Conversely, with proper mounting the abundance of low energy electrons may be due to additional spectra as is the case with Ag^{110}.

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The Hyperfine Structure of the Ground Term of Hydrogen

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References to a paper[1] by the authors on the hyperfine structure of hydrogen indicate that the results are understood to have a higher accuracy than they do. The present note is intended as an addendum to the paper with the object of stating the limitations more clearly. The Hamiltonian contains a term called Y in the paper referred to, which contains products of Dirac's α-matrices. This term is responsible for the hyperfine structure. The employment of its expectation value in order to obtain an additive correction to the energy is the apparent limit of its applicability. The wave function by means of which the expectation value is calculated is obtained from Eq. (2) in reference 1 which is not accurate to relative order v^2/c^2 where v is the electron velocity. The expectation value of Y cannot be expected to be accurate to relative order v^2/c^2 except by accident. Therefore no claims for the correctness of the relativistic terms in the correction to hyperfine structure involving m/M can be made. The reason for reporting on the results of the calculations which gave such effects was that the relativistic effects which have been calculated can be expected to have a bearing on the actual corrections. No certain method of obtaining these appears to be available.

It should also be mentioned that in the first of the two Eqs. (3.1) an approximation has been made. This is immaterial for the hyperfine structure terms of relative order m/M and it does not affect the relativistic corrections to these terms in a qualitative way.

The hyperfine structure appears in the calculation as a relativistic effect. The relativistic corrections to it remain uncertain because the Hamiltonian does not determine the wave function with the required accuracy.

* Assisted by ONR.
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On the Decay of K^{40}

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An interesting feature of the K^{40} decay is the evidence for electron capture[1-5] and no evidence for positron emission.[6] The purpose of this note is to point out several consequences of this fact.

The consequences are: (1) a determination of an upper limit to the $A^{40}-K^{40}$ mass difference, (2) the possibility of observing positrons from K^{40} if estimates[1-3] of the K capture are correct, and (3) a determination of the ratio of the nuclear matrix elements for the A- and Ca-transitions.

The ratio of positron emission to electron capture is independent of the nuclear matrix elements to a large extent** and should, therefore, give a reliable estimate of the mass difference. If the expressions for forbidden β-transitions[7, 8] are used, the ratio of positron emission to electron capture under the third forbidden axial vector or tensor interactions and $Z=19$ is

$$\lambda^{\beta^+}/\lambda^c=\frac{0.450\eta^{6\frac{1}{2}}}{(\eta+2)^8}[0.0676+1.25\eta$$
$$+8.48\eta^2+12.5\eta^3+1.74\eta^4+0.079\eta^5],$$

where $\eta=\Delta M-2$ and ΔM is the atomic mass difference in units of the mass of the electron. The mass difference obtained by use of this expression and from the expressions arising from various fourth forbidden interactions are practically identical.

Table I gives the $A^{40}-K^{40}$ atomic mass difference as a function of the ratio of positron emission to electron capture. If the experimental values[1-3] $\lambda^{\beta^-}/\lambda^c=\frac{1}{2}$ and $\lambda^{\beta^+}/\lambda^{\beta^-}<0.01$ are used,[6] then $\lambda^{\beta^+}/\lambda^c<0.005$ and the $A^{40}-K^{40}$ mass difference is less than 1.6 Mev.

Table I. $A^{40}-K^{40}$ atomic mass differences.

$\Delta M(mc^2)$	0–2	3.00	3.25	3.50	3.75	4.00	4.25
$\lambda^{\beta^+}/\lambda^c$	0	0.00165	0.00675	0.0203	0.0494	0.104	0.195

The experiments on the K^{40} β^--energy endpoint require that the 1.55 Mev γ-ray be placed on the A^{40} side of the decay scheme. If experiments of references 1 to 3 are correct there are approximately fifteen K captures to one γ-ray so that most of the K captures go to the ground state. This would lead to the conclusion that there is one positron to every two hundred and fifty electrons. The probability for positrons from the internal pair creation of the γ-ray or β-ray is much smaller.

If one uses the value of the $\lambda^{\beta^-}/\lambda^c$ ratio, the corresponding upper limit to the $K^{40}-A^{40}$ mass difference, and β^--energy endpoint, one can estimate the ratio of the $(K^{40}-A^{40})$ to $(K^{40}-Ca^{40})$ nuclear matrix element. These are

$$\left(\frac{|Q_{\mathrm{K-A}}|^2}{|Q_{\mathrm{K-Ca}}|^2}\right)=50,\quad \left(\frac{|Q_{\mathrm{K-A}}|^2}{|Q_{\mathrm{K-Ca}}|^2}\right)=\tfrac{1}{2},$$

$$\lambda^{\beta^-}/\lambda^c=\tfrac{1}{2},\quad \lambda^{\beta^-}/\lambda^c=10,$$

$$E_{\beta^-}=1.4\text{ Mev},\quad E_{\beta^-}=1.4\text{ Mev}.$$

If the higher value of $\lambda^{\beta^-}/\lambda^c$ is approximately correct, it would indicate that the A^{40} and Ca^{40} nuclear states are very similar and probably have the same parity. However, the lower value of $\lambda^{\beta^-}/\lambda^c$ has more experimental support.

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** This ratio is completely independent of the nuclear matrix element for the third forbidden tensor and axial vector interaction and the fourth forbidden scalar, axial vector and pseudoscalar interactions. For the other fourth forbidden interactions and the various linear combinations,the $\lambda^{\beta^+}/\lambda^c$ ratio involves the ratio of certain matrix elements between the same initial and final states. These can be estimated fairly well.
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