

Energy of the Gamma-Rays of Radioindium and Radiomanganese

We have measured the energies of the gamma-rays from RdIn (54 min.) and RdMn by recording the coincidences produced by Compton electrons ejected from a 0.45 cm aluminum plate placed in front of two counters.¹ Insertion of aluminum foils between the two counters causes a decrease in the number of coincidences. If D_1 is the thickness of aluminum in g/cm² which cuts the number of coincidences to one-half, the energy, E , of the gamma-ray is given by the relation

$$D_1 = C_1 \frac{(E/mc^2)^2}{(E/mc^2) + 1},$$

where C_1 is a constant, practically independent of energy, which must be determined with the help of some gamma-ray of known energy. A similar formula with a different constant C can be used for the quarter value thickness. The formula assumes that the gamma-ray is monochromatic.

The apparatus was calibrated using the gamma-rays of radiothorium filtered through 6 cm of lead (energy 2.65 Mev), and also those of radium filtered through 4 cm of lead (energy 1.8 Mev). After correcting for the absorption by the counter walls, the values of the constant C shown in Table I were obtained using both standards. They agree to 3 percent.

The curves obtained for RdMn and RdIn are shown in Fig. 1. The initial number of coincidences in 5 minutes were for RdMn 125, for RdIn 266; the background was 8 in 5 minutes. The half-value and quarter-value thicknesses are shown in the table together with the value for the energy of the gamma-rays calculated therefrom. The average energies of the gamma-rays are for RdMn 1.65 Mev, RdIn 1.39 Mev. We also tried to measure the gamma-rays from RdAs but these, while present, were too weak to admit of measurement.

Using a single counter, surrounded by enough lead to stop all beta-rays from the source, we measured the absorption of the gamma-rays of RdMn, RdIn, and Th C'' in lead and copper. Because of the weak intensity of the sources, the geometrical arrangement for these measurements was not good enough to allow one to use the absorption coefficients thus obtained to calculate the energy without applying large corrections. This was apparent from the work on Th C''. The results did show, however, that the gamma-rays were *monochromatic* and that their energy was considerably less than that of the gamma-ray from Th C''. The period of the gamma-ray from each sub-

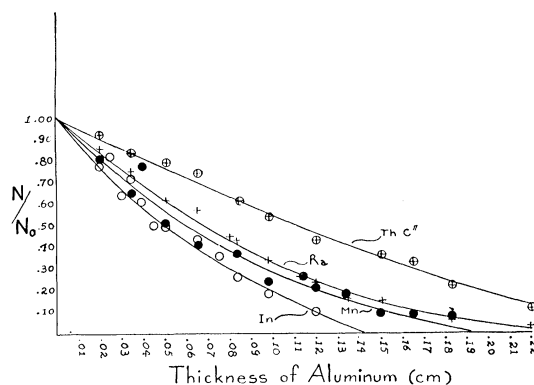


FIG. 1.

stance was measured and found to be the same as that for the beta-activity.

The beta-ray spectrum of RdMn has been measured by Brown and Mitchell² who found that the distribution curve could be decomposed into two curves with end-points at 2.9 and 1.2 Mev. It was supposed that the difference in energy between these two end-points should correspond to a gamma-ray of this energy, namely 1.7 Mev. The fact that we have found a monochromatic gamma-ray from RdMn of energy 1.65 Mev lends strong support to this view. We hope to extend this work to the study of other elements to see if this relationship holds in general.

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¹ F. Rasetti, Zeits. f. Physik **97**, 64 (1935).

² M. V. Brown and A. C. G. Mitchell, Phys. Rev. **50**, 593 (1936).

Sharp Absorption Lines for Use as a Comparison Spectra in Stellar Photography

For a number of years astronomers have been looking for a better substance than thin layers of Nd solution to use as a reference spectra for measuring Doppler shift in connection with an objective prism. It occurred to the author that Eu salt, theoretically, should be a much better substance than Nd for this purpose. The basic state of Eu⁺⁺⁺ in the solid is a ⁷F₀ and a number of transitions should occur to upper states which have J values of 0 or 1. Such states do not split in the electric field of the crystal and therefore should not be much affected in the fluctuating fields caused by temperature vibration. One would then expect that absorption lines arising from such transitions would be sharp in a glass even at room temperatures.

Eu has now become available in appreciable quantities through the brilliant researches of Dr. H. N. McCoy.¹ He very generously gave the author 20 grams to further research on the absorption spectra of solids.

Photographs were made of the absorption spectra of solid Eu₂(SO₄)₃·8H₂O and of Eu₂O₃ suspended and dis-

TABLE I. Gamma-ray energies from In and Mn.

ELE- MENT	HALF- VALUE cm	QUARTER- VALUE cm	CALIBRA- TION ENERGY Mev	$C_{1/2}$ g/cm ²	$C_{1/4}$ g/cm ²	ENERGY Mev
Th C''	0.110	0.178	2.65	0.0630	0.107	—
Ra	0.070	0.118	1.8	0.0670	0.113	—
Mn	0.059	0.106	—	0.0650	0.110	1.61 1.69 } 1.65
In	0.051	0.091	—	0.0650	0.110	1.28 1.49 } 1.39