

Physics. — *On the structure of the spectrum of ionized Argon (Ar II).*

By T. L. DE BRUIN. (Communicated by Prof. P. ZEEMAN.)

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1. *Introduction.*

In a former paper in these Proceedings ¹⁾ I have communicated a partial analysis of the spectrum of ionized Argon (Ar II), in which especially the quartet system in connection with the analogous spectrum of ionized Neon (Ne II) is discussed. This paper contains further energy levels found from the spectrum and the theoretical identification. A list of all till now classified lines is given.

2. *Structure of the spectrum.*

The energy levels of the simply ionized Argon atom (Ar II) are built upon the ground levels of the double ionized atom (Ar III). These groundlevels arise from the atomic configuration of a 3-quantum orbit with two 3s and four 3p electrons. According to the theory of HEISENBERG, PAULI and HUND this configuration gives the lowest energy level as ³P and also the metastable levels ¹D and ¹S. These terms are the basic terms of the ionized atom and according to the simple rules of HUND the following terms of Ar II can be deduced.

TABLE 1. Energy levels Ar II.

Electronic configuration				Symbol	Basic term: ³ P		Basic term: ¹ D	Basic term: ¹ S
1 s	2 s 2 p	3 s 3 p 3 d	4 s 4 p 4 d 4 f 5 s		Terms		Terms	Terms
					Quartet	Doublet	Doublet	Doublet
2	2 6	2 5		s ² p ⁵		P		
2	2 6	2 4 1		s ² p ⁴ . 3 d	F D P	F D P	G F D P S	D
2	2 6	2 4	1	s ² p ⁴ . 4 s	P	P	D	S
2	2 6	2 4	1	s ² p ⁴ . 4 p	D P S	D P S	F D P	P
2	2 6	2 4	1	s ² p ⁴ . 4 d	F D P	F D P	G F D P S	D
2	2 6	2 4	1	s ² p ⁴ . 5 s	P	P	D	S

¹⁾ DE BRUIN: These Proceedings 31, N^o. 6, 593, 1928. Zeitschr. f. Phys. 48. 62. 1928

The spectral lines arising from terms based upon the most stable state 3P will appear as the strongest in the spectrum. The following figure gives a survey of the terms arising from this 3P state through the coupling of a $3p$, $3d$, $4s$, $4p$, $5s$ and $4d$ electron.

For simplicity of the figure the fine structure of the levels (splitting according to the inner quantum numbers j) is not given. Each connecting line does not represent one spectral line, but a whole group, a multiplet.

For simplicity also the intercombinations are not given.

