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Highly Ionized Spectra of Nitrogen and Oxygen

Kjell Bockasten
Physics Department
University of Uppsala
Uppsala, Sweden

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Highly Ionized Spectra of Nitrogen and Oxygen.

(K. Bockasten, J. Bromander, R. Hallin, B. Johansson)

The work on taking plates with accurate standard lines has been continued, but has been delayed a little, because the spark gap of the theta pinch has not worked well. But we hope to solve that problem.

In table 5 the calculated unperturbed energy levels of NV are given for all levels with $n \leq 10$. The calculation was described briefly in the preceding status report. The deviation between the observed and calculated values, which are given in column four in the table, can be explained in most cases as uncertainties of lines with short wavelengths and for terms with $l \geq 2$ qualitively in terms of Stark effect displacements. For this reason Stark effect displacements for different m-values have been calculated as functions of the electric field for terms with n = 4 - 7 and $l \geq 2$. The procedure for this calculation is described by Bockasten in his paper about CIV*. The calculations, which involve the solution of secular equations, have been performed with an I.B.M. 1620 computer and the program can be used for similar calculations in other spectra. The results are given in Fig. 3 - 5 in form of graphs showing the position of the states versus field strength. The zero of the wave number axis is the hydrogenic value. From these Stark effect calculations the displacements of the energy levels were calculated for a field strength of 30 kV/cm. They are given in column five in the table.

The measured wave length of the transition 4d-5f (1616 Å) appears to be extremely sensitive to the initial gas pressure. The measurements of this transition and the transition 4f - 5g (1619 Å) are given for various initial gas pressures in Fig. 6 where also the calculated unperturbed positions are given. The displacements of the transition 4d - 5f is considerable and can not be explained by Stark effect calculations using hydrogenic wave functions, whereas the displacements of the transition 4f - 5g are much smaller and can quantitatively be explained by the Stark effect calculations. The same effect for the corresponding transitions in CIV (2524 and 2529 Å) has been observed from discharges in ethylene.

* Bockasten, K., Ark.Fys. 10, 567 (1956).

Table 5. Calculated unperturbed energy levels for NV.

Term	$E_{calc.}$ cm^{-1}	Interval Calc.	$E_{obs.} - E_{calc.}$	Stark effect displacement for 30 kV/cm
2s $^2S_{1/2}$	0.0		0.0	
3s $^2S_{1/2}$	456 126.4		+ 0.2	
4s $^2S_{1/2}$	606 348.0		- 1.3	
5s $^2S_{1/2}$	673 884.4		+ 1.8	
6s $^2S_{1/2}$	709 937.4		- 0.3	
7s $^2S_{1/2}$	731 423.7		- 0.4	
8s $^2S_{1/2}$	745 252.5			
9s $^2S_{1/2}$	754 673.5			
10s $^2S_{1/2}$	761 379.0			
2p $^2P_{1/2}$	80 463.2	258.6	0.0	
$^2P_{3/2}$	80 721.8		+ 0.1	
3p $^2P_{1/2}$	477 766.1	76.7	- 0.4	
$^2P_{3/2}$	477 842.8		- 0.8	
4p $^2P_{1/2}$	615 140.0	32.1	+ 1.0	
$^2P_{3/2}$	615 172.1		+ 1.7	
5p $^2P_{1/2}$	678 299.2	16.4	- 0.9	
$^2P_{3/2}$	678 315.6		- 1.2	
6p $^2P_{1/2}$	712 462.9	9.5	+ 0.3	
$^2P_{3/2}$	712 472.4		+ 0.2	
7p $^2P_{1/2}$	733 002.7	5.9		
$^2P_{3/2}$	733 008.6			
8p $^2P_{1/2}$	746 305.5	3.9		
$^2P_{3/2}$	746 309.4			
9p $^2P_{1/2}$	755 411.0	2.8		
$^2P_{3/2}$	755 413.8			
10p $^2P_{1/2}$	761 915.8	2.1		
$^2P_{3/2}$	761 917.9			

