

STRUCTURA FINA SI SPECTRELE ATOMILOR CU UNUL SAU CU DOI ELECTRONI DE VALENTA (Completare pentru cadrul didactic indrumator)

1. Reglarea initiala a spectrometrului

Prin ajustarea initiala corecta a aparatului precizia masuratorilor creste substantial.

Fanta si firele reticulare trebuie pozitionate exact in planele focale ale lentulelor corespunzatoare.

Fanta si suprafetele prisme trebuie sa fie paralele cu axa de rotatie a telescopului.

Unele reglaje trebuie efectuate intr-o incapere cu lumina slaba.

Reglari preliminare

Reglati masuta aparatului cat mai orizontal posibil (din ochi).

- aliniati din ochi colimatorul 4 masa 6 si telescopul 7 cat mai orizontal
- centrati alateral telescopul si colimatorul su suruburile de deplasare si apoi fixati-le bine. In timpul reglarii nu desfaceti prea mult suruburile deoarece ele fixeaza colimatorul si telescopul.

Axa optica a telescopului trebuie fixata perpendicular pe retea.

Reteaua trebuie fixata pe axa de rotatie a telescopului, paralel cu axa lui de rotatie.

2. Exemple de rezultate

Tabelul urmator da un exemplu de determinari ale lungimilor de unda ale He. Pentru definitia lui $\Delta\alpha$ a se vedea Fig. 5 din referat.

In coloana notata $\frac{\lambda_{5700} / \text{cm}}{\text{nm}}$ sunt valorile lui λ calculate presupunand $N = 570$

mm^{-1} , adica $n = 5700 \text{ mm}^{-1}$. In coloana notata $\frac{\lambda_{5706} / \text{cm}}{\text{nm}}$ sunt valorile lui λ calculate

presupunand $N = 570,6 \text{ mm}^{-1}$, adica $n = 5706 \text{ mm}^{-1}$. Se observa ca ultimele sunt mai apropiate de cele gasite in literatura.

Tabel cu lungimi de unda masurate in spectrul He.

$\Delta\alpha$	$\frac{\lambda_{5700} / \text{cm}}{\text{nm}}$	$\frac{\lambda_{5706} / \text{cm}}{\text{nm}}$	$\frac{\lambda_{\text{air}}}{\text{nm}}$	$\frac{\lambda_{\text{vacuum}}}{\text{nm}}$
29.56°	447.6	447.1	447.0	447.1
31.18°	471.5	471.0	471.2	471.3
32.62°	492.7	492.2	492.1	492.2
33.24°	501.8	501.3	501.5	501.6
39.17°	588.1	587.5	587.4	587.6
44.79°	668.4	667.7	667.6	667.8
47.55°	707.3	706.5	706.3	706.5

Tabel cu determinari ale structurii fine a Na

Linie	ordin de difracție n	$\Delta\alpha$	$\frac{\lambda_{5706}}{\text{cm nm}}$
D ₁	1	39.300°	589.33
	2	84.542°	589.41
D ₂	1	39.250°	588.61
	2	84.425°	588.74

Valoarea medie a separarii este $\lambda(D_1) - \lambda(D_2) = 0,70 \text{ nm}$, fata de valoarea corecta $\lambda(D_1) - \lambda(D_2) = 589,5930 \text{ nm} - 588,9963 \text{ nm} = 0,5967 \text{ nm}$.

Mai jos este prezentat spectrul sodiului, cu tranzitiile interesante. Se observa jos liniile D₁ (indicele lipseste pe schema) si D₂.