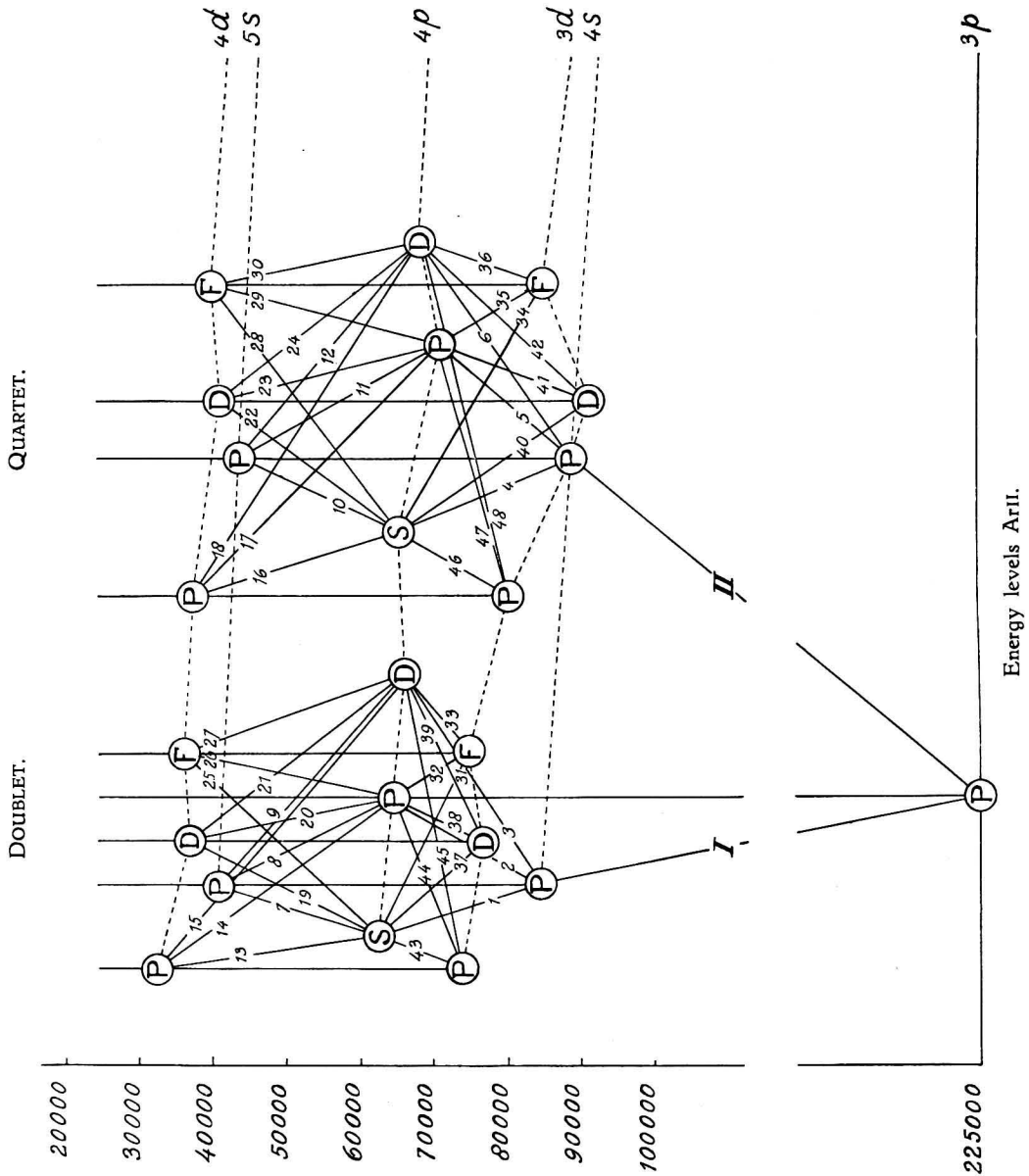


TABLE 2. Termtable Ar II (Basic term 3P).

N ^o .	Exp. Term	Term-value	Term-difference	Theor. Term	N ^o .	Exp. Term	Term-value	Term-difference	Theor. Term
1	2P_2	224758	1431	$3p\ {}^2P_2$	36	2P_1	65047.98	-532.96	$4p\ {}^2P_1$
2	2P_1	223327		$3p\ {}^2P_1$	37	2P_2	64515.02		$4p\ {}^2P_2$
3	4D_4	92427.28	153.98	$3d\ {}^4D_4$	38	4D_4	41079.08	121.80	$4d\ {}^4D_4$
4	4D_3	92273.30		$3d\ {}^4D_3$	39	4D_3	40957.28		$4d\ {}^4D_3$
5	4D_2	92123.68		$3d\ {}^4D_2$	40	4D_2	40768.67		$4d\ {}^4D_2$
6	4D_1	92016.65	107.03	$3d\ {}^4D_1$	41	4D_1	40562.38	206.29	$4d\ {}^4D_1$
7	2D_3	—		$3d\ {}^2D_3$	42	2D_3	40026.38		$4d\ {}^2D_3$
8	2D_2	—	70030—82000	$3d\ {}^2D_2$	43	2D_2	39894.73	? 131.65	$4d\ {}^2D_2$
9	4F_5	—		$3d\ {}^4F_5$	44	4F_5	39661.58		$4d\ {}^4F_5$
10	4F_4	—		$3d\ {}^4F_4$	45	4F_4	39130.03	$4d\ {}^4F_4$	
11	4F_3	—		$3d\ {}^4F_3$	46	4F_3	38680.44	$4d\ {}^4F_3$	
12	4F_2	—		$3d\ {}^4F_2$	47	4F_2	38414.11	$4d\ {}^4F_2$	
13	4P_1	—		$3d\ {}^4P_1$	48	4P_1	38583.18	$4d\ {}^4P_1$	
14	4P_2	—		$3d\ {}^4P_2$	49	4P_2	38284.18	$4d\ {}^4P_2$	
15	4P_3	—		$3d\ {}^4P_3$	50	4P_3	37863.58	$4d\ {}^4P_3$	
16	2F_4	—		$3d\ {}^2F_4$	51	2F_4	37938.38	$4d\ {}^2F_4$	
