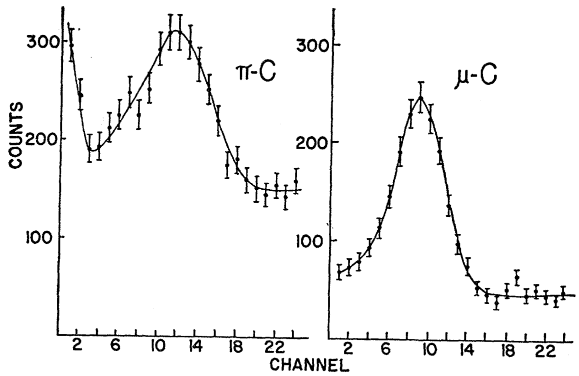

FIG. 2. Typical pulse-height distribution curves of x-rays from the $2p$ to $1s$ transition in C. The first curve corresponds to 400 000 stopped π mesons and the second to 50 000 stopped μ mesons.

whenever they are in coincidence (10^{-7} sec) with the output of the meson telescope.

Meson x-rays from the K, L, and M series have been observed. Typical examples of the curves obtained are shown in Figs. 2 and 3. The width of the peaks is mainly instrumental. Part of this width is due to the statistical fluctuations in the NaI phototube, which are considerable at low energies, and part to the effects of the high singles counting rate. The positions of the peaks agree within our present errors of 10–15 percent with the energies computed in an elementary way.

For the measurements of relative intensities the targets used had the same surface density and linear thickness. After subtracting the background estimated visually from the shape of the curves (this procedure introduces one of the largest errors in the measurement) the counts of all channels within each peak were added together, and then divided by the number of counts in the meson telescope. The relative intensities thus obtained were corrected for (1) absorption of the x-rays in the target and intervening material, (2) chemical effects, (3) NaI detection efficiency, (4) detection efficiency of coincidence circuits. Adequate tests proved that (4) was practically 100 percent down to 25 kev. When compounds were used (N_2H_4 for N, H_2O for O, LiF for F, and LiCl for Cl) it was assumed that each atom, except H, captured in proportion to Z. The intensities from C and CH_2 were found to be the same within 10 percent.

The results for π x-rays are shown in Fig. 4. The small intensity at low Z is believed to be due to competition with the Auger effect. However, if this is the sole contribution to the decreased intensity, our data agree with the approximate estimates of Fermi and Teller[3] but disagree with the calculations of Burbidge and deBorde.[4] The decrease for high Z is due to nuclear capture from mesonic orbits of total quantum number 2 ($2p$ state) for the K lines, and 3 (presumably $3d$ state) for the L lines. Work is in progress to study the behavior of the M lines.

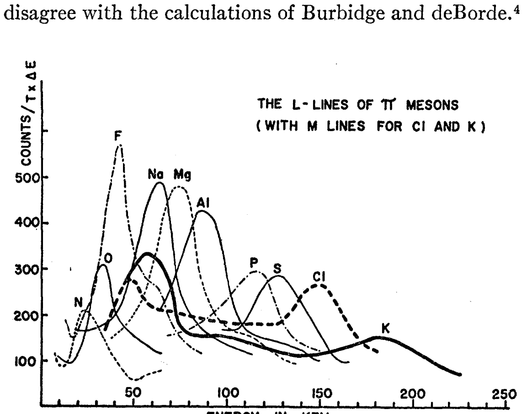

FIG. 3. Pulse-height distribution curves for $\pi-L$ radiation. All curves reduced to the same scale by dividing each reading by telescope counts and by pulse-height-selector channel width. The points have been omitted for clarity. $\pi-M$ radiation appears in Cl and K curves.

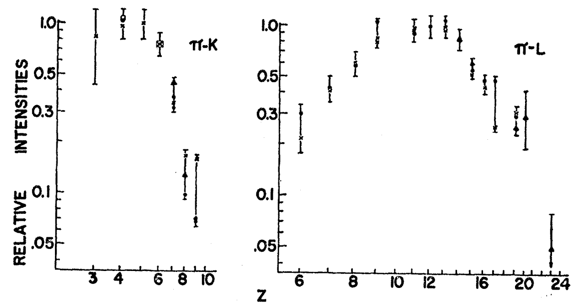

FIG. 4. Z dependence of relative intensities of K and L radiation from π mesons. Each symbol represents a different run. The intensities of B and Mg were arbitrarily set equal to unity in the K and L plots, respectively. The intensity of Li $-K$ line is uncertain because of large corrections due to low energy.

