5584	2.9848	3.4112
		ADP			1.0590	1.4120	1.7650	2.1180	2.4710	2.8240
	LA1,2	ADP	3.1698							
		KAP	1.2664	2.5328						
		LSD				1.3448	1.6810	2.0172	2.3534	2.6896
	LB1	EDDT	3.7150							
		ADP	3.0754							
		KAP	1.2286	2.4572	3.6858					
		LSD				1.3048	1.6310	1.9572	2.2834	2.6096
	LB3,4	EDDT	3.5512							
		ADP	2.9397							
		KAP	1.1744	2.3488	3.5232					
		LSD				1.2472	1.5590			
	LL	ADP	3.6272							
		KAP	1.4491							
	LN	ADP	3.5024							
		KAP	1.3993							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
36 Krypton	KA1,2	LIF		1.9634	2.9451					
		EDDT			1.3464	1.7952	2.2440	2.6928	3.1416	3.5904
		ADP			1.1145	1.4860	1.8575	2.2290	2.6005	2.9720
	KB1	LIF		1.7568	2.6352	3.5136				
		EDDT			1.2048	1.6064	2.0080	2.4096	2.8112	3.2128
		ADP				1.3296	1.6620	1.9944	2.3268	2.6592
	LA1,2	EDDT	3.5740							
		ADP	2.9587							
		KAP	1.1820	2.3640	3.5460					
		LSD				1.2552	1.5690	1.8828	2.1966	2.5104
	LB1	EDDT	3.4639							
		ADP	2.8674							
		KAP		2.2912	3.4368					
		LSD				1.2164	1.5205	1.8246	2.1287	2.4328
	LB3	EDDT	3.3212							
		ADP	2.7493							
		KAP		2.1968	3.2952					
	LB4	EDDT	3.3395							
		ADP	2.7645							
		KAP		2.2088	3.3132					
37 Rubidium	KA1,2	LIF		1.8536	2.7804	3.7072				
		EDDT			1.2711	1.6948	2.1185	2.5422	2.9659	3.3896
		ADP			1.0524	1.4032	1.7540	2.1048	2.4556	2.8064
	KB1	LIF		1.6572	2.4858	3.3144				
		EDDT			1.1364	1.5152	1.8940	2.2728	2.6516	3.0304
		ADP				1.2544	1.5680	1.8816	2.1952	2.5088
	LA1	EDDT	3.3459							
		ADP	2.7698							
		KAP		2.2132	3.3198					
		LSD					1.4690	1.7628	2.0566	2.3504
	LB1	EDDT	3.2351							
		ADP	2.6781							
		KAP		2.1398	3.2097					
		LSD					1.4200	1.7040	1.9880	2.2720
	LB3	EDDT	3.1032							
		ADP	2.5689							
		KAP		2.0526	3.0789					
	LB4	EDDT	3.1184							
		ADP	2.5815							
		KAP		2.0626	3.0939					
	LL	ADP	3.1654							
		KAP	1.2646							
	LN	EDDT	3.6764							
		ADP	3.0434							
		KAP	1.2159							
	LG2,3	EDDT	2.7641							
		ADP	2.2882							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
38 Strontium	KA1,2	LIF		1.7530	2.6295	3.5060				
		EDDT			1.2021	1.6028	2.0035	2.4042	2.8049	3.2056
		ADP				1.3268	1.6585	1.9902	2.3219	2.6536
	KB1	LIF		1.5656	2.3484	3.1312				
		EDDT			1.0737	1.4316	1.7895	2.1474	2.5053	2.8632
		ADP				1.1852	1.4815	1.7778	2.0741	2.3704
	LA1	EDDT	3.1376							
		ADP	2.5974							
		KAP		2.0754	3.1131					
		LSD					1.3775	1.6530	1.9285	2.2040
	LB1	EDDT	3.0284							
		ADP	2.5070							
		KAP		2.0032	3.0048					
		LSD					1.3295	1.5954	1.8613	2.1272
	LB3	EDDT	2.9112							
		ADP	2.4099							
		KAP		1.9256	2.8884					
	LB4	EDDT	2.9274							
		ADP	2.4233							
		KAP		1.9362	2.9043					
	LG2,3	EDDT	2.5806							
		ADP	2.1362							
	LL	EDDT	3.5826							
		ADP	2.9657							
	LN	EDDT	3.4368							
		ADP	2.8450							
39 Yttrium	KA1,2	LIF		1.6602	2.4903	3.3204				
		EDDT			1.1385	1.5180	1.8975	2.2770	2.6565	3.0360
		ADP				1.2568	1.5710	1.8852	2.1994	2.5136
	KB1	LIF		1.4812	2.2218	2.9624	3.7030			
		EDDT			1.0158	1.3544	1.6930	2.0316	2.3702	2.7088
		ADP				1.1212	1.4015	1.6818	1.9621	2.2424
	LA1	EDDT	2.9483							
		ADP	2.4407							
		KAP		1.9502	2.9253					
		LSD					1.2945	1.5534	1.8123	2.0712
	LB1	EDDT	2.8401							
		ADP	2.3511							
		KAP		1.8786	2.8179	3.7572				
	LB3	EDDT	2.7354							
		ADP	2.2644							
		KAP		1.8094	2.7141	3.6188				
	LB4	EDDT	2.7517							
		ADP	2.2779							
		KAP		1.8200	2.7300	3.6400				

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
39 Yttrium continued	LG2,3	EDDT	2.4154							
		ADP	1.9995							
	LL	EDDT	3.3633							
		ADP	2.7842							
	LN	EDDT	3.2189							
		ADP	2.6647							
40 Zirconium	KA1,2	LIF		1.5744	2.3616	3.1488				
		EDDT			1.0797	1.4396	1.7995	2.1594	2.5193	2.8792
		ADP				1.1916	1.4895	1.7874	2.0853	2.3832
	KB1	LIF		1.4034	2.1051	2.8068	3.5085			
		EDDT				1.2832	1.6040	1.9248	2.2456	2.5664
		ADP				1.0620	1.3275	1.5930	1.8585	2.1240
	LA1	EDDT	2.7754							
		ADP	2.2975							
		KAP		1.8358	2.7537	3.6716				
	LB1	EDDT	2.6682							
		ADP	2.2088							
		KAP		1.7648	2.6472	3.5296				
	LB2	EDDT	2.5540							
		ADP	2.1143							
		KAP		1.6894	2.5341	3.3788				
	LB3	EDDT	2.5754							
		ADP	2.1319							
		KAP		1.7034	2.5551	3.4068				
	LB4	EDDT	2.5914							
		ADP	2.1452							
		KAP		1.7140	2.5710	3.4280				
	LG1	EDDT	2.4617							
		ADP	2.0378							
	LG2,3	EDDT	2.2647							
		ADP	1.8748							
	LL	EDDT	3.1631							
		ADP	2.6185							
	LN	EDDT	3.0206							
		ADP	2.5005							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
41 Niobium	KA1,2	LIF		1.4952	2.2428	2.9904	3.7380			
		EDDT			1.0254	1.3672	1.7090	2.0508	2.3926	2.7344
		ADP				1.1316	1.4145	1.6974	1.9803	2.2632
	KB1	LIF		1.3314	1.9971	2.6628	3.3285			
		EDDT				1.2172	1.5215	1.8258	2.1301	2.4344
		ADP				1.0076	1.2595	1.5114	1.7633	2.0152
	LA1	EDDT	2.6171							
		ADP	2.1665							
		KAP		1.7310	2.5965	3.4620				
	LB1	EDDT	2.5110							
		ADP	2.0787							
		KAP		1.6608	2.4912	3.3216				
	LB2	EDDT	2.3947							
		ADP	1.9824							
		KAP		1.5840	2.3760	3.1680				
	LB3	EDDT	2.4278							
		ADP	2.0098							
		KAP		1.6058	2.4087	3.2116				
	LB4	EDDT	2.4439							
		ADP	2.0231							
	LG1	EDDT	2.3025							
		ADP	1.9060							
	LG2,3	EDDT	2.1279							
		ADP	1.7615							
	LL	EDDT	2.9798							
		ADP	2.4667							
	LN	EDDT	2.8396							
		ADP	2.3506							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
42 Molybdenum	KA1,2	LIF		1.4212	2.1318	2.8424	3.5530			
		EDDT				1.2996	1.6245	1.9494	2.2743	2.5992
		ADP				1.0756	1.3445	1.6134	1.8823	2.1512
	KB1	LIF		1.2644	1.8966	2.5288	3.1610			
		EDDT				1.1560	1.4450	1.7340	2.0230	2.3120
	LA1	EDDT	2.4718							
		ADP	2.0462							
		KAP		1.6350	2.4525	3.2700				
	LB1	EDDT	2.3669							
		ADP	1.9594							
		KAP		1.5656	2.3484	3.1312				
	LB2	EDDT	2.2509							
		ADP	1.8633							
		KAP		1.4888	2.2332	2.9776				
	LB3	EDDT	2.2920							
		ADP	1.8974							
		KAP		1.5160	2.2740	3.0320				
	LB4,6	EDDT	2.3083							
		ADP	1.9108							
		KAP		1.5268	2.2902	3.0536				
	LG1	EDDT	2.1606							
		ADP	1.7886							
	LG2,3	EDDT	2.0025							
		ADP	1.6577							
	LL	EDDT	2.8121							
		ADP	2.3279							
	LN	EDDT	2.6734							
		ADP	2.2131							
43 Technetium	KA1, 2	LIF		1.3528	2.0292	2.7056	3.3820			
		EDDT				1.2368	1.5460	1.8552	2.1644	2.4736
		ADP				1.0240	1.2800	1.5360	1.7920	2.0480
	KB1	LIF		1.2026	1.8039	2.4052	3.0065	3.6078		
		EDDT				1.0996	1.3745	1.6494	1.9243	2.1992
	LA1	EDDT	2.3382							
		ADP	1.9356							
		KAP		1.5466	2.3199	3.0932				
	LB1	EDDT	2.2345							
		ADP	1.8498	3.6996						
		KAP		1.4780	2.2170	2.9560	3.6950			
	LB2	EDDT	2.1196							
		ADP	1.7547	3.5094						
		KAP		1.4020	2.1030	2.8040				
	LG1	EDDT	2.0300							
		ADP	1.6805	3.3610						

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
44 Ruthenium	KA1,2	LIF		1.2888	1.9332	2.5776	3.2220			
		EDDT				1.1784	1.4730	1.7676	2.0622	2.3568
	KB1	LIF		1.1448	1.7172	2.2896	2.8620	3.4344		
		EDDT				1.0468	1.3085	1.5702	1.8319	2.0936
	LA1	EDDT	2.2154							
		ADP	1.8340	3.6680						
		KAP		1.4654	2.1981	2.9308	3.6635			
	LB1	EDDT	2.1125							
		ADP	1.7488	3.4976						
		KAP		1.3972	2.0958	2.7944	3.4930			
	LB2	EDDT	1.9987							
		ADP	1.6546	3.3092						
		KAP		1.3220	1.9830	2.6440				
	LB3,6	EDDT	2.0513							
		ADP	1.6981	3.3962						
		KAP		1.3568	2.0352	2.7136				
	LB4	EDDT	2.0679							
		ADP	1.7118	3.4236						
		KAP		1.3678	2.0517	2.7356				
	LG1	EDDT	1.9121							
		ADP	1.5828							
	LG2,3	EDDT	1.7819							
		ADP	1.4750							
	LL	EDDT	2.5162							
		ADP	2.0830							
	LN	EDDT	2.3797							
		ADP	1.9700							
45 Rhodium	KA1,2	LIF		1.2294	1.8441	2.4588	3.0735	3.6882		
		EDDT				1.1240	1.4050	1.6860	1.9670	2.2480
	KB1	LIF		1.0910	1.6365	2.1820	2.7275	3.2730		
	LA1	EDDT	2.1019							
		ADP	1.7400	3.4800						
		KAP		1.3902	2.0853	2.7804	3.4755			
	LB1	EDDT	1.9998							
		ADP	1.6555	3.3110						
		KAP		1.3228	1.9842	2.6456	3.3070			
	LB2	EDDT	1.8885							
		ADP	1.5633	3.1266						
		KAP		1.2492	1.8738	2.4984				
	LB3	EDDT	1.9441							
		ADP	1.6093	3.2186						
		KAP		1.2858	1.9287	2.5716				
	LB4	EDDT	1.9608							
		ADP	1.6232	3.2464						
		KAP		1.2970	1.9455	2.5940				