17	2F_3	—		$3d\ {}^2F_3$	52	2F_3	37165.88	? 772.50	$4d\ {}^2F_3$
18	2P_1	—	$3d\ {}^2P_1$	53	2P_1	34819.88	$4d\ {}^2P_1$		
19	2P_2	—	$3d\ {}^2P_2$	54	2P_2	34161.88	-658.00	$4d\ {}^2P_2$	
20	4P_3	90512.88	844.40	$4s\ {}^4P_3$	55	4P_3	43160.38	627.76	$5s\ {}^4P_3$
21	4P_2	89668.48		$4s\ {}^4P_2$	56	4P_2	42532.62		$5s\ {}^4P_2$
22	4P_1	89152.78		$4s\ {}^4P_1$	57	4P_1	41803.48		$5s\ {}^4P_1$
23	2P_2	86510.88	1014.74	$4s\ {}^2P_2$	58	2P_2	41664.18	824.00	$5s\ {}^2P_2$
24	2P_1	85496.14		$4s\ {}^2P_1$	59	2P_1	40840.18		$5s\ {}^2P_1$
25	4P_3	69711.13	307.75	$4p\ {}^4P_3$	60	4P_3	—	30000—35000	$5p\ {}^4P_3$
26	4P_2	69403.38		$4p\ {}^4P_2$	61	4P_2	—		$5p\ {}^4P_2$
27	4P_1	69046.08		$4p\ {}^4P_1$	62	4P_1	—		$5p\ {}^4P_1$
28	4D_4	67520.58	439.36	$4p\ {}^4D_4$	63	4D_4	—	30000—35000	$5p\ {}^4D_4$
29	4D_3	67081.22		$4p\ {}^4D_3$	64	4D_3	—		$5p\ {}^4D_3$
30	4D_2	66586.65		$4p\ {}^4D_2$	65	4D_2	—		$5p\ {}^4D_2$
31	4D_1	66326.33	260.32	$4p\ {}^4D_1$	66	4D_1	—	30000—35000	$5p\ {}^4D_1$
32	2D_3	66024.28		$4p\ {}^2D_3$	67	2D_3	—		$5p\ {}^2D_3$
33	2D_2	65360.38	663.90	$4p\ {}^2D_2$	68	2D_2	—	30000—35000	$5p\ {}^2D_2$
34	4S_2	63705.60		$4p\ {}^4S_2$	69	4S_2	—		$5p\ {}^4S_2$
35	2S_1	63665.08		$4p\ {}^2S_1$	70	2S_1	—		$5p\ {}^2S_1$

