The Spectra of Neon in the Extreme Ultraviolet

J. C. Boyce, *George Eastman Research Laboratory of Physics, Massachusetts Institute of Technology*

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Increased dispersion and resolving power have made possible a revision and extension of previous work on the spectra of neon in the extreme ultraviolet. Lists of classified lines are given for Ne I, Ne II, Ne III and Ne IV in the range from λ2000 to λ282. No new lines were found for Ne I but the accuracy of the wave-lengths is considerably improved. For the other stages of ionization the number of lines identified or resolved has been doubled. Term tables are given for Ne II, Ne III and Ne IV including in them the results of other workers, notably de Bruin, from investigations in the more accessible portion of the spectrum.

With the two-meter-focus normal-incidence broad-range vacuum spectrograph[1] the extreme ultraviolet spectra of the electrodeless discharge in neon have been investigated. In addition to lines of Ne I, II, III and IV, lines of hydrogen and of several stages of ionization of carbon, nitrogen and oxygen appeared. These latter lines were easily recognized from Edlén's list[2] and in the region below λ800 his values of their wave-lengths were sometimes used as standards. The principal standards used were the first and intermediate orders of such neon and impurity lines whose higher orders fell on the longer wave-length portion of the plate. Such higher orders were there compared with the lines from an iron arc. The difficulties with the previous standards in the extreme ultraviolet have been mentioned in an abstract[3] and suggested revised values will be published in due course. Excellent agreement was obtained on wave-lengths determined from different exposures or from different orders of the same exposure. For lines whose wave-length is given to three decimal places the probable error is less than 0.01A and in many cases less than 0.005A. In certain cases where the character of the line did not permit precise measurement (as with very strong or very faint lines) the error may be as great as 0.02A and these wave-lengths are given to two decimal places. The plates were independently measured by Dr. Carol A. Rieke and by the writer, each measuring the plate in both directions. The method of reduction used was that discussed in the description of the instrument.[1] As most of the previous measurements of neon lines in the extreme ultraviolet[4, 5, 6, 7] were made with small vacuum spectrographs and depended upon very uncertain wave-length standards, it seems worth while to publish revised values for the lines already known. The lines newly identified or newly resolved in the present investigation are denoted by an asterisk.

Ne I. The revised values for a number of classified lines are given in Table I. The electrodeless discharge is not particularly suitable for the excitation of higher series members of arc spectra and not as many lines were observed as were previously known. The value of the $^1S_0$ ground state of the atom, 173,930 (corresponding to an ionization potential of 21.47 volts) as given by Lyman and Saunders[4] is not appreciably altered. An extensive term table is given by Bacher and Goudsmit[8] to which reference is made for the multiplet designations used.

Table I. *Ne I classified lines.*

λ	Int.	ν	Classification
743.70	12	134,463	$(2s)^2\,(2p)^6\,{}^1S_0-(2s)^2\,(2p)^5\,3s\,2_1°$
735.89	30	135,890	$3s\,4_1°$
629.729	6	158,798	$4s\,2_1°$
626.819	6+	159,536	$4s\,4_1°$
619.092	4	161,527	$3d\,2_1°$
618.668	5	161,638	$3d\,6_1°$
615.623	5−	162,437	$3d\,12_1°$
602.712	4−	165,917	$5s\,2_1°$
600.04	2	166,655	$5s\,4_1°$
598.86	1	166,984 blend	$4d\,2_1°$
598.698	2+	167,030	$4d\,6_1°$
595.911	3	167,810	$4d\,12_1°$
591.82	2	168,970	$6s\,2_1°$
589.92	1	169,514 double	$5d\,6_1°$
			$5d\,2_1°$
589.16	1	169,733	$6s\,4_1°$
587.20	1	170,300	$5d\,12_1°$

[1] K. T. Compton and J. C. Boyce, R. S. I. **5**, 218 (1934).
[2] B. Edlén, Zeits. f. Physik **85**, 85 (1933).
[3] J. C. Boyce, Phys. Rev. **45**, 289 (1934).