The μ x-rays behave similarly except that the "Auger effect" is more important at a given Z, and that nuclear capture is not observed.

Work is in progress for the determination of the absolute intensities and for a more careful study of the energies.

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Decay of V^{52}

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THE irradiation of normal V with thermal neutrons has been reported to produce three activities[1] which have been assigned to V^{52}. These activities were found to decay with half-lives of 2.6 min, 3.75 min, and 16 hr. Recent work has been reported[2] on the 16-hr activity and an energy level scheme proposed which includes all three activities.

The present study of V^{52} was made using 180° magnetic photographic spectrometers and a 10-channel coincidence scintillation

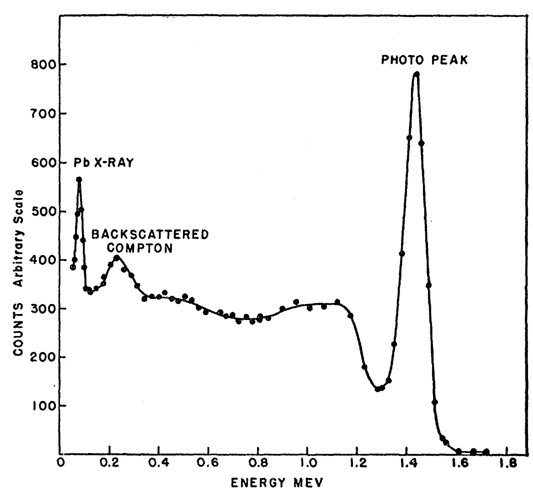

FIG. 1. Gamma-ray pulse-height distribution resulting from V^{52} (3.7 min).

spectrometer. Sources were obtained by neutron irradiation of V_2O_5 in the Argonne heavy water reactor.

Irradiations of about 5 minutes produce a strong 3.75-min activity in V. The conversion electron spectrum of such samples was examined in the region of 10 kev to 2 Mev, and no electron lines were detected. The scintillation spectrometer was used to study the unconverted photons, and the resulting spectrum is shown in Fig. 1. It is clear that there is only one gamma ray present to any appreciable extent in this activity. Its energy is 1.44 ± 0.02 Mev, and its half-life is 3.75 min. The β rays were studied by absorption in Al, and it was found that a β ray whose maximum energy is about 2.6 Mev is in coincidence with the 1.44-Mev gamma ray. The coincidence Al absorption curve did not differ from the singles absorption curve, so that it is concluded that most, if not all, of the beta rays feed the 1.44-Mev level in Cr^{52}.

An attempt was made to detect the 2.6-min activity reported by Renard. Sources were irradiated for periods of 1, 3, and 10 minutes and their decay followed with an ionization chamber and a vibrating reed electrometer. The decay curves were all simple, with a half-life of about 3.7 min. Other investigators[3] also find no evidence for the metastable state in V^{52} reported by Renard. The assignment of a 2.6-min activity to V is thus considered to be doubtful.

A weak activity with a half-life of about 15 hr was found in V samples irradiated for about 15 hr. The scintillation spectrum of this activity, however, corresponds to the spectrum obtained from the 15-hr Na^{24}. A spectroscopic analysis of the V_2O_5 established that Na was an impurity with 0.05 percent abundance. In order to determine if any of the activity was due to V, the Na was chemically separated from the V after irradiation. Both the Na and the V fractions were then counted with the scintillation spectrometer. It was found that the activity of the Na fraction was more than 100 times that of the V fraction, and that the V fraction was only two times the background.

The results of this study indicate that V^{52} decays with a 3.75-min half-life by the emission of a single beta ray of energy 2.6 Mev followed by a gamma ray of energy 1.44 Mev. Neither the 2.6-min nor the 16-hr activity previously reported in V^{52} was found.