3. *Termtable. Ionization potential.*

The following energy levels are found from the analysis of the spectrum (See table 2).

As the figure shows some Rydberg series are found. These can serve us for calculating the absolute term values of the spectrum. For that purpose the serie $4s\ ^4P_2$ and $5s\ ^4P_2$ is the best one, because the variation of the quantum defect will be a minimum here. These two terms can be represented by :

$$4s\ ^4P_2 = 89668,48 = \frac{4R}{(4 - 1,787483)^2}$$

and

$$5s\ ^4P_2 = 42532,62 = \frac{4R}{(5 - 1,787483)^2}.$$

This gives a value of 224758 frequency units for the groundstate of the ionized Argon atom, which agrees with an ionization potential of 27.75 ± 0.05 Volt. Because the ionization potential of Ar I is 15.69 Volt ¹⁾ one needs $15.69 + 27.75$ Volt = 43.44 Volt to produce the whole spectrum from the ground state of the neutral atom. This agrees rather well with the value experimentally found by BARTON : 45.3 ± 1.5 Volt ²⁾. BARTON got this value by means of the investigation of $\frac{e}{m}$ for ions, using the method of SMYTH ³⁾.

4. *Experimental part.*

I have made new experiments by using a grating mounting (grating 8×5 cm total number of lines 51949) to check the consisting wavelength-measurements ⁴⁾. The spectrum has been produced in the same manner as in the case of ionized Neon ⁵⁾, we made use of a heavy condensed discharge through a narrow capilar ($\frac{3}{4}$ mm) ⁶⁾. The analysis of the spectrum had already shown, that measurement of the complete spectrum was not necessary and that the accurate wavelength measurements of KAYSER could be used. I have however found by means of a discharge of high brilliancy new, mostly weak lines. The measurements of the author are given in hundredths of Angström, those of KAYSER in thousandths of Angström.

The spectrum of the double ionized atom (Ar III) could also be produced

¹⁾ MEISSNER: Zeitschr. f. Phys. **37**. 238. 1926; **39**. 172. 1926; **40**. 839. 1927.

²⁾ BARTON: Phys. Rev. **25**. 469. 1925.