Term	$E_{calc.}$, cm^{-1}	Interval Calc.	$E_{obs.} - E_{calc.}$	Stark effect displacement for 30 kV/cm
3d $^2D_{3/2}$	484 404.0	22.5	+ 0.2	
$^2D_{5/2}$	484 426.5		- 0.6	
4d $^2D_{3/2}$	617 915.1	9.5	+ 1.2	- 0.02
$^2D_{5/2}$	617 924.6		+ 0.9	
5d $^2D_{3/2}$	679 712.6	4.8		- 0.2
$^2D_{5/2}$	679 717.4		+ 0.2	
6d $^2D_{3/2}$	713 278.1	2.8	- 0.8	- 0.6
$^2D_{5/2}$	713 280.9		- 1.6	
7d $^2D_{3/2}$	733 514.9	1.7	- 2.1*	- 1.9
$^2D_{5/2}$	733 516.6			
8d $^2D_{3/2}$	746 648.0	1.2		
$^2D_{5/2}$	746 649.2			
9d ^2D	755 651.8	0.8		
10d ^2D	762 091.2	0.6		
4f $^2F_{5/2}$	618 057.7	4.7	+ 1.5	+ 0.02
$^2F_{7/2}$	618 062.4		+ 1.3	
5f ^2F	679 792.3	2.4	- 1.9	- 0.6
6f ^2F	713 325.9	1.4	- 2.1	- 2.8
7f ^2F	733 545.6	0.9	- 2.9	- 6.6
8f ^2F	746 668.9	0.6		
9f ^2F	755 666.1	0.4		
10f ^2F	762 101.7	0.3		
5g ^2G	679 800.0	1.5	+ 2.0	+ 0.6
6g ^2G	713 330.6	0.8	- 1.7	- 0.9
7g ^2G	733 548.6	0.5		- 3.3
8g ^2G	746 671.5			
9g ^2G	755 667.5			
10g ^2G	762 102.7			

* Centre of gravity

Term	E_{cale}, cm^{-1}	Interval Calc.	$E_{obs.} - E_{calc.}$	Stark effect displacement for 30 kV/cm
6h ^2H	713 332.0		+ 2.5	+ 2.8
7h ^2H	733 549.5			+ 1.2
8h ^2H	746 671.5			
9h ^2H	755 668.0			
10h ^2H	762 103.1			
7i ^2I	733 550.0			+ 5.6
8i ^2I	746 671.8			
9i ^2I	755 668.2			
10i ^2I	762 103.2			
8k ^2K	746 672.0			
9k ^2K	755 668.3			
10k ^2K	762 103.3			
9l ^2L	755 668.4			
10l ^2L	762 103.4			

