

57. INNER CONVERSION IN X-RAY SPECTRA

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M. N. SAHA AND J. B. MUKHERJEE

(Nature, 133, 377, 1934)

MORE than ten years ago, Coster¹ reported that he had carried out experiments with heavy elements for tracing X-ray characteristic lines due to the transition $L_1(2s) \leftarrow L_{2,3}$ ($2P_{\frac{1}{2}}, 2P_{\frac{3}{2}}$), but got no positive results. During the last ten years, a number of other investigators² have also reported negative results.

These failures have remained rather mysterious for the transition $L_1 \leftarrow L_{2,3}$ ($\Delta n=0$) is not forbidden by quantum mechanics and actual calculation based on wave mechanics shows that the expected line should be quite intense. A recent search by one of us (J. B. M.) for the expected line of W (L_1-L_3 ; $\nu/R=139.5$; $\lambda=6.4\text{\AA}$.) also yielded no positive result though both the excitation and exposure were more than sufficient. A search into the current literature shows that though these lines ($L_1 \leftarrow L_3$) have not been obtained, a number of lines of heavy elements (73 Ta to 81 Tl) due to the transitions between N -levels ($N_{4,5} \leftarrow N_{6,7}$) have been obtained by Thibaud³, del Rosario⁴, Magnusson⁵, Prins and Takens⁶, while the last two workers report lines due to the transitions ($M_{2,3} \leftarrow M_{4,5}$) of a number of elements. Since in all these lines $\Delta n=0$, the failure to obtain the lines due to the transition ($L_1 \leftarrow L_3$) was remarkable.

It appears to us that the failure to obtain the ($L_1 \leftarrow L_3$) line is to be completely ascribed to the inner conversion of such lines in the M -levels of the elements. A scrutiny of the L -level values of the elements shows that from 92 U to 68 Er the (L_1-L_3) values are greater and very close to

the M -level values; for example, in W, the ν/R value for (L_1-L_3) is equal to 139.5 while $M_4=137.5$, $M_5=132.9$.

An application of a modified form of the formula for inner conversion given by Miss Swirles, Taylor and Mott, and Hulme⁷ shows that the (L_1-L_3) lines should be completely converted in such cases. It is only in 68 Er that the (L_1-L_3) ν/R value is just less than any of the M -level values and much larger than N -level values. But this situation persists only up to 55 Cs; from iodine again, L_1-L_3 becomes just larger than some M -values, so that it is expected that only elements from Er to Cs are capable of showing lines due to ($L_1 \leftarrow L_3$) transitions. This conclusion has not yet been tested.

It appears that the phenomenon of inner conversion is responsible for many of the intensity anomalies which are observed in the line spectra of X-rays, as was suggested some years ago by Wentzel.

Physical Laboratory,
University of Allahabad.

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