illustrated by helium p_2n_2 *whose cosmic abundance, according to the latest estimate, is 120 times greater than that of* ***all*** *of the other elements*, excluding hydrogen, which has a simple nucleus. This shell of 2 neutrons or of 2 protons has not received the attention which it merits.

For a discussion of closed shells with 20, 50, 82 neutrons or protons, or 126 neutrons, a paper by Maria Mayer may be consulted.[2]

[1] W. D. Harkins and M. Popelka, Jr., Phys. Rev. **76**, 989 (1949).
[2] M. G. Mayer, Phys. Rev. **74**, 235 (1948).

The Ratio of L_I to K Capture*

M. E. Rose and J. L. Jackson**
Oak Ridge National Laboratory, Oak Ridge, Tennessee
September 29, 1949

THE phenomenon of orbital electron capture from the L_I shell was observed recently by Pontecorvo, Kirkwood, and Hanna[1] in A^{37}. The experimental value of the ratio of probabilities for L_I to K capture was reported to be between 8 and 9 percent. As was mentioned in reference 1 a computed ratio of only 6 percent is obtained using relativistic wave functions with Slater screening constants.[2]

It is possible to use a much better representation of the screening and we have calculated the L_I to K capture ratio using (1) relativistic wave functions computed on the Eniac by J. Reitz[3] with a potential function obtained from a Thomas-Fermi field with exchange and (2) self-consistent field wave functions.[4] In the case of the relativistic wave functions the small screening for the 1*s* wave function was not considered and an extrapolation had to be carried out since the 2*s* wave functions are available for $Z=29$, 49, 84 and 92 only. Since the ratio is not very sensitive with Z (see Fig. 1), this extrapolation seems safe enough. The Hartree wave functions used for A included the effect of exchange and the neglect of non-relativistic effects makes a rather trivial error in the case of A. The results are:

	L/K ratio
(1) relativistic wave functions	8.2 percent
(2) Hartree wave functions	8.1 percent

and the agreement with the observed value is all that could be desired.

The L/K ratio for other values of Z may be obtained from Fig. 1, curve (1) for medium and heavy atoms and curve (2) for light atoms. In Fig. 1 the square of the ratio of the 2*s* to 1*s* wave functions at the nuclear radius is shown. The L/K capture ratio is obtained by multiplying by the square of the ratio of neutrino energies in the two cases,[2] but in almost every case this latter ratio should be very close to unity.

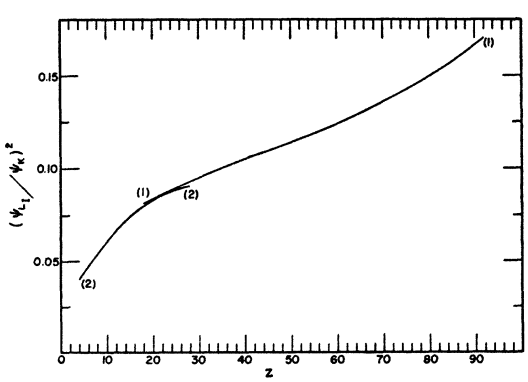

FIG. 1. Ratio of electron densities for L_I and K shell at nuclear radius *versus* Z: Curve (1): relativistic wave functions with Thomas-Fermi field plus exchange. Curve (2): Hartree self-consistent field wave functions. To obtain ratio of L_I to K capture multiply by square of ratio of neutrino energies in the two cases, $(E_{L_I}/E_K)^2$.

* This document is based on work performed under Contract No. W-7405, eng 26 for the AEC at the Oak Ridge National Laboratory.
** Present address, New York University.

[1] Pontecorvo, Kirkwood, and Hanna, Phys. Rev. **75**, 982 (1949).
[2] R. E. Marshak, Phys. Rev. **61**, 431 (1942).
[3] The authors are indebted to Dr. Reitz for a pre-publication copy of these wave function tables.
[4] Complete references are to be found in D. R. Hartree, Reports on Progress in Physics, XI (1946–47).

The Disintegration Scheme of Tm^{170}

J. S. Fraser
Radiation Laboratory, McGill University, Montreal, Quebec, Canada
September 27, 1949

NEW evidence for the complexity of the beta-ray spectrum of 127-day Tm^{170} has been obtained by the use of a thin lens spectrometer supplemented by β-γ-coincidence measurements. The beta-ray spectrum has been shown to consist of two components; one with a maximum energy of (970 ± 5) kev as reported previously, and a second with an endpoint of (886 ± 5) kev comprising approximately 10 percent of the transitions. The single weak gamma-ray,[1–4] largely internally converted, has been found to have an energy of (83.9 ± 0.2) kev.

The source was prepared from "Specpure" Tm_2O_3 irradiated in the Chalk River pile to give a specific activity of 5 mc/mg. The source thickness was estimated to be 0.25 mg/cm² and it was mounted on a 0.03 mg/cm² Nylon film rendered conducting by a layer of evaporated aluminum (0.02 mg/cm²). The counter window was made up of Nylon films to a thickness of 0.055 mg/cm² and passed electrons of energy greater than 7 kev. Good statistics were obtained and the high energy end of the spectrum was studied carefully. The Kurie plot of the beta-spectrum using the relativistic coulomb correction factor is shown in Fig. 1. If the assumption is made that the higher energy group is of the allowed shape, then the discontinuity in the Kurie plot is indicative of a weak beta-ray group of lower maximum energy. Subtraction of the main group from the total yields a reasonably straight line which when extrapolated to the energy axis gives an end point of (900 ± 20) kev (curve C, Fig. 1). The rise of the curve

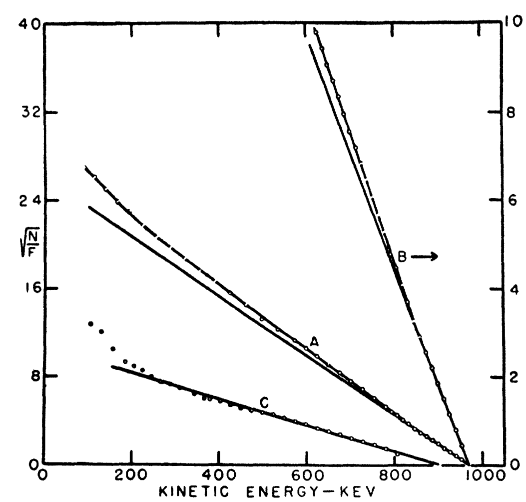

FIG. 1. Kurie plot of the Tm^{170} beta-spectrum. Curve A is the curve of the experimental points, curve B is the high energy end plotted with an expanded ordinate scale, and curve C is obtained by subtracting the main group.