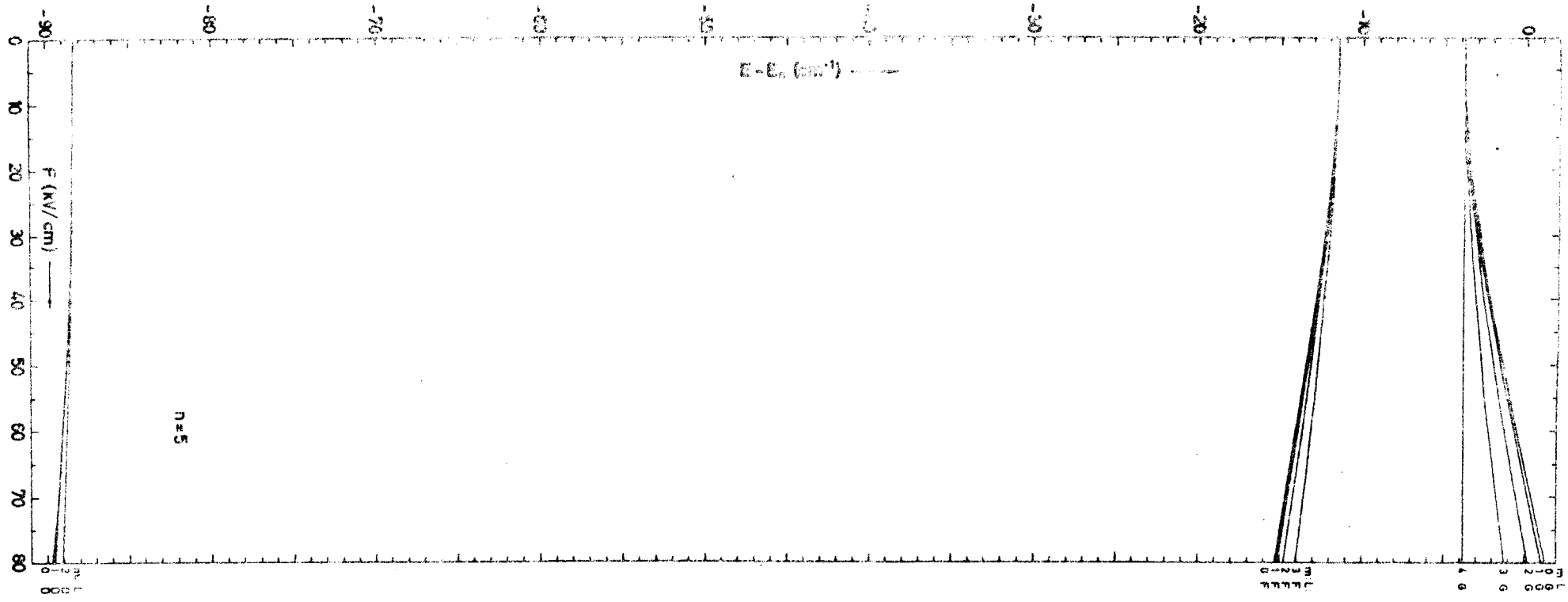


Fig. 3. Stark effect displacements of the energy states for $n = 5$ and $l \geq 2$ in NV.

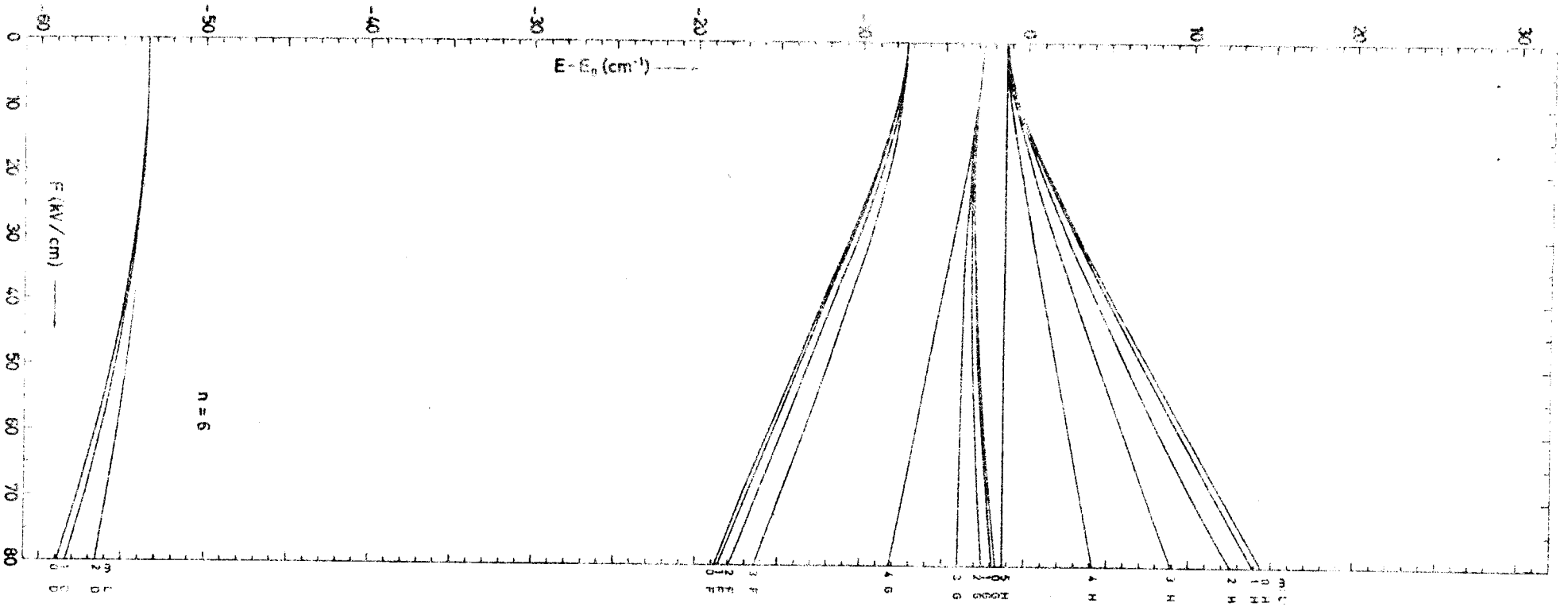


Fig. 4, Stark effect displacements of the energy states for $n = 6$ and $l \geq 2$ in NV.