[4] T. Lyman and F. A. Saunders, Proc. Nat. Acad. Sci. **12**, 92 (1926).
[5] H. B. Dorgelo and J. H. Abbink, Zeits. f. Physik **37**, 667 (1926).
[6] H. N. Russell, K. T. Compton and J. C. Boyce, Proc. Nat. Acad. Sci. **14**, 280 (1928).
[7] J. C. Boyce and K. T. Compton, Proc. Nat. Acad. Sci. **15**, 656 (1929).
[8] R. F. Bacher and S. Goudsmit, *Atomic Energy States*, McGraw Hill (1932).

TABLE II. *Ne II classified lines.*

λ	Int.	ν	Classification
1938.82	5+	51,577.8	$(2s)^2\ (2p)^4\ (^3P)\ 3s\ ^2P_{\frac{1}{2}}$ — $(2s)^2\ (2p)^4\ (^1D)\ 3p\ ^2P_{1\frac{1}{2}}^{\circ}$
1930.02	7−	51,812.8	$^2P_{\frac{1}{2}}$ — $^2P_{\frac{1}{2}}^{\circ}$
1916.09	8	52,189.7	$^2P_{1\frac{1}{2}}$ — $^2P_{1\frac{1}{2}}^{\circ}$
1907.49	5	52,424.8	$^2P_{1\frac{1}{2}}$ — $^2P_{\frac{1}{2}}^{\circ}$
1688.38	4	59,228.4	$(2s)\ (2p)^6\ ^2S_{\frac{1}{2}}$ — $(2s)^2\ (2p)^4\ (^1D)\ 3p\ ^2P_{1\frac{1}{2}}^{\circ}$
1681.70	3	59,463.7	$^2S_{\frac{1}{2}}$ — $^2P_{\frac{1}{2}}^{\circ}$
462.388	14	216,269	$(2s)^2\ (2p)^5\ ^2P_{\frac{1}{2}}^{\circ}$ — $(2s)\ (2p)^6\ ^2S_{\frac{1}{2}}$
460.725	15	217,049	$^2P_{1\frac{1}{2}}^{\circ}$ — $^2S_{\frac{1}{2}}$
* 456.895	5−	218,867	$(2s)^2\ (2p)^5\ ^2P_{\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^3P)\ 3s\ ^4P_{1\frac{1}{2}}$
456.344	4	219,133	$^2P_{1\frac{1}{2}}^{\circ}$ — $^4P_{2\frac{1}{2}}$
455.270	7	219,650	$^2P_{\frac{1}{2}}^{\circ}$ — $^4P_{1\frac{1}{2}}$
454.648	5+	219,950	$^2P_{1\frac{1}{2}}^{\circ}$ — $^4P_{\frac{1}{2}}$
447.813	8	223,307	$(2s)^2\ (2p)^5\ ^2P_{\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^3P)\ 3s\ ^2P_{1\frac{1}{2}}$
446.591	7	223,919	$^2P_{\frac{1}{2}}^{\circ}$ — $^2P_{\frac{1}{2}}$
446.252	8	224,089	$^2P_{1\frac{1}{2}}^{\circ}$ — $^2P_{1\frac{1}{2}}$
445.032	7+	224,703	$^2P_{1\frac{1}{2}}^{\circ}$ — $^2P_{\frac{1}{2}}$
407.136	8	245,618	$(2s)^2\ (2p)^5\ ^2P_{\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^1D)\ 3s\ ^2D_{1\frac{1}{2}}$
405.852	9	246,395	$^2P_{1\frac{1}{2}}^{\circ}$ — $^2D_{2\frac{1}{2},\,1\frac{1}{2}}$
362.456	4	275,896	$(2s)^2\ (2p)^5\ ^2P_{\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^1S)\ 3s\ ^2S_{\frac{1}{2}}$
361.427	5	276,678	$^2P_{1\frac{1}{2}}^{\circ}$ — $^2S_{\frac{1}{2}}$
* 357.534	5	279,694	$(2s)^2\ (2p)^5\ ^2P_{\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^3P)\ 3d\ ^2D_{1\frac{1}{2}}$
* 356.795	5d	280,273	$^2P_{1\frac{1}{2}}^{\circ}$ — $^2D_{2\frac{1}{2}}$
* 356.534	3	280,478	$^2P_{1\frac{1}{2}}^{\circ}$ — $^2D_{1\frac{1}{2}}$
* 356.436	2	280,555	$(2s)^2\ (2p)^5\ ^2P_{\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^3P)\ 3d\ ^2P_{\frac{1}{2}}$