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
45 Rhodium continued	LG1	EDDT	1.8030	3.6060						
		ADP	1.4925							
	LG2,3	LIF	3.6854							
		EDDT	1.6850							
		ADP	1.3949							
	LL	EDDT	2.3851							
		ADP	1.9745							
	LN	EDDT	2.2502							
		ADP	1.8627							
46 Palladium	KA1,2	LIF		1.1736	1.7604	2.3472	2.9340	3.5208		
		EDDT				1.0732	1.3415	1.6098	1.8781	2.1464
	KB1	LIF		1.0410	1.5615	2.0820	2.6025	3.1230	3.6435	
	LA1	EDDT	1.9969							
		ADP	1.6531	3.3062						
		KAP		1.3208	1.9812	2.6416	3.3020			
	LB1	EDDT	1.8956							
		ADP	1.5692	3.1384						
		KAP		1.2538	1.8807	2.5076	3.1345			
	LB2	EDDT	1.7871	3.5742						
		ADP	1.4794	2.9588						
		KAP		1.1820	1.7730	2.3640				
	LB3	EDDT	1.8445	3.6890						
		ADP	1.5269	3.0538						
		KAP		1.2200	1.8300	2.4400				
	LB4	EDDT	1.8613	3.7226						
		ADP	1.5408	3.0816						
		KAP		1.2310	1.8465	2.4620				
	LG1	LIF	3.7244							
		EDDT	1.7028	3.4056						
		ADP	1.4096	2.8192						
	LG2,3	LIF	3.4891							
		EDDT	1.5953							
		ADP	1.3206							
	LL	EDDT	2.2642							
		ADP	1.8744							
	LN	EDDT	2.1307							
		ADP	1.7638							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
47 Silver	KA1,2	LIF		1.1216	1.6824	2.2432	2.8040	3.3648		
		EDDT				1.0256	1.2820	1.5384	1.7948	2.0512
	KB1	LIF			1.4910	1.9880	2.4850	2.9820	3.4790	
	LA1	EDDT	1.8993							
		ADP	1.5723	3.1446						
		KAP		1.2562	1.8843	2.5124	3.1405			
	LB1	EDDT	1.7989	3.5978						
		ADP	1.4891	2.9782						
		KAP			1.7847	2.3796	2.9745	3.5694		
	LB2	LIF	3.7030							
		EDDT	1.6931	3.3862						
		ADP	1.4015	2.8030						
		KAP			1.6797	2.2396				
	LB3	EDDT	1.7525	3.5050						
		ADP	1.4508	2.9016						
		KAP			1.7388	2.3184				
	LB4	EDDT	1.7695	3.5390						
		ADP	1.4648	2.9296						
		KAP			1.7556	2.3408				
	LG1	LIF	3.5225							
		EDDT	1.6105	3.2210						
		ADP	1.3332	2.6664						
	LG2	LIF	3.3120							
		EDDT	1.5143							
		ADP	1.2536							
	LG5	LIF	3.6162							
		EDDT	1.6534							
		ADP	1.3687							
	LL	EDDT	2.1523							
		ADP	1.7817							
	LN	EDDT	2.0200							
		ADP	1.6722							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
48 Cadmium	LA1	EDDT	1.8088	3.6176						
		ADP	1.4974	2.9948						
		KAP		1.1964	1.7946	2.3928	2.9910	3.4892		
	LB1	LIF	3.7380							
		EDDT	1.7091	3.4182						
		ADP	1.4148	2.8296						
		KAP			1.6956	2.2608	2.8260	3.5892		
	LB2	LIF	3.5140							
		EDDT	1.6067	3.2134						
		ADP	1.3300	2.6600						
		KAP			1.5939	2.1252				
	LB3	LIF	3.6447							
		EDDT	1.6664	3.3328						
		ADP	1.3795	2.7590						
		KAP			1.6533	2.2044				
	LB4	LIF	3.6818							
		EDDT	1.6834	3.3668						
		ADP	1.3935	2.7870						
		KAP			1.6701	2.2268				
	LG1	LIF	3.3355							
		EDDT	1.5250	3.0500						
		ADP	1.2624	2.5248						
	LG2,3	LIF	3.1375							
		EDDT	1.4345							
		ADP	1.1875							
	LL	EDDT	2.0483							
		ADP	1.6956							
	LN	EDDT	1.9171							
		ADP	1.5870							
49 Indium	LA1	LIF	3.7719							
		EDDT	1.7245	3.4490						
		ADP	1.4276	2.8552						
		KAP			1.7109	2.2812	2.8515	3.4218		
	LB1	LIF	3.5551							
		EDDT	1.6254	3.2508						
		ADP	1.3456	2.6912						
		KAP			1.6128	2.1504	2.6880	3.2256		
	LB2	LIF	3.3383							
		EDDT	1.5263	3.0526						
		ADP	1.2635	2.5270						
		KAP			1.5144	2.0192				
	LB3	LIF	3.4696							
		EDDT	1.5864	3.1728						
		ADP	1.3132	2.6264						
		KAP			1.5738	2.0984				

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
49 Indium continued	LB4	LIF	3.5068							
		EDDT	1.6034	3.2068						
		ADP	1.3273	2.6546						
		KAP			1.5906	2.1208				
	LG1	LIF	3.1620							
		EDDT	1.4457	2.8914						
		ADP	1.1968	2.3936						
	LG2,3	LIF	2.9798							
		EDDT	1.3624							
		ADP	1.1278							
	LL	EDDT	1.9516							
		ADP	1.6156							
	LN	EDDT	1.8211							
		ADP	1.5075							
50 Tin	LA1	LIF	3.5998							
		EDDT	1.6459	3.2918						
		ADP	1.3625	2.7250						
		KAP			1.6329	2.1772	2.7215	3.2658		
	LB1	LIF	3.3848							
		EDDT	1.5476	3.0952						
		ADP	1.2811	2.5622						
		KAP			1.5354	2.0472	2.5590	3.0708	3.5826	
	LB2	LIF	3.1751							
		EDDT	1.4517	2.9034						
		ADP	1.2017	2.4034	3.6051					
		KAP			1.4403	1.9204				
	LB3	LIF	3.3057							
		EDDT	1.5114	3.0228						
		ADP	1.2512	2.5024	3.7536					
		KAP			1.4994	1.9992				
	LB4	LIF	3.3432							
		EDDT	1.5285	3.0570						
		ADP	1.2654	2.5308						
		KAP			1.5165	2.0220				
	LG1	LIF	3.0010							
		EDDT	1.3721	2.7442						
		ADP	1.1358	2.2716						
	LG2,3	LIF	2.8325							
		EDDT	1.2950							
		ADP	1.0720							
	LL	EDDT	1.8615							
		ADP	1.5410							
	LN	EDDT	1.7322							
		ADP	1.4339							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
51 Antimony	LA1	LIF	3.4391							
		EDDT	1.5724	3.1448						
		ADP	1.3016	2.6032						
		KAP			1.5600	2.0800	2.6000	3.1200	3.6400	
	LB1	LIF	3.2256							
		EDDT	1.4748	2.9496						
		ADP	1.2208	2.4416	3.6624					
		KAP			1.4631	1.9508	2.4385	2.9262	3.4139	
	LB2	LIF	3.0232							
		EDDT	1.3823	2.7646						
		ADP	1.1443	2.2886	3.4329					
		KAP			1.3713	1.8284				
	LB3	LIF	3.1524							
		EDDT	1.4413	2.8826						
		ADP	1.1931	2.3862	3.5793					
		KAP			1.4301	1.9068				
	LB4	LIF	3.1900							
		EDDT	1.4585	2.9170						
		ADP	1.2074	2.4148	3.6222					
		KAP			1.4469	1.9292				
	LG1	LIF	2.8515							
		EDDT	1.3037	2.6074						
		ADP	1.0792	2.1584	3.2376					
	LG2,3	LIF	2.6951							
		EDDT	1.2322							
		ADP	1.0200							
	LL	EDDT	1.7777							
		ADP	1.4716							
	LN	LIF	3.6074							
		EDDT	1.6494							
		ADP	1.3654							
52 Tellurium	LA1	LIF	3.2891							
		EDDT	1.5038	3.0076						
		ADP	1.2449	2.4898	3.7347					
		KAP			1.4919	1.9892	2.4865	2.9838	3.4811	
	LB1	LIF	3.0767							
		EDDT	1.4067	2.8134						
		ADP	1.1645	2.3290	3.4935					
		KAP			1.3956	1.8608	2.3260	2.7912	3.2564	3.7216
	LB2	LIF	2.8821							
		EDDT	1.3177	2.6354						
		ADP	1.0908	2.1816	3.2724					
		KAP			1.3074	1.7432				
	LB3	LIF	3.0088							
		EDDT	1.3757	2.7514						
		ADP	1.1388	2.2776	3.4164					
		KAP			1.3647	1.8196				

