Seeing that the values of the md's themselves are of a higher order than their differences, the precision of the conclusions drawn from the differences is reliable.

If we interpolate on the curve ΔE_{4n} we get for the 16 isobars the value: 9.4 ± 0.6 mMU. (The possible mean error was estimated from the graph.)

Subtracting this from the md of $O_8^{16}=136.61\pm0.2$ mMU, we get 127.2 ± 0.7 for the md, and finally 16.0102 ± 0.0007 MU for the mass of N_7^{16}.

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Energy of Beta-Rays from K^{40}

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A NEW enriched sample of K^{40} prepared by the Electromagnetic Division of the Carbide and Carbon Chemical Corporation, Oak Ridge, Tennessee,[1] has been examined to redetermine the maximum β-ray energy, previously reported as $E_m=1.9\pm0.2$ Mev.[2] The new sample is enriched about 100-fold in K^{40} and has the following analysis: K^{39} 76.6 ± 0.5 percent, K^{40} 1.31 ± 0.05 percent, K^{41} 22.1 ± 0.5 percent. 233 mg of KCl were mounted on thin aluminum (7 mg/cm²) using a sample thickness of 33 mg/cm². The same counting geometry previously described[2] was used. Figure 1 shows the absorption curve, the upper data give the measured counting rates, the lower, less counter background. Examination of the original data shows the end point to be between 625 and 700 mg/cm² corresponding to a maximum energy $E_m=1.45\pm0.15$ Mev.

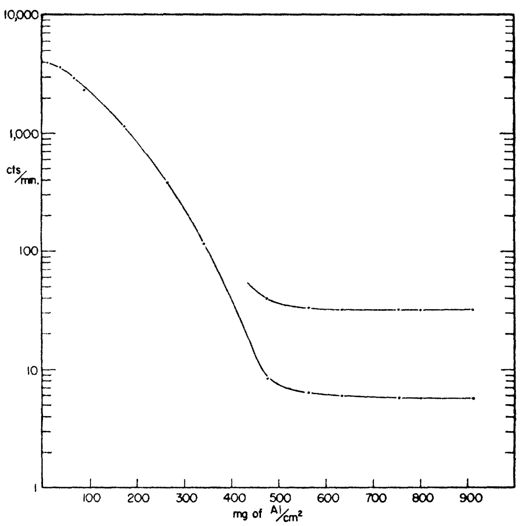

FIG. 1. Counting rates for different absorber thicknesses. Upper curve, measured counting rates; lower, rates with background counts subtracted.

The sample previously investigated is being reinvestigated to determine the basis of the earlier value.

A penetrating γ-ray component (5.7 counts/min.) is observed. In the geometry used the ratio of γ-counts to β-counts is $I_\gamma/I_\beta=0.0014$. Using a thin sample of Na^{24} in the same geometry $I_\gamma/I_\beta=0.046$. Since Na^{24} is known to have one 1.38-Mev and one 2.76-Mev γ-ray for each β-ray,[3] about 60 percent of the disintegration rate is due to the 1.38-Mev component $I_{1.38}/I_\beta=0.028$. The ratio of these values gives an approximate ratio of disintegration constants for γ- and β-emission in K^{40}. The value so obtained is $\lambda_\gamma/\lambda_\beta=0.05\pm0.01$.

A new determination of the β-ray disintegration constant was made using a thin sample (6 mg/cm²) of KCl weighing 19.7 mg. The counting rate at 21 percent geometry corrected to zero absorber was 350 counts/min. The disintegration constant for β-decay is therefore $\lambda_\beta=4.3\pm0.4\times10^{-10}$ yr.$^{-1}$. The disintegration constant for γ-ray emission is correspondingly $\lambda_\gamma=0.21\pm0.05\times10^{-10}$ yr.$^{-1}$.

* Research work carried out under auspices of the AEC.
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Exchange Moments of H^3 and He^3

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IT has been shown that the assumption of an interaction between nucleons which involves a space exchange operator implies the existence of exchange currents which may give a non-vanishing contribution to the magnetic moment of a nucleus.[1] In the expression for the exchange moment of the H^3 nucleus, obtained when using a Gauss potential and Gauss wave function, the major contribution to the exchange moment is proportional to the strength of the tensor interaction and to the amplitude of the ^4D part of the wave function. Since the value of the H^3 exchange moment was found to be much smaller than the H^3 moment anomaly,[2] it was concluded that this exchange moment is inadequate to account for the anomaly.

Recent work[3] on interactions with the Yukawa radial dependence has had the result that a relatively large amount of tensor interaction is required to fit the low energy deuteron data, particularly if the tensor and central ranges are taken to be the same. A stronger tensor interaction would be expected to favor a correspondingly larger exchange moment, so it seemed worth while to reinvestigate the magnitude of the exchange moment using Yukawa potentials. Several interactions were considered:[4] they were similar in that they all had "symmetrical" exchange properties and range of ordinary forces equal to the Breit range ($M\sim326m_e$); they differed in the strength and range of the tensor force.

The wave function used was the simple mixture of ^2S and ^4D used by Gerjuoy and Schwinger.[5] Since particularly accurate wave functions did not seem necessary, simple Gauss radial functions were considered in the beginning. A variational calculation to minimize the energy showed the Gauss radial functions to be completely unsatisfactory, inasmuch as no binding was obtained even on the assumption of an all central interaction;[6] consequently, the radial dependence $\exp\{-a(r_{12}+r_{23}+r_{31})\}$ was adopted. With this radial dependence one easily finds 200 percent binding of H^3 on the assumption of all central forces.[7]

When the interactions involving a tensor force are introduced into the variational calculation, no binding is obtained unless the tensor range is taken to be longer than that of the central forces.[8] As a consequence the interaction finally adopted[9] had a tensor range appreciably longer ($M\sim245m_e$) than the Breit range. The minimum of energy (60 percent of the experimental binding energy) was found for a choice of the parameters:

$$a_S=2.70/r_0,\quad a_D=5.22/r_0,\quad D^2=2.6 \text{ percent},$$

where D^2 is the ^4D probability and r_0 is e^2/m_ec^2.