³⁾ SMYTH: Phys. Rev. **25**. 452. 1925.

⁴⁾ KAYSER: Handbuch. V. **61**; EDER und VALENTA: Denkschr. Wien. Akad. **64**. I. 1897. Beitr. z. Photochem. 1904; L. BLOCH, E. BLOCH et G. DÉJARDIN: Ann. de Phys. **2**. 461. 1924.

⁵⁾ DE BRUIN: Zeitschr. f. Phys. **44**. 157. 1927; **46**. 856. 1928.

⁶⁾ I express my thanks to Mr. J. v. D. ZWAAL, chief of the technical service of the laboratory, for making the quartz tubes.

5. Classification of the Ar II lines¹⁾.

TABLE 3. Classification of the Ar II lines.

Int.	λ I. A.	ν_{vacuum}	Termcombination	M ²⁾	Int.	λ I. A.	ν_{vacuum}	Termcombination	M
1	5287.00	18909.0	4 s ² P ₁ — 4 p ⁴ D ₂	—	7	4430.185	22566.11	4 s ⁴ P ₁ — 4 p ⁴ D ₂	6
3	5145.395	19429.45	4 s ² P ₂ — 4 p ⁴ D ₃	—	10	4425.995	22587.23	4 s ⁴ P ₂ — 4 p ⁴ D ₃	6
5	5062.019	19749.47	4 s ⁴ P ₁ — 4 p ⁴ P ₂	5	4	4420.943	22613.14	3 d ⁴ D ₁ — 4 p ⁴ P ₂	41
4	5017.151	19926.08	4 s ² P ₂ — 4 p ⁴ D ₂	—	7	4400.956	22715.81	3 d ⁴ D ₄ — 4 s ⁴ P ₃	41
5	5009.246	19957.53	4 s ⁴ P ₂ — 4 p ⁴ P ₃	5	6	4400.101	22720.39	3 d ⁴ D ₂ — 4 s ⁴ P ₂	41
3	4972.16	20106.4	4 s ⁴ P ₁ — 4 p ⁴ P ₁	5	2	4383.730	22805.24	4 s ² P ₂ — 4 p ⁴ S ₂	—
6	4965.059	20135.14	4 s ² P ₁ — 4 p ² D ₂	3	8	4379.657	22826.44	$\left. \begin{array}{l} 4 s \ ^4P_1 - 4 p \ ^4D_1 \\ 4 p \ ^2S_1 - 5 s \ ^2P_1 \end{array} \right\}$	$\left. \begin{array}{l} 6 \\ 7 \end{array} \right\}$
5	4933.226	20265.07	4 s ⁴ P ₂ — 4 p ⁴ P ₂	5	5	4375.942	22845.82	4 s ² P ₂ — 4 p ² S ₁	1
3	4889.06	20448.1	4 s ² P ₁ — 4 p ² P ₁	2	2	4375.031	22850.68	4 p ² P ₂ — 5 s ² P ₂	8
8	4879.824	20486.83	4 s ² P ₂ — 4 p ² D ₃	3	5	4371.334	22869.90	3 d ⁴ D ₃ — 4 p ⁴ P ₂	41
2	4866.00	20545.0	4 p ⁴ S ₂ — 5 s ⁴ P ₃	10	1	4358.48	22937.3	4 p ⁴ S ₂ — 4 d ⁴ D ₂	22
6	4847.783	20622.25	4 s ⁴ P ₂ — 4 p ⁴ P ₁	5	5	4352.198	22970.46	3 d ⁴ D ₁ — 4 p ⁴ P ₁	41
9	4805.993	20801.56	4 s ⁴ P ₃ — 4 p ⁴ P ₃	5	10	4348.062	22992.30	4 s ⁴ P ₃ — 4 p ⁴ D ₄	6
5	4764.848	20981.18	4 s ² P ₁ — 4 p ² P ₂	2	5	4332.035	23077.37	3 d ⁴ D ₂ — 4 s ⁴ P ₁	41
7	4735.885	21109.49	4 s ⁴ P ₃ — 4 p ⁴ P ₂	5	7	4331.194	23081.85	4 s ⁴ P ₂ — 4 p ⁴ D ₂	6
6	4726.847	21149.85	4 s ² P ₂ — 4 p ² D ₂	3	1	4319.67	23143.4	4 d ⁴ D ₁ — 4 p ⁴ S ₂	22
3	4721.66	21173.1	4 p ⁴ S ₂ — 5 s ⁴ P ₂	10	5	4282.894	23342.16	4 s ⁴ P ₂ — 4 p ⁴ D ₁	6
6	4657.889	21462.96	4 s ² P ₂ — 4 p ² P ₁	2	4	4275.167	23384.35	4 p ² P ₁ — 5 s ² P ₂	8
1	4588.00	21789.7	4 p ⁴ S ₂ — 4 s ² P ₁	—	3	4267.49	23426.4	4 p ⁴ D ₂ — 5 s ⁴ P ₃	12
6	4579.347	21831.08	4 s ² P ₁ — 4 p ² S ₁	1	6	4266.524	23431.71	4 s ⁴ P ₃ — 4 p ⁴ D ₃	6
1	4564.50	21902.1	4 p ⁴ S ₂ — 5 s ⁴ P ₁	10	2	4255.57	23492.0	4 p ² D ₃ — 5 s ⁴ P ₂	—
2	4547.79	21982.5	4 p ² P ₂ — 5 s ⁴ P ₂	—	5	4228.150	23644.37	4 s ⁴ P ₂ — 4 p ² D ₃	—
7	4545.040	21995.86	4 s ² P ₂ — 4 p ² P ₂	2	6	4222.679	23675.00	4 p ² P ₂ — 5 s ² P ₁	8
5	4502.941	22201.51	4 p ² D ₂ — 5 s ⁴ P ₃	—	5	4218.683	23697.43	4 p ² D ₂ — 5 s ² P ₂	9
2	4535.57	22041.7	4 p ⁴ S ₂ — 5 s ² P ₂	—	3	4201.946	23791.82	4 s ⁴ P ₁ — 4 p ² D ₂	12
4	4460.512	22412.69	3 d ⁴ D ₂ — 4 p ⁴ P ₃	41	4	4179.319	23920.62	4 p ⁴ D ₃ — 5 s ⁴ P ₃	12
5	4431.002	22561.95	3 d ⁴ D ₃ — 4 p ⁴ P ₃	41	3	4178.344	23926.21	4 s ⁴ P ₃ — 4 p ⁴ D ₂	6