* 356.131	4−	280,796	$(2s)^2\ (2p)^5\ ^2P_{1\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^3P)\ 3d\ ^2F_{2\frac{1}{2}}$
* 355.946	2	280,942	$(2s)^2\ (2p)^5\ ^2P_{\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^3P)\ 3d\ ^2P_{1\frac{1}{2}}$
* 355.848	1	281,020	$(2s)^2\ (2p)^5\ ^2P_{1\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^3P)\ 3d\ ^4F_{2\frac{1}{2}}$
* 355.647	3	281,178	$(2s)^2\ (2p)^5\ ^2P_{1\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^3P)\ 3d\ ^4P_{2\frac{1}{2}}$
* 355.450	2	281,334	$(2s)^2\ (2p)^5\ ^2P_{1\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^3P)\ 3d\ ^2P_{\frac{1}{2}}$
* 354.954	4	281,727	$^2P_{1\frac{1}{2}}^{\circ}$ — $^2P_{1\frac{1}{2}}$
* 353.922	2+	282,548	$(2s)^2\ (2p)^5\ ^2P_{\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^3P)\ 4s\ ^2P_{1\frac{1}{2}}$
* 353.206	3	283,121	$^2P_{\frac{1}{2}}^{\circ}$ — $^2P_{\frac{1}{2}}$
* 352.946	4	283,329	$^2P_{1\frac{1}{2}}^{\circ}$ — $^2P_{1\frac{1}{2}}$
* 352.237	2+	283,900	$^2P_{1\frac{1}{2}}^{\circ}$ — $^2P_{\frac{1}{2}}$
* 331.50	2	301,657	$(2s)^2\ (2p)^5\ ^2P_{\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^3P)\ 4d\ ^2D_{1\frac{1}{2}}$?
* 331.06	1	302,057	$(2s)^2\ (2p)^5\ ^2P_{\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^3P)\ 4d\ ^2P_{1\frac{1}{2},\,\frac{1}{2}}$?
* 330.77	3	302,321	$(2s)^2\ (2p)^5\ ^2P_{1\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^3P)\ 4d\ ^2D_{2\frac{1}{2}}$?
* 330.62	2+	302,463	$^2P_{1\frac{1}{2}}^{\circ}$ — $^2D_{1\frac{1}{2}}$?
* 330.20	2	302,846	$(2s)^2\ (2p)^5\ ^2P_{1\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^3P)\ 4d\ ^2P_{1\frac{1}{2},\,\frac{1}{2}}$?
* 328.08	2+	304,807	$(2s)^2\ (2p)^5\ ^2P_{\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^1D)\ 3d\ ^2P_{1\frac{1}{2},\,\frac{1}{2}}$
* 327.63	2	305,221	$(2s)^2\ (2p)^5\ ^2P_{\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^1D)\ 4s\ ^2D_{2\frac{1}{2}}$?
* 327.33	3	305,506	$(2s)^2\ (2p)^5\ ^2P_{\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^1D)\ 3d\ ^2D_{1\frac{1}{2}}$
* 327.25	2	305,581	$(2s)^2\ (2p)^5\ ^2P_{1\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^1D)\ 3d\ ^2P_{1\frac{1}{2},\,\frac{1}{2}}$
* 326.77	3	306,022	$(2s)^2\ (2p)^5\ ^2P_{1\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^1D)\ 4s\ ^2D_{2\frac{1}{2},\,1\frac{1}{2}}$?
* 326.54	5	306,240	$(2s)^2\ (2p)^5\ ^2P_{1\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^1D)\ 3d\ ^2D_{1\frac{1}{2}}$
* 324.56	2	308,110	$(2s)^2\ (2p)^5\ ^2P_{1\frac{1}{2}}^{\circ}$ — $(2s)^2\ (2p)^4\ (^1D)\ 3d\ ^2F_{2\frac{1}{2}}$

