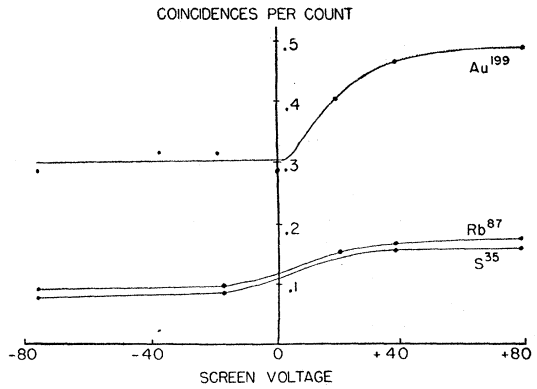

FIG. 2. Coincidence curves for Au^{199}, Rb^{87}, and S^{35}, plotted as a function of screen voltage.

for S^{35} and Rb^{87}, as well as the curve for Au^{199}, all obtained with a total source plus backing thickness of about 0.1 mg/cm². The close agreement of Rb^{87} with S^{35} is apparent. Au^{199}, which emits beta-radiation followed approximately 40 percent of the time by conversion electrons,[12] has a much higher coincidence rate.

On the basis of these results, it seems safe to conclude that the disintegration of Rb^{87} consists of a simple beta-decay.

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* AEC Predoctoral Fellow.

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Transmission of X-Rays through Calcite near the Bragg Angle

GUENTER SCHWARZ AND GEORGE L. ROGOSA
Department of Physics, Florida State University, Tallahassee, Florida
(Received March 17, 1952)

RECENTLY Campbell[1] has reconsidered the problem of the transmission of x-ray radiation through a crystal when set at the Bragg angle. This same problem has also been investigated experimentally by Bragg, Bosanquet, and James[2] and Borrmann.[3,4] When a monochromatic beam of x-rays falls on a thin crystal, as this crystal is rotated through the Bragg angle, part of the incident beam is reflected and part of it is transmitted straight through. Bragg, using a rocksalt crystal, has observed that this transmitted intensity at a wavelength of about 0.5A will decrease at the Bragg angle, whereas Campbell at about 1.5A has measured an increase in this intensity for various crystals.

We have measured the transmitted intensity at the Bragg angle for single crystals of calcite using monochromatic radiation from 0.7A to 2.3A. A double crystal spectrometer served as a monochromator. When working at the wavelength of a strong emission line, sufficient intensity was available to use the (1, +1) position at the peak of the line. When using the continuum from a W target, because of intensity limitation, the (1, −1) position was used to obtain limited monochromatization. The crystal under investigation was mounted on the axis of an Allison-type spectrometer and could be rotated by a synchronous motor drive at an angular speed of 27 sec/min. Crystals with the reflecting planes parallel to the surface using both external and internal reflections were investigated. In some cases crystals were cut with planes perpendicular to the surface. An indication of the perfection of the crystal was obtained from the width of the (1, −1) diffraction pattern which in all cases was a symmetrical curve.[5] The intensity was measured with an argon filled Geiger counter and a General Radio counting rate meter, the output of which was recorded with an Esterline-Angus recording milliameter.

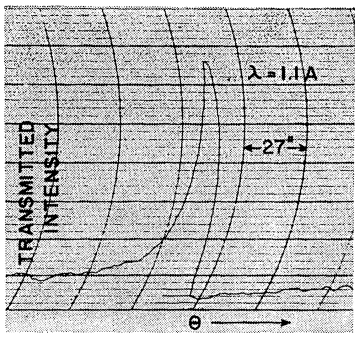

FIG. 1. Transmission curve for a calcite crystal.

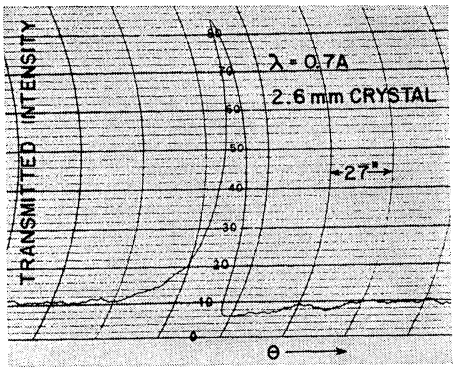

FIG. 2. Transmission curve for a 2.6-mm calcite crystal.