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
52 Tellurium continued	LB4	LIF	3.0465							
		EDDT	1.3929	2.7858						
		ADP	1.1531	2.3062	3.4593					
		KAP			1.3818	1.8424				
	LG1	LIF	2.7122							
		EDDT	1.2491	2.4892	3.7203					
		ADP	1.0265	2.0530	3.0795					
	LG2,3	LIF	2.5672							
		EDDT	1.1738							
	LL	LIF	3.7168							
		EDDT	1.6994							
		ADP	1.4068							
	LN	LIF	3.4382							
		EDDT	1.5720							
		ADP	1.3013							
53 Iodine	LA1	LIF	3.1484							
		EDDT	1.4395	2.8790						
		ADP	1.1916	2.3832	3.5748					
		KAP			1.4280	1.9040	2.3800	2.8560	3.3320	
	LB1	LIF	2.9373							
		EDDT	1.3430	2.6860						
		ADP	1.1117	2.2234	3.3351					
		KAP			1.3323	1.7764	2.2205	2.6646	3.1087	3.5528
	LB2	LIF	2.7504							
		EDDT	1.2575	2.5140						
		ADP	1.0410	2.0820	3.1230					
		KAP			1.2477	1.6636				
	LB3	LIF	2.8741							
		EDDT	1.3141	2.6282						
		ADP	1.0878	2.1756	3.2634					
		KAP			1.3038	1.7384				
	LB4	LIF	2.9119							
		EDDT	1.3314	2.6628						
		ADP	1.1021	2.2042	3.3063					
		KAP			1.3209	1.7612				
	LG1	LIF	2.5823							
		EDDT	1.1806	2.3612	3.5418					
		ADP		1.9546	2.9319					
	LG2,3	LIF	2.4473							
		EDDT	1.1189	2.2279	3.3567					
		ADP		1.8526	2.7789					
	LL	LIF	3.5573							
		EDDT	1.6265							
		ADP	1.3464							
	LN	LIF	3.2798							
		EDDT	1.4995							
		ADP	1.2413							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
54 Xenon	LA1	LIF	3.0150							
		EDDT	1.3785	2.7570						
		ADP	1.1411	2.2822	3.4233					
		KAP			1.3677	1.8236	2.2795	2.7354	3.1913	3.6472
	LB1	LIF	2.8030							
		EDDT	1.2815	2.5630						
		ADP	1.0609	2.1218	3.1827					
		KAP			1.2714	1.6952	2.1190	2.5428	2.9666	3.3904
	LB2	LIF	2.6260							
		EDDT	1.2006	2.4012	3.6018					
		ADP		1.9878	2.9817					
		KAP			1.1910	1.5880				
	LG1	LIF	2.4620							
		EDDT	1.1256	2.2512	3.3768					
		ADP		1.8636	2.7954					
55 Cesium	LA1	LIF	2.8920							
		EDDT	1.3222	2.6444						
		ADP	1.0946	2.1892	3.2838					
		KAP			1.3119	1.7492	2.1865	2.6238	3.0611	3.4984
	LB1	LIF	2.6834							
		EDDT	1.2269	2.4538	3.6807					
		ADP	1.0156	2.0312	3.0468					
		KAP			1.2171	1.6228	2.0285	2.4342	2.8399	3.2456
	LB2	LIF	2.5114							
		EDDT	1.1482	2.2964	3.4446					
		ADP		1.9010	2.8515					
	LB3	LIF	2.6281							
		EDDT	1.2016	2.4032	3.6048					
		ADP		1.9894	2.9841					
	LB4	LIF	2.6664							
		EDDT	1.2191	2.4382	3.6573					
		ADP	1.0092	2.0184	3.0276					
	LG1	LIF	2.3477							
		EDDT	1.0734	2.1468	3.2202					
		ADP		1.7772	2.6658					
	LG3	LIF	2.2325							
		EDDT	1.0207							
	LL	LIF	3.2666							
		EDDT	1.4935							
		ADP	1.2364							
	LN	LIF	2.9927							
		EDDT	1.3683							
		ADP	1.1327							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
56 Barium	LA1	LIF	2.7751							
		EDDT	1.2688	2.5376						
		ADP	1.0504	2.1008	3.1512					
		KAP			1.2588	1.6784	2.0980	2.5176	2.9372	3.3568
	LB1	LIF	2.5673							
		EDDT	1.1738	2.3476	3.5214					
		ADP		1.9434	2.9151					
		KAP				1.5528	1.9410	2.3292	2.7174	3.1056
	LB2	LIF	2.4042							
		EDDT	1.0992	2.1984	3.2976					
		ADP		1.8198	2.7297	3.6396				
		KAP				1.4540	1.8175			
	LB3	LIF	2.5159							
		EDDT	1.1503	2.3006	3.4509					
		ADP		1.9044	2.8566					
		KAP				1.5216	1.9020			
	LB4	LIF	2.5548							
		EDDT	1.1681	2.3362	3.5043					
		ADP		1.9340	2.9010					
		KAP				1.5452	1.9315			
	LG1	LIF	2.2412							
		EDDT	1.0247	2.0494	3.0741					
		ADP		1.6964	2.5446					
	LG3	LIF	2.1339							
	LL	LIF	3.1350							
		EDDT	1.4333							
		ADP	1.1865							
	LN	LIF	2.8619							
		EDDT	1.3085							
		ADP	1.0832							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
57 Lanthanum	LA1	LIF	2.6650							
		EDDT	1.2185	2.4370	3.6555					
		ADP	1.0087	2.0174	3.0261					
		KAP			1.2090	1.6120	2.0150	2.4180	2.8210	3.2240
	LB1	LIF	2.4582							
		EDDT	1.1239	2.2478	3.3717					
		ADP		1.8608	2.7912	3.7216				
		KAP				1.4868	1.8585	2.2302	2.6019	2.9736
	LB2	LIF	2.3026							
		EDDT	1.0528	2.1056	3.1584					
		ADP		1.7430	2.6145	3.4860				
		KAP				1.3924	1.7405			
	LB3	LIF	2.4101							
		EDDT	1.1019	2.2038	3.3057					
		ADP		1.8244	2.7366	3.6488				
		KAP				1.4576	1.8220			
	LB4	LIF	2.4487							
		EDDT	1.1196	2.2392	3.3588					
		ADP		1.8536	2.7804	3.7072				
		KAP				1.4808	1.8510			
	LG1	LIF	2.1415							
		EDDT		1.9582	2.9373					
		ADP		1.6210	2.4315	3.2420				
	LG3	LIF	2.0407							
	LL	LIF	3.0060							
		EDDT	1.3744							
		ADP	1.1377							
	LN	LIF	2.7395							
		EDDT	1.2525							
		ADP	1.0368							
	MA1,2	KAP	2.2501							
		LSD		1.1948	1.7922	2.3896	2.9870	3.5844		
	MB	KAP	2.1941							
		LSD			1.7475	2.3300	2.9125	3.4950		

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
58 Cerium	LA1	LIF	2.5611							
		EDDT	1.1710	2.3420	3.5130					
		ADP		1.9386	2.9079					
		KAP				1.5488	1.9360	2.3232	2.7104	3.0976
	LB1	LIF	2.3557							
		EDDT	1.0770	2.1540	3.2310					
		ADP		1.7832	2.6748	3.5664				
		KAP				1.4248	1.7810	2.1372	2.4934	2.8496
	LB2	LIF	2.2085							
		EDDT	1.0097	2.0194	3.0291					
		ADP		1.7078	2.5617	3.4156				
		KAP				1.3356	1.6695			
	LB3	LIF	2.3105							
		EDDT	1.0564	2.1128	3.1692					
		ADP		1.7490	2.6235	3.4980				
		KAP				1.3972	1.7465			
	LB4	LIF	2.3489							
		EDDT	1.0739	2.1478	3.2217					
		ADP		1.7780	2.6670	3.5560				
		KAP				1.4204	1.7755			
	LG1	LIF	2.0484							
		EDDT		1.8730	2.8095	3.7460				
		ADP		1.5506	2.3259	3.1012				
		KAP				1.2388	1.5485			
	LG3	LIF	1.9548							
	LL	LIF	2.8915							
		EDDT	1.3220							
		ADP	1.0944							
	LN	LIF	2.6199							
		EDDT	1.1979							
	MA1,2	KAP	2.1258							
		LSD			1.6932	2.2576	2.8220	3.3864		
	MB	KAP	2.0841							
		LSD			1.6602	2.2136	2.7670	3.3204		

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
59 Praseodymium	LA1	LIF	2.4626							
		EDDT	1.1259	2.2518	3.3777					
		ADP		1.8642	2.7963	3.7284				
		KAP				1.4892	1.8615	2.2338	2.6061	2.9784
	LB1	LIF	2.2584							
		EDDT	1.0326	2.0652	3.0958					
		ADP		1.7096	2.5644	3.4192				
		KAP				1.3660	1.7075	2.0490	2.3905	2.7320
	LB2	LIF	2.1190							
		EDDT		1.9376	2.9064					
		ADP		1.6040	2.4060	3.2080				
		KAP				1.2816	1.6020			
	LB3	LIF	2.2168							
		EDDT	1.0135	2.0270	3.0405					
		ADP		1.6780	2.5170	3.3560				
		KAP				1.3408	1.6760			
	LB4	LIF	2.2546							
		EDDT	1.0308	2.0616	3.0924					
		ADP		1.7066	2.5599	3.4132				
		KAP				1.3636	1.7045			
	LG1	LIF	1.9607							
		EDDT		1.7928	2.6892	3.5856				
		ADP		1.4842	2.2263	2.9684				
	LG3	LIF	1.8736							
	LL	LIF	2.7837							
		EDDT	1.2727							
		ADP	1.0536							
	LN	LIF	2.5120							
		EDDT	1.1485							
	MA1,2	KAP	2.0176							
		LSD			1.6071	2.1428	2.6785	3.2142	3.7499	
	MB	KAP	1.9748							
		LSD			1.5729	2.0972	2.6215	3.1458	3.6701	

Z-ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
60 Neodymium	LA1	LIF	2.3700							
		EDDT	1.0836	2.1672	3.2508					
		ADP		1.7940	2.6910	3.5880				
		KAP				1.4332	1.7915	2.1498	2.5081	2.8664
	LB1,4	LIF	2.1665							
		EDDT		1.9812	2.9718					
		ADP		1.6400	2.4600	3.2800				
		KAP				1.3104	1.6380	1.9656	2.2932	2.6208
	LB2	LIF	2.0355							
		EDDT		1.8612	2.7918	3.7224				
		ADP		1.5408	2.3112	3.0816				
		KAP				1.2312	1.5390			
	LB3	LIF	2.1264							
		EDDT		1.9444	2.9166					
		ADP		1.6096	2.4144	3.2192				
		KAP				1.2860	1.6075			
	LG1	LIF	1.8775							
		EDDT		1.7168	2.5752	3.4336				
		ADP		1.4212	2.1318	2.8424				
	LG3	LIF	1.7961							
	LL	LIF	2.6756							
		EDDT	1.2233							
		ADP	1.0127							
	LN	LIF	2.4090							
		EDDT	1.1014							
	MA1,2	KAP	1.9167							
		LSD			1.5267	2.0356	2.5445	3.0534	3.5623	
	MB	KAP	1.8750							
		LSD			1.4934	1.9912	2.4890	2.9868	3.4846	
61 Promethium	LA1	LIF	2.2827							
		EDDT	1.0436	2.0872	3.1308					
		ADP		1.7278	2.5917	3.4556				
		KAP				1.3804	1.7255	2.0706	2.4157	2.7608
	LB1	LIF	2.0811							
		EDDT		1.9030	2.8545					
		ADP		1.5754	2.3631	3.1508				
		KAP				1.2588	1.5735	1.8882	2.2029	2.5176
	LB2	LIF	1.9557							
		EDDT		1.7884	2.6826	3.5768				
		ADP		1.4804	2.2206	2.9608				
	LB3	LIF	2.0420							
		EDDT		1.8672	2.8008	3.7344				
		ADP		1.5456	2.3184	3.0912				
		KAP				1.2348	1.5435			
	LG1	LIF	1.7988							
		EDDT		1.6448	2.4672	3.2896				
		ADP		1.3616	2.0424	2.7232				

Z-ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
62 Samarium	LA1	LIF	2.1994							
		EDDT	1.0056	2.0112	3.0168					
		ADP		1.6648	2.4972	3.3296				
		KAP				1.3300	1.6625	1.9950	2.3275	2.6600
	LB1	LIF	1.9976							
		EDDT		1.8266	2.7399	3.6532				
		ADP		1.5120	2.2680	3.0240				
		KAP				1.2080	1.5100	1.8120	2.1140	2.4160
	LB2	LIF	1.8818	3.7636						
		EDDT		1.7208	2.5812	3.4416				
		ADP		1.4244	2.1366	2.8488				
	LB3	LIF	1.9619							
		EDDT		1.7940	2.6910	3.5880				
		ADP		1.4850	2.2275	2.9700				
	LB4	LIF	2.0004							
		EDDT		1.8292	2.7438	3.6584				
		ADP		1.5142	2.2713	3.0284				
	LG1	LIF	1.7264	3.4530						
		EDDT		1.5788	2.3682	3.1576				
		ADP		1.3070	1.9605	2.6140				
	LG3	LIF	1.6550							
	LL	LIF	2.4820							
		EDDT	1.1348							
	LN	LIF	2.2184							
		EDDT	1.0143							
	MA1,2	KAP	1.7282	3.4564						
		LSD			1.3764	1.8352	2.2940	2.7528	3.2116	3.6704
	MB	KAP	1.7028	3.4056						
		LSD			1.3563	1.8084	2.2605	2.7126	3.1647	3.6168
63 Europium	LA1	LIF	2.1205							
		EDDT		1.9390	2.9085					
		ADP		1.6052	2.4078	3.2104				
		KAP				1.2824	1.6030	1.9236	2.2442	2.5648
	LB1	LIF	1.9201							
		EDDT		1.7558	2.6337	3.5116				
		ADP		1.4534	2.1801	2.9068	3.6335			
		KAP					1.4515	1.7418	2.0321	2.3224
	LB2	LIF	1.8118	3.6236						
		EDDT		1.6568	2.4852	3.3136				
		ADP		1.3714	2.0571	2.7428				
	LB3	LIF	1.8865	3.7730						
		EDDT		1.7240	2.5875	3.4500				
		ADP		1.4280	2.1420	2.8560				
	LB4	LIF	1.9259							
		EDDT		1.7610	2.6415	3.5220				
		ADP		1.4578	2.1867	2.9156				

Z-ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
63 Europium continued	LG1	LIF	1.6576	3.3152						
		EDDT		1.5158	2.2737	3.0316				
		ADP		1.2548	1.8822	2.5096				
	LG3	LIF	1.5909							
	LL	LIF	2.3951							
		EDDT	1.0951							
	LN	LIF	2.1313							
	MA1,2	KAP	1.6564	3.3128						
		LSD			1.3194	1.7592	2.1990	2.6388	3.0786	3.5184
	MB	KAP	1.6247	3.2494						
		LSD			1.2942	1.7256	2.1570	2.5884	3.0198	3.4512
64 Gadolinium	LA1	LIF	2.0460							
		EDDT		1.8708	2.8062	3.7416				
		ADP		1.5488	2.3232	3.0976				
		KAP				1.2372	1.5465	1.8558	2.1651	2.4744
	LB1	LIF	1.8462	3.6924						
		EDDT		1.6882	2.5323	3.3764				
		ADP		1.3974	2.0961	2.7948	3.4935			
		KAP					1.3955	1.6746	1.9537	2.2328
	LB2	LIF	1.7454	3.4908						
		EDDT		1.5960	2.3940	3.1920				
		ADP		1.3212	1.9818	2.6424				
	LB3	LIF	1.8145	3.6290						
		EDDT		1.6592	2.4888	3.3184				
		ADP		1.3736	2.0604	2.7472				
	LB4	LIF	1.8530	3.7060						
		EDDT		1.6944	2.5416	3.3888				
		ADP		1.4026	2.1039	2.8052				
	LG1	LIF	1.5918	3.1836						
		EDDT		1.4556	2.1834	2.9112				
		ADP		1.2048	1.8072	2.4096				
	LG3	LIF	1.5289							
	LL	LIF	2.3117							
		EDDT	1.0569							
	LN	LIF	2.0493							
	MA1,2	KAP	1.5749	3.1498						
		LSD			1.2543	1.6724	2.0905	2.5086	2.9267	3.3448
	MB	KAP	1.5505	3.1010						
		LSD			1.2351	1.6468	2.0585	2.4702	2.8819	3.2936