TABLE III. *Ne II term values.*

$(2s)^2\ (2p)^5$	$^2P_{1\frac{1}{2}}^{\circ}$	0	$(2s)^2\ (2p)^4\ (^3P)\ 3d$	$^4P_{\frac{1}{2}}$	280,770.2
	$^2P_{\frac{1}{2}}^{\circ}$	782		$^4P_{1\frac{1}{2}}$	280,991.7
$(2s)\ (2p)^6$	$^2S_{\frac{1}{2}}$	217,050		$^4P_{2\frac{1}{2}}$	281,173.5
$(2s)^2\ (2p)^4\ (^3P)\ 3s$	$^4P_{2\frac{1}{2}}$	219,133.0	$(2s)^2\ (2p)^4\ (^3P)\ 3d$	$^2P_{\frac{1}{2}}$	281,334.5
	$^4P_{1\frac{1}{2}}$	219,650.8		$^2P_{1\frac{1}{2}}$	281,722.3
	$^4P_{\frac{1}{2}}$	219,949.9	$(2s)^2\ (2p)^4\ (^3P)\ 4s$	$^4P_{2\frac{1}{2}}$	282,000.0
$(2s)^2\ (2p)^4\ (^3P)\ 3s$	$^2P_{1\frac{1}{2}}$	224,089.3		$^4P_{1\frac{1}{2}}$	282,376.7
	$^2P_{\frac{1}{2}}$	224,701.8		$^4P_{\frac{1}{2}}$	282,682.2
$(2s)^2\ (2p)^4\ (^3P)\ 3p$	$^4P_{2\frac{1}{2}}^{\circ}$	246,194.8	$(2s)^2\ (2p)^4\ (^3P)\ 4s$	$^2P_{1\frac{1}{2}}$	283,323.7
	$^4P_{1\frac{1}{2}}^{\circ}$	246,417.4		$^2P_{\frac{1}{2}}$	283,896.5
	$^4P_{\frac{1}{2}}^{\circ}$	246,599.9	$(2s)^2\ (2p)^4\ (^3P)\ 4d$	$^2D_{2\frac{1}{2}}$	302,321 ?
$(2s)^2\ (2p)^4\ (^1D)\ 3s$	$^2D_{2\frac{1}{2}}$	246,396.5		$^2D_{1\frac{1}{2}}$	302,452 ?
	$^2D_{1\frac{1}{2}}$	246,400.0	$(2s)^2\ (2p)^4\ (^3P)\ 4f$	$^4D_{3\frac{1}{2}}^{\circ}$	302,830.6
$(2s)^2\ (2p)^4\ (^3P)\ 3p$	$^4D_{3\frac{1}{2}}^{\circ}$	249,110.8		$^4D_{2\frac{1}{2}}^{\circ}$	302,845.5
	$^4D_{2\frac{1}{2}}^{\circ}$	249,448.0		$^4D_{1\frac{1}{2}}^{\circ}$	302,905.2
	$^4D_{1\frac{1}{2}}^{\circ}$	249,697.7		$^4D_{\frac{1}{2}}^{\circ}$	302,991.2
	$^4D_{\frac{1}{2}}^{\circ}$	249,841.8	$(2s)^2\ (2p)^4\ (^3P)\ 4d$	$^2P_{1\frac{1}{2},\,\frac{1}{2}}$	302,884 ?
$(2s)^2\ (2p)^4\ (^3P)\ 3p$	$^2D_{2\frac{1}{2}}^{\circ}$	251,013.3	$(2s)^2\ (2p)^4\ (^3P)\ 4f$	$^4F_{4\frac{1}{2}}^{\circ}$	302,905.8
	$^2D_{1\frac{1}{2}}^{\circ}$	251,524.7		$^4F_{1\frac{1}{2}}^{\circ}$	303,511.6
$(2s)^2\ (2p)^4\ (^3P)\ 3p$	$^2S_{\frac{1}{2}}^{\circ}$	252,800.8		$^4F_{3\frac{1}{2}}^{\circ}$	303,530.8
$(2s)^2\ (2p)^4\ (^3P)\ 3p$	$^4S_{1\frac{1}{2}}^{\circ}$	252,956.0		$^4F_{2\frac{1}{2}}^{\circ}$	303,826.6