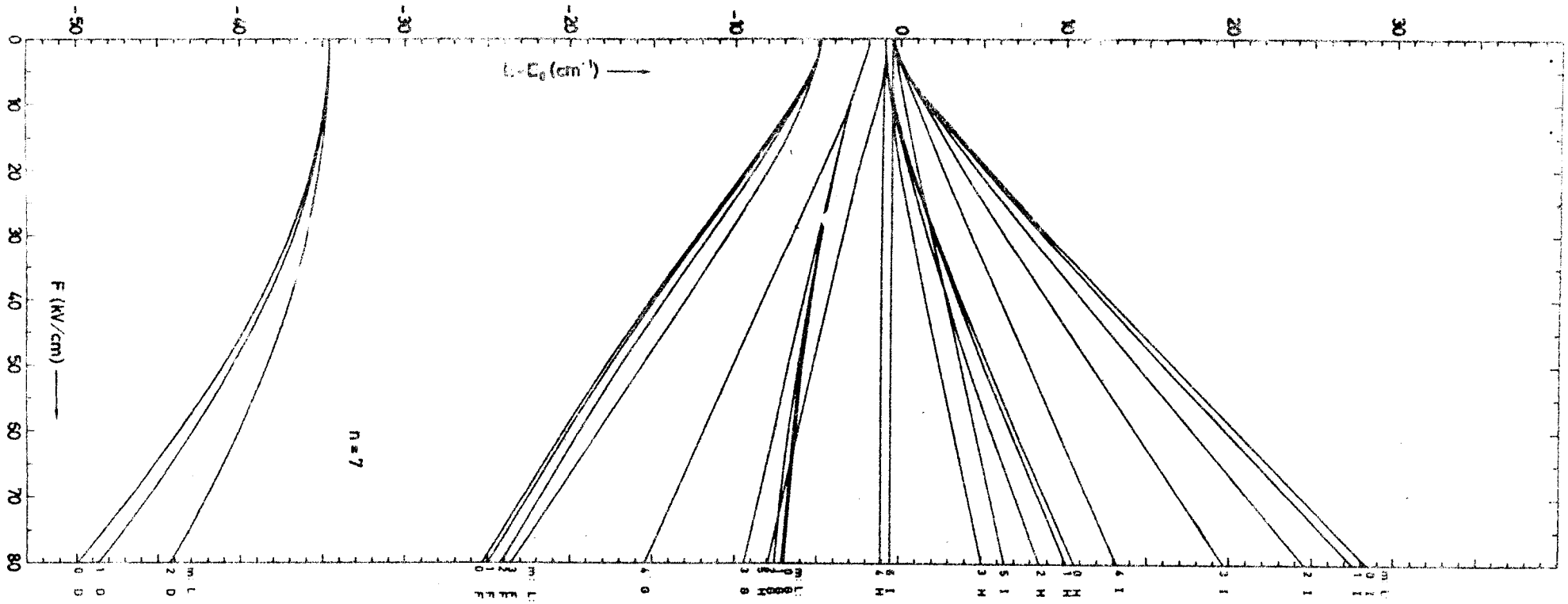
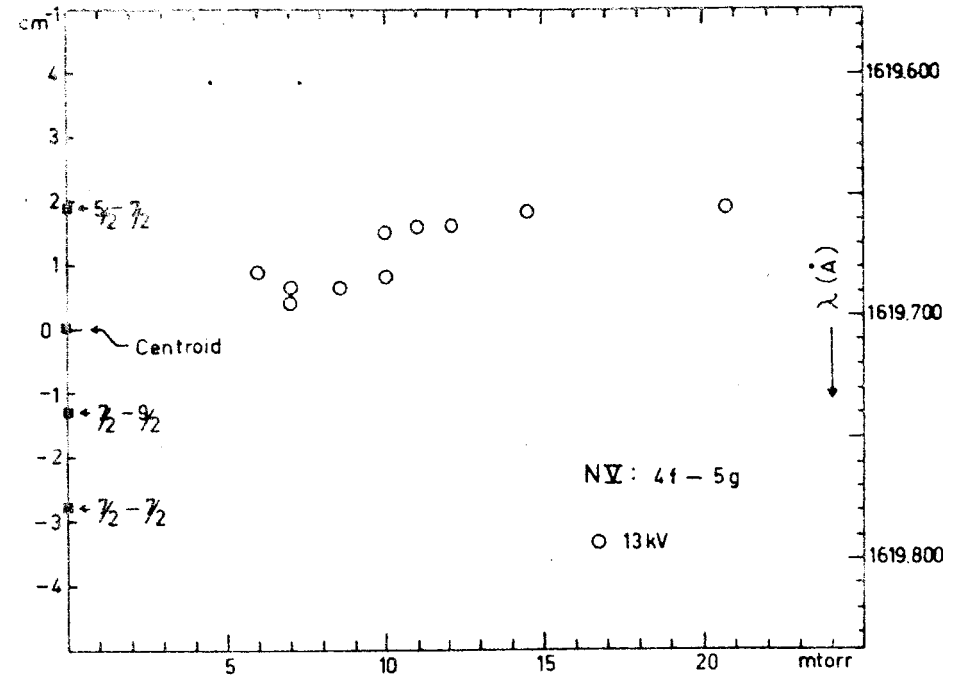