Z-ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
65 Terbium	LA1	LIF	1.9754							
		EDDT		1.8064	2.7096	3.6128				
		ADP		1.4954	2.2431	2.9908	3.7385			
		KAP				1.1948	1.4935	1.7922	2.0909	2.3896
	LB1	LIF	1.7762	3.5524						
		EDDT		1.6242	2.4363	3.2484				
		ADP		1.3446	2.0169	2.6892	3.3615			
		KAP					1.3430	1.6116	1.8802	2.1488
	LB2	LIF	1.6823	3.3646						
		EDDT		1.5384	2.3076	3.0768				
		ADP		1.2734	1.9101	2.5468				
	LB3	LIF	1.7460	3.4920						
		EDDT		1.5966	2.3949	3.1932				
		ADP		1.3216	1.9824	2.6432				
	LB4	LIF	1.7849	3.5698						
		EDDT		1.6322	2.4483	3.2644				
		ADP		1.3512	2.0268	2.7024				
	LG1	LIF	1.5296	3.0592						
		EDDT		1.3988	2.0982	2.7976				
		ADP		1.1578	1.7367	2.3156				
	LG3	LIF	1.4712							
	LL	LIF	2.2335							
		EDDT	1.0212							
	LN	LIF	1.9728							
	MA1, 2	KAP	1.5026	3.0052						
		LSD			1.1967	1.5956	1.9945	2.3934	2.7923	3.1912
	MB	ADP	3.7061							
		KAP	1.4806	2.9612						
		LSD				1.5724	1.9655	2.3586	2.7517	3.1448
66 Dysprosium	LA1	LIF	1.9087							
		EDDT		1.7454	2.6181	3.4908				
		ADP		1.4448	2.1672	2.8896	3.6120			
		KAP					1.4430	1.7316	2.0202	2.3088
	LB1	LIF	1.7100	3.4200						
		EDDT		1.5636	2.3454	3.1272				
		ADP		1.2944	1.9416	2.5888	3.2360			
		KAP					1.2925	1.5510	1.8095	2.0680
	LB2	LIF	1.6230	3.2460						
		EDDT		1.4842	2.2263	2.9684				
		ADP		1.2286	1.8429	2.4572				
	LB3,6	LIF	1.6810	3.3620						
		EDDT		1.5372	2.3058	3.0744				
		ADP		1.2724	1.9086	2.5448				
	LB4	LIF	1.7201	3.4402						
		EDDT		1.5728	2.3592	3.1456				
		ADP			1.3020	1.9530				

Z-ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
66 Dysprosium continued	LG1	LIF	1.4726	2.9452						
		EDDT		1.3466	2.0199	2.6932				
		ADP		1.1146	1.6719	2.2292				
	LG3	LIF	1.4167							
	LL	LIF	2.1583							
	LN	LIF	1.8973							
	MA1,2	ADP	3.6120							
		KAP	1.4430	2.8860						
		LSD				1.5324	1.9155	2.2986	2.6817	3.0648
	MB	ADP	3.5441							
		KAP	1.4159	2.8318						
		LSD				1.5036	1.8795	2.2554	2.6313	3.0072
67 Holmium	LA1	LIF	1.8447	3.6894						
		EDDT		1.6868	2.5302	3.3736				
		ADP		1.3964	2.0946	2.7928	3.4910			
		KAP					1.3945	1.6734	1.9523	2.2312
	LB1	LIF	1.6468	3.2936						
		EDDT		1.5058	2.2587	3.0116				
		ADP		1.2466	1.8699	2.4932	3.1165	3.7398		
	LB2	LIF	1.5668	3.1336						
		EDDT		1.4328	2.1492	2.8656				
		ADP		1.1860	1.7790	2.3720				
	LB3	LIF	1.6192	3.2384						
		EDDT		1.4806	2.2209	2.9612				
		ADP		1.2256	1.8384	2.4512				
	LB4	LIF	1.6586	3.3172						
		EDDT		1.5166	2.2749	3.0332				
		ADP		1.2554	1.8831	2.5108				
	LG1	LIF	1.4170	2.8340						
		EDDT		1.2958	1.9437	2.5916				
		ADP		1.0726	1.6089	2.1452				
	LG3	LIF	1.3640							
	LL	LIF	2.0863							
	LN	LIF	1.8256							
	MA1,2	ADP	3.4675							
		KAP	1.3853	2.7706						
		LSD				1.4712	1.8390	2.2068	2.5746	2.9424
	MB	ADP	3.3932							
		KAP	1.3556	2.7112						
		LSD				1.4396	1.7995	2.1594	2.5193	2.8792

Z-ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
68 Erbium	LA1	LIF	1.7842	3.5684						
		EDDT		1.6316	2.4474	3.2632				
		ADP		1.3506	2.0259	2.7012	3.3765			
		KAP					1.3490	1.6188	1.8886	2.1584
	LB1	LIF	1.5872	3.1744						
		EDDT		1.4514	2.1771	2.9028	3.6285			
		ADP		1.2014	1.8021	2.4028	3.0035	3.6042		
	LB2	LIF	1.5139	3.0278						
		EDDT		1.3844	2.0766	2.7688				
		ADP		1.1460	1.7190	2.2920				
	LB3	LIF	1.5615	3.1230						
		EDDT		1.4278	2.1417	2.8556				
		ADP		1.1820	1.7730	2.3640				
	LB4	LIF	1.6007	3.2014						
		EDDT		1.4636	2.1954	2.9272				
		ADP		1.2116	1.8174	2.4232				
	LG1	LIF	1.3638	2.7276						
		EDDT		1.2470	1.8705	2.4940				
		ADP		1.0324	1.5486	2.0648				
	LG3	LIF	1.3145							
	LL	LIF	2.0191							
	LN	LIF	1.7564							
	MA1,2	ADP	3.3310							
		KAP	1.3308	2.6616						
		LSD				1.4132	1.7665	2.1198	2.4731	2.8264
	MB	ADP	3.2525							
		KAP	1.2994	2.5988						
		LSD				1.3800	1.7250	2.0700	2.4150	2.7600
69 Thulium	LA1	LIF	1.7262	3.4524						
		EDDT		1.5784	2.3676	3.1568				
		ADP		1.3066	1.9599	2.6132	3.2665			
		KAP					1.3050	1.5660	1.8270	2.0880
	LB1	LIF	1.5298	3.0596						
		EDDT		1.3988	2.0982	2.7976	3.4970			
		ADP		1.1580	1.7370	2.3160	2.8950	3.4740		
	LB2	LIF	1.4631	2.9262						
		EDDT		1.3378	2.0067	2.6756				
		ADP		1.1074	1.6611	2.2148				
	LB3	LIF	1.5053	3.0106						
		EDDT		1.3764	2.0646	2.7528				
		ADP		1.1394	1.7091	2.2788				
	LB4	LIF	1.5443	3.0886						
		EDDT		1.4120	2.1180	2.8240				
		ADP		1.1690	1.7535	2.3380				

Z-ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
69 Thulium continued	LG1	LIF	1.3153	2.6306						
		EDDT		1.2028	1.8042	2.4056				
		ADP			1.4934	1.9912				
	LG3	LIF	1.2678							
	LL	LIF	1.9550							
	LN	LIF	1.6957							
	MA1,2	ADP	3.2020							
		KAP	1.2793	2.5586						
		LSD				1.3584	1.6980	2.0376	2.3772	2.7168
	MB	ADP	3.1209							
		KAP	1.2468	2.4936	3.7404					
		LSD				1.3240	1.6550	1.9860	2.3170	2.6480
70 Ytterbium	LA1	LIF	1.6718	3.3436						
		EDDT		1.5288	2.2932	3.0576				
		ADP		1.2654	1.8981	2.5308	3.1635			
		KAP					1.2640	1.5168	1.7696	2.0224
	LB1	LIF	1.4755	2.9510						
		EDDT		1.3492	2.0238	2.6984	3.3730			
		ADP		1.1168	1.6752	2.2336	2.7920	3.3504		
	LB2	LIF	1.4152	2.8304						
		EDDT		1.2940	1.9410	2.5880				
		ADP		1.0712	1.6068	2.1424				
	LB3	LIF	1.4523	2.9046						
		EDDT		1.3280	1.9920	2.6560				
		ADP		1.0994	1.6491	2.1988				
	LB4	LIF	1.4913	2.9826						
		EDDT		1.3636	2.0454	2.7272				
		ADP		1.1288	1.6932	2.2576				
	LG1	LIF	1.2675	2.5350						
		EDDT		1.1590	1.7385	2.3180				
		ADP			1.4391	1.9188				
	LG3	LIF	1.2222							
	MA1	EDDT	3.7210							
		ADP	3.0803							
		KAP	1.2306	2.4612	3.6918					
		LSD				1.3068	1.6335	1.9602	2.2869	2.6136
	MB	EDDT	3.6161							
		ADP	2.9935							
		KAP	1.1959	2.3918	3.5877					
		LSD				1.2700	1.5875	1.9050	2.2225	2.5400

Z-ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
71 Lutetium	LA1	LIF	1.6194	3.2388						
		EDDT		1.4808	2.2212	2.9616	3.7020			
		ADP		1.2258	1.8387	2.4516	3.0645	3.6774		
	LB1	LIF	1.4234	2.8468						
		EDDT		1.3016	1.9524	2.6032	3.2540			
		ADP		1.0774	1.6161	2.1548	2.6935	3.2322		
	LB2	LIF	1.3700	2.7400						
		EDDT		1.2528	1.8792	2.5056				
		ADP		1.0370	1.5555	2.0740				
	LB3	LIF	1.4014	2.8028						
		EDDT		1.2814	1.9221	2.5628				
		ADP		1.0608	1.5912	2.1216				
	LB4	LIF	1.4405	2.8810						
		EDDT		1.3172	1.9758	2.6344				
		ADP		1.0904	1.6356	2.1808				
	LG1	LIF	1.2222	2.4444	3.6666					
		EDDT		1.1176	1.6764	2.2352				
		ADP			1.3878	1.8504				
	LG3	LIF	1.1794							
	LL	LIF	1.8361							
	LN	LIF	1.4775							
	MA1	EDDT	3.5845							
		ADP	2.9673							
		KAP		2.3710	3.5565					
		LSD				1.2588	1.5735	1.8882	2.2029	2.5176
	MB	EDDT	3.4750							
		ADP	2.8766							
		KAP		2.2984	3.4476					
		LSD				1.2204	1.5255	1.8306	2.1357	2.4408
72 Hafnium	LA1	LIF	1.5695	3.1390						
		EDDT		1.4352	2.1528	2.8704	3.5880			
		ADP		1.1880	1.7820	2.3760	2.9700	3.5640		
	LB1,6	LIF	1.3739	2.7478						
		EDDT		1.2564	1.8846	2.5128	3.1410			
		ADP		1.0400	1.5600	2.0800	2.6000	3.1200	3.6400	
	LB2	LIF	1.3262	2.6524						
		EDDT		1.2128	1.8192	2.4256				
		ADP		1.0038	1.5057	2.0076				
	LB3	LIF	1.3529	2.7058						
		EDDT		1.2370	1.8555	2.4740				
		ADP		1.0240	1.5360	2.0480				
	LB4	LIF	1.3920	2.7840						
		EDDT		1.2728	1.9092	2.5456				
		ADP		1.0536	1.5804	2.1072				
	LG1	LIF	1.1789	2.3578	3.5367					
		EDDT		1.0780	1.6170	2.1560				
		ADP			1.3386	1.7848				