$(2s)^2\ (2p)^4\ (^3P)\ 3p$	$^2P_{1\frac{1}{2}}^{\circ}$	254,167.0	$(2s)^2\ (2p)^4\ (^3P)\ 4f$	$^4G_{4\frac{1}{2}}^{\circ}$	303,465.1
	$^2P_{\frac{1}{2}}^{\circ}$	254,294.0		$^4G_{5\frac{1}{2}}^{\circ}$	303,475.7
$(2s)^2\ (2p)^4\ (^1D)\ 3p$	$^2F_{2\frac{1}{2}}^{\circ}$	274,366.9		$^4G_{2\frac{1}{2}}^{\circ}$	303,602.3
	$^2F_{3\frac{1}{2}}^{\circ}$	274,411.3		$^4G_{3\frac{1}{2}}^{\circ}$	303,701.1
$(2s)^2\ (2p)^4\ (^1D)\ 3p$	$^2P_{1\frac{1}{2}}^{\circ}$	276,278.6	$(2s)^2\ (2p)^4\ (^3P)\ 4f$	$^2D_{1\frac{1}{2}}^{\circ}$	303,465.4
	$^2P_{\frac{1}{2}}^{\circ}$	276,514.1		$^2D_{2\frac{1}{2}}^{\circ}$	303,882.3
$(2s)^2\ (2p)^4\ (^1S)\ 3s$	$^2S_{\frac{1}{2}}$	276,678.0	$(2s)^2\ (2p)^4\ (^1D)\ 3d$	$^2G_{4\frac{1}{2}}$	305,336.2
$(2s)^2\ (2p)^4\ (^1D)\ 3p$	$^2D_{1\frac{1}{2}}^{\circ}$	277,327.6		$^2G_{3\frac{1}{2}}$	305,337.2
	$^2D_{2\frac{1}{2}}^{\circ}$	277,346.1	$(2s)^2\ (2p)^4\ (^1S)\ 3p$	$^2P_{1\frac{1}{2}}^{\circ}$	305,399.2
$(2s)^2\ (2p)^4\ (^3P)\ 3d$	$^4D_{3\frac{1}{2}}$	279,139.1		$^2P_{\frac{1}{2}}^{\circ}$	305,409.3
	$^4D_{2\frac{1}{2}}$	279,220.6	$(2s)^2\ (2p)^4\ (^1D)\ 3d$	$^2P_{\frac{1}{2}}$	305,568.9
	$^4D_{1\frac{1}{2}}$	279,326.8		$^2P_{1\frac{1}{2}}$	305,584.2
	$^4D_{\frac{1}{2}}$	279,425.1	$(2s)^2\ (2p)^4\ (^1D)\ 4s$	$^2D_{2\frac{1}{2},\,1\frac{1}{2}}$	306,018 ?
$(2s)^2\ (2p)^4\ (^3P)\ 3d$	$^4F_{4\frac{1}{2}}$	280,174.4	$(2s)^2\ (2p)^4\ (^1D)\ 3d$	$^2D_{1\frac{1}{2}}$	306,244.8
	$^4F_{3\frac{1}{2}}$	280,702.5		$^2D_{2\frac{1}{2}}$	206,689.8
	$^4F_{1\frac{1}{2}}$	280,949.6	$(2s)^2\ (2p)^4\ (^1D)\ 3d$	$^2F_{3\frac{1}{2}}$	307,992.2
	$^4F_{2\frac{1}{2}}$	281,028.1		$^2F_{2\frac{1}{2}}$	308,103.3
$(2s)^2\ (2p)^4\ (^3P)\ 3d$	$^2F_{3\frac{1}{2}}$	280,264.0	$(2s)^2\ (2p)^4\ (^1D)\ 3d$	$^2S_{\frac{1}{2}}$	308,776.8
	$^2F_{2\frac{1}{2}}$	280,799.3	$(2s)^2\ (2p)^4\ (^1S)\ 3d$	$^2D_{2\frac{1}{2}}$	327,954.7
$(2s)^2\ (2p)^4\ (^3P)\ 3d$	$^2D_{2\frac{1}{2}}$	280,271.0		$^2D_{1\frac{1}{2}}$	327,968.2
	$^2D_{1\frac{1}{2}}$	280,475.6			

