and to Professor Merle Tuve of the Carnegie Institution of Washington for supplying our laboratory with part of the balloons used for these experiments.

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Evidence for a Complex Disintegration of I^{131} *

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THE negatron spectrum of I^{131}, obtained from Oak Ridge as a chemically separated decay product of Te^{131}, has been studied. This study was initiated because of a discrepancy reported by Miskel[1] between two methods of determining the absolute disintegration rate of I^{131}.

The present investigation was conducted with a semi-circular uniform field magnetic spectrometer having a radius of curvature of 5.7 cm. The dimensions of the vacuum chamber, however, are quite large with relation to the usual chamber size for an instrument having this radius of curvature such that it is believed that scattering within the instrument is small. The interior of the vacuum chamber is constructed of Aquadag coated Lucite.

The G-M counter utilized a thin window which passed electrons above 3 kev, this window being made of composite films of Formvar and Zapon. These films, after being placed over the exit slit, were dried under a lamp. Windows prepared in this manner appear to be more satisfactory than those prepared only of Formvar or Zapon.

Three sources were used in this investigation; a thin source of 0.18 mg/cm² mounted upon a 0.25-mil Al backing, a second source of 0.32 mg/cm² mounted upon a 0.06
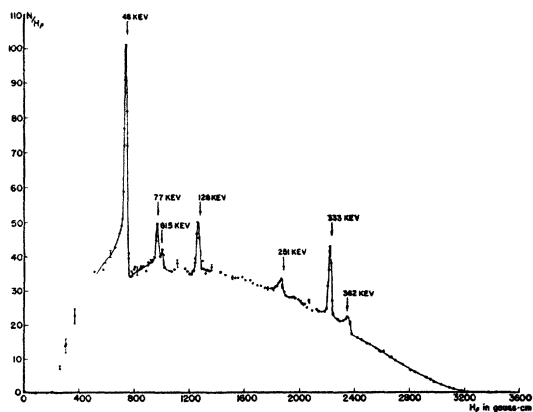

FIG. 1. Momentum distribution of the negatrons from I^{131}. Energies shown are those of the internal conversion lines. Sample statistical errors are indicated for selected points within the several regions of the spectrum. Other points within the same region have approximately the same statistical error.
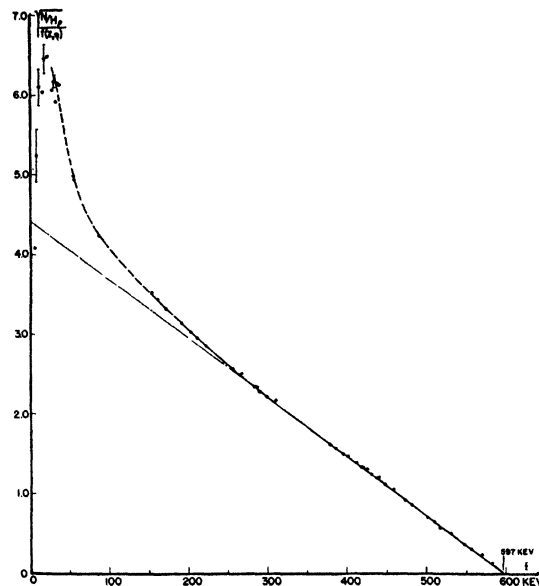

FIG. 2. Kurie plot of the negatron spectrum of I^{131}. $f(Z,\eta)$ is here the Fermi relativistic function rather than the Kurie non-relativistic approximation. The internal conversion line regions are not plotted.

mg/cm² Zapon backing, and a fairly thick source of 0.79 mg/cm² mounted upon a 0.25-mil Al backing. The thickness of the 0.32-mg/cm² source was determined by weighing and that of the others was in turn determined by comparison of relative intensities. The results are derived from a combination of the data from the two thinner sources. The thickest source, with its correspondingly higher counting rate, was used to confirm the existence of the low intensity peaks.

Figure 1 shows the negatron momentum spectrum of I^{131}. In addition to the internal conversion lines at 48 kev and 334 kev reported by Downing, Deutsch, and Roberts,[2] several weaker lines have been found in the current investigation. One of these, at 251 kev, was found by the M.I.T. group in their internal conversion, beta-coincidence data.

If one assumes a gamma-ray whose energy is 83±2 kev then the lines at 48, 77, and 81.5 kev correspond, respectively, to this gamma's K, L, and M conversion lines. Likewise the lines at 333 and 362 kev correspond to the K and L lines for a gamma whose energy is 368±7 kev. Assuming that the other conversion lines are produced in the K shell of Xe, energies can be ascribed to the associated gamma-rays of 163±3 kev and 286±6 kev. Consistent fluctuations within 85–120-kev and 260–320-kev regions suggest the possibility of more low intensity conversion peaks, but with the present arrangements these are too weak to be accurately determined.

The Kurie plot is shown in Fig. 2. Here the true Fermi relativistic Coulomb function is used rather than the more commonly used Kurie non-relativistic approximation. Extrapolation of the higher energy data gives a maximum beta-energy of 597±5 kev. The internal conversion peaks have been omitted from the plot.