Z-ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
72 Hafnium continued	LG3	LIF	1.1378							
	LL	LIF	1.7811	3.5622						
	LN	LIF	1.5231							
	MA1	EDDT	3.4470							
		ADP	2.8535							
		KAP		2.2800	3.4200					
		LSD				1.2108	1.5135	1.8162	2.1189	2.4216
	MB	EDDT	3.3394							
		ADP	2.7644							
		KAP		2.2088	3.3132					
		LSD					1.4660	1.7592	2.0524	2.3456
	MG	EDDT	2.9916							
		ADP	2.4765							
73 Tantalum	LA1	LIF	1.5218	3.0436						
		EDDT		1.3916	2.0874	2.7832	3.4790			
		ADP		1.1520	1.7280	2.3040	2.8800	3.4560		
	LB1	LIF	1.3269	2.6538						
		EDDT		1.2134	1.8201	2.4268	3.0335	3.6402		
		ADP		1.0044	1.5066	2.0088	2.5110	3.0132	3.5154	
	LB2	LIF	1.2844	2.5688						
		EDDT		1.1744	1.7616	2.3488				
		ADP			1.4583	1.9444				
	LB3	LIF	1.3067	2.6134						
		EDDT		1.1948	1.7922	2.3896				
		ADP			1.4835	1.9780				
	LB4	LIF	1.3456	2.6912						
		EDDT		1.2304	1.8456	2.4608				
		ADP		1.0186	1.5279	2.0372				
	LG1	LIF	1.1378	2.2756	3.4134					
		EDDT		1.0404	1.5606	2.0808				
		ADP			1.2918	1.7224				
	LG3	LIF	1.0994							
	LL	LIF	1.7282	3.4564						
	LN	LIF	1.4709							
	MA1	EDDT	3.3155							
		ADP	2.7447							
		KAP		2.1930	3.2895					
		LSD					1.4555	1.7466	2.0377	2.3288
	MB	EDDT	3.2106							
		ADP	2.6578							
		KAP		2.1236	3.1854					
		LSD					1.4095	1.6914	1.9733	2.2552
	MG	EDDT	2.8858							
		ADP	2.3889							
		KAP		1.9088	2.8632					

Z-ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
74 Tungsten	LA1	LIF	1.4763	2.9526						
		EDDT		1.3500	2.0250	2.7000	3.3750			
		ADP		1.1176	1.6764	2.2352	2.7940	3.3528		
	LB1	LIF	1.2817	2.5634						
		EDDT		1.1720	1.7580	2.3440	2.9300	3.5160		
		ADP			1.4553	1.9404	2.4255	2.9106	3.3957	
	LB2	LIF	1.2446	2.4892	3.7338					
		EDDT		1.1380	1.7070	2.2760				
		ADP			1.4130	1.8840				
	LB3	LIF	1.2628	2.5256						
		EDDT		1.1546	1.7319	2.3092				
		ADP			1.4337	1.9116				
	LB4	LIF	1.3017	2.6034						
		EDDT		1.1902	1.7853	2.3804				
		ADP			1.4778	1.9704				
	LG1	LIF	1.0985	2.1970	3.2955					
		EDDT		1.0044	1.5066	2.0088				
		ADP			1.2471	1.6628				
	LG3	LIF	1.0619							
	LL	LIF	1.6781	3.3562						
	LN	LIF	1.4211							
	MA1	EDDT	3.1928							
		ADP	2.6430							
		KAP		2.1118	3.1677					
		LSD					1.4015	1.6818	1.9621	2.2424
	MB	EDDT	3.0892							
		ADP	2.5573							
		KAP		2.0434	3.0651					
		LSD					1.3560	1.6272	1.8984	2.1696
	MG	EDDT	2.7836							
		ADP	2.3043							
75 Rhenium	LA1	LIF	1.4328	2.8656						
		EDDT		1.3102	1.9653	2.6204	3.2755			
		ADP		1.0846	1.6269	2.1692	2.7115	3.2538		
	LB1	LIF	1.2384	2.4768	3.7152					
		EDDT		1.1324	1.6986	2.2648	2.8310	3.3972		
		ADP			1.4061	1.8748	2.3435	2.8122	3.2809	3.7496
	LB2	LIF	1.2066	2.4132	3.6198					
		EDDT		1.1032	1.6548	2.2064				
		ADP			1.3701	1.8268				
	LB3	LIF	1.2202	2.4404	3.6606					
		EDDT		1.1158	1.6737	2.2316				
		ADP			1.3854	1.8472				
	LB4	LIF	1.2591	2.5182						
		EDDT		1.1514	1.7271	2.3028				
		ADP			1.4295	1.9060				

Z-ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
75 Rhenium continued	LG1	LIF	1.0609	2.1218	3.1827					
		EDDT			1.4550	1.9400				
		ADP			1.2045	1.6060				
	LG3	LIF	1.0261							
	LL	LIF	1.6304							
	LN	LIF	1.3733							
	MA1	EDDT	3.0764							
		ADP	2.5467							
		KAP		2.0348	3.0522					
		LSD					1.3505	1.6206	1.8907	2.1608
	MB	EDDT	2.9738							
		ADP	2.4617							
		KAP		1.9670	2.9505					
		LSD					1.3055	1.5666	1.8277	2.0888
	MG	EDDT	2.6915							
		ADP	2.2281							
76 Osmium	LA1	LIF	1.3911	2.7822						
		EDDT		1.2720	1.9080	2.5440	3.1800			
		ADP		1.0530	1.5795	2.1060	2.6325	3.1590	3.6855	
	LB1	LIF	1.1972	2.3944	3.5916					
		EDDT		1.0946	1.6419	2.1892	2.7365	3.2838		
		ADP			1.3593	1.8124	2.2655	2.7186	3.1717	3.6248
	LB2	LIF	1.1697	2.3394	3.5091					
		EDDT		1.0696	1.6044	2.1392				
		ADP			1.3281	1.7708				
	LB3	LIF	1.1794	2.3588	3.5382					
		EDDT		1.0784	1.6176	2.1568				
		ADP			1.3392	1.7856				
	LB4	LIF	1.2183	2.4366	3.6549					
		EDDT		1.1140	1.6710	2.2280				
		ADP			1.3833	1.8444				
	LG1	LIF	1.0249	2.0498	3.0747					
		EDDT			1.4058	1.8744				
		ADP			1.1637	1.5516				
	LG3	LIF		1.9834	2.9751					
		EDDT			1.3602	1.8136				
		ADP			1.1259	1.5012				
	LL	LIF	1.5848							
	MA1,2	EDDT	2.9674							
		ADP	2.4564							
		KAP		1.9628	2.9442					
		LSD					1.3025	1.5630	1.8235	2.0840
	MB	EDDT	2.8652							
		ADP	2.3718							
		KAP		1.8952	2.8428					
		LSD					1.2580	1.5096	1.7612	2.0128
	MG	EDDT	2.5976							
		ADP	2.1504							

Z-ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
77 Iridium	LA1	LIF	1.3513	2.7026						
		EDDT		1.2356	1.8534	2.4712	3.0890	3.7068		
		ADP		1.0228	1.5342	2.0456	2.5570	3.0684	3.5798	
	LB1	LIF	1.1578	2.3156	3.4734					
		EDDT		1.0586	1.5879	2.1172	2.6465	3.1758	3.7051	
		ADP			1.3146	1.7528	2.1910	2.6292	3.0674	3.5056
	LB2	LIF	1.1352	2.2704	3.4056					
		EDDT		1.0380	1.5570	2.0760				
		ADP			1.2891	1.7188				
	LB3	LIF	1.1409	2.2818	3.4227					
		EDDT		1.0432	1.5648	2.0864				
		ADP			1.2954	1.7272				
	LB4	LIF	1.1795	2.3590	3.5385					
		EDDT		1.0786	1.6179	2.1572				
		ADP			1.3392	1.7856				
	LG1	LIF		1.9816	2.9724					
		EDDT			1.3590	1.8120				
		ADP			1.1250	1.5000				
	LG3	LIF		1.9186	2.8779					
		EDDT			1.3158	1.7544				
		ADP			1.0893	1.4524				
	LL	LIF	1.5409							
	MA1	EDDT	2.8629							
		ADP	2.3699							
		KAP		1.8936	2.8404					
		LSD					1.2570	1.5084	1.7598	2.0112
	MB	EDDT	2.7603							
		ADP	2.2850							
		KAP		1.8258	2.7387					
	MG	EDDT	2.5152							
		ADP	2.0821							

Z-ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
78 Platinum	LA1	LIF	1.3129	2.6258						
		EDDT		1.2006	1.8009	2.4012	3.0015	3.6018		
		ADP			1.4907	1.9876	2.4845	2.9814	3.4783	
	LB1	LIF	1.1198	2.2396	3.3594					
		EDDT		1.0240	1.5360	2.0480	2.5600	3.0720	3.5840	
		ADP			1.2714	1.6952	2.1190	2.5428	2.9666	3.3904
	LB2	LIF	1.1019	2.2038	3.3057					
		EDDT		1.0076	1.5114	2.0152				
		ADP			1.2510	1.6680				
	LB3	LIF	1.1038	2.2076	3.3114					
		EDDT		1.0092	1.5138	2.0184				
		ADP			1.2531	1.6708				
	LB4	LIF	1.1422	2.3844	3.4266					
		EDDT		1.0444	1.5666	2.0888				
		ADP			1.2969	1.7292				
	LG1	LIF		1.9158	2.8737					
		EDDT			1.3137	1.7516				
		ADP			1.0875	1.4500				
	LG3	LIF		1.8556	2.7834	3.7112				
		EDDT			1.2726	1.6968				
		ADP			1.0533	1.4044				
	LL	LIF	1.4993							
	MA1	EDDT	2.7644							
		ADP	2.2884							
		KAP		1.8284	2.7426	3.6568				
	MB	EDDT	2.6645							
		ADP	2.2057							
		KAP		1.7624	2.6436	3.5248				
	MG	EDDT	2.4322							
		ADP	2.0134							
79 Gold	LA1	LIF	1.2763	2.5526						
		EDDT		1.1670	1.7505	2.3340	2.9175	3.5010		
		ADP			1.4493	1.9324	2.4155	2.8986	3.3817	
	LB1	LIF	1.0835	2.1670	3.2505					
		EDDT			1.4862	1.9816	2.4770	2.9724	3.4678	
		ADP			1.2303	1.6404	2.0505	2.4606	2.8707	3.2808
	LB2	LIF	1.0701	2.1402	3.2103					
		EDDT			1.4676	1.9568				
		ADP			1.2150	1.6200				
	LB3	LIF	1.0678	2.1356	3.2034					
		EDDT			1.4646	1.9528				
		ADP			1.2123	1.6164				