The results of both Bragg and Campbell were confirmed using the peaks of Mo $K\alpha 1$ and Cu $K\alpha 1$. The expected decrease in the transmitted intensity was observed at the short wavelength and the expected increase was observed at the longer wavelength. By using Cr $K\alpha$ radiation a large increase in transmitted intensity at the Bragg angle was also observed. With the spectrometer set to pass radiation of about 1.1A, the transmitted intensity was found to show a dip on the long wavelength side of the Bragg angle and a substantial increase at the Bragg angle as shown in Fig. 1. The absorption on the two sides of the Bragg angle was not the same.

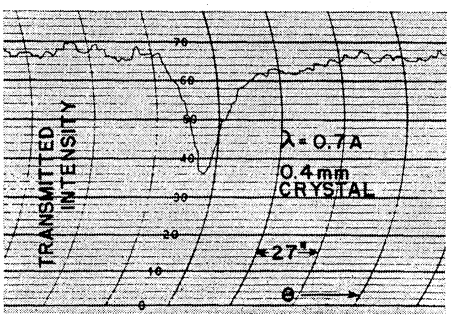

FIG. 3. Transmission curve for a 0.4-mm calcite crystal.

This effect was observed with two different crystals. In the (1, −1) position, for the W continuum at 0.7A, the results depended on the crystal thickness. Figures 2, 3, and 4 show this effect for three

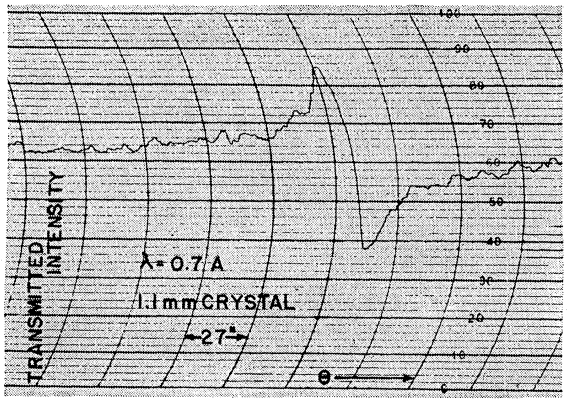

FIG. 4. Transmission curve for a 1.1-mm calcite crystal.

different crystals. Using the internal planes of a cleaved crystal of 2.6-mm thickness, the transmitted intensity showed an increase at the Bragg angle; a thin crystal of 0.4-mm thickness showed a decrease while a 1.1-mm thick crystal showed both a minimum and maximum. Further experiments on the transmitted intensity as a function of wavelength and crystal thickness are in progress.

We wish to express our appreciation to Professor S. K. Allison for the loan of a spectrometer. This work was supported by a grant from the Research Corporation.

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The Gamma-Radiations from V^{48} and Nb^{92}†

HAROLD K. TICHO, DAVID GREEN, AND J. REGINALD RICHARDSON
Department of Physics, University of California, Los Angeles, California
(Received March 10, 1952)

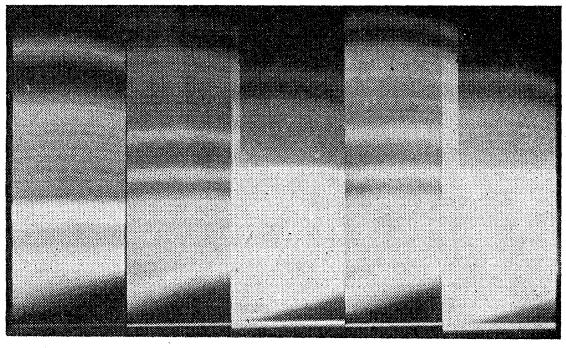
THE disintegration of the isotope V^{48} is followed by the emission of two gamma-rays[1,2] of energy 1.320 Mev and 0.990 Mev in cascade.