Ne II. The classified lines are given in Table II, the term values in Table III. The first six lines were discovered by Frisch[9] but their present measurements are believed to be more accurate and give a better agreement with the combination principle. Term tables have been given by Russell, Compton and Boyce[6] and more extensively by de Bruin and Bakker.[10] The new results slightly alter the relative position of the sets of terms converging to the different limits, as the only connection between these sets was given by the lines of Frisch and by those around λ400. The series limit (to the $^3P_2$ state of Ne III) as estimated from series of only two members (the 3*s* and 4*s* terms) is 331,350, corresponding to an ionization potential for Ne II of 40.91 volts.

Ne III. Classified lines are given in Table IV and term values in Table V. A number of triplet lines have been measured by von Keussler[11] using a grazing incidence vacuum spectrograph. None of his lines is repeated in Table IV except three at λ313 for which the present measurements are believed to be slightly better. von Keussler's work provides the connection, through the

TABLE IV. *Ne III classified lines.*

λ	Int.	ν	Classification			
*1257.190	6	79,542.2	$(2s)^2\,(2p)^3\,(^4S).3s$	$^3S_1{}^\circ$ —	$(2s)^2\,(2p)^3\,(^2D).3p$	$^3P_2$
*1255.685	5	79,637.8		$^3S_1{}^\circ$ —		$^3P_1$
*1255.026	2	79,679.6		$^3S_1{}^\circ$ —		$^3P_0$
491.050	9	203,645	$(2s)^2\,(2p)^4$	$^3P^1$ —	$2s(2p)^5$	$^3P_2{}^\circ$
490.310	7	203,953		$^3P_0$ —		$^3P_1{}^\circ$
489.641	4	204,231		$^3P_1$ —		$^3P_1{}^\circ$
489.501	10	204,290		$^3P_2$ —		$^3P_2{}^\circ$
488.868	7	204,554		$^3P_1$ —		$^3P_0{}^\circ$
488.103	8−	204,875		$^3P_2$ —		$^3P_1{}^\circ$
427.840	3+	233,732	$(2s)^2\,(2p)^4$	$^1S_0$ —	$2s(2p)^5$	$^1P_1{}^\circ$
379.308	7	263,638	$(2s)^2\,(2p)^4$	$^1D_2$ —	$2s(2p)^5$	$^1P_1{}^\circ$
313.92	1	318,552	$(2s)^2\,(2p)^4$	$^3P_0$ —	$(2s)^2\,(2p)^3\,(^4S).3s$	$^3S_1{}^\circ$
313.677	3	318,799		$^3P_1$ —		$^3S_1{}^\circ$
313.048	4	319,441		$^3P_2$ —		$^3S_1{}^\circ$
* 308.559	1	324,087	$(2s)^2\,(2p)^4$	$^1S_0$ —	$(2s)^2\,(2p)^3\,(^2P).3s$	$^1P_1{}^\circ$
* 301.124	4	332,089	$(2s)^2\,(2p)^4$	$^1D_2$ —	$(2s)^2\,(2p)^3\,(^2D).3s$	$^1D_2{}^\circ$
* 282.50	0+	353,982	$(2s)^2\,(2p)^4$	$^1D_2$ —	$(2s)^2\,(2p)^3\,(^2P).3s$	$^1P_1{}^\circ$