Fig. 5. Stark effect displacements of the energy states for $n = 7$ and $l \geq 2$ in NV.



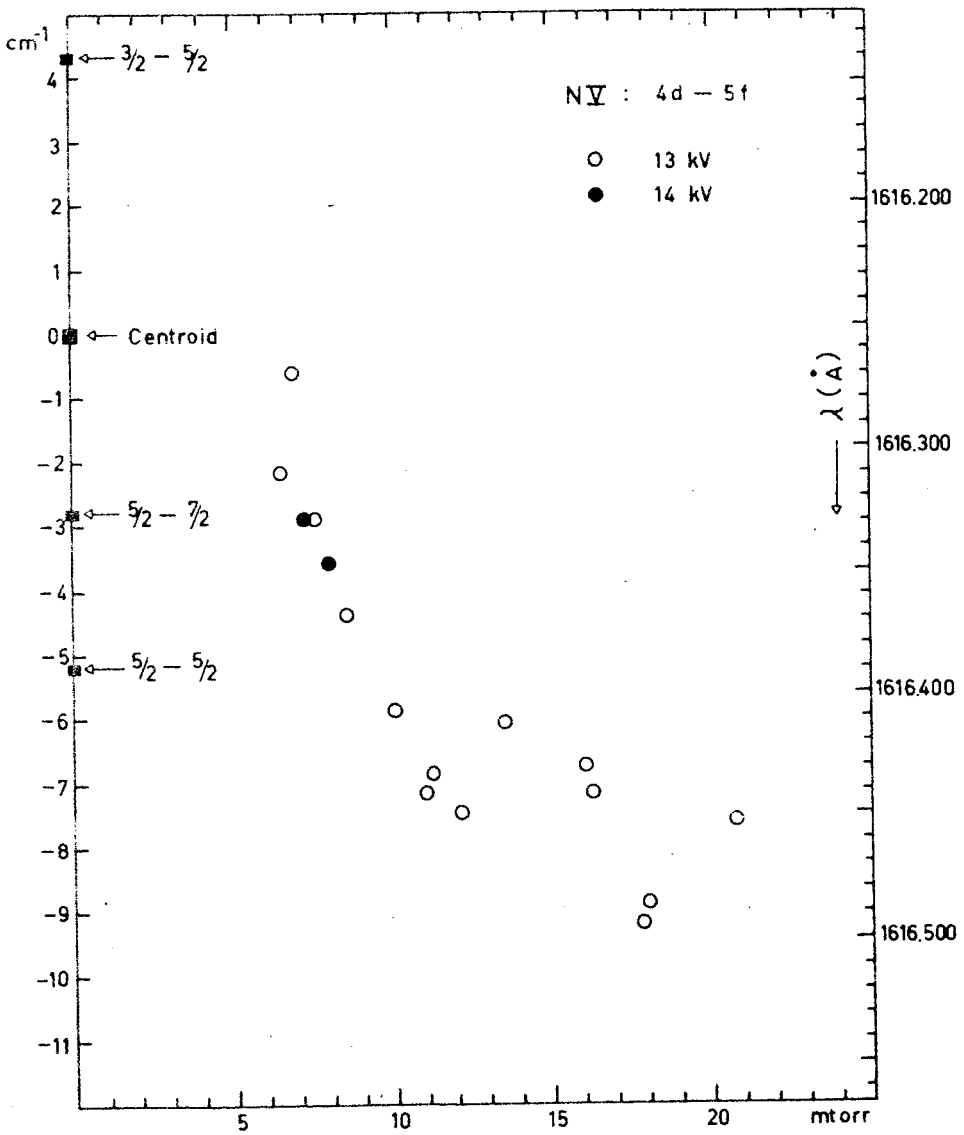


Fig. 6 The measured wavelengths for the transitions 4f - 5g (1619 Å) and 4d - 5f (1616 Å) with various initial gas pressures.