by Eqs. (2a, b), then

$$A\Delta\nu M=(1.19)(M^2S\alpha u)^{2/3}+(0.789)(M^2S\alpha u)^{3/7}. \qquad (4)$$

Equation (3) is valid when there is little absorption from the beam for wave numbers $|\nu-\nu_0|>3M^{-1}$. Equation (4) is valid when the beam is largely absorbed for all $|\nu-\nu_0|<3M^{-1}$. When neither of these conditions is satisfied, the value of $A$ is intermediate between that given by Eqs. (3) and (4). In Fig. 1, where these equations are plotted, it is seen that the actual absorption curve in this range is always concave upwards and thus could not be confused experimentally with the concave downwards curve that begins when the lines in a band begin to overlap. The stronger absorption from Eq. (4) than from (3) for large $M^2S\alpha u$ is due entirely to the larger $k(\nu)$ in the red wing.

We have also calculated the transmission of an idealized band of equally spaced, equally intense lines with $k(\nu)$ given by Eqs. (2a, b) by the same procedure used by Elsasser[5] for the Lorentz shape. In our case the calculations have to be performed numerically. The results are given in Fig. 2. The region of validity

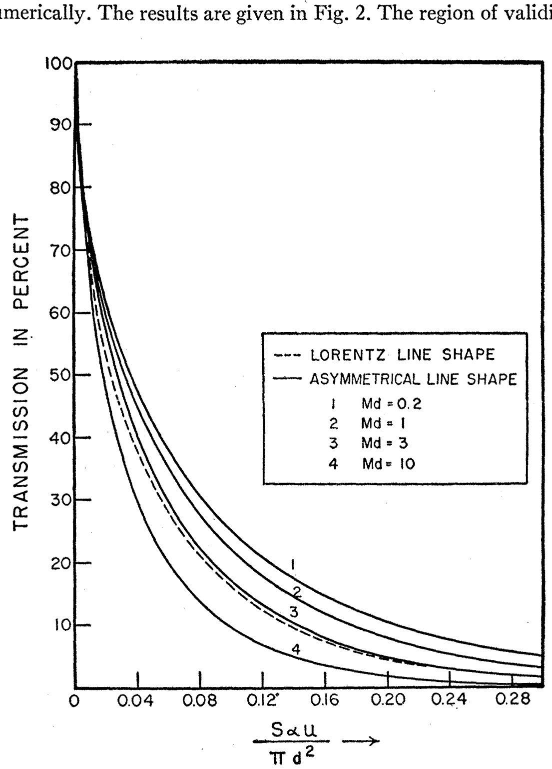


FIG. 2. Transmission of an idealized band as a function of $S\alpha u/\pi d^2$, where $d$ is the separation between line centers in the band.

of these curves is determined by considerations similar to those for a single line. The curves for $Md\leqq 1$ should be modified by using $k(\nu)$ from Eq. (1) for nearby lines and Eqs. (2a, b) for more distant lines.

An experimental measurement of the line shape in the wings by accurate measurement of the absorption of a single line would be desirable in view of the importance of this subject for band absorption and for considerations of heat transfer in the atmosphere.[6] A paper discussing these applications in detail will appear shortly in another journal.

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## Interferometric Measurements of the Hyperfine Structure of the Mercury Green Line*

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IN his classic work on the subject, Schüler[1] did not include accurate wavelength measurements of the six normally unresolved components which make up the main part of the green line of mercury. He did, however, from theoretical considerations predict accurately all the components which have been found, including an analysis of their separations.

Gehrcke and Lau,[2] followed by Burger and Van Cittert[3] using quite different techniques, measured all components. The values given by these authors checked reasonably well with Schüler's earlier measurements of the resolved components and predictions of the unresolved.

Recently, Breit[4] has pointed out the importance, for a better understanding of intranuclear forces, of more accurate measurements of hyperfine structure components. Mercury hyperfine structure has a particular significance in this respect because it has five even isotopes and two odd, thus offering an array of nuclear levels for studying and evaluating anomalous behavior.

In the present work previous measurements of the hyperfine structure of the green line of mercury have been refined by application of a novel Fabry-Perot interferometer which permits photographing of patterns rapidly and with high resolution. Each interferometer plate consists of a multilayer film formed by the alternate deposition of layers of two dissimilar dielectrics. The resultant film is similar to that which is deposited in the fabrication of the presently available commercial interference filters.[5] In this way a resolving power of nearly three million has been obtained using spacers of only 37 mm in a standard Fabry-Perot interferometer. Since absorption in a multilayer film is very much lower than that inherent in a silver film, transmission is considerably higher for equivalent reflecting power. Indeed, it has been possible to make high resolution interferograms in a matter of minutes, so quickly that only the crudest temperature regulation is required.

