tors. We estimate the cluster correction to be 0.3±0.3 Mev and the energy denominator correction (compared to the result with $\delta E=0$) to be 1.0±0.5 Mev, giving a final result for the energy (at the minimum) of −14.8±0.6 Mev. It is to be emphasized that this result is very much more accurate than the knowledge of the potentials, particularly since the odd-state potentials have been omitted.

Finally, it is interesting to point out that these results agree, within one or two Mev, with those which can be obtained from the same potential in the effective-mass approximation[3,4] with the effects of the exclusion principle neglected.

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Contribution to Lamb Shift Due to Finite Proton Size

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THE scattering of high-energy electrons by protons has recently been interpreted in terms of a finite spatial distribution of charge for the proton.[1] We have noticed that the resultant deviation from a pure Coulomb field is such as to reduce the existing discrepancy[2] between theoretical and experimental results for the hydrogen Lamb shift. Since the proton size is small compared to atomic dimensions, one easily finds, using nonrelativistic wave functions,

$$\Delta E=\tfrac{1}{6}|\psi(0)|^2e^2\langle R^2\rangle_{\mathrm{Av}},$$

where $\langle R^2\rangle_{\mathrm{Av}}$ is the mean square radius of the proton charge distribution and $\psi(0)$ is the amplitude of the hydrogen wave function at the origin. (A similar result was obtained by Salpeter[3] in discussing the effect of proton motion in the deuteron Lamb shift.) Taking the mean value given by Chambers and Hofstadter, $R_{\mathrm{rms}}=(0.77\pm0.10)\times10^{-13}$ cm, one finds the energy shift for the $2S_{\frac{1}{2}}$ level:

$$\Delta E=0.118\pm0.03\ \text{Mc/sec.}$$

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Nuclear Emulsion Evidence for Parity Nonconservation in the Decay Chain $\pi^+-\mu^+-e^+$*†

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LEE and Yang[1] recently re-examined the problem as to whether parity is conserved in nature and emphasized the fact that one actually lacks experimental evidence in support of this most natural hypothesis in the case of weak interactions (such as β decay). Violation of parity conservation can be inferred essentially only by measuring the probability distribution of some *pseudoscalar* quantity, e.g., of the projection of a polar vector along an axial vector, and measurements of this kind had not been reported. Lee and Yang suggested several experiments in which a spin direction is available as a suitable axial vector; in particular, they pointed out that the initial direction of motion of the muon in the process $\pi\rightarrow\mu+\nu$ can serve for this purpose, as the muon will be produced with its spin axis along its initial line of motion if the Hamiltonian responsible for this process does not have the customary invariance properties. If parity is further not conserved in the process $\mu\rightarrow e+2\nu$, then a forward-backward asymmetry in the distribution of angles $W(\theta)$ between this initial direction of motion and the momentum, $\mathbf{p}_e$, of the decay electron is predicted.

It is easy to observe the pertinent correlation by bringing π^+ mesons to rest in a nuclear emulsion in which the μ^+ meson also stops. One has only to bear in mind two facts: (1) even weak magnetic fields, such as the fringing field of a cyclotron, can obliterate a real effect, as the precession frequency of a Dirac μ meson is $(2.8/207)\times10^6$ sec^{-1}/gauss; (2) μ^+ can form "muonium," i.e., (μ^+e^-), and the formation of this atom can be an additional source of depolarization, both through its internal hyperfine splitting and the precession of its total magnetic moment around the external field. In the absence of specific experiments on muonium formation, one can perhaps be guided by analogous data on positronium in solids.[2,3]

With these facts in mind, we exposed (in early October, 1956) nuclear emulsion pellicles (1 mm thick) to a π^+ beam of the University of Chicago synchrocyclotron. The pellicles were contained inside three concentric tubular magnetic shields and subject to $\leq4\times10^{-3}$ gauss. Over 1300 complete $\pi-\mu-e$ decays have been recorded to date, and the space angle θ defined above has been calculated for each. From these preliminary data we find[4]

$$\left\{\int_{90^\circ}^{180^\circ}|W(\theta)|d\Omega-\int_0^{90^\circ}|W(\theta)|d\Omega\right\}\Big/\int_0^{180^\circ}W(\theta)d\Omega=0.062\pm0.027,$$