The theoretical magnetic moment may be compared with the experimental moment; it is also used in determining the fine-structure constant α; and it contributes to the Lamb shift. The magnetic moment is measured by determining μ_e/μ_p and μ_p/μ_0, where μ_p is the proton moment. The measurements of μ_e/μ_p have been quite accurate.[3] On the other hand, there are two conflicting experimental determinations[4,5] of μ_p/μ_0, which result in two different values for the magnetic moment:

References	μ_e/μ_0
3 and 4	1.001146±0.000012
3 and 5	1.001165±0.000011.

The theoretical value[6] for the hyperfine splitting in hydrogen is proportional to the quantity

$$\alpha^2(\mu_p/\mu_0)(\mu_e/\mu_0)=\alpha^2(\mu_p/\mu_e)(\mu_e/\mu_0)^2.$$

Since there is agreement on the experimental value of μ_p/μ_e, we use the second form, together with the present value of α,[7] to determine a new value. This turns out to be

$$1/\alpha=137.039.$$

The theoretical Lamb shifts in hydrogen, deuterium, and singly ionized helium are affected by the changes in both α and μ_e. Incorporating these changes into the calculations of Salpeter,[8] along with the proton-recoil recoil corrections of Fulton and Martin,[9] and the proton-structure corrections of Aron and Zuchelli,[10] we obtain the following results in Mc/sec:

	Theoretical	Experimental	Reference
S_H	1057.99±0.13	1057.77± 0.10	11
S_D	1059.23±0.13	1059.00± 0.10	11
S_D-S_H	1.24±0.04	1.23± 0.15	11
S_{He}	14055.9 ±2.1	14043 ±13.0	12

The experimental values[11,12] have been listed for comparison. There remain several uncomputed theoretical effects which are expected to be of the same order of magnitude as the indicated theoretical uncertainties.

The magnetic moment of the μ meson, as computed by Suura and Wichmann, and Petermann,[13] would be changed to read

$$\mu_\mu=\left(1+\frac{\alpha}{2\pi}+0.75\frac{\alpha^2}{\pi^2}\right)\frac{e\hbar}{2m_\mu c}.$$

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Note added in proof.—Petermann[14] has placed upper and lower bounds on the separate terms of Karplus and Kroll. He finds that their value for μIIc does not lie within the appropriate bounds. Assuming the other terms to be correct, he concludes that μ^4/μ_0 $=(-0.53\pm0.37)\alpha^2/\pi^2$, which is consistent with the value presented above.

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Allowed Capture-Positron Branching Ratios

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In a previous paper,[1] tables of allowed K capture-positron branching ratios were presented. However, it was pointed out by Wapstra[2] and Perlman[3] that numerical errors existed in the table. These errors appear in the first, third, and fifth columns of Table II of reference 1, each entry of which should be multiplied by the factors of 0.5018, 1.2244, and 0.6462, respectively. In Table I of this communication, the corrected table of allowed K to positron branching ratios is given. In this work, the effect of the finite nuclear size on the bound electron wave functions, which was ignored in reference 1, was taken into account.[4] This effect, which is negligible for low Z, reduces the branching ratio by about 10% for $Z=84$ and by about 15% for $Z=92$. Effects of finite size on the positron wave functions was ignored, since it is a considerably smaller effect.[5]

As in reference 1, the bound electron wave functions were taken from Reitz's thesis[6] except for $Z=16$, for

Table I. Allowed K to positron branching ratios.

$W_0/mc^2 \diagdown Z$	16	29	49	84	92
1.28	46.6	707	1.208×10^4	4.56×10^5	8.92×10^5
1.44	8.65	112	1.58×10^3	4.50×10^4	8.41×10^4
1.60	2.83	33.6	425	1.03×10^4	1.84×10^4
1.76	1.24	13.9	164	3.57×10^3	5.01×10^3
1.92	0.641	6.91	77.6	1.57×10^3	2.67×10^3
2.08	0.373	3.91	42.3	807	1.36×10^3
2.40	0.190	1.60	16.4	289	479
2.88	0.0613	0.597	5.86	96.4	158
3.84	0.0169	0.160	1.51	23.6	39.0
4.80	7.00×10^{-3}	0.0648	0.603	9.10	15.7
5.76	3.56×10^{-3}	0.0328	0.302	4.82	8.05
6.72	2.06×10^{-3}	0.0188	0.173	2.82	4.75
7.68	1.30×10^{-3}	0.0118	0.109	1.80	3.06
8.64	8.85×10^{-4}	7.93×10^{-3}	0.0729	1.23	2.10
9.60	6.29×10^{-4}	5.60×10^{-3}	0.0513	0.879	1.52
10.56	4.48×10^{-4}	4.09×10^{-3}	0.0377	0.652	1.13
11.52	3.37×10^{-4}	3.07×10^{-3}	0.0281	0.498	0.869
12.48	2.60×10^{-4}	2.37×10^{-3}	0.0219	0.393	0.685

which Slater screening constants in the usual formula[7] for bound electronic wave functions were used. The use of Reitz's wave functions (instead of Slater screening constants) reduces the branching ratios by about 1% at intermediate $Z(\sim 50)$ and by about 2% at high Z.

It should be stressed that the Z in Table I refers to the charge of the *parent* nucleus.

