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THE FLUORESCENCE SPECTRUM OF Pu+3 IN LaCl3

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THE FLUORESCENCE SPECTRUM OF  $\text{Pu}^{+3}$  IN  $\text{LaCl}_3$

Burris B. Cunningham, Dieter M. Gruen, John G. Conway  
and Ralph D. McLaughlin

March 23, 1956

## THE FLUORESCENCE SPECTRUM OF $\text{Pu}^{+3}$ IN $\text{LaCl}_3$ \*

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We wish to report here the first observation of the  $\text{Pu}^{+3}$  fluorescence spectrum.

The fluorescence was observed in a crystal of  $\text{LaCl}_3$  (m. p.  $860^\circ\text{C}$ ) containing approximately 0.1 percent  $\text{Pu}^{+3}$ . We used the same experimental techniques described in a recent Letter to the Editor<sup>1</sup> on the fluorescence spectrum of  $\text{Am}^{+3}$  in  $\text{LaCl}_3$ .

The fluorescence is self-excited at room temperature due to the radioactivity of  $\text{Pu}^{239}$  but the self-excitation is much weaker than in the case of the  $\text{Am}^{241}$ , partly because of the difference in half-lives.

All of the lines observed in the fluorescence spectrum are listed in Table I together with their visually estimated intensities. Lines marked with an asterisk coincide exactly with lines found in the absorption spectrum, and may be assumed to represent transitions from excited electronic states to the  ${}^6\text{H}_{5/2}$  level of the ground state multiplet.

Most of the lines listed except the most intense are observed only at  $77^\circ\text{K}$ .

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\* This work was done under the auspices of the United States Atomic Energy Commission.

<sup>1</sup> Gruen, Conway, McLaughlin and Cunningham, J. Chem. Phys. 24,

An attempt has been made to rule out as far as possible effects due to lanthanide or actinide impurities.

The  $\text{LaCl}_3$  starting material came from Research Chemicals Co. Low temperature absorption spectra on a single crystal of this material showed no absorption lines due to other rare earths. The plutonium (24,300 year alpha emitting  $\text{Pu}^{239}$ ) was especially purified by standard chemical procedures. No lanthanide or actinide impurities were found in the sample used for this work by emission spectroscopic analysis. In spite of the attempts made to avoid impurity effects, three lines were observed at 4998, 5061, and 5132 Å which are not believed to be plutonium lines. These three lines also appeared in the fluorescence spectrum of  $\text{Am}^{+3}$  but their intensity was lessened upon the preparation of a purer sample. If they are truly plutonium lines other plutonium lines of comparable intensity should have been observed in the  $\text{Am}^{+3}$  fluorescence.

One of us (D. M. G.) wishes to thank Dr. G. T. Seaborg and the staff of the University of California Radiation Laboratory for making possible a year's stay at the Radiation Laboratory.

Table 1. Fluorescence Spectrum of  $\text{Pu}^{+3}$  in  $\text{LaCl}_3$  at 77°K

| No. | Wavelength (Å) | Intensity | No. | Wavelength (Å) | Intensity |
|-----|----------------|-----------|-----|----------------|-----------|
| 1   | 4975. 4        | 3         | 14  | 5232. 9        | 4         |
| 2   | 4991. 8        | 4         | 15  | 5233. 7        | 8         |
| 3   | 5045. 8        | 3         | 16  | 6147. 7        | 10        |
| 4   | 5076. 8        | 2         | 17  | 6159. 9        | 8         |
| 5   | 5156. 6 *      | 8         | 18  | 6188. 7        | 8         |
| 6   | 5163. 3 *      | 10        | 19  | 6200. 8        | 8         |
| 7   | 5166. 6        | 10        | 20  | 6278. 9        | 7         |
| 8   | 5175. 0        | 10        | 21  | 6288. 9        | 4         |
| 9   | 5183. 3        | 10        | 22  | 6320. 9        | 3         |
| 10  | 5200. 4        | 8         | 23  | 6330. 9        | 3         |
| 11  | 5208. 6        | 8         | 24  | 6342. 8        | 3         |
| 12  | 5217. 7        | 4         | 25  | 6353. 4        | 3         |
| 13  | 5225. 5        | 5         |     |                |           |

\*) These lines appear in both absorption and fluorescence.