Isotope Shift in the $_{58}$Ce II Spectrum*

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The spectrum of Ce II from enriched samples of Ce^{136} and Ce^{138} has been studied and compared with the same spectrum from natural Ce. Only a negligible isotope shift, certainly less than 6 percent of that between the isotopes with 82 and 84 neutrons, has been found between the isotopes with 78, 80, and 82 neutrons.

THE isotope shift between Ce^{140} and Ce^{142} has been measured by Brix and Frank[1] in some of the lines $4f^26s\,{}^4H$, ${}^2H$, ${}^4F-4f^26p\,{}^4I^\circ$, ${}^4H^\circ$, ${}^2H^\circ$, ${}^4G^\circ$. An attempt was made by Murakawa and Ross[2] to measure a shift between Ce^{138} and Ce^{140} in the $4f^26s\,{}^4H_{9/2}-4f^26p\,{}^4I^\circ_{9/2}$ line by using an enriched (4.4 percent) sample of Ce^{138}. Murakawa and Ross estimated an upper limit of this shift at about the half of the $Ce^{140}-Ce^{142}$ shift, which was found by Brix and Frank to be 0.054 ± 0.003K,[3] with the Ce^{142} towards lower frequency.

A new attempt has been made to measure not only the $Ce^{138}-Ce^{140}$ shift, but also the $Ce^{136}-Ce^{140}$ shift, in the lines where Brix and Frank measured the shift between Ce^{140} and Ce^{142}. Enriched samples[4] of Ce^{138} (13.1 percent) and Ce^{136} (first 22.3 percent, later 30 percent) were available.

The experimental setup consisted of 3 parallel hollow cathode tubes[5] and a modified Steinheil three-prism spectrograph (designed and built by Mr. George Streander at Wisconsin) with a Perot-Fabry interferometer in the parallel beam between the collimator and the prisms. The spacers used in the interferometer had the sizes: 15, 18, 19, 20, 25, 27, 30, and 40 mm. The coating on the plates was silver in most of the exposures and an aluminum-magnesium alloy in the others. The reflectivity exceeded 90 percent.

The shift between Ce^{140} and Ce^{142} could be measured in all the lines with all three samples and the value agrees with the value found by Brix and Frank. It was, however, impossible to find any structure from the Ce^{138} and Ce^{136} isotopes, which lines seem to coincide with the Ce^{140} lines. Not even a line broadening was detected. A quantitative measurement of the lines gave the following values for the shifts:

$Ce^{136}-Ce^{140}$: 0.0003 ± 0.0032K (33 measurements),

$Ce^{138}-Ce^{140}$: 0.0002 ± 0.0035K (12 measurements),

with the lighter isotopes in each case towards higher frequency. The uncertainty includes the largest deviation from the average.

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[1] P. Brix and H. Kopfermann, Z. Physik **127**, 289 (1950).
[2] K. Murakawa and J. S. Ross, Phys. Rev. **83**, 1272 (1951).
[3] 1K(kayser)$\equiv$1 cm^{-1}, following a recommendation of the international Joint Commission for Spectroscopy [see J. Opt. Soc. Am. **43**, 410 (1953)].
[4] Produced by the *Y*-12 plant, Carbide and Carbon Chemicals Corporation, and obtained by allocation from the U. S. Atomic Energy Commission.
[5] H. Arroe and J. E. Mack, J. Opt. Soc. Am. **40**, 386 (1950).