The decrease of the branching ratio due to screening depends on W_0 and Z. For $Z=16$, it varies between $5\frac{1}{4}\%$ at $W_0=1.6\,mc^2$ to $2\frac{3}{4}\%$ at $W_0=4.8\,mc^2$. For $Z=29$, for the same range of W_0, the correction varies between $7\frac{3}{4}\%$ and $3\frac{1}{2}\%$; for $Z=49$ between $14\frac{1}{2}\%$ and $5\frac{3}{4}\%$; for $Z=84$ between $26\frac{3}{4}\%$ and $8\frac{3}{4}\%$; and for $Z=92$ between $29\frac{1}{2}\%$ and $10\frac{1}{4}\%$. These numbers are in essential agreement, within the 1 to 2% probable error in the numerical calculations, with those presented at the New York Meeting.[8] (Most of this error stems from the screening correction.)

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Circular Polarization of Internal Bremsstrahlung

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Lee and Yang's suggestion[1] that parity might not be conserved in weak interactions and the experimental proof[2–4] of the correctness of their suggestion have made desirable a re-examination of all processes in which weak interactions take part. The internal bremsstrahlung associated with K capture will be examined in this paper for properties which are consequences of parity nonconservation, with particular attention being given to the two-component neutrino theory.[5,6]

This paper will follow in detail the notation and methods introduced previously for studying the spectra and angular correlations of the internal bremmstrahlung gamma ray.[7] It follows directly from a theorem proved in IB that the asymmetry of the gamma rays emitted by an oriented electron-capturing nucleus[8] will be the same as the asymmetry which would be obtained if the nucleus were to emit positrons of zero mass; therefore, this paper will deal with the polarization of the bremsstrahlung, which has not been studied before. It is possible to envisage the bremsstrahlung as arising from the emission of a virtual positron, which annihilates one of the K electrons,[9] the momentum (and angular momentum) of the positron being carried off by the gamma ray. Since, as was predicted theoretically,[6,10,11] and as has been verified experimentally,[12,13] beta particles are circularly polarized, it is not implausible that the gamma ray might also be polarized.[14]

The matrix element for capture of a K electron, with emission of a gamma ray, is given by Eq. (12) of IB:

$$X_{K\gamma}=ie(2\omega)^{-\frac{1}{2}}\phi(0)\bar{u}_\nu(\mathbf{q},\rho)\bar{\Lambda}\left(\frac{i\gamma_\mu g_\mu-m}{g^2+m^2}\right)\mathbf{e}^*\cdot\gamma u_e(0,\sigma). \quad (1)$$

Since we are now interested in circular polarizations, it is necessary to introduce complex polarization vectors,

$$\mathbf{e}=2^{-\frac{1}{2}}(\boldsymbol{\varepsilon}_1\pm i\boldsymbol{\varepsilon}_2).$$

The plus sign refers to right circular polarization,[15] the minus sign to left circular polarization ($\boldsymbol{\varepsilon}_1$ and $\boldsymbol{\varepsilon}_2$ are two perpendicular real unit vectors, which, with a unit vector $\boldsymbol{\kappa}$ having the direction of the photon propagation, form a right-handed triad). The square of $X_{K\gamma}$, summed over the electron and neutrino spins, is

$$\sum|X_{K\gamma}|^2=-\frac{2\pi\alpha}{\omega}[\phi(0)]^2\tfrac{1}{4}\,\mathrm{Tr}\left\{\frac{i\gamma_\mu g_\mu-m}{g^2+m^2}\boldsymbol{\gamma}\cdot\mathbf{e}^*(1+i\gamma_0)\right.$$
$$\left.\times\boldsymbol{\gamma}\cdot\mathbf{e}\left(\frac{i\gamma_\mu g_\mu-m}{g^2+m^2}\right)N(-\mathbf{k},-\mathbf{q},\xi)\right\}. \quad (2)$$

Note that

$$\begin{aligned}\boldsymbol{\gamma}\cdot\mathbf{e}^*\boldsymbol{\gamma}\cdot\mathbf{e}&=\tfrac{1}{2}(\gamma_1\mp i\gamma_2)(\gamma_1\pm i\gamma_2)\\&=1\mp\boldsymbol{\kappa}\cdot\boldsymbol{\sigma}.\end{aligned} \quad (3)$$

Again, the upper sign refers to right circular polarization, the lower sign to left circular polarization. Equation (2) can now be reduced in a straightforward way to

$$\sum|X_{K\gamma}|^2=\pi\alpha\omega^{-1}m^{-2}[\phi(0)]^2 \times\tfrac{1}{4}\,\mathrm{Tr}\{(i\gamma_0-i\boldsymbol{\gamma}\cdot\boldsymbol{\kappa})(1\mp\boldsymbol{\kappa}\cdot\boldsymbol{\sigma})N\}. \quad (4)$$

The factor $(i\gamma_0-i\boldsymbol{\gamma}\cdot\boldsymbol{\kappa})(1\mp\boldsymbol{\kappa}\cdot\boldsymbol{\sigma})\times\frac{1}{4}$ is equal to the projection operator (in hole theory) for a massless positron, traveilng in the direction of $\boldsymbol{\kappa}$, which is right (minus sign) or left (plus sign) circularly polarized. Equation (4) therefore shows that the polarization of the gamma ray is the same as the polarization of a zero-mass positron; this relation does not depend on the nature of the beta interaction. In the two-component theory, with scalar and tensor interactions, positrons have a degree of right circular polarization equal to v/c, and therefore the gamma ray will be 100% right circularly polarized, in the approximation considered here. [See IB (13), et seq.]