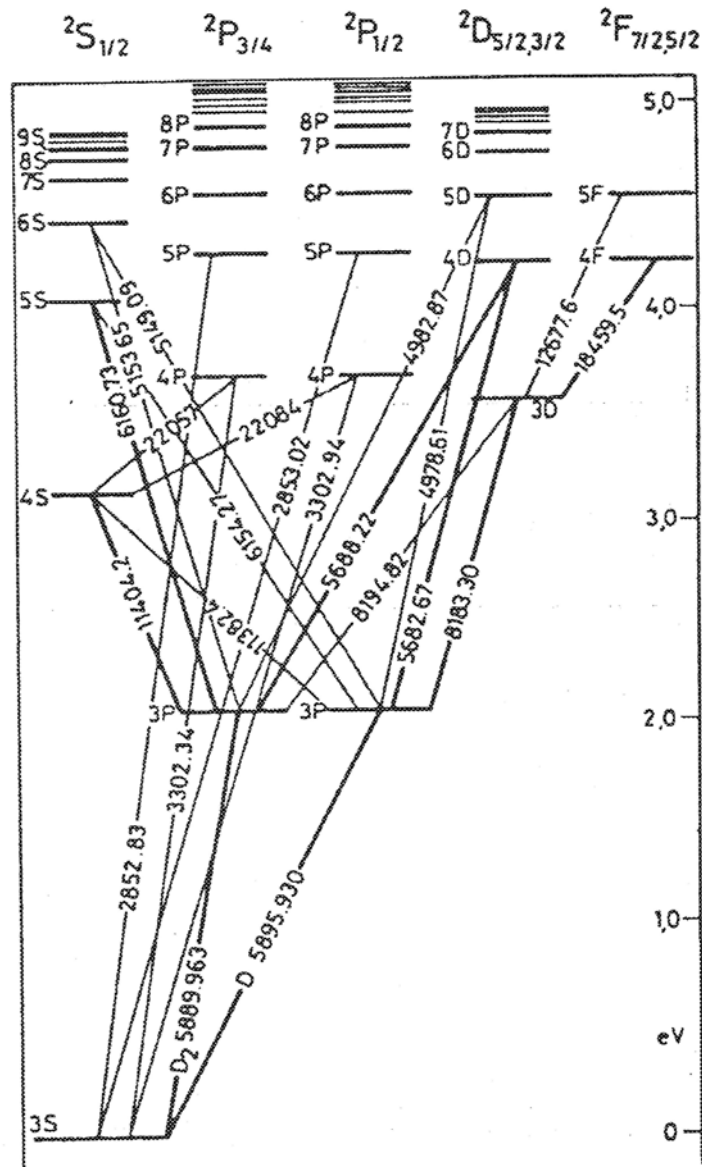


Fig. 3. Spectrul sodiului

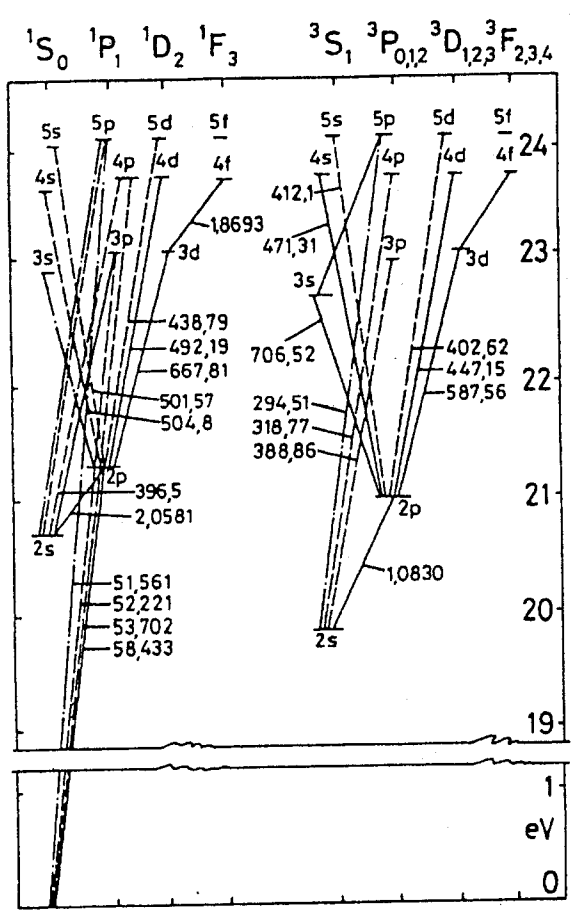


Fig. 6: Spectrum of helium.

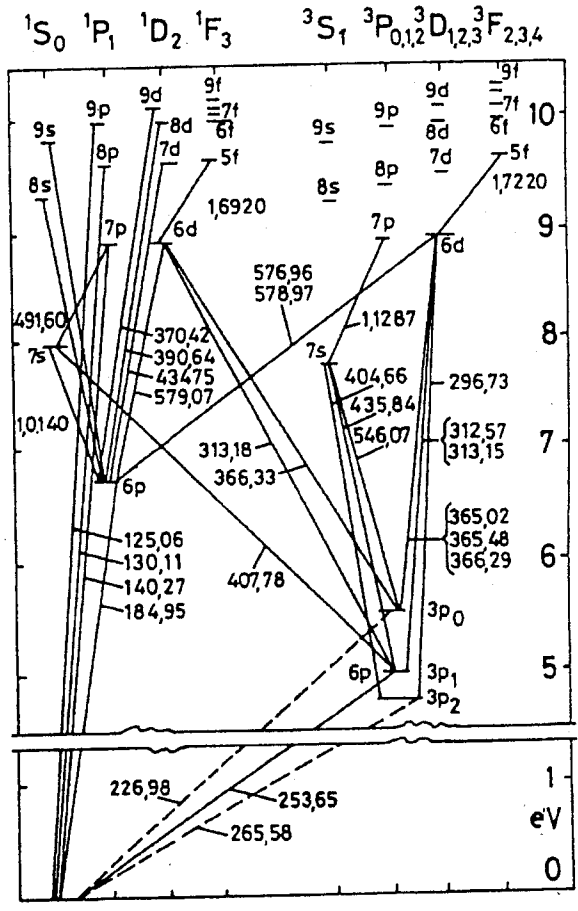


Fig. 7: Spectrum of mercury.