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Beta-Ray Spectrum of Mg^{28}†

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THE nuclide Mg^{28} has been recently reported by Lindner[1] and Sheline.[2] Sheline also proposed a decay scheme,[3] and Marquez[4] reported the beta-ray spectrum of Mg^{28} to have an allowed shape, a maximum energy of 418 ± 10 kev, and a logft of 4.25.

As an outgrowth of the work of Lindner, it was possible to study the beta-ray spectrum of Mg^{28} in this laboratory. The beta-ray energy obtained from these measurements differs from the value of Marquez.[4]

A sample of sodium chloride weighing about five grams was wrapped in aluminum foil and bombarded in the Berkeley 184-inch cyclotron with 340-Mev protons. The Mg^{28} was isolated in a carrier-free state and about 10^6 disintegrations per minute were mounted on a thin zapon film for the beta-ray spectrum determinations.

Using a ring-focused, long magnetic lens beta-ray spectrometer,[5] an examination of the electron spectrum was made in the energy range 100 to 3500 kev. A Fermi plot of the data shows two transitions, as may be seen in Fig. 1.

The high-energy component is from Al^{28} whose beta decay has been reported by Motz[6] to have an allowed shape and a maximum energy of 2865 ± 10 kev. He also set a limit of less than two percent for the high-energy beta-ray transition to the ground state.

In the present work the high-energy component from Al^{28} had an allowed shape beyond the Mg^{28} activity, and a least-squares fit of the Fermi plot gave an end point of 2878 ± 14 kev, which within our error is in agreement with the reported values. Also an upper limit of less than 0.8 percent can be set for the high-energy beta-ray transition to the ground state.

The lower-energy component from Mg^{28} was then resolved from the Al^{28} transition by subtracting from the observed activity the

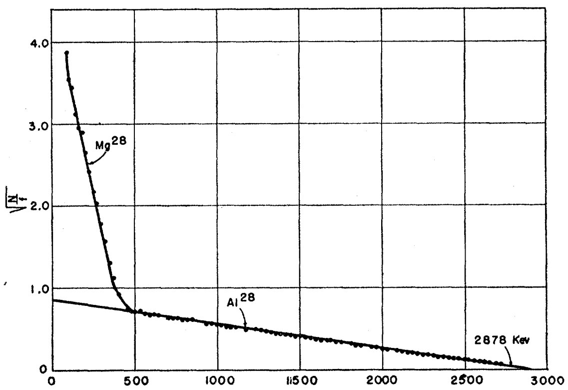

FIG. 1. Fermi analysis of the $Mg^{28}-Al^{28}$ beta-ray spectra.

extrapolated activity of the Al^{28} for a given momentum. The resulting Mg^{28} Fermi plot shows an allowed shape from 100 kev to the end point. By using a least-squares fit, a maximum energy of 459 ± 2 kev was obtained. From the graphs given by Moszkowski[7] the logft value is determined as 4.45.

A check on the Fermi analysis of the low-energy data was made using a carrier-free sample of Cs^{137}, mounted in the same way as the $Mg^{28}-Al^{28}$ mixture. The Cs^{137} Fermi plot, corrected for the forbidden factor a, extrapolated to an energy of 523 ± 2 kev, in excellent agreement with the published values.[8] Figure 2 shows the

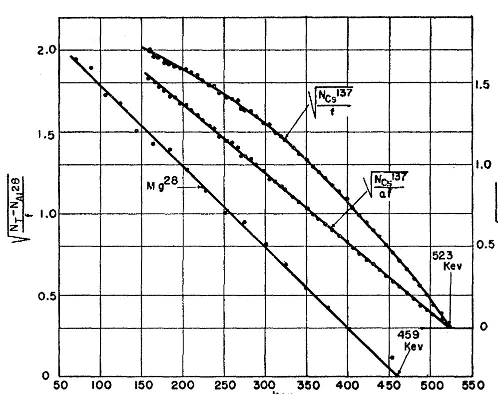

FIG. 2. Resolved Mg^{28} Fermi plot, with Cs^{137} data for comparison.

Mg^{28} data resolved from the Al^{28} spectrum, with the Cs^{137} plot on the same energy axis.

These observations, which agree with the Al^{28} energy, and give a nine percent increase over the Mg^{28} energy previously reported, were reproduced on four spectrometer runs using two separate Mg^{28} samples.