A typical interferogram is shown in Fig. 1. This was made by using an enriched isotope sample furnished by the Isotopes Division of the U. S. Atomic Energy Commission. The sample illustrated contains nearly equivalent amounts of $Hg^{198}$, $Hg^{200}$, $Hg^{202}$, and $Hg^{204}$. The components shown are approximately 0.03 $cm^{-1}$ apart.

In Table I are given measurements of the central components

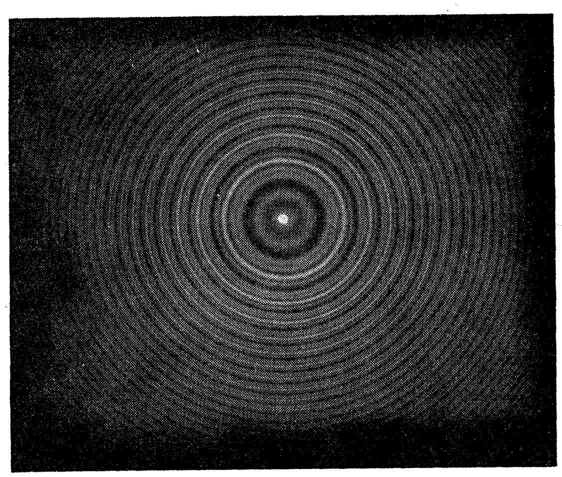

FIG. 1. A typical interferogram of the mercury green line, using an enriched isotope sample.

TABLE I. Hg hyperfine structure 5461A, comparative data (units $10^{-3}$ cm$^{-1}$).

| Isotope | 201(c, e)[a] | 198 | 200 | 199(B)[a] | 202 | 204 |
|---|---|---|---|---|---|---|
| Sch[1] | −93 | −64 | −37 | ... | 0 | 20 |
| G&L[5] | −90 | −60 | −36 | ... | 0 | 30 |
| B&V.C.[2] | −89 | −60 | −31 | ... | 0 | 28 |
| J.S. | −86.9 | −56.6 | −32.6 | 0.4 | 0 | 29.8 |

[a] Designation according to Schüler.

obtained by using a number of enriched samples excited by electrodeless discharge. Precision of measurement is ±0.0005 cm$^{-1}$. The value given for component $B$ of $Hg^{199}$ was made using an enriched sample containing practically no $Hg^{202}$. This is believed to be the first reported measurement of this particular component. The present measurement of the $Hg^{198}$ component is seen to differ markedly from previous ones. This was the most difficult component for earlier researchers to measure in ordinary mercury because of its relatively low concentration. It was not possible to measure the component of $Hg^{196}$ because of its close coincidence with two strong components of $Hg^{201}$ and the fact that it has not been possible so far to obtain a sufficiently enriched sample.

It seems very certain that the even component frequencies of 5461A do not lie in a sequence according to atomic weights as has been reported for other mercury lines.[6]

TABLE II. Odd-even staggering (isotopic units).

| | $Hg^{199}$ | $Hg^{201}$ |
|---|---|---|
| $5461-6^3P_2-7^3S_1$ | 0.87 | 0.34 |
| $2537-6^1S_0-6^3P_1$ | 0.9 | 0.3 |
| $6072-7^3S_1-8^1P_1$ | 0.6 | 0.6 |
| $6716-7^1S_0-8^1P_1$ | 0.8 | 0.6 |
| $5676-7^3S_1-9^1P_1$ | 0.8 | 0.8 |

Utilizing the definitions of Breit,[4] staggering values were calculated for $Hg^{199}$ and $Hg^{201}$ of the green line. These are shown in Table II compared with approximate values for other lines taken from a diagram of Schüler[7] and Keyston. It is interesting to note that the values obtained for 5461A in the present research are in good agreement with those of Schüler for 2537A, which can be measured with about five times less available resolution.

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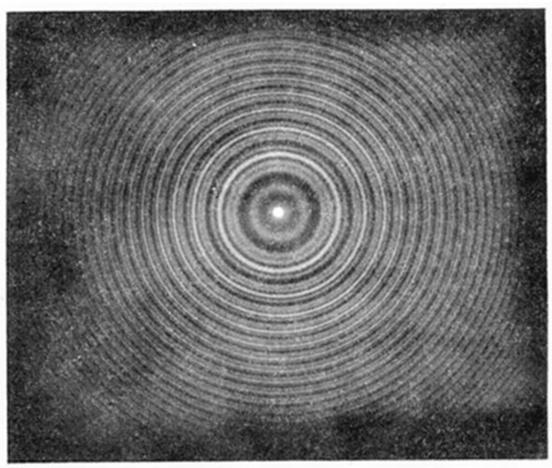

FIG. 1. A typical interferogram of the mercury green line, using an enriched isotope sample.