CLM - P 125

CULHAM LIBRARY
REFERENCE ONLY

This document is intended for publication in a journal, and is made available on the understanding that extracts or references will not be published prior to publication of the original, without the consent of the authors.

CLM - P 125

CULHAM LIBRARY
23 DEC 1966

United Kingdom Atomic Energy Authority

RESEARCH GROUP

Preprint

HELIUM-LIKE SPECTRA OF CARBON NITROGEN AND NEON

B. C. FAWCETT
F. E. IRONS

Culham Laboratory
Abingdon Berkshire

1966

Enquiries about copyright and reproduction should be addressed to the Librarian, UKAEA, Culham Laboratory, Abingdon, Berkshire, England

UNCLASSIFIED
(Approved for publication)

CLM - P 125

HELIUM-LIKE SPECTRA OF CARBON, NITROGEN AND NEON

by

B.C. FAWCETT
F.E. IRONS

(Submitted for publication in Proc. Phys. Soc.)

U.K.A.E.A. Research Group,
Culham Laboratory,
Nr. Abingdon,
Berks.

October, 1966 (ED)

Previous observations of spectra, isoelectronic with helium, of the transitions $2p\,^1P-nd\,^1D$, $2s\,^3S-np\,^3P$ and $2p\,^3P-nd\,^3D$, are incomplete (Moore, 1949, Peacock 1964). In this letter wavelengths for these transitions for carbon, using laser and vacuum sparks, and for nitrogen and neon using a thetatron, are reported. The records were obtained with a two meter grazing incidence spectrograph (Gabriel et al. 1965) with 2^o or 4^o angles of incidence and the wavelengths were measured by reference to lines of OVI (Edlen 1934) and CV(Tyren 1936).

The laser spark spectra were emitted from the plasma formed when a giant ruby laser of peak power 500 MW and duration 15 nanoseconds was focussed onto a polythene fibre (Fawcett et al. 1966a). They showed the well-developed series of CV $2p\,^1S-nd\,^1P$, $2s\,^3P-np\,^3P$ and $2p\,^3P-nd\,^3D$ with a 10 shots exposure. A number of these lines were also recorded in 300 discharges of a 90 kV coaxial vacuum spark (Fawcett 1965) fitted with carbon electrodes. The nitrogen and neon spectra were acquired in 100 discharges of a 45 kJ thetatron (Green 1963) filled with 50 mtorr of hydrogen plus 5% of nitrogen or neon, using a microsecond shutter and exposing only during the second half cycle (Fawcett et al. 1966b).

The lines were identified using isoelectronic extrapolation followed by the Ritz formula (Edlen 1964). Wavelengths of the lines thus identified are listed in the accompanying table. Our observed values are liable to a maximum error of ± 0.04 Å except in the three cases indicated. The accuracy was in some cases limited by the instrumental widths and in others by the triplet lines being unresolved.

The methods of calculating wavelengths mentioned above may also be used to predict lines that have not yet been observed. Since the new data leads to a significant improvement in the accuracy of such predictions some of these have been included in the table. The accuracy of our calculated wavelengths is better than ± 0.2 Å except for neon where it is better than ± 0.5 Å.

REFERENCES

1. EDLEN, B., 1934, Nova Acta Reg. Soc. Sci. Uppsala (IV) 9, no.6, pp.1-153.

2. EDLEN, B., 1964, Hanb. d. Phys., 27, (Berlin: Springer-Verlag), pp.123-124.

3. FAWCETT, B.C., 1965, Proc. Phys. Soc., 86, pp.1087-1089.

4. FAWCETT, B.C., GABRIEL, A.H., IRONS, F.E., PEACOCK, N.J., SAUNDERS, P.A.H. 1966a, Proc. Phys. Soc., 88, pp.1051-1053.

5. FAWCETT, B.C., GABRIEL, A.H., 1966b, Proc. Phys. Soc., 88, pp.262-264.

6. GABRIEL, A.H., SWAIN, I.R. and WALLER, W.A., 1965, J. Sci. Instrum., 42, pp.94-97.

7. GREEN, T.S., 1963, Phys. Fluids, 6, pp.864-874.

8. MOORE, C.E., 1949, Atomic Energy Levels, N.B.S. Circular 467 (Washington: National Bureau of Standards).

9. PEACOCK, N.J., 1964, Proc. Phys. Soc., 84, pp.803-805.

10. TYREN, F., 1936, Zeit. Phys. 98, pp.774.

TABLE OF OBSERVED AND CALCULATED WAVELENGTHS

TRANSITION	CV		NVI		OVII	OVII	NeIX	
	CALC.	OBS.	CALC.	OBS.	CALC.	OBS.	CALC.	OBS.
$2p^3P - 3d^3D$		248.70 ✝		173.92		128.44P	78.3	78.38
2p - 4d		186.72		130.32		96.12P	58.5	
2p - 5d		167.39		116.81		86.07P	52.4	
2p - 6d	158.48	158.47	110.59		81.44	81.50P	49.5	
2p - 7d	153.55	153.53±0.06 Å	107.15		78.89	78.94P	48.0	
2p - 8d	150.51		105.0		77.31			
2p - 9d	148.5		103.6		76.3			
2p -10d	147.1		102.6		75.5			
$2s^3S - 3p^3P$		227.22		161.22		120.37P	74.4	
2s - 4p		173.27		122.44		91.02P	56.1	
2s - 5p		156.23B		110.23		81.89P	50.3	
2s - 6p	148.33	148.35±0.06 Å	104.58		77.68		47.7	
2s - 7p	143.97	143.94±0.06 Å	101.46		75.35		46.3	
2s - 8p	141.27		99.5		73.9			
2s - 9p	139.5		98.3		73.0			
2s -10p	138.2		97.4		72.3			
$2p^1P - 3d^1D$		267.26						
2p - 4d		197.02						
2p - 5d		175.67						
2p - 6d	165.91							
2p - 7d	160.53							
2p - 8d	157.2							

B = Blend
P = (Peacock 1964, Max. Error ± 0.05 Å)
✝ = Two lines of this triplet have been reported previously (Edlen 1934) at 248.668 and 248.744.