Letters to the Editor

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The Lifetime of the μ^+-Meson

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An experiment is in progress to determine the probabilities of nuclear capture of μ^--mesons stopped in elements of low atomic number. The apparatus, which accepts the normal sea level mixture of positive and negative mesons, measures the distribution of delays between the stopping of mesons and the emission of decay electrons. The composite decay curve, so obtained, is then analyzed for positive and negative meson decay components. It was first necessary to determine accurately the μ^+-meson lifetime by stopping the mesons in iron, whose atomic number is sufficiently large that no μ^--decays are recorded,[1] and this result is reported here since it is believed to be more accurate than previously published values.

Three trays of GM counters, A, B, C (Fig. 1), are used. The meson absorber, bars of pure iron filling a volume 50 cm$\times$47 cm

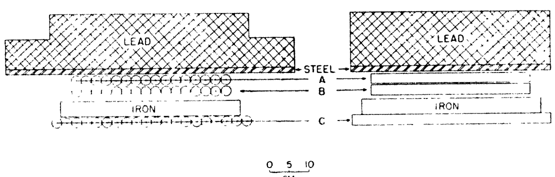

Fig. 1. Experimental arrangement. All counters are 1-inch diameter with 0.7-mm brass walls; those in tray B feed individual pulse-shaping amplifiers. Above A is a $5\frac{1}{2}$-inch thick lead shield for soft radiation, while the only material immediately below the counters is a steel frame supporting them $4\frac{1}{2}$ feet above the floor.

$\times$3.8 cm, is placed in the 5-cm gap between trays B and C. Electronic circuits record the distribution of delays between mesons stopping [anticoincidences $(AB-C)$] and decay electrons [single counts in B or C] with ten nearly contiguous coincidence channels, each $\sim$1 μsec wide. The first channel has a preselected initial delay. An automatic calibration of all channel delay limits is made daily, using two artificial pulses generated by an accurate "interval marker."[2] Each channel limit determination has a maximum random error of $\pm$0.005 μsec; systematic error is believed to be $<$0.3 percent.

Runs were made for four different conditions as summarized in Table I. The differential decay curve, shown in Fig. 2, combines the results of runs 1 and 2. Corrections were made for dead-time losses, for drifts of the channel positions, for prompt events delayed by counter lags, for inequality of channel widths, and for chance coincidences; only the last two were of appreciable importance. The number of chance delayed coincidences was computed from the prompt coincidence rates and verified by the results of runs 2, 3, and 4. Run 3 showed, in addition to chance counts, a background of decays with an intensity one-sixth that resulting from the iron absorber. Since these are caused by mesons stopping mainly in the brass counter walls and in the steel framework, and since they showed a lifetime not statistically different from that obtained from run 1, no correction was made

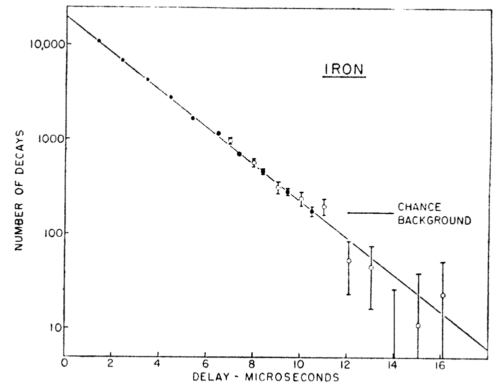

Fig. 2. Semilogarithmic plot of the number of decays recorded in each channel (after corrections) at the delay corresponding to the midpoint of the channel. The solid circles indicate the data of run 1, and the open circles, the data of run 2 normalized to the same number of stopped mesons. Standard deviations are indicated.

for them. A least squares fit to the data plotted in Fig. 2 gives a mean life $\tau=2.22\pm0.02$ (standard deviation) μsec for the μ^+-meson. The corresponding half-life is 1.54 μsec. The best previous

Table I. Description of the four runs.

				Approximate total number of delayed counts recorded		
Run	Iron absorber	Initial delay (μsec)	Total hours	μ-decays (10 channels)	Chance (10 channels)	Counter lags (all in first channel)
1	In	0.8	398.2	29100	1690	500
2	In	6.4	105.6	640	440	0
3	Out	0.8	249.0	3020	1110	330
4	Out	6.4	43.7	40	180	0

measurements by Nereson and Rossi[3] ($\tau=2.15\pm0.07$ μsec), by Ticho[4] ($\tau=2.11\pm0.10$ μsec), and by Conversi and Piccioni[5] ($\tau=2.33\pm0.15$ μsec), are all in agreement with our value.

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[1] Conversi, Pancini, and Piccioni, Phys. Rev. **71**, 209 (1947); T. Sigurgeirsson and K. A. Yamakawa, Revs. Modern Phys. **21**, 124 (1949).
[2] W. E. Bell and E. P. Hincks (to be published).
[3] N. Nereson and B. Rossi, Phys. Rev. **64**, 199 (1943).
[4] H. K. Ticho, Phys. Rev. **74**, 1337 (1948).
[5] M. Conversi and O. Piccioni, Phys. Rev. **70**, 859 (1946).

The Radioactive Decay of Ca^{41}

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The measurements of Richards, Smith, and Browne[1] on the threshold of the reaction $K^{41}(p,n)Ca^{41}$ show that 0.44$\pm$0.02 Mev is available for the decay of Ca^{41} by K-capture to K^{41}.

As a result of their studies of the neutron capture γ-ray spectrum of calcium, Kinsey, Bartholomew, and Walker[2] have proposed a cross section of about 0.35 barn for the reaction $Ca^{40}(n,\gamma)Ca^{41}$.

Calcium oxide samples were irradiated with slow neutrons for varying lengths of time. After extensive chemical purification the calcium sources were examined in an attempt to detect the characteristic K x-rays of potassium (K_α—3.31 kev) produced by K-capture in Ca^{41}. A proportional counter with a thin polystyrene window (1.5 mg/cm^2) was used. The counter was filled with a mixture of argon and methane. The x-ray energy was measured by comparison with the K x-rays of copper (K_α—8.05 kev).