A gamma-ray of higher energy has also been reported by Fluharty and Deutsch[3] in 1 percent of the disintegrations. They reported that the energy was between 1.6 Mev and 2.2 Mev. Zobel[4] found a high energy gamma-ray in 3.5 percent of the disintegrations. By observing the absorption of the Compton electrons he concluded that the energy was consistent with the 2.31 Mev to be assigned to a cross-over gamma-ray.

We have observed the gamma-radiation emitted from a V^{48} sample prepared by the p, n reaction from titanium bombarded in the FM cyclotron at UCLA. The observations were made on a NaI spectrometer[5] of the Hofstadter type. The vanadium fraction was chemically separated.[6]

Figure 1 shows the comparison spectra of Na^{22}, V^{48}, and Na^{24}. Microdensitometer traces of these spectra were used to evaluate the high energy V^{48} line in terms of the 1.277-Mev photoline of Na^{22}, the 1.380-Mev photoline of Na^{24}, the 2.76-Mev photoline of Na^{24}, the 1.74-Mev pair line of Na^{24}, and the 1.320-Mev photoline of V^{48}. The result of these comparisons gave a spread of less than 1 percent and may be stated as 2.22±0.02 Mev. This line is therefore clearly not a cross-over line which would involve the sum of the 0.990-Mev and 1.320-Mev energies. A small pair peak corresponding to the 2.22-Mev line was observed between the photoline of the 0.99-Mev and 1.32-Mev radiations.

An estimate of the relative number of the 2.22-Mev and 1.32-Mev quanta was made in the following manner. A series of five exposures were made of the V^{48} of varying length, 15 sec, 30 sec, 1 min, 15 min, 30 min, all on a single film. By comparing the times required for equal darkening of the 2.22- and 1.32-Mev photolines an estimate was made of the relative number of pulses per unit energy interval at the peaks of the lines. This was also done with Na^{24} for the 1.38-Mev and 2.76-Mev photolines. Assuming that the number of quanta in this latter case were equal we then drew a calibration curve for our particular spectrometer. This curve was drawn between the Na^{24} points with the help of the theoretical cross section involved and remembering the dependence of peak width on energy. In this manner we obtain that in the case of V^{48} the number of 2.22-Mev quanta is 3.6 percent of the 1.32-Mev quanta. We consider that the limit of error in this estimate is a factor of two. The chemically separated sample of V^{48} was followed in this way over several half-lives, and it was found that the



(a) (b) (c) (d) (e)

FIG. 1. Comparison gamma-ray spectra: (a) Na^{22}, (b) Na^{24}, (c) V^{48}, (d) Na^{24}, (e) V^{48}. The gain for (a) Na^{22} was increased by a factor of 1.96 relative to the others.

ratio of 2.22-Mev to 1.32-Mev quanta remained constant within the experimental uncertainty.

An unsuccessful search was made for a possible 90-kev gamma-ray which might be in cascade with the 2.22-Mev line. However, the fact that we did not find this radiation may not be significant in view of the possible masking by the large amount of annihilation radiation present. The upper limit to the number of cross-over gamma-rays of 2.31 Mev can be set from our measurements at 0.5 percent of the number of 1.32-Mev quanta.

Nb^{93} was bombarded by 20-Mev protons. Chemical separation was performed.[6] The spectrum indicated the presence of two lines, one very intense line with an energy of 0.933±0.009 Mev and one weak line of energy 1.84±0.02 Mev. Relative intensity measurements as a function of time indicated that although the decay of the 0.93-Mev line was consistent with the 10-day half-life of Nb^{92}, the 1.84-Mev line corresponded to a much longer half-life. Bombardments at varying proton energies indicated that the 1.84-Mev line should probably be assigned to the 42-day isomer of Nb^{93} produced by $Nb^{93}(p, p)Nb^{93*}$. The energy of the 0.93-Mev line agrees well with other measurements.[7,8]

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