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
79 Gold continued	LB4	LIF	1.1065	2.2130	3.3195					
		EDDT		1.0118	1.5177	2.0236				
		ADP			1.2564	1.6752				
	LG1	LIF		1.8528	2.7792	3.7056				
		EDDT			1.2708	1.6944				
		ADP			1.0518	1.4024				
	LL	LIF	1.4596							
	MA1	EDDT	2.6700							
		ADP	2.2103							
		KAP		1.7660	2.6490	3.5320				
	MB	EDDT	2.5711							
		ADP	2.1284							
		KAP		1.7006	2.5509	3.4012				
	MG	EDDT	2.3525							
		ADP	1.9475							
80 Mercury	LA1	LIF	1.2411	2.4822	3.7233					
		EDDT		1.1348	1.7022	2.2696	2.8370	3.4044		
		ADP			1.4091	1.8788	2.3485	2.8182	3.2879	3.7576
	LB1	LIF	1.0486	2.0972	3.1458					
		EDDT			1.4382	1.9176	2.3970	2.8764	3.3558	
		ADP			1.1904	1.5872	1.9840	2.3808	2.7776	3.1744
	LB2	LIF	1.0396	2.0792	3.1188					
		EDDT			1.4259	1.9012				
		ADP			1.1805	1.5740				
	LB3	LIF	1.0334	2.0668	3.1002					
		EDDT			1.4175	1.8900				
		ADP			1.1733	1.5644				
	LB4	LIF	1.0721	2.1442	3.2163					
		EDDT			1.4706	1.9608				
		ADP			1.2174	1.6232				
	LG1	LIF		1.9730	2.9595					
		EDDT			1.3530	1.8040				
		ADP			1.1202	1.4936				
	LL	LIF	1.4215							
	MA1	EDDT	2.5908							
		ADP	2.1447							
		KAP		1.7136	2.5704	3.4272				
	MB	EDDT	2.4927							
		ADP	2.0635							
		KAP		1.6488	2.4732	3.2976				
	MG	EDDT	2.2760							
		ADP	1.8841							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
81 Thallium	LA1	LIF	1.2073	2.4146	3.6219					
		EDDT		1.1040	1.6560	2.2080	2.7600	3.3120		
		ADP			1.3707	1.8276	2.2845	2.7414	3.1983	3.6552
	LB1	LIF	1.0151	2.0302	3.0453					
		EDDT			1.3923	1.8564	2.3205	2.7846	3.2487	3.7128
		ADP			1.1526	1.5368	1.9210	2.3052	2.6894	3.0736
	LB2	LIF	1.0103	2.0206	3.0309					
		EDDT			1.3857	1.8476				
		ADP			1.1472	1.5296				
	LB3	LIF	1.0006	2.0012	3.0018					
		EDDT			1.3725	1.8300				
		ADP			1.1361	1.5148				
	LB4	LIF	1.0391	2.0782	3.1173					
		EDDT			1.4253	1.9004				
		ADP			1.1799	1.5732				
	LG1	LIF		1.7350	2.6025	3.4700				
		EDDT			1.1898	1.5864				
		ADP			1.3132	1.6415				
	LL	LIF	1.3847							
	MA1	EDDT	2.4968							
		ADP	2.0669							
		KAP		1.6514	2.4771	3.3028				
	MB	EDDT	2.4002							
		ADP	1.9869							
		KAP		1.5876	2.3814	3.1752				
	MG	EDDT	2.2059							
		ADP	1.8261							
82 Lead	LA1	LIF	1.1750	2.3500	3.5250					
		EDDT		1.0744	1.6116	2.1488	2.6860	3.2232		
		ADP			1.3341	1.7788	2.2235	2.6682	3.1129	3.5576
	LB1	LIF		1.9642	2.9463					
		EDDT			1.3470	1.7960	2.2450	2.6940	3.1430	3.5920
		ADP			1.1151	1.4868	1.8585	2.2302	2.6019	2.9736
	LB2	LIF		1.9658	2.9487					
		EDDT			1.3482	1.7976				
		ADP			1.1160	1.4880				
	LB3	LIF		1.9380	2.9070					
		EDDT			1.3290	1.7720				
		ADP			1.1001	1.4668				

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
82 Lead continued	LB4	LIF	1.0074	2.0148	3.0222					
		EDDT			1.3818	1.8424				
		ADP			1.1439	1.5252				
	LG1	LIF		1.6792	2.5188	3.3584				
		EDDT			1.1517	1.5356				
	LL	LIF	1.3498							
	MA1	EDDT	2.4162							
		ADP	2.0002							
		KAP		1.5982	2.3973	3.1964				
	MB	EDDT	2.3205							
		ADP	1.9209							
		KAP		1.5348	2.3022	3.0696				
	MG	EDDT	2.1372							
		ADP	1.7692							
83 Bismuth	LA1	LIF	1.1438	2.2876	3.4314					
		EDDT		1.0458	1.5687	2.0916	2.6145	3.1374	3.6603	
		ADP			1.2987	1.7316	2.1645	2.5974	3.0303	3.4632
	LB1	LIF		1.9038	2.8557					
		EDDT			1.3056	1.7408	2.1760	2.6112	3.0464	3.4816
		ADP			1.0806	1.4408	1.8010	2.1612	2.5214	2.8816
	LB2	LIF		1.9102	2.8653					
		EDDT			1.3101	1.7468				
		ADP			1.0845	1.4460				
	LB3	LIF		1.8768	2.8152	3.7536				
		EDDT			1.2870	1.7160				
		ADP			1.0656	1.4208				
	LB4	LIF		1.9536	2.9304					
		EDDT			1.3398	1.7864				
		ADP			1.1091	1.4788				
	LG1	LIF		1.6262	2.4393	3.2524				
		EDDT			1.1151	1.4868				
	LL	LIF	1.3160							
	MA1	EDDT	2.3402							
		ADP	1.9372							
		KAP		1.5478	2.3217	3.0956				
	MB	EDDT	2.2444							
		ADP	1.8579	3.7158						
		KAP		1.4846	2.2269	2.9692	3.7115			
	MG	EDDT	2.0717							
		ADP	1.7150							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
84 Polonium	LA1	LIF	1.1137	2.2274	3.3411					
		EDDT		1.0184	1.5276	2.0368	2.5460	3.0552	3.5644	
		ADP			1.2645	1.6860	2.1075	2.5290	2.9505	3.3720
	LB1	LIF		1.8442	2.7663	3.6884				
		EDDT			1.2648	1.6864	2.1080	2.5296	2.9512	3.3728
		ADP			1.0470	1.3960	1.7450	2.0940	2.4430	2.7920
	LB2	LIF		1.8584	2.7876	3.7168				
		EDDT			1.2744	1.6992				
		ADP			1.0551	1.4068				
	LB3	LIF		1.8184	2.7276	3.6368				
		EDDT			1.2471	1.6628				
		ADP			1.0323	1.3764				
	LB4	LIF		1.8948	2.8422					
		EDDT			1.2993	1.7324				
		ADP			1.0755	1.4340				
	LG1	LIF		1.5748	2.3622	3.1496				
		EDDT			1.0800	1.4400				
	LL	LIF	1.2825							
85 Astatine	LA1	LIF	1.0850	2.1700	3.2550					
		EDDT			1.4880	1.9840	2.4800	2.9760	3.4720	
		ADP			1.2318	1.6424	2.0530	2.4636	2.8742	3.2848
	LB1	LIF		1.7870	2.6805	3.5740				
		EDDT			1.2255	1.6340	2.0425	2.4510	2.8595	3.2680
		ADP			1.0143	1.3524	1.6905	2.0286	2.3667	2.7048
	LB2	LIF		1.8100	2.7150	2.6200				
		EDDT			1.2411	1.6548				
		ADP			1.0275	1.3700				
	LB3	LIF		1.7628	2.6442	3.5256				
		EDDT			1.2087	1.6116				
		ADP			1.0008	1.3344	1.6680			
	LG1	LIF		1.5258	2.2887	3.0516				
		EDDT			1.0464	1.3952				
86 Radon	LA1	LIF	1.0572	2.1144	3.1716					
		EDDT			1.4499	1.9332	2.4165	2.8998	3.3831	
		ADP			1.2003	1.6004	2.0005	2.4006	2.8007	3.2008
	LB1	LIF		1.7320	2.5980	3.4640				
		EDDT			1.1877	1.5836	1.9795	2.3754	2.7713	3.1672
		ADP				1.3108	1.6385	1.9662	2.2939	2.6216
	LB2	LIF		1.7620	2.6430	3.5240				
		EDDT			1.2084	1.6112				
		ADP			1.0002	1.3336				
	LB3	LIF		1.7088	2.5632	3.4176				
		EDDT			1.1718	1.5624				
	LG1	LIF		1.4786	2.2179	2.9572				
		EDDT			1.0140	1.3520				

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
87 Francium	LA1	LIF	1.0300	2.0600	3.0900					
		EDDT			1.4127	1.8836	2.3545	2.8254	3.2963	
		ADP			1.1694	1.5592	1.9490	2.3388	2.7286	3.1184
	LB1	LIF		1.6792	2.5188	3.3584				
		EDDT			1.1517	1.5356	1.9195	2.3034	2.6873	3.0712
		ADP				1.2712	1.5890	1.9068	2.2246	2.5424
	LB2	LIF		1.7154	2.5731	3.4308				
		EDDT			1.1763	1.5684				
	LB3	LIF		1.6558	2.4837	3.3116				
		EDDT			1.1355	1.5140				
	LG1	LIF		1.4328	2.1492	2.8656				
88 Radium	LA1	LIF	1.0046	2.0092	3.0138					
		EDDT			1.3779	1.8372	2.2965	2.7558	3.2151	3.6744
		ADP			1.1406	1.5208	1.9010	2.2812	2.6614	3.0416
	LB1	LIF		1.6274	2.4411	3.2548				
		EDDT			1.1160	1.4880	1.8600	2.2320	2.6040	2.9760
		ADP				1.2316	1.5395	1.8474	2.1553	2.4632
	LB2	LIF		1.6704	2.5056	3.3408				
		EDDT			1.1457	1.5276				
	LB3	LIF		1.6054	2.4081	3.2108				
		EDDT			1.1010	1.4680				
	LB4	LIF		1.6812	2.5218	3.3624				
		EDDT			1.1529	1.5372				
	LG1	LIF		1.3892	2.0838	2.7784				
	LL	LIF	1.1671							
89 Actinium	LA1	LIF		1.9598	2.9397					
		EDDT			1.3440	1.7920	2.2400	2.6880	3.1360	3.5840
		ADP			1.1124	1.4832	1.8540	2.2248	2.5956	2.9664
	LB1	LIF		1.5780	2.3670	3.1560				
		EDDT			1.0821	1.4428	1.8035	2.1642	2.5249	2.8856
		ADP				1.1944	1.4930	1.7916	2.0902	2.3888
	LB2	LIF		1.6280	2.4420	3.2560				
		EDDT			1.1163	1.4884				
	LB3	LIF		1.5564	2.3346	3.1128				
		EDDT			1.0674	1.4232				
	LG1	LIF		1.3412	2.0118	2.6824				

