Hyperfine Structure of Ionized Mercury Lines

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December 8, 1940

In connection with my work on the "hyperfine structure of the quadrupole line 2815A and some other lines of ionized mercury,"[1] Dr. L. Sibaiya published a letter[2] in a recent issue of *The Physical Review* in which he refers to a paper on the "hyperfine structure of some Hg II lines" published by Venkatesachar and himself[3] several years ago. I regret very much that I had overlooked this interesting paper and did not refer to it in my article. The structure of the line 3984A observed by me deviates much less from their findings than from the data reported in papers of several authors referred to in my article. Nevertheless, I disagree with other statements of Dr. L. Sibaiya and I should like to make here a few remarks on this matter.

Although Venkatesachar and Sibaiya[3] found the correct correlation of components to the Hg isotopes in the line 3984A they were able to determine from the observed structure only the difference of separations in the two levels $6^2P_{3/2}$ and $5d^96s^2\,{}^2D_{5/2}$. Therefore, they calculated the splittings from the formula of Goudsmit.[4] As the calculated difference of separations did not agree closely with the measured value, for the $6^2P_{3/2}$ level they adopted the theoretical value without further explanation and then estimated the separation in the ${}^2D_{5/2}$ level from their experimental results. In contradistinction to this, all spin separations (Hg^{199}) and isotope shifts reported in my paper are purely experimental. On photographs with overexposed main components, a very weak component at about $+1.000$ cm^{-1} was observed which might permit the evaluation of the separations in each level independently. But, on account of the low accuracy of the measurements under these circumstances, this component was not reported in my paper and the analysis was carried out by using the separation of the ${}^2D_{5/2}$ level found from the measurements of the structure of the line 2815A. Since the separations found experimentally by me agree very closely with those expected from Goudsmit's formula, it is not surprising that they agree so perfectly with the value reported by Venkatesachar and Sibaiya in the case of the level $6^2P_{3/2}$ and less perfectly in the case of the level ${}^2D_{5/2}$.

My report[1] on the analysis of some allowed lines of Hg II (3984A and 2848A) was incidental, since the main purpose of my paper was the analysis of the forbidden quadrupole line 2815A. In the case of the line 2848A the structure observed by me[1] differs from the results of Venkatesachar and Sibaiya.[3] The last line investigated by Venkatesachar and Sibaiya[3] and mentioned in Dr. L. Sibaiya's letter,[2] namely the line 2262A, has also been analyzed by me, among many other lines of Hg II. My pictures show that the structure reported by Venkatesachar and Sibaiya is incomplete and is due to overlapping of orders (they used only one Lummer-Gehrcke plate for the analysis). Contrary to their conclusion, the odd isotopes have a quite considerable total spin separation in the upper state $5d^96s6p\,{}^2\bar{D}_{5/2}$ (about 0.7 cm^{-1}), which is in agreement with the presence of an unpaired $6s$ electron in this state. The correlation of the even isotopes is opposite to that adopted by Venkatesachar and Sibaiya. It leads to a considerably smaller isotope shift in the level ${}^2\bar{D}_{5/2}$ (0.3 cm^{-1}) than the value reported by them (0.68 cm^{-1}). The smaller shift is also in agreement with the presence of only one $6s$ electron (two $6s$ electrons give a shift of 0.5 cm^{-1} in the levels $5d^96s^2\,{}^2D_{3/2,\,5/2}$). I hope to report the results of the analysis of a considerable number of lines (about 130) of Hg II soon.

[1] S. Mrozowski, Phys. Rev. **57**, 207 (1940).
[2] L. Sibaiya, Phys. Rev. **58**, 925 (1940).
[3] B. Venkatesachar and L. Sibaiya, Proc. Ind. Acad. Sci. **1**, 8 (1934).
[4] S. Goudsmit, Phys. Rev. **43**, 636 (1933).

Isotopic Weights of Ni Isotopes by the Doublet Method

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November 10, 1940

There are five isotopes for Ni, their relative abundance being estimated as follows:[1]

Mass No.	58	60	61	62	64
Relative Abundance	68.0	27.2	0.1	3.8	0.9

While Aston[2] had reported the value of 57.9116 ± 0.0020 for the isotopic weight of Ni^{58}, we obtained the following values for mass differences of these five doublets by photographing all five doublets of Ni isotopes by the electric discharge through the vapor mixture of $Ni(CO)_4$ and $n-C_7H_{16}$ with a mass-spectrograph of Bainbridge-Jordan type.

Doublet	Number of Doublets Measured	Difference of Mass ($\Delta M\times10^3$)
$C^{12}{}_4H_{10}-Ni^{58}$	16	137.12 ± 0.39
$C^{12}{}_5-Ni^{60}$	10	69.59 ± 0.31
$C^{12}{}_5H-Ni^{61}$	3	$73.5\ \pm1.5$
$C^{12}{}_5H_2-Ni^{62}$	7	86.07 ± 0.37
$C^{12}{}_5H_4-Ni^{64}$	3	104.48 ± 0.54

By employing these results as well as $H^1=1.008131\pm0.033\times10^{-4}$ and $C^{12}=12.003871\pm0.33\times10^{-4}$,[3] the isotopic weights of Ni isotopes were obtained as follows:

Isotopic Weight	Packing Fraction
$Ni^{58}=57.95967\pm4.1\times10^{-4}$	-6.97 ± 0.07
$Ni^{60}=59.94977\pm3.5$	-8.37 ± 0.06
$Ni^{61}=60.9540\ \pm15.$	$-7.5\ \pm0.3$
$Ni^{62}=61.94955\pm3.9$	-8.14 ± 0.06
$Ni^{64}=63.94740\pm5.6$	-8.22 ± 0.09

With both these results and aforementioned relative abundance, we calculated chemical atomic weight of Ni as 58.69, adopting the Smyth's conversion factor 1.000275. This value shows perfect agreement with the international chemical atomic weight of Ni 58.69.

[1] O. Hahn, S. Flügge, J. Mattauch, Physik. Zeits. **41**, 1 (1940).
[2] F. W. Aston, Nature **141**, 1096 (1938).
[3] K. Ogata, Proc. Phys.-Math. Soc. Japan **22**, 486 (1940).