TABLE V. *Ne III term values.*

$(2s)^2\,(2p)^4$	$^3P_2$	0
	$^3P_1$	643
	$^3P_0$	922
$(2s)^2\,(2p)^4$	$^1D_2$	25,841
$(2s)^2\,(2p)^4$	$^1S_0$	55,747
$2s(2p)^5$	$^3P_2{}^\circ$	204,290
	$^3P_1{}^\circ$	204,876
	$^3P_0{}^\circ$	205,199
$2s(2p)^5$	$^1P_1{}^\circ$	289,479
$(2s)^2\,(2p)^3\,(^4S).3s$	$^3S_1{}^\circ$	319,442.00
$(2s)^2\,(2p)^3\,(^2D).3s$	$^3D_3{}^\circ$	353,145.00
	$^3D_2{}^\circ$	353,174.16
	$^3D_1{}^\circ$	353,194.40
$(2s)^2\,(2p)^3\,(^4S).3p$	$^3P_1$	356,663.30
	$^3P_{02}$	356,673.62
$(2s)^2\,(2p)^3\,(^2D).3s$	$^1D_2{}^\circ$	357,930
$(2s)^2\,(2p)^3\,(^2P).3s$	$^3P_2{}^\circ$	374,431.00
	$^3P_1{}^\circ$	374,457.75
	$^3P_0{}^\circ$	374,474.66
$(2s)^2\,(2p)^3\,(^2P).3s$	$^1P_1{}^\circ$	379,834
$(2s)^2\,(2p)^3\,(^2D).3p$	$^3D_1$	389,055.24
	$^3D_2$	389,066.37
	$^3D_3$	389,136.05
$(2s)^2\,(2p)^3\,(^2D).3p$	$^3F_2$	391,411.02
	$^3F_3$	391,426.94
	$^3F_4$	391,447.31
$(2s)^2\,(2p)^3\,(^4S).3d$	$^3D_1{}^\circ$	398,189.80
	$^3D_2{}^\circ$	398,193.93
	$^3D_3{}^\circ$	398,207.84
$(2s)^2\,(2p)^3\,(^2D).3p$	$^3P_2$	398,983.64
	$^3P_1$	399,079.57
	$^3P_0$	399,122.12
$(2s)^2\,(2p)^3\,(^2P).3p$	$^3D_2$	409,842.08
	$^3D_3$	409,844.53
	$^3D_1$	409,852.23
$(2s)^2\,(2p)^3\,(^2P).3p$	$^3S_1$	410,131.72
$(2s)^2\,(2p)^3\,(^2P).3p$	$^3P_0$	412,290.59
	$^3P_1$	412,310.11
	$^3P_2$	412,317.21
$(2s)^2\,(2p)^3\,(^2D).3d$	$^3F_2{}^\circ$	435,252.90
	$^3F_3{}^\circ$	435,569.00
	$^3F_4{}^\circ$	435,617.80
$(2s)^2\,(2p)^3\,(^2D).3d$	$^3G_5{}^\circ$	436,558.35
	$^3G_4{}^\circ$	436,585.34
	$^3G_3{}^\circ$	436,608.56
$(2s)^2\,(2p)^3\,(^2D).3d$	$^3D_3{}^\circ$	436,841.63
	$^3D_2{}^\circ$	436,918.39
	$^3D_1{}^\circ$	436,963.49
$(2s)^2\,(2p)^3\,(^2D).3d$	$^3P_2{}^\circ$	444,370.00
	$^3P_1{}^\circ$	444,397.16
	$^3P_0{}^\circ$	444,417.37
$(2s)^2\,(2p)^3\,(^2D).3d$	$^3S_1{}^\circ$	444,625.38

[9] S. Frisch, Zeits. f. Physik **64**, 499 (1930).
[10] T. L. de Bruin and C. J. Bakker, Zeits. f. Physik **69**, 19 (1931). Also, T. L. de Bruin, Zeits. f. Physik **44**, 157 (1927); **46**, 856 (1928).
[11] V. von Keussler, Zeits. f. Physik **85**, 1 (1933).

TABLE VI. *Ne IV classified lines.*

543.884	7	183,863	$(2s)^2\,(2p)^3\,{}^4S^\circ_{1\frac{1}{2}} - 2s(2p)^4\,{}^4P_{2\frac{1}{2}}$
542.076	6	184,476	${}^4S^\circ_{1\frac{1}{2}} - {}^4P_{1\frac{1}{2}}$
541.124	5	184,801	${}^4S^\circ_{1\frac{1}{2}} - {}^4P_{\frac{1}{2}}$
*521.810	2−	191,641	$(2s)^2\,(2p)^3\,{}^2P^\circ_{1\frac{1}{2}} - 2s(2p)^4\,{}^2D_{2\frac{1}{2}}$
*521.730	2−	191,670	${}^2P^\circ_{\frac{1}{2}} - {}^2D_{1\frac{1}{2}}$
*469.865	3−	212,827	$(2s)^2\,(2p)^3\,{}^2D^\circ_{1\frac{1}{2}} - 2s(2p)^4\,{}^2D_{2\frac{1}{2}}$
*469.817	2	212,849	{ ${}^2D^\circ_{2\frac{1}{2}} - {}^2D_{2\frac{1}{2}}$ { ${}^2D^\circ_{1\frac{1}{2}} - {}^2D_{2\frac{1}{2}}$
*421.584	2	237,201	$(2s)^2\,(2p)^3\,{}^2P^\circ_{\frac{1}{2},\,1\frac{1}{2}} - 2s(2p)^4\,{}^2S_{\frac{1}{2}}$
388.23	1−	257,579	$(2s)^2\,(2p)^3\,{}^2P^\circ_{\frac{1}{2},\,1\frac{1}{2}} - 2s(2p)^4\,{}^2P_{1\frac{1}{2}}$
387.13	0+	258,311	${}^2P^\circ_{\frac{1}{2},\,1\frac{1}{2}} - {}^2P_{\frac{1}{2}}$
*358.70	2−	278,784	$(2s)^2\,(2p)^3\,{}^2D^\circ_{2\frac{1}{2},\,1\frac{1}{2}} - 2s(2p)^4\,{}^2P_{1\frac{1}{2}}$