A considerable rise above the extrapolated straight line portion of the Kurie plot is indicated at low energies. If one believes that a Kurie plot can significantly be resolved to give lower energy components of the beta-spectrum, then this may mean that the beta-spectrum of I^{131} is complex. There are, however, indications[3] that a Kurie plot may rise at low energies above its straight line portion without its spectrum being complex. It may also be mentioned that the large number of internal conversion lines in this region may contribute to this rise.

The fact that the sum of the high intensity gammas 83 kev+368 kev and the sum of the low intensity gammas 163 kev+286 kev both add to 450 kev within the experimental errors makes it possible that these two sets of gammas follow parallel transitions from a single excited state of Xe^{131} to its ground state.

The authors wish to express their appreciation of many helpful discussions with Professor H. Primakoff.

* Assisted by the joint program of the Office of Naval Research and Atomic Energy Commission.
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The Photoelastic Properties of Diamond

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IN a recent communication[1] the authors discussed the photoelastic properties of crystals in terms of atomic concepts and included a discussion of the photoelastic constants of diamond obtained by Ramachandran.[2] Ramachandran's values had been questioned by West and Makas[3] who stated that the magnitudes of the stress-optic constants $(\pi_{11} - \pi_{12})$ and π_{44} were in error by a factor of 10^2 and that the signs of the constants were wrong. Examination of Ramachandran's data, however, showed that the values of the constants for diamond were given correctly in units of cm^2/g.[4] Furthermore, it was felt that there was not sufficient evidence to warrant the rejection of Ramachandran's signs and that, since there is no way of calculating the atomic anisotropy contributions which play an important rule in determining the signs of the photoelastic constants, only an independent experimental check could settle the question.

West and Makas[5] have since made qualitative observations which confirmed their earlier conclusions about the sign and Ramachandran[6] has recently stated that he has redetermined the signs and agrees with West and Makas that the signs as given in his paper are incorrect. He attributed the error in his paper to an inadvertent reversal in sign of the compensator constant. The authors have independently confirmed these conclusions by measurements on two of the diamonds used by Ramachandran.[7]

In view of the change in sign of the diamond data it is necessary to reconsider their significance. A re-examination of Ramachandran's data shows that the reversal in sign of $(\pi_{11} - \pi_{12})$ and π_{44} changes only the signs of the individual constants and not their magnitudes. The corrected photoelastic constants are:

$$p_{11} = -0.125 \qquad \pi_{11} = -0.43 \times 10^{-2} \text{ meter}^2/\text{Newton}$$
$$p_{12} = +0.325 \qquad \pi_{12} = +0.37$$
$$p_{44} = -0.11 \qquad \pi_{44} = -0.27$$
$$p_{11} - p_{12} = -0.45 \qquad \pi_{11} - \pi_{12} = -0.80.$$

From these, a recalculation of the atomic anisotropy constants and related quantities gives the following values:

$$\lambda_{11} = +0.42 \qquad \lambda_{11} - \lambda_{12} = -0.38$$
$$\lambda_{12} = +0.80 \qquad \lambda_0 = +0.5$$
$$\lambda_{44} = +2.2 \qquad \rho(dn/d\rho) = +1.24.$$

As Mueller[8] has pointed out, the density contribution to p_{11} and p_{12} is positive in all crystals. In cubic crystals with D lattices, the Lorentz-Lorenz and Coulomb contributions are generally smaller than the density contribution. Positive values of p_{11} and p_{12} should, therefore, be obtained if only these three contributions are important. This is found to be true for many crystals where the atomic anisotropy contribution is small. The atomic anisotropy contribution can, however, be larger than the combined density, Lorentz-Lorenz, and Coulomb contributions and can thereby yield negative values for both p_{11} and p_{12} as in MgO $(p_{11} = -0.3; p_{12} = -0.08)$.[9]

In diamond where Coulomb contributions are zero, the Lorentz-Lorenz contribution to p_{11} is negative. Even though λ_{11} is relatively small (compare, for example, $\lambda_{11} = 1.2$ for NaCl which has a positive p_{11}) the net effect is a negative p_{11}. On the other hand, the Lorentz-Lorenz contribution to p_{12} is positive, and the λ_{12} is not sufficiently large to make p_{12} negative.

The Lorentz-Lorenz contribution to p_{44} in diamond is positive. Here, however, the atomic anisotropy contribution λ_{44}, is large, being about 10 to 20 times as large as those for the alkali halides, so the resultant p_{44} is negative. The relatively large λ_{44} can be attributed to the covalent nature of the bonding in diamond and the distortion of the bond angles by a shearing strain. In ionic crystals central forces predominate and shearing strains do not cause large effects. The λ_{44}, therefore, should be a measure of the amount of homopolar bonding in a crystal. Until data are available on the polarizability and optical strengths of the ions, however, only qualitative estimates of this constant can be obtained from photoelastic data. It is, therefore, not as useful for estimating the amount of homopolar bonding as λ_0 which is more easily obtained. A distortion of the bond angles is also obtained for normal strains and accounts in part for the fact that λ_{11} and λ_{12} of diamond are of the same order of magnitude. (See also the discussion of the relative magnitudes of λ_{11} and λ_{12} in the previous communication.)

The authors' conclusion that the $\lambda_{11} - \lambda_{12}$ may be negative for CsCl, ZnS, and diamond structures is not invalidated by the change in sign of the diamond constants.

The change in refractive index with density, however, is now found to be positive instead of negative as given in the former note.[1] This leaves MgO as the only crystal