SERIES SPECTRA OF BERYLLIUM, Be_I AND Be_{II}

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Abstract

The determination of the wave-lengths and term values of all the most important lines of Be_{II} and of the triplet system of Be_I has been completed. The results are given in tabular form.

IN 1924 we published[1] a preliminary report upon the application of our method to the determination of the chief characteristics of the series spectra of Be_{II}. With the aid of the same hot-spark technique, and especially because of the courtesy of Mr. Hugh Cooper of the Kemet Laboratories Inc., Cleveland, in presenting us with some pure metallic beryllium for use as the tips of our electrodes, we have recently been able to complete the location of all of the most important lines and the assignment of all of the important term values in both Be_{II} and the triplet system of Be_I.

Table I gives all of the lines of Be_I and Be_{II} together with their intensities and spectral assignments which our plates have brought to light, and in the last two columns are found the term values computed from

Table I

Series lines of beryllium

Int.	λ I.A. Vac.	ν	Δν	Designation	Term Values	
			Lines of Be_{II}			
1	842.03	118760.6		$2s$–$4p$	$2s$	146880.5
0	1026.97	97373.8		$2p$–$5d$	$3s$	58649.3
3	1036.32	96495.8		$2s$–$3p$	$4s$	31424.8
2	1143.01	87448.1		$2p$–$4d$	$5s$	19546.3
8	1512.303	66124.3	6.5	$2p_2$–$3d$		
10	1512.451	66117.8		$2p_1$–$3d$	$2p_2$	114951.7
6	1776.118	56302.6	7.0	$2p_2$–$3s$	$2p_1$	114945.1
8	1776.339	56295.6		$2p_1$–$3s$	$3p$	50384.7
1	2454.63	40739.3		$3s$–$5p$	$4p$	28120.2
4	3047.86	32809.9	Probably oxygen	$3p$–$5d$	$5p$	17910.2
	3131.324	31935.37		$2s$–$2p_1$		
	3131.972	31928.77	6.6	$2s$–$2p_2$	$3d$	48827.4
4	3198.01	31269.4		$3d$–$5f$	$4d$	27460.4
1	3234.47	30917.0		$3d$–$5p$	$5d$	17574.6
3	3242.71	30838.4		$3p$–$5s$		
5	3275.57	30529.0		$3s$–$4p$	$4f$	27435.0
7	4362.21	22924.2		$3p$–$4d$	$5f$	17558.0
8	4674.55	21392.4		$3d$–$4f$		
2	4829.58	20705.7		$3d$–$4p$		
4	5274.28	18959.9		$3p$–$4s$		

[1] Bowen and Millikan, Nature **114**, 380 (1924).

Int.	λ I.A. Vac.	ν	Δν	Designation	Term Values	
			Lines of Be_I			
1	1943.60	51450.9	Possibly oxygen	$2p$–$8d$	$3s$	23110.22
1	1964.81	50895.5	Possibly oxygen	$2p$–$7d$	$4s$	10685.0
2	1998.19	50045.3		$2p$–$6d$	$5s$	6186.9
1	2033.43	49178.0		$2p$–$6s$	$6s$	4033.0
4	2056.71	48621.3		$2p$–$5d$		
4	2126.57	47024.1		$2p$–$5s$	$2p_3$	53212.86
10	2175.72	45961.8		$2p$–$4d$	$2p_2$	53212.18
6	2351.50	42526.0		$2p$–$4s$	$2p_1$	53209.83
	2495.299	40075.36	.69	$2p_3$–$3d$		
	2495.342	40074.67		$2p_2$–$3d$	$3d$	13137.50
	2495.487	40072.34	2.33	$2p_1$–$3d$	$4d$	7249.2
	2651.255	37717.99			$5d$	4589.7
	2651.350	37716.63			$6d$	3165.7
	2651.406	37715.84			$7d$	2315.5
	2651.433	37715.45		pp' group	$8d$	1760.1
	2651.497	37714.54				
	2651.564	37713.59				
	3321.969	30102.63	.66	$2p_3$–$3s$		
	3322.042	30101.97		$2p_2$–$3s$		
	3322.303	30099.60	2.37	$2p_1$–$3s$		

TABLE II

Comparison of frequencies of series terms for stripped atoms Li_I *to* C_{IV}

	N	2	3	4	5
	$109732/N^2$	27433.00	12192.44	6858.25	4389.28
s	Li	43486.3	16280.5	8475.2	5187.8
	Be/4	36720.1	14662.3	7856.2	4886.6
	B/9	33993.1	13970.7		
	C/16	32502.1	13581.4		
p_1	Li	28582.5	12560.4	7018.2	4473.6
	Be/4	28736.3	12596.2	7030.1	4477.6
	B/9	28616.1			
	C/16	28465.3	12504.3		
d	Li		12203.1	6863.5	4389.6
	Be/4		12206.9	6865.1	4393.7
	B/9		12207.8		
	C/16		12208.3		
f	Li			6856.1	4381.8
	Be/4			6858.8	4389.5
	B/9			6860.2	
f'	B/9				4390.6

them. Of the twenty Be_{II} lines here listed six had been previously obtained and published by us in our preliminary report, and two of these six, namely, the strong pair at 3131A were in the preceding literature. Also, of the twenty Be_I lines here listed fourteen had been observed by others and series assignments correctly made for all but two of them,[2] though no term values had been, nor indeed could be, found. The fine structure separations of the pair at 3131A and the triplets at 2495A

[2] Paschen-Götze, Seriengesetze der Linienspektren, p. 71.

and 3322A and the *pp′* group at 2651A were taken from Back's work[2] with an instrument of high resolution, though he does not give absolute wave-lengths. These latter were taken from Rowland and Tatnall[3] and Exner and Haschek,[3] and corrected to I. A. Vac.

For convenience of reference and comparison we have arranged in Table II all of the series terms of the stripped atoms of the first row of the periodic table in the form which we have previously used, following Fowler and Paschen for the second row.[4] The values in this table are obtained, save in the case of lithium, taken from Fowler, from our preceding articles.[2,5]

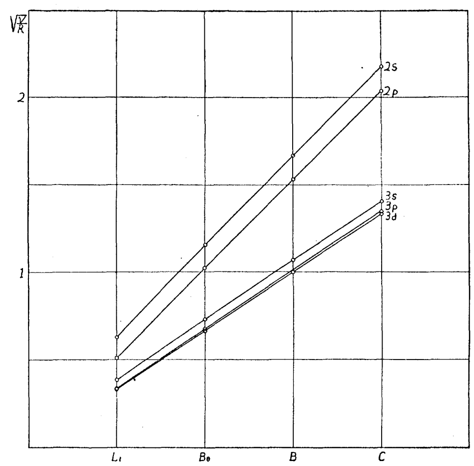

Fig. 1. Moseley's law in the field of optics.

Also in Fig. 1 we present the same graphic display with the aid of which we have previously shown[4] in the case of the stripped atoms of the second row, how beautifully the Moseley law holds in the field of optics wherever the spectra compared arise from atoms of the same electronic structure, but of varying nuclear charge. On account of the greater simplicity of the present electronic structure the "Moseley straight-line" is here the most perfect one which we have thus far found in the field of optics.

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[3] Kayser, Handbuch der Spektroskopie, vol. V, 161.
[4] Bowen and Millikan, Phys. Rev. **25**, 303 (1925).
[5] Bowen and Millikan, Proc. Nat. Acad. Sci. **10**, 199 (1924).