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
90 Thorium	LA1	LIF		1.9118	2.8677					
		EDDT			1.3110	1.7489	2.1850	2.6220	3.0590	3.4960
		ADP			1.0854	1.4472	1.8090	2.1708	2.5326	2.8944
	LB1	LIF		1.5302	2.2953	3.0604				
		EDDT			1.0494	1.3992	1.7490	2.0988	2.4486	2.7984
		ADP				1.1584	1.4480	1.7376	2.0272	2.3168
	LB2	LIF		1.5868	2.3802	3.1736				
		EDDT			1.0884	1.4512				
	LB3	LIF		1.5096	2.2644	3.0192				
		EDDT			1.0353	1.3804				
	LB4,17	LIF		1.5850	2.3775	3.1700				
		EDDT			1.0869	1.4492				
	LG1	LIF		1.3062	1.9593	2.6124				
	LL	LIF	1.1150							
	MA1	EDDT	1.8921							
		ADP	1.5663	3.1326						
		KAP		1.2514	1.8771	2.5028	3.1285	3.7542		
	MB	EDDT	1.8023	3.6046						
		ADP	1.4920	2.9840						
		KAP		1.1920	1.7880	2.3840	2.9800	3.5760		
	M4–N2	EDDT	2.4414							
		ADP	2.0210							
	M5–N3	EDDT	2.3956							
		ADP	1.9831							
	M3–N1	EDDT	2.0863							
		ADP	1.7271							
	M4–O2	EDDT	1.7427							
		ADP	1.4427							
	M3–N4	LIF	3.7174							
		EDDT	1.6997							
		ADP	1.4070							
		LIF	3.7174							
	MG	LIF	3.6794							
		EDDT	1.6823							
		ADP	1.3926							
	M2–N1	LIF	3.5371							
		EDDT	1.6172							
		ADP	1.3387							
	M3–O1	LIF	3.2826							
		EDDT	1.5008							
		ADP	1.2424							
	M3–O4	LIF	3.1310							
		EDDT	1.4315							
		ADP	1.1850							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
90 Thorium continued	M1–N2	LIF	3.1333							
		EDDT	1.4326							
		ADP	1.1859							
	M2–N4	LIF	3.0120							
		EDDT	1.3771							
		ADP	1.1400							
	M1–N3	LIF	2.9439							
		EDDT	1.3460							
		ADP	1.1142							
91 Protactinium	LA1	LIF		1.8654	2.7981	3.7308				
		EDDT			1.2792	1.7056				
		ADP			1.0590	1.4120				
	LL	LIF	1.0906							
	M4–N2	EDDT	2.3741							
		ADP	1.9653							
	M5–N3	EDDT	2.3278							
		ADP	1.9270							
	M3–N1	EDDT	2.0346							
		ADP	1.6842							
	MA1	EDDT	1.8389	3.6778						
		ADP	1.5223	3.0446						
		KAP		1.2164	1.8246	2.4328	3.0410	3.6492		
	MB	EDDT	1.7496	3.4992						
		ADP	1.4483	2.8966						
		KAP		1.1572	1.7358	2.3144	2.8930	3.4716		
	M4–O2	LIF	3.6904							
		EDDT	1.6873							
		ADP	1.3968							
	M3–N4	LIF	3.6142							
		EDDT	1.6525							
		ADP	1.3679							
	MG	LIF	3.5772							
		EDDT	1.6355	3.2710						
		ADP	1.3539	2.7078						
	M2–N1	LIF	3.4409							
		EDDT	1.5732							
		ADP	1.3023							
	M3–O1	LIF	3.2445							
		EDDT	1.4834							
		ADP	1.2280							
	M3–O4	LIF	3.0380							
		EDDT	1.3890							
		ADP	1.1498							
	M2–N4	LIF	2.9098							
		EDDT	1.3304							
		ADP	1.1013							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
92 Uranium	LA1	LIF		1.8210	2.7315	3.6420				
		EDDT			1.2489	1.6652				
		ADP			1.0338	1.3784				
	LL	LIF	1.0670							
	M4–N2	EDDT	2.3090							
		ADP	1.9114							
	M5–N3	EDDT	2.2618							
		ADP	1.8724							
	M3–N1	EDDT	1.9801							
		ADP	1.6391							
	MA1	EDDT	1.7876	3.5752						
		ADP	1.4798	2.9596						
		KAP			1.7736	2.3648	2.9560	3.5472		
	MB	LIF	3.7154							
		EDDT	1.6988	3.3976						
		ADP	1.4062	2.8124						
		KAP			1.6854	2.2472	2.8090	3.3708		
	M4–O2	LIF	3.5772							
		EDDT	1.6355							
		ADP	1.3539							
	M3–N4	LIF	3.5210							
		EDDT	1.6099							
		ADP	1.3327							
	MG	LIF	3.4800							
		EDDT	1.5911	3.1822						
		ADP	1.3171	2.6342						
	M2–N1	LIF	3.3287							
		EDDT	1.5219							
		ADP	1.2599							
	M3–O1	LIF	3.1202							
		EDDT	1.4266							
		ADP	1.1810							
	M3–O4	LIF	2.9480							
		EDDT	1.3478							
		ADP	1.1158							
	M1–N2	LIF	2.9148							
		EDDT	1.3327							
		ADP	1.1032							
	M2–N4	LIF	2.8186							
		EDDT	1.2887							
		ADP	1.0668							
	M1–N3	LIF	2.7505							
		EDDT	1.2576							
		ADP	1.0410							

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
93 Neptunium	LA1	LIF		1.7772	2.6658	3.5544				
		EDDT			1.2189	1.6252	2.0315	2.4378	2.8441	3.2504
		ADP			1.0089	1.3452	1.6815	2.0178	2.3541	2.6904
	LB1	LIF		1.3958	2.0937	2.7916	3.4895			
		EDDT				1.2760	1.5950	1.9140	2.2330	2.5520
		ADP				1.0564	1.3205	1.5846	1.8487	2.1128
	LB2	LIF		1.4712	2.2068	2.9424				
		EDDT			1.0089	1.3452				
	LB3	LIF		1.3784	2.0676	2.7568				
	LB4	LIF		1.4534	2.1801	2.9068				
	LG1	LIF		1.1944	1.7916	2.3888				
	LL	LIF	1.0428							
94 Plutonium	LA1	LIF		1.7374	2.6061	3.4748				
		EDDT			1.1916	1.5888	1.9860	2.3832	2.7804	3.1776
		ADP				1.3152	1.6440	1.9728	2.3016	2.6304
	LB1	LIF		1.3566	2.0349	2.7132	3.3915			
		EDDT				1.2404	1.5505	1.8606	2.1707	2.4808
		ADP				1.0268	1.2835	1.5402	1.7969	2.0536
	LB2	LIF		1.4388	2.1582	2.8776				
	LB3	LIF		1.3386	2.0079	2.6772				
	LB4	LIF		1.4148	2.1222	2.8296				
	LG1	LIF		1.1582	1.7373					
	LL	LIF	1.0226							
95 Americium	LA1	LIF		1.6974	2.5461	3.3948				
		EDDT			1.1640	1.5520	1.9400	2.3280	2.7160	3.1040
		ADP				1.2848	1.6060	1.9272	2.2484	2.5696
	LB1	LIF		1.3166	1.9749	2.6332	3.2915			
		EDDT				1.2040	1.5050	1.8060	2.1070	2.4080
	LB2	LIF		1.4028	2.1042	2.8056				
	LB3	LIF		1.2978	1.9467	2.5956				
		EDDT			1.1721	1.5628				
	LB4	LIF		1.3728	2.0592	2.7456				
	LG1	LIF		1.1242	1.6863	2.2484				

Z–ELEMENT	LINE	CRYSTAL	1	2	3	4	5	6	7	8
96 Curium	LA1	LIF		1.6580	2.4879	3.3160				
		EDDT			1.1370	1.5160	1.8950	2.2740	2.6530	3.0320
		ADP				1.2548	1.5685	1.8822	2.1959	2.5096
	LB1	LIF		1.2780	1.9170	2.5560	3.1950			
		EDDT				1.1684	1.4605	1.7526	2.0447	2.3368
	LB2	LIF		1.3700	2.0550	2.7400				
	LG1	LIF		1.0920	1.6380	2.1840				
97 Berkelium	LA1	LIF		1.6200	2.4300	3.2400				
		EDDT			1.1109	1.4812	1.8515	2.2218	2.5921	2.9624
		ADP				1.2260	1.5325	1.8390	2.1455	2.4520
	LB1	LIF		1.2420	1.8630	2.4840	3.1050	3.7260		
		EDDT				1.1356	1.4195	1.7034	1.9873	2.2712
	LB2	LIF		1.3380	2.0070	2.6760				
	LG1	LIF		1.0600	1.5900	2.1200				
98 Californium	LA1	LIF		1.5840	2.3760	3.1680				
		EDDT			1.0863	1.4484	1.8105	2.1726	2.5347	2.8968
		ADP				1.1988	1.4985	1.7982	2.0979	2.3976
	LB1	LIF		1.2060	1.8090	2.4120	3.0150	3.6180		
		EDDT				1.1028	1.3785	1.6542	1.9299	2.2056
		ADP				1.1988	1.4985	1.7982	2.0979	2.3976
	LB2	LIF		1.3060	1.9590	2.6120				
	LG1	LIF		1.0300	1.5450	2.0600				

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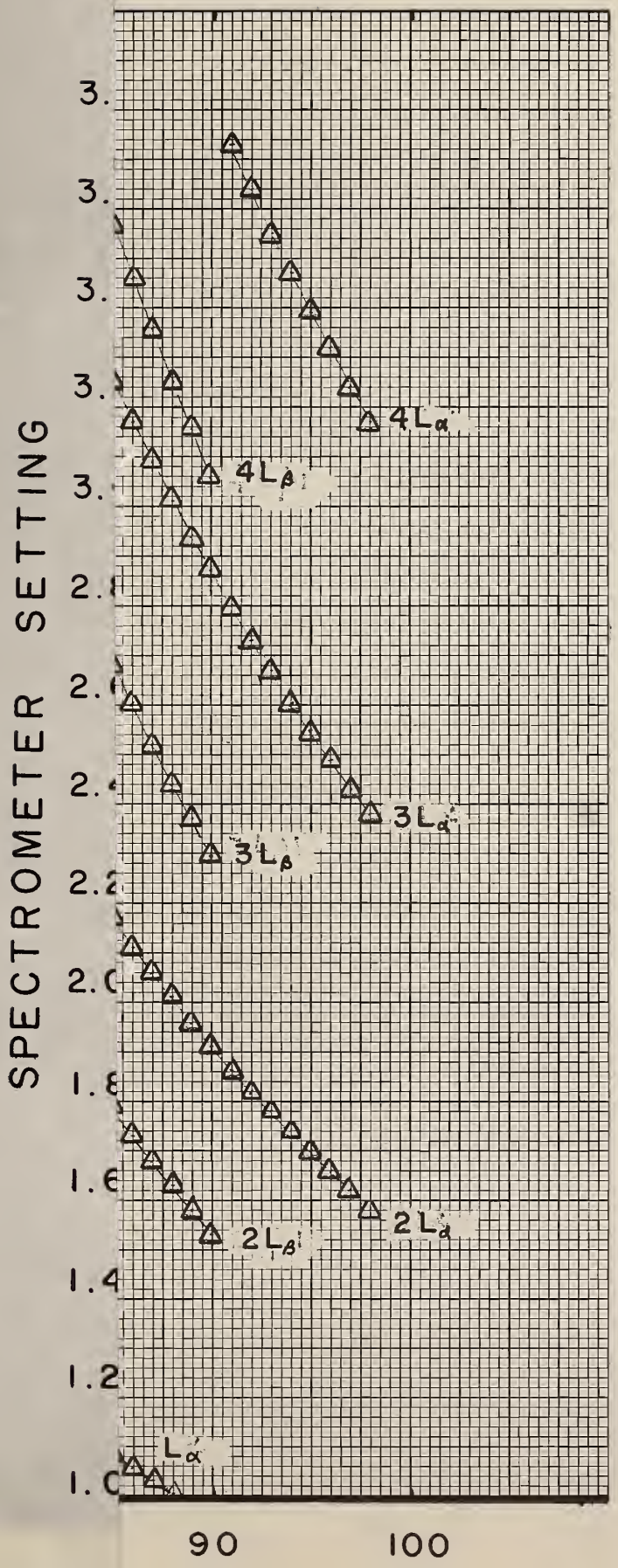
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3.
3.
3.
3.
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2.
2.
2.
1.
1.
1.
1.
4Lα
4Lβ
3Lα
3Lβ
2Lα
2Lβ
Lα
90
100

LiF CRYSTAL

SPECTROMETER SETTING

3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00

10 20 30 40 50 60 70 80 90 100

$6K_\alpha$
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$5K_\alpha$
$5K_\beta$
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K_β
K_α

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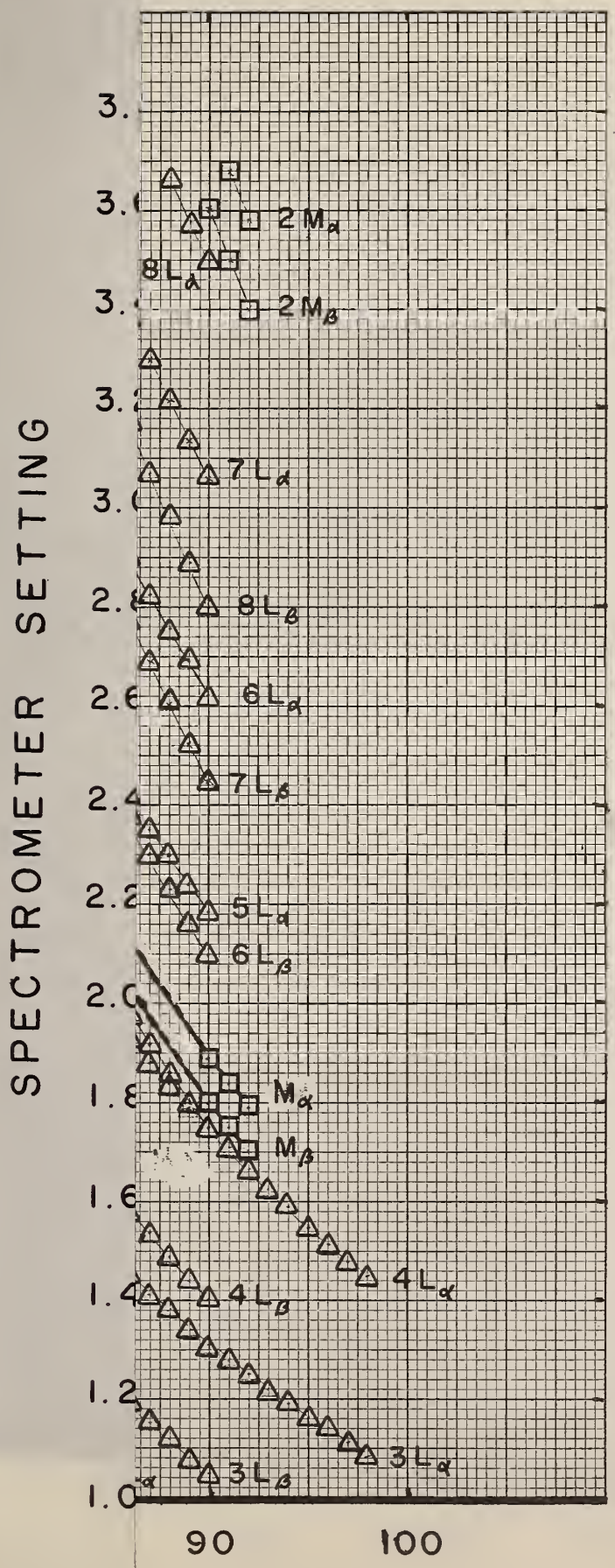
L_β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1.2
1.0
90
100
2 M_α
8 L_α
2 M_β
7 L_α
8 L_β
6 L_α
7 L_β
5 L_α
6 L_β
M_α
M_β
4 L_α
4 L_β
3 L_α
3 L_β

