TABLE I. Isotope splittings in erbium, in wave-number units. $\Delta\nu_{\text{mean}}$ are the mean values of measurements using four different spacer sizes. The upper numbers are $\nu_{168}-\nu_{170}$ and the lower numbers are $\nu_{166}-\nu_{168}$. R gives the ratio of the splittings.

λ, A	$\Delta\nu_{\text{mean}}$	R	λ, A	$\Delta\nu_{\text{mean}}$	R
4729	0.046_6 0.046_6	1.00	4496	0.044_2 0.046_3	0.96
4722	-0.050_6 -0.051_3	0.99	4426	-0.047_2 -0.050_0	0.94
4673	-0.049_5 -0.046_9	1.06	4424	-0.043_8 -0.040_4	1.08
4606	-0.045_6 -0.045_6	1.00	4409	-0.045_1 -0.046_2	0.98
4552	0.045_8 0.047_6	0.96	4331	-0.053_0 -0.052_0	1.02
4531	0.047_5 0.044_6	1.07			

s-electrons. For instance, the usual change of a *p*-electron to an *s*-electron would give a positive shift. No analysis is available for erbium, but the isotope structure may give useful clues. The hollow cathode source usually enhances the ionized spectra, and since the shifts are of the magnitude to be expected from the second spectrum, it is presumed that the lines showing the shifts are caused by Er II. The positive isotope shifts probably arise from the electronic transitions $4f^{12}6p$ to $4f^{12}6s$ and $4f^{11}6s6p$ to $4f^{11}6s^2$, and the negative shifts probably arise from the two-electron transition $4f^{11}6s6p$ to $4f^{11}5d^2$. The configurations $4f^{12}6s$ and $4f^{11}6s6p$ should give similar splittings; the configuration $4f^{11}6s^2$ would give splittings twice as great if it were not that the mutual screening of the 6*s*-electrons tends to reduce the effect.

The work is being continued, lines are being measured in other regions of the spectrum, and the complete results will be reported later.

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Threshold Values of Internal Conversion Coefficients for the *K*-Shell

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RECENT computations of the internal conversion coefficients for the *K*-shell have been reported for various Z and for k (γ-ray energy) greater than 0.3–0.5 electron masses.[1] The extrapolation of these results to lower energies is uncertain for two reasons: first, the mathematical formulation of the problem is of such complexity that no simple extrapolation rule can be used; second, the numbers are computed for unscreened wave functions.

In an attempt to resolve the mathematical difficulties, computations have been made on the threshold values of the conversion coefficients. These computations were performed by taking the limiting values of the formulas of reference 1, as p, the electron momentum, approaches zero positively. Under these conditions many simplifications arise, and it is possible to compute the results on a desk machine.

TABLE I. Threshold values of internal conversion coefficients for the *K*-shell.

Z	α_1	α_2	α_3	α_4	α_5
10	7.329(3)	8.184(5)	4.281(7)	1.340(9)	2.867(10)
20	4.510(2)	1.251(4)	1.596(5)	1.232(6)	6.459(6)
30	8.720(1)	1.030(3)	6.060(3)	1.922(4)	4.338(4)
40	2.403(1)	1.606(2)	5.600(2)	9.300(2)	1.123(3)
50	1.085(1)	3.741(1)	8.317(1)	8.112(1)	5.926(1)
60	5.190(0)	1.081(1)	1.623(1)	1.035(1)	4.834(0)
70	2.713(0)	3.604(0)	3.721(0)	1.598(0)	5.479(−1)
80	1.636(0)	1.334(0)	9.516(−1)	3.152(−1)	8.995(−2)
88	9.989(−1)	6.622(−1)	3.551(−1)	1.094(−1)	2.977(−2)
96	6.691(−1)	3.661(−1)	1.848(−1)	4.991(−2)	8.452(−3)
Z	β_1	β_2	β_3	β_4	β_5
10	4.222(2)	2.219(5)	3.472(7)	2.587(9)	1.124(11)
20	1.087(2)	1.415(4)	5.471(5)	9.874(6)	1.084(8)
30	5.075(1)	2.893(3)	4.867(4)	3.919(5)	1.841(6)
40	3.072(1)	8.942(2)	8.830(3)	3.892(4)	1.003(5)
50	2.123(1)	3.881(2)	2.374(3)	6.466(3)	1.032(4)
60	1.737(1)	2.033(2)	8.215(2)	1.484(3)	1.626(3)
70	1.548(1)	1.225(2)	3.393(2)	4.257(2)	3.158(2)
80	1.528(1)	8.304(1)	1.605(2)	1.436(2)	7.637(1)
88	1.764(1)	6.582(1)	9.549(1)	6.576(1)	2.714(1)
96	2.313(1)	5.608(1)	6.060(1)	3.394(1)	1.034(1)

The results are given in Table I. The notation is that of reference 1. Since screening has been ignored, the threshold energies for which these results were computed were those obtained from the relativistic single-electron model, given by $k=1-(1-[\alpha Z]^2)^{\frac{1}{2}}$. Figures in parentheses indicate the power of 10 by which the number must be multiplied.

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Primary Specific Ionization of Cosmic Rays in Hydrogen*

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MANY attempts have been made to test the dependence of primary specific ionization upon momentum for high energy particles. Such measurements have been made by Kunze,[1] Corson and Brode,[2] J. G. Wilson,[3] Sen Gupta,[4] and Hazen[5,6] by the use of cloud chamber techniques. Except for Sen Gupta, who reported an increase for electrons but not for mesons, the other observers were unable to support the relativistic increase in ionization beyond the minimum as predicted in the theory of collision loss given by Bethe.[7]

Low efficiency counters have been employed by Danforth and Ramsey,[8] Cosyns,[9] and most recently by Hereford.[10] Of these, Hereford obtained results in substantial agreement with theory upon comparing the primary specific ionization of 1-Mev electrons with that of the sea-level cosmic radiation. This technique makes use of the unique dependence of the efficiency of a counter, operating in the Geiger region, upon the primary specific ionization,

$$\text{efficiency}=1-\epsilon^{-JLP/76}.$$

The present experiment makes use of this technique to compare the primary specific ionization in hydrogen of two groups of cosmic-ray particles of different average momenta. The efficiency of a low pressure (2.0 cm Hg) hydrogen-filled counter was measured at sea level and under ~140 feet of rock. These measurements were made with a fourfold coincidence telescope which included the hydrogen counter and 20 cm of lead. The average momentum of the sea-level cosmic radiation (presumed to be principally μ-mesons because of the Pb filter), computed on the basis of the