Hg, Cd and Zn are also two-electron systems and possess the structure of 2 series. The spin-orbit interaction, however, is relatively pronounced so that only the total angular momentum

$$J = L + S$$

Colour	λ/nm	Transition	Relative intensity
red	706.5	$3^3S \rightarrow 2^1P$	5
red	667.8	$3^1D \rightarrow 2^1P$	6
red	656.0	He II	4-6
yellow	587.6	$3^3D \rightarrow 2^3P$	10
green	504.8	$4^1S \rightarrow 2^1P$	2
green	492.2	$4^1D \rightarrow 2^1P$	4
blue	471.3	$4^3S \rightarrow 2^3P$	3
blue	447.1	$4^3D \rightarrow 2^3P$	6
blue	438.8	$5^1D \rightarrow 2^1P$	3
violet	414.4	$6^1D \rightarrow 2^1P$	2
violet	412.1	$5^3S \rightarrow 2^3P$	3
violet	402.6	$5^3D \rightarrow 2^3P$	5
violet	396.5	$4^1P \rightarrow 2^1S$	4
violet	388.9	$3^3P \rightarrow 2^3S$	10

Table 4: He-I spectrum.

is an energy conservation parameter. Splitting within a triplet is pronounced. Moreover, the selection rule

$$\Delta S = 0$$

is no longer valid since S is no longer a conservation parameter (transition from $L-S$ for the $j-j$ coupling).

Colour	λ/nm	Transition
red	690	$8^3P_2 \rightarrow 7^3S$
red	624	$9^1P \rightarrow 7^1S$
red	611	$8^1P \rightarrow 7^3S$
red	608	$8^1P \rightarrow 7^1S$
yellow	578	$\left\{ \begin{array}{l} 6^3D_2, 6^3D_1 \\ 6^1D_2 \rightarrow 6^1P_1 \end{array} \right.$
green	548	$7^3S \rightarrow 6^3P_1$
blue-green	496	Hg II
blue-green	492	$8^1D \rightarrow 6^1P_1$
blue	435	$7^1D \rightarrow 6^1P$
violet	408	$7^1S \rightarrow 6^3P_1$

Table 5: Measured Hg-1 spectrum

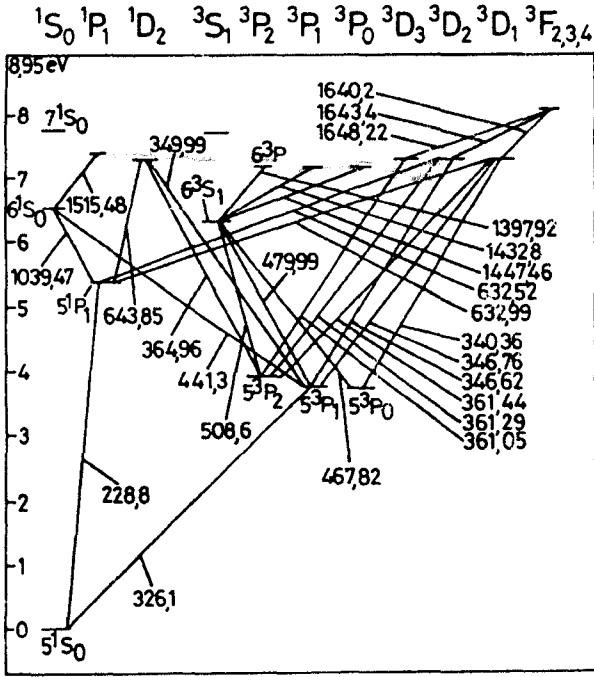


Fig. 8: Spectrum of Cd.

Colour	λ/nm	Transition
red	645	$6^1D_2 \rightarrow 5^1P_1$
red	633	$5^3D_1 \rightarrow 5^1P_1$
green	517	$7^1S_0 \rightarrow 5^1P_1$
green	509	$6^3S_1 \rightarrow 5^3P_2$
blue	480	$6^3S_1 \rightarrow 5^3P_1$
blue	469	$6^3S_1 \rightarrow 5^3P_0$
violet	441	$6^1S_0 \rightarrow 5^3P_1$

Table 6: Measured Cd spectrum.

Colour	λ/nm	Transition
red	636	$4^1P_1 \rightarrow 4^1D_1$
yellow	589	Zn II
yellow	579	$\left\{ \begin{array}{l} 5^3S_1 \rightarrow 7^3P_2 \\ 5^3S_1 \rightarrow 7^3P_1 \end{array} \right.$
green	534	$5^3S_1 \rightarrow 8^3P_0$
green	519	$4^1P_1 \rightarrow 6^1S_0$
green	508	$5^3S_1 \rightarrow 9^3P_1$
blue	481	$4^3P_2 \rightarrow 5^3S_1$
blue	472	$4^3P_1 \rightarrow 5^3S_1$
blue	468	$4^3P_0 \rightarrow 5^3S_1$
violet	463	$4^1P_1 \rightarrow f^1D_2$
violet	429	$\left\{ \begin{array}{l} 4^3P_1 \rightarrow 5^1S_0 \\ 4^1P_1 \rightarrow 7^1S_0 \end{array} \right.$

Table 7: Measured Zn spectrum.