¹⁾ For the connection between classification and ZEEMAN-effect we refer to: C. J. BAKKER, T. L. DE BRUIN and P. ZEEMAN, these Proceedings **31**, N^o. 7, 780, 1928.

²⁾ The column M refers to the numbers of the corresponding multiplets in the figure.

TABLE 3 (Continued).

Int.	λ I. A.	ν_{vacuum}	Termcombination	M	Int.	λ I. A.	ν_{vacuum}	Termcombination	M
1	4173.77	23952.4	4 p $^2P_2 - 4 d$ 4D_1	—	2	3911.571	25557.96	4 p $^4D_1 - 4 d$ 4D_2	24
6	4156.135	24054.06	4 p $^4D_2 - 5 s$ 4P_2	12	3	3900.613	25629.76	4 p $^4D_2 - 4 d$ 4D_3	24
1	4129.67	24208.2	4 p $^2P_1 - 5 s$ 2P_1	8	4	3891.978	25686.62	3 d $^4D_3 - 4 p$ 4D_2	42
4	4112.766	24307.70	4 s $^4P_2 - 4 p$ 2D_2	—	3	3891.400	25690.44	3 d $^4D_1 - 4 p$ 4D_1	42
10	4103.957	24359.88	$\left\{ \begin{array}{l} 4p \ ^4D_4 - 5 s \ ^4P_3 \\ 4p \ ^2D_3 - 5 s \ ^2P_2 \end{array} \right.$	$\left\{ \begin{array}{l} 12 \\ 9 \end{array} \right.$	3	3880.281	25764.04	4 p $^4D_1 - 4 d$ 4D_1	24
5	4082.385	24488.59	$\left\{ \begin{array}{l} 4p \ ^2P_2 - 4 d \ ^2D_3 \\ 4s \ ^4P_3 - 4 p \ ^2D_3 \end{array} \right.$	$\left\{ \begin{array}{l} 20 \\ - \end{array} \right.$	4	3875.256	25797.49	3 d $^4D_2 - 4 p$ 4D_1	42
2	4077.057	24520.59	5 s $^2P_1 - 4 p$ 2D_2	9	3	3872.176	25817.98	4 p $^4D_2 - 4 d$ 4D_2	24
6	4076.704	24522.72	4 p $^4D_1 - 5 s$ 4P_1	12	8	3868.568	25842.06	4 p $^4S_2 - 4 d$ 4P_3	16
4	4072.429	24548.48	4 p $^4D_3 - 5 s$ 4P_2	12	9	3850.565	25962.88	4 s $^4P_2 - 4 p$ 4S_2	4
1	4065.25	24591.8	4 p $^2D_2 - 4 d$ 4D_2	—	3	3845.385	25997.86	$\left\{ \begin{array}{l} 4p \ ^2D_3 - 4 d \ ^2D_3 \\ 4s \ ^4P_3 - 4 p \ ^2P_2 \end{array} \right.$	$\left\{ \begin{array}{l} 21 \\ - \end{array} \right.$
4	4038.816	24752.76	3 d $^4D_3 - 4 p$ 4D_4	42	3	3844.771	26002.00	4 p $^4D_3 - 4 d$ 4D_4	24
5	4033.872	24783.10	4 p $^4D_2 - 5 s$ 4P_1	12	4	3841.559	26023.74	4 p $^4D_2 - 4 d$ 4D_1	24
1	4031.47	24797.8	4 p $^2D_2 - 4 d$ 4D_1	—	3	3830.435	26099.31	3 d $^4D_2 - 4 p$ 2D_2	—
8	4013.852	24906.71	3 d $^4D_4 - 4 p$ 4D_4	42	5	3826.826	26123.93	4 p $^4D_3 - 4 d$ 4D_3	24
1	4011.377	24922.08	4 p $^4D_2 - 5 s$ 2P_2	—	3	3825.715	26131.52	4 p $^2D_3 - 4 d$ 2D_2	21
1	3994.885	25025.16	4 p $^4S_2 - 4 d$ 4F_3	28	5	3809.499	26242.74	4 p $^4P_2 - 5 s$ 4P_3	11
4	3992.046	25042.75	3 d $^4D_2 - 4 p$ 4D_3	42	3	3808.596	26248.97	3 d $^4D_3 - 4 p$ 2D_3	—
2	3988.228	25066.73	4 p $^2D_3 - 4 d$ 4D_3	—	4	3799.446	26312.18	4 p $^4D_3 - 4 d$ 4D_2	24
6	3979.391	25122.39	4 p $^4S_2 - 4 d$ 4P_1	16	3	3786.386	26402.93	3 d $^4D_4 - 4 p$ 2D_3	—
3	3974.709	25151.98	4 s $^4P_3 - 4 p$ 2D_2	—	7	3780.868	26441.47	4 p $^4D_4 - 4 d$ 4D_4	24
3	3974.496	25153.33	$\left\{ \begin{array}{l} 4s \ ^4P_2 - 4 p \ ^2P_2 \\ 4p \ ^2P_1 - 4 d \ ^2D_2 \end{array} \right.$	$\left\{ \begin{array}{l} - \\ 20 \end{array} \right.$	4	3770.569	26513.69	4 p $^4P_1 - 5 s$ 4P_2	11
5	3968.346	25192.32	3 d $^4D_3 - 4 p$ 4D_3	42	6	3765.313	26550.70	4 p $^4P_3 - 5 s$ 4P_3	11
2	3958.379	25255.75	4 p $^2D_3 - 4 d$ 4D_2	—	5	3763.565	26563.03	4 p $^4D_4 - 4 d$ 4D_3	24
3	3952.742	25291.76	4 p $^4S_2 - 4 d$ 4F_2	28	3	3750.278	26657.14	3 d $^4D_1 - 4 p$ 2D_2	—
6	3946.140	25334.07	4 p $^2D_2 - 4 d$ 2D_3	21	2	3746.985	26680.57	4 p $^2D_2 - 4 d$ 4F_3	—
4	3944.259	25346.16	3 d $^4D_4 - 4 p$ 4D_3	42	1	3735.392	26763.37	3 d $^4D_2 - 4 p$ 2D_2	—
6	3932.567	25421.51	4 p $^4S_2 - 4 d$ 4P_2	16	10	3729.300	26807.09	4 s $^4P_3 - 4 p$ 4S_2	4
3	3931.232	25430.14	3 d $^4D_1 - 4 p$ 4D_2	42	3	3720.467	26870.73	4 p $^4P_2 - 5 s$ 4P_2	11
6	3928.599	25447.20	4 s $^4P_1 - 4 p$ 4S_2	4	3	3717.217	26894.22	4 p $^2D_3 - 4 d$ 4F_4	—
5	3925.753	25465.65	4 p $^2D_2 - 4 d$ 2D_2	21	1	3714.694	26913.22	3 d $^4D_3 - 4 p$ 2D_2	—
4	3914.781	25537.01	3 d $^4D_2 - 4 p$ 4D_2	42	2	3710.017	26946.41	4 p $^2D_2 - 4 d$ 4F_2	—

TABLE 3 (Continued).