EDDT CRYSTAL

SPECTROMETER SETTING

3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00

10 20 30 40 50 60 70 80 90 100

ATOMIC NUMBER

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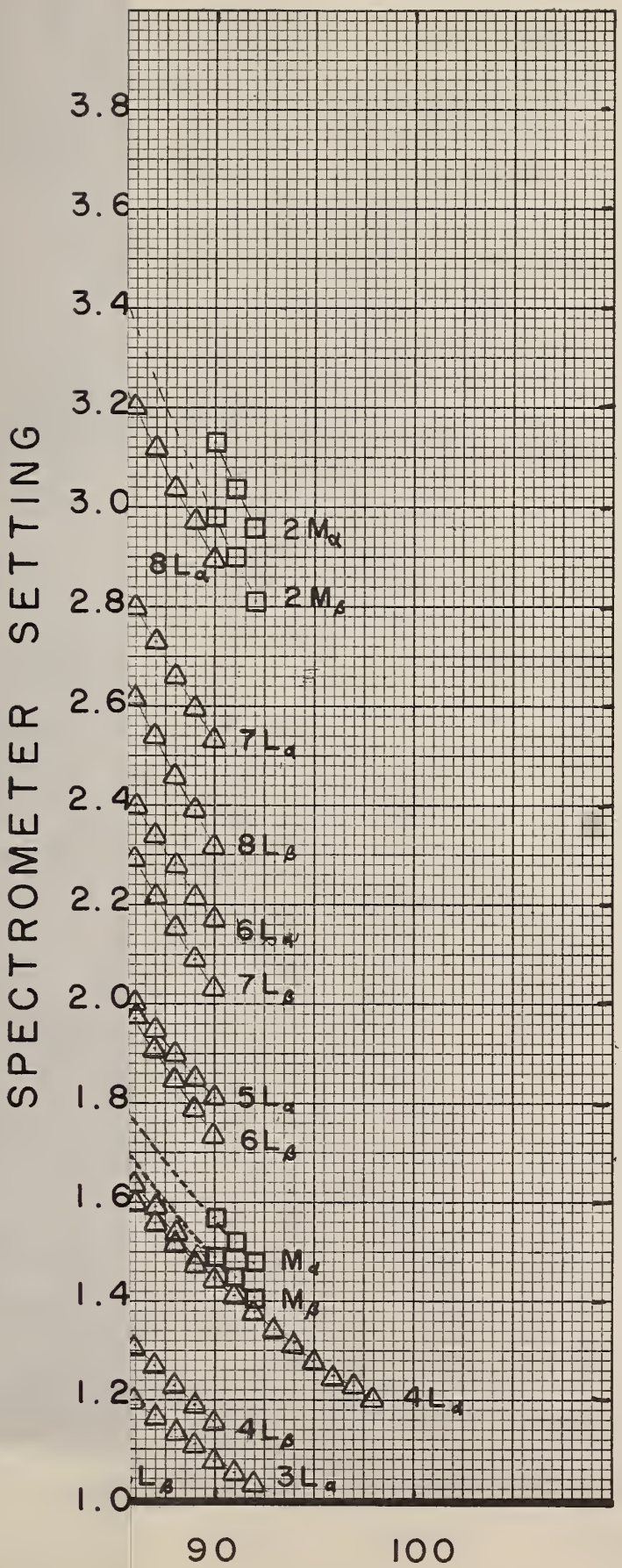
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1.6
1.4
1.2
1.0
90
100
2 Mα
8 Lα
2 Mβ
7 Lα
8 Lβ
6 Lγ
7 Lβ
5 Lα
6 Lβ
Mα
Mβ
4 Lα
4 Lβ
3 Lα
Lβ

ADP CRYSTAL

SPECTROMETER SETTING

3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00

10 20 30 40 50 60 70 80 90 100

ATOMIC NUMBER

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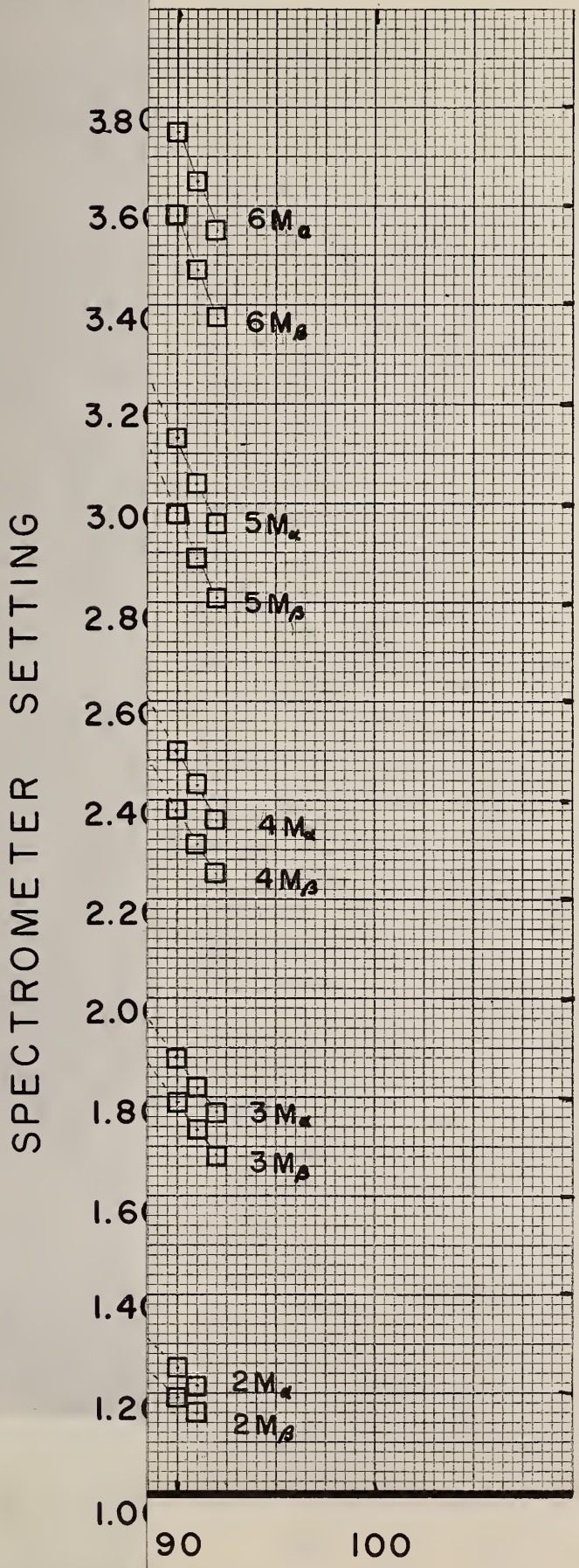
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1.6
1.4
1.2
1.0
6Mα
6Mβ
5Mα
5Mβ
4Mα
4Mβ
3Mα
3Mβ
2Mα
2Mβ
90
100

KAP CRYSTAL

SPECTROMETER SETTING

3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
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1.60
1.40
1.20
1.00

10 20 30 40 50 60 70 80 90 100

ATOMIC NUMBER

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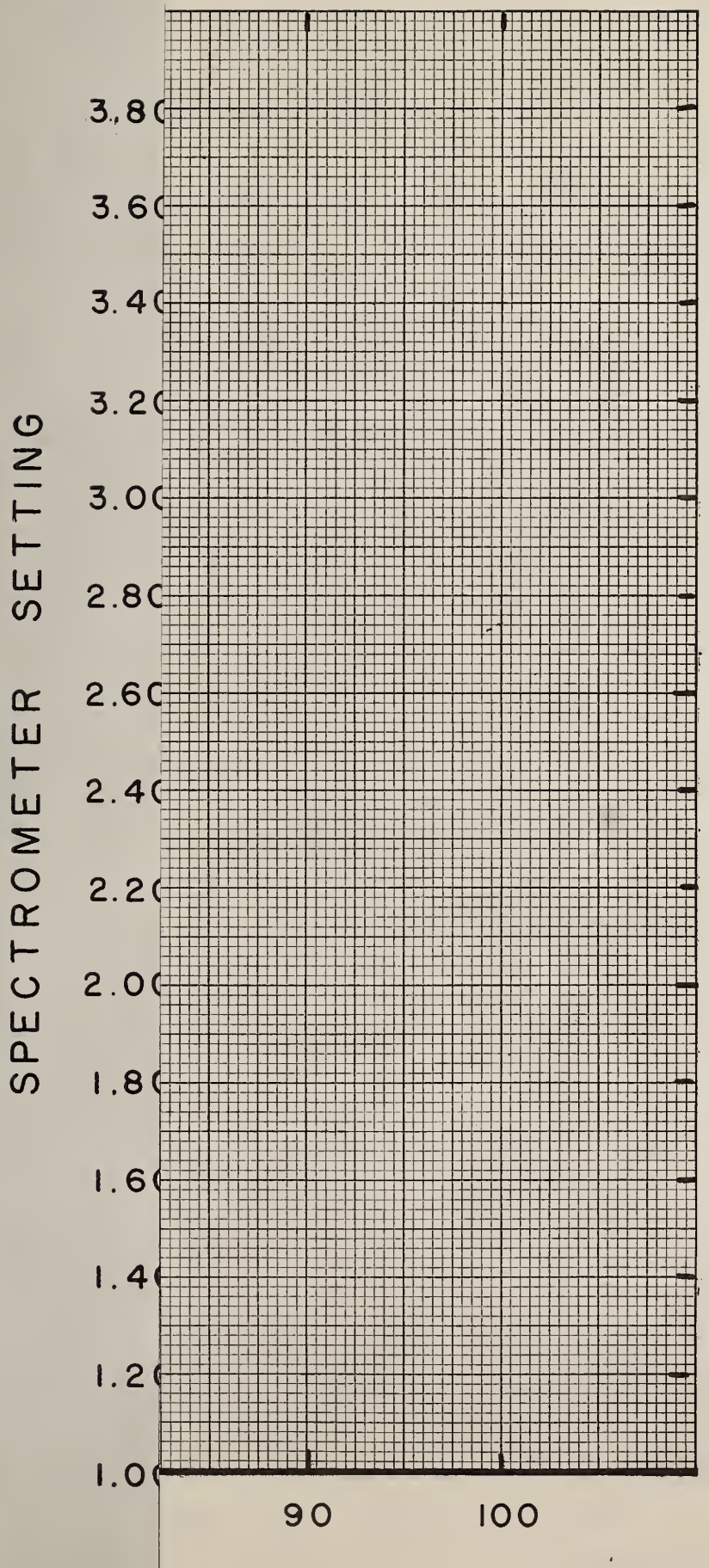
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2.8
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1.8
1.6
1.4
1.2
1.0
90
100

LSD CRYSTAL

SPECTROMETER SETTING

3.80
3.60
3.40
3.20
3.00
2.80
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00

10 20 30 40 50 60 70 80 90 100

ATOMIC NUMBER

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$8K_\alpha$ $8K_\beta$

L_α L_β
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$3L_\alpha$ $3L_\beta$
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$5L_\alpha$ $5L_\beta$
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$2M_\alpha$ $2M_\beta$
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$5M_\alpha$ $5M_\beta$
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