The calculated exchange moment of H^3 was 0.016 n.m., to be compared with 0.035 n.m. obtained with the Gauss potential.[1] This reduction comes about directly as a consequence of the long range of the tensor interaction. With a long tensor range a weaker tensor force suffices to give account of the deuteron quadrupole moment, and with a weaker tensor force the ^4D probability in H^3 is reduced. The exchange moment, which is proportional to both the ^4D amplitude and the strength of the tensor forces, is thus doubly reduced. Since it seems unlikely that an interaction which involves very strong tensor forces will give enough binding for H^3, we can probably conclude that this exchange moment will not make a major contribution to the H^3 moment anomaly.

Parallel calculations with inclusion of the Coulomb energy were made for He^3 in order to estimate the effects of the small difference between the H^3 and He^3 wave functions on the sums of the ordinary and exchange moments;[1,10] these effects are completely negligible.

This problem was suggested by Professor R. G. Sachs, who gave us much helpful advice; we were materially aided by information supplied us by Professor Herman Feshbach.

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** AEC Predoctoral fellow.

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Radioactivity of K^{40}*

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A DETERMINATION of the beta-radioactivity of K^{40} has been made by an internal calibration of KCl sources with standardized amounts of Na^{24}. If the near identity of the absorption curves of the spectra of Na^{24} and K^{40} reported by Hirzel and Wäffler[1] is assumed, the method of internal calibration of the potassium source eliminates the need of corrections for differences in self-absorption, geometry, back-scattering, and intrinsic counter efficiency for the two activities. Fortunately, the short half-life of Na^{24} (14.8 hours) makes the method experimentally practical, for the sodium can be "removed" after it has been used for calibration by simply allowing it to decay.

A Co^{60} standard prepared by the National Bureau of Standards was used to calibrate an approximately equal activity of impurity-free Na^{24} on both a platinum and copper cathode gamma-counter. The ratio of the efficiency of the platinum counter for the detection of the gamma-rays of Co^{60} to its efficiency for the detection of the gamma-rays of Na^{24} was taken as 0.664, and the corresponding ratio for the copper counter as 0.584. These values are from coincidence measurements by Peacock.[2] Small corrections of the order of 2 percent were made in each case for the difference in absorption of the gamma-rays from the two activities in traversing quarter-inch aluminum and sixteenth-inch lead shields surrounding the counters. The statistical error in counting and the uncertainty in the assumed efficiency ratios amounted to about 4 percent in each case, while the value of Na^{24} activity measured on the copper counter agreed with that measured on the platinum to within 3 percent. A small aliquot of the Na^{24} solution, measured by pipetting and checked gravimetrically, was added to about 4 grams of KCl in solution. The mixture was brought to dryness in a nickle crucible and ground to insure homogenous distribution of the sodium activity throughout the KCl.

Eighth-inch thick aluminum slides with the active material held in circular depressions of $\frac{3}{32}''$ depth and 5.7 square centimeters area served as source holders. The slides were held rigidly in a channel provided in the counter support, with the KCl directly beneath the 10-micron mica window of a bell-shaped beta-counter. Reproducibility of geometry and constancy of the counter efficiency were checked regularly with a thick standard source of potassium chloride. The slides were counted periodically from the original measurement, when the beta-activity of the sodium was about thirty times that of the K^{40}, until all but a negligible amount of the sodium had decayed—a total of seven measurements for each source. During the first two counting periods, an experimentally determined correction of about 3 percent was made for the effect of the Na^{24} gamma-rays, this correction being applied to all later measurements. The seven resulting counting rates for each slide gave points on the decay curve of Na^{24}, with the activity of the K^{40} present as a constant background.

From these data a best value for the counting rates of the potassium and the sodium at some initial time was calculated for each of the sources. Over the range of source thicknesses used, the ratio of the counting rates, and therefore the ratio of the net efficiencies of the counter for the two spectra, was independent of source thickness to within the statistical error of 2 percent. (See Table I.)

TABLE I. Ratio of counting rates for various thicknesses of sources.

Source thickness in milligrams/cm²	Na^{24} betas/K^{40} betas
43	32.2
63	33.2
74	32.8
79	32.9
97	33.0

If the absorption curves of the two spectra are identical, then their net counting efficiencies may be taken as equal. The ratio of the known activity of the sodium in each source to the activity of the potassium is then equal to the ratio of the counting rates of the two. An average of the data from the five sources gives the specific activity of potassium as 30.6 ± 2.0 betas/second/gram of ordinary potassium.

I should like to express my appreciation to Professor M. Deutsch for suggesting the method employed and to Dr. R. K. Osborne for his constant advice during the course of this research.

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The Beta-Ray Spectra of Cu^{64} and the Ratio of $N+/N-$

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IN a previous Letter to the Editor[1] reporting the investigations on the negatron and positron spectra of Cu^{64}, we pointed out that a gradual but consistent reduction of deviation *versus* the source thickness at low energy region has been observed and with the thinnest ($\sim$0.1 mg/cm²) and most uniform source prepared, the deviation was found to be much less than previously reported in other laboratories.[2–4] Since the theoretical interpretation of the experimental results involves the Coulomb correction factor which is particularly sensitive for positrons in the low energy region, the screening and relativistic corrections calculated by Longmire and Brown[5]