TABLE VII. *Ne IV term values.*

$(2s)^2\,(2p)^3$	${}^4S^\circ_{1\frac{1}{2}}$	0	$(2s)^2\,(2p)^3$	${}^2P^\circ_{\frac{1}{2}}$	21,202
				${}^2P^\circ_{1\frac{1}{2}}$	21,212
$2s(2p)^4$	${}^4P_{2\frac{1}{2}}$	183,863	$2s(2p)^4$	${}^2D_{2\frac{1}{2}}$	212,852
	${}^4P_{1\frac{1}{2}}$	184,476		${}^2D_{1\frac{1}{2}}$	212,872
	${}^4P_{\frac{1}{2}}$	184,801			
$(2s)^2\,(2p)^3$	${}^2D^\circ_{2\frac{1}{2}}$	0	$2s(2p)^4$	${}^2S_{\frac{1}{2}}$	258,408
	${}^2D^\circ_{1\frac{1}{2}}$	25	$2s(2p)^4$	${}^2P_{1\frac{1}{2}}$	278,786
				${}^2P_{\frac{1}{2}}$	279,518

ground state, between the three independent triplet term systems found by de Bruin.[12] A multiplet has been found at λ1257−1255 which gives more accurately this connection between those triplets associated with the ${}^4S$ and ${}^2D$ limits. For the sake of completeness all of de Bruin's triplet terms have been included in the table but it should be noted that those associated with the ${}^2P$ limit are, as a group, not finally located with respect to the remaining group of de Bruin's terms. This uncertainty may be estimated as less than 50 cm^{-1}. As no connection has been found, de Bruin's quintet terms have been omitted from the table. The singlet terms given are located with respect to the ground state of the atom by means of the nebular lines.[13] No series are present to permit the calculation of an accurate ionization potential for Ne III but it may be estimated as 63.3±1 volts.

Ne IV. Classified lines are given in Table VI and term values in Table VII. As no intersystem lines are found the quartet and doublet terms are listed separately, but from the work of von Keussler mentioned above it may be estimated that the ${}^2D^\circ$ term lies about 34,000 cm^{-1} above the ${}^4S^\circ$ term. The doublet separations of λ521 and λ469 are both resolved only in higher orders, where they are difficult to measure because of further, still unresolved, structure. The term intervals based on these lines are, therefore, quite tentative and represent one possible interpretation of the line structure. The multiplet intervals in the low states along this isoelectronic sequence from O II to Si VIII show considerable irregularities[14, 15, 16] but all of the Ne IV doublet terms listed would be expected to be inverted with the exception of the ${}^2P^\circ$. These doublet lines should be investigated under the higher resolving power of a grazing incidence vacuum spectrograph as upon their structure would depend the structure of the forbidden ${}^2D^\circ - {}^2P^\circ$ transition in Ne IV.[13, 17] The shorter wave-length companion of λ358 is obscured by the adjacent strong line of Ne II. Further comparisons show that combinations between $3s$ and $3d$ electron configurations and the ground configuration will give lines of wave-length shorter than λ200. The ionization potential of Ne IV is about 97 volts.

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[12] T. L. de Bruin, Zeits. f. Physik **77**, 505 (1932).

[13] J. C. Boyce, D. H. Menzel and C. H. Payne, Proc. Nat. Acad. Sci. **19**, 581 (1933).

[14] O II. B. Edlén, Nova Acta Reg. Soc. Sci. Upsaliensis, Ser. IV, Vol. 9, No. 6 (1934).

[15] F III. I. S. Bowen, Phys. Rev. **45**, 82 (1934).

[16] Na IV to Si VIII. J. Söderquist, Nova Acta Reg. Soc. Sci. Upsaliensis, Ser. IV, Vol. 9, No. 7 (1934).

[17] P. Swings and B. Edlén, Comptes rendus **198**, 1748 (1934).