quence 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.

* Work supported by Wisconsin Alumni Research Foundation.
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Radioactivity of K^{40}*

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February 7, 1949

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.

* Supported in part by the joint program of the ONR and the AEC.
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The Beta-Ray Spectra of Cu^{64} and the Ratio of $N+/N-$

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February 14, 1949

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]

were used. In carrying out the calculations, they had overlooked one factor which is of importance to this comparison. When this is considered, their results are in good agreement with the corrections calculated by M. E. Rose[6] for negatrons which are indeed negligible. However, the corrections for positrons turn out to be considerably larger than those for negatrons. These small corrections do not account for all the deviations observed in the low energy region where the true distribution of electrons is susceptible to distortion due to the finite source thickness and backing. Nevertheless these corrections improve the over-all agreements. In Fig. 1, we have re-

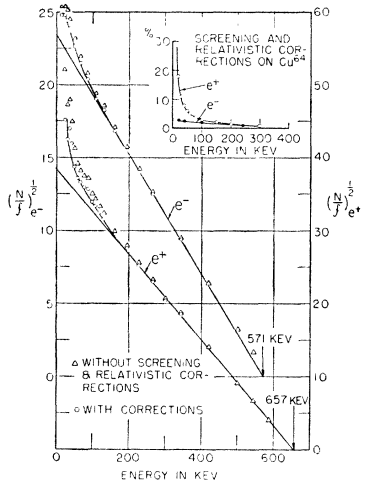

FIG. 1. Kurie plots of Cu^{64} negatron and positron spectra.

plotted the Kurie plots of Cu^{64} negatron and positron spectra. In the upper right corner of Fig. 1 is an insert of the revised screening and relativistic corrections for Cu^{64}. With these corrections, the negatron curve now starts to deviate from the straight line in the Kurie plot around 130 kev, and the positron curve begins to deviate around 140 kev. Even at 50 kev the deviation from the Kurie plot for negatrons is less than 6 percent, for positrons not more than 8 percent. In Fig. 2, the

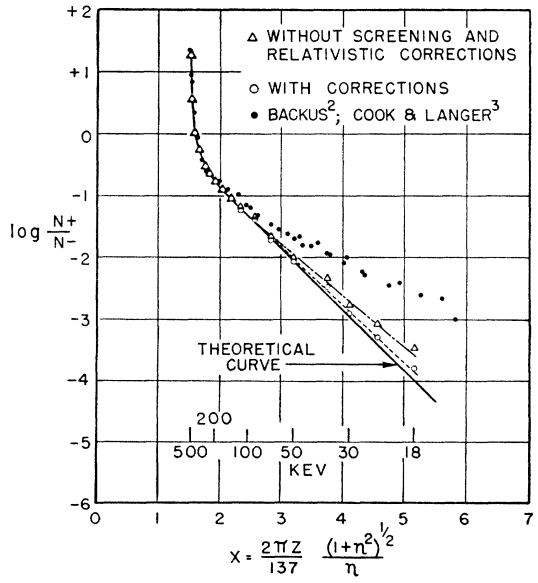

FIG. 2. The ratio of the number of positrons to the number of negatrons as a function of energy.

logarithm of the ratio of the positrons to negatrons is plotted against x. The theoretical curve is drawn according to the approximation formula where $Z_{Ni}=Z_{Zn}=Z_{Cu}$. If the exact equation is used, the theoretical curve will be rotated upward approximately one degree in Fig. 2. This figure illustrates that even without screening and relativistic corrections, the experimental value of the ratio of positrons to negatrons is less than twice the theoretical value at 18 kev. However, when the corrections are applied, the agreement between the experimental and theoretical values is excellent. The dotted curve in Fig. 2 shows the data of Backus[2] and Cook and Langer[3] adjusted to our data in the high energy region.

If there is distortion due to elastic backscattering or change of detector efficiency with energy, this should affect the electron and positron curves equally, and thus the ratio $N+/N-$ should remain unaffected. On the other hand, the inelastic scattering effects must be small here. Otherwise, they would tend to affect the positrons more than the electrons at low energies due to the sharper low energy "cut-off" of the positron momentum distribution curve and, thus, increase the $N+/N-$ ratio at low energies.

The good agreement between the theoretical and experimental curves in Fig. 2 indicates that the Fermi theory probably does approximate the true distributions for negatrons and positrons at low energies. In any event, any remaining true deviations must be much smaller than has been previously suggested.[2,3]

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The Fundamental Band of Carbon Monoxide at 4.7μ in the Solar Spectrum*

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February 17, 1949

DURING 1948 high dispersion spectrograms of the sun were obtained in Columbus, Ohio using a prism-grating infra-red spectrograph designed by Dr. R. Noble under the direction of Professor H. H. Nielsen (instrument of the Pfund type, focal length of the parabolic mirrors: 100 cm, aperture: f/5). The installation was equipped with a rapid response Perkin-Elmer thermopile, an electronic amplifier of the same firm, and a Brown recorder. In particular, the region extending from 2250 cm^{-1} (4.44μ) to 1990 cm^{-1} (5.02μ) was mapped with an echelette grating ruled with 7200 lines per inch. Spectral lines 0.5 cm^{-1} apart are clearly separated.

The new solar spectrograms have been compared with measurements published in 1947 on the fundamental bands of $C^{12}O^{16}$ and $C^{13}O^{16}$ situated in the 4.7μ region.[1] In this publication the wave numbers of 51 rotational lines are given for the fundamental band of $C^{12}O^{16}$. It is stated that the positions of the lines are reliable to about ± 0.07 cm^{-1}.

In the solar spectrum part of the CO band (from R_{15} to R_{28}) falls in a region of stong absorption due to the 4.5μ band of N_2O^2 and to the 4.3μ band of CO_2. Of the 38 remaining lines, twenty correspond within ± 0.10 cm^{-1} to sharp lines observed in the solar spectrum while the eighteen others are masked by stronger lines or may be found in the wings of such lines. The distribution of intensities also corresponds to that observed in the laboratory. Hence, it may be stated that the fundamental band of $C^{12}O^{16}$ is present on the observed solar spectrograms. Because of the complexity of these spectrograms it has not been possible to decide with certainty about the identification of the fundamental band due to $C^{13}O^{16}$.