Int.	λ I. A.	ν_{vacuum}	Termcombination	M	Int.	λ I. A.	ν_{vacuum}	Termcombination	M
3	3678.328	27178.54	4 p $^4P_3 - 5 s$ 4P_2	11	8	3480.486	28723.43	4 p $^4D_2 - 4 d$ 4P_3	18
1	3669.550	27243.56	4 p $^4P_1 - 5 s$ 4P_1	11	6	3476.776	28754.07	4 p $^4P_3 - 4 d$ 4D_3	23
3	3656.120	27343.64	4 p $^2D_3 - 4 d$ 4F_3	—	4	3466.383	28840.29	4 p $^4P_2 - 4 d$ 4D_1 4 p $^4D_4 - 4 d$ 4F_3	23 30
3	3650.991	27382.05	4 p $^4P_1 - 5 s$ 2P_2	—	5	3454.148	28942.44	4 p $^4P_3 - 4 d$ 4D_2	23
4	3622.204	27599.69	4 p $^4P_2 - 5 s$ 4P_1	11	3	3430.400	29142.79	4 p $^4D_3 - 4 d$ 2F_4	—
1	3603.97	27739.3	4 s $^4P_2 - 5 s$ 2P_2	—	2	3421.671	29217.14	4 p $^4D_3 - 4 d$ 4P_3	18
1	3603.53	27742.7	4 p $^2D_3 - 4 d$ 2P_2	15	3	3388.566	29502.57	4 p $^2S_1 - 4 d$ 2P_2	13
10	3588.483	27859.00	4 p $^4D_4 - 4 d$ 4F_5	30	1	3379.424	29582.07	4 p $^4D_4 - 4 d$ 2F_4	—
7	3582.397	27906.23	4 p $^4D_2 - 4 d$ 4F_3	30	3	3370.937	29656.85	4 p $^4D_4 - 4 d$ 4P_3	18
6	3581.652	27912.14	4 p $^4D_1 - 4 d$ 4F_2	30	2	3366.618	29694.90	4 p $^2P_2 - 4 d$ 2P_1	14
10	3576.658	27951.11	4 p $^4D_3 - 4 d$ 4F_4	30	2	3307.228	30228.31	4 p $^2P_1 - 4 d$ 2P_1	14
2	3565.071	28041.95	4 p $^4D_1 - 4 d$ 4P_2	18	5	3293.628	30353.05	4 p $^2P_2 - 4 d$ 2P_2	14
1	3564.436	28046.94	4 p $^4P_1 - 5 s$ 2P_2	—	3	3281.727	30463.01	4 p $^4P_1 - 4 d$ 4P_1	17
5	3559.545	28085.49	4 p $^2D_3 - 4 d$ 2F_4	27	2	3273.336	30541.09	4 p $^2D_2 - 4 d$ 2P_1	15
5	3548.530	28172.66	4 p $^4D_2 - 4 d$ 4F_2	30	4	3263.582	30632.37	4 p $^4P_1 - 4 d$ 4F_2	29
8	3545.642	28195.59	4 p $^2D_2 - 4 d$ 2F_3	27	5	3249.842	30761.88	4 p $^4P_1 - 4 d$ 4P_2	17
5	3535.364	28277.57	4 p $^4P_1 - 4 d$ 4D_2	23	5	3243.705	30820.08	4 p $^4P_2 - 4 d$ 4P_1	17
3	3521.281	28390.66	4 p $^4D_4 - 4 d$ 4F_4	30	1	3236.682	30886.94	4 p $^2P_1 - 4 d$ 2P_2	14
4	3520.041	28400.66	4 p $^4D_3 - 4 d$ 4F_3	30	1	3226.035	30988.94	4 p $^4P_2 - 4 d$ 4F_2	29
1	3517.929	28417.71	3 d $^4D_2 - 4 p$ 4S_2	40	1	3212.597	31118.50	4 p $^4P_2 - 4 d$ 4P_2	17
8	3514.426	28446.04	4 p $^4P_2 - 4 d$ 4D_3	23	3	3204.339	31198.70	4 p $^2D_2 - 4 d$ 2P_2	14
3	3509.811	28483.44	4 p $^4P_1 - 4 d$ 4D_1	23	2	3194.270	31297.04	4 p $^4F_3 - 4 d$ 4F_2	29
1	3499.665	28566.02	3 d $^4D_3 - 4 p$ 4S_2	40	4	3181.044	31427.16	4 p $^4P_3 - 4 d$ 4P_2	17
9	3491.573	28632.22	4 p $^4P_3 - 4 d$ 4D_4	23	5	3169.682	31539.81	4 p $^4P_2 - 4 d$ 4P_3	17
5	3491.290	28634.54	4 p $^4P_2 - 4 d$ 4D_2	23	6	3139.026	31847.82	4 p $^4P_3 - 4 d$ 4P_3	17

in this manner. The measurement and the analysis of this spectrum has already been begun.

The plate shows a reproduction of a part of the spectrum. Several important multiplets in this region are marked, while for orientation several wavelengths are added.

6. *The spectrum in the extreme violet*¹⁾.

On account of the analysis of the visible Ar II spectrum an interpretation can be given of the line groups found by DORGELO and ABBINK²⁾ in the extreme violet. Those are combinations with the deep groundstate $3p^2P_{21}$:

I.	4.	730,91	136816	$3p^2P_1 - 4s^2P_2$
	3.	725,53	137830	$3p^2P_1 - 4s^2P_1$
	3.	723,35	138246	$3p^2P_2 - 4s^2P_2$
	1.	718,05	139266	$3p^2P_2 - 4s^2P_1$
II.	6.	740,23	135093	$3p^2P_2 - 4s^4P_2$
III.	12.	932,06	107289	$3p^2P_1 - sp^6^2S_1$
	15.	919,79	108720	$3p^2P_2 - sp^6^2S_1$

Some of the other groups found belong to the spectrum of the double ionized atom (Ar III).

7. *Comparison with other atomic configurations.*

The analysis of a spectrum is especially important for the study of the binding of electrons by means of comparison with other atomic configurations. The iso-electron configurations of Cl I, Ar II, K III cannot yet be compared, because an analysis of Cl I and K III fails.

We can now however compare the atomic configurations:

17. Cl II, 18. Ar II, 19. K II, 20. Ca. II, 21. Sc. II, because in the last time something more is known on the spectra of Cl II³⁾, K II⁴⁾ and Sc II⁵⁾. We will not give an extensive comparison but only some examples.

a. The ionization potentials in the above mentioned configurations are (25); 27.75; 31.68; 11.81 and 12.84 Volt. The discontinual decay in the case of Ca II is clear, because in the case of Cl II, Ar II and K II a 4 s-electron less strongly bound must be removed.

b. We now give attention to the energy values of the 4 s-orbits in the above mentioned configurations. Because the s orbits are orbits with inner loop which means they partially come into the atomic core in the neighbourhood of the nucleus, one will expect with increasing nuclear charge stronger binding, thus higher energy value and larger quantum defect, as also is exhibited in the following table.

¹⁾ Prof. K. T. COMPTON had the kindness to send me the copy of the paper on the spectrum of Ar II in the extreme violet (K. T. COMPTON, J. C. BOYCE and H. N. RUSSELL), which will be printed in the "Physical Review". For the classification of the Ar II lines in the extreme violet we refer to that paper.

²⁾ DORGELO und ABBINK: Zeitschr. f. Phys. 41. 753. 1927.

³⁾ BOWEN: Phys. Rev. 31. 34. 1928.

⁴⁾ DE BRUIN: Archives Néerl. 11. 70. 1928; BOWEN: Phys. Rev. 31. 497. 1928.

⁵⁾ RUSSELL and MEGGERS: Sc. P. Bur. of. Stand. N^o. 558. 329. 1927.

Atomic-configuration	Energyvalue 4 s-terms	Effective prin- cipal quantum number	Quantum- defect
17 . Cl II	84000	2.28	1.72
18 . A II	88000	2.23	1.77
19 . K II	92000	2.18	1.82
20 . Ca II	96000	2.14	1.86
21 . Sc II	102000	2.07	1.93

8. Summary.

The spectrum of ionized Argon has been investigated experimentally. Some 180 lines have been ordered in a term scheme. From the 59 theoretical levels predicted by HUND's theory, arising from the coupling $3p, 3d, 4s, 4p, 4d, 5s$ (3P), 46 have been identified. The remaining terms lay in regions which, combining, give spectral lines in the infra red and the extreme violet.

The ionization potential has been found from the spectrum and amounts to 27.75 ± 0.05 Volt. A comparison is made with other, in the periodic system neighbouring atomic configurations.

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*Laboratory "Physica" of the University
of Amsterdam.*

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