SARD : I should like to remark that if the difference between the polarizations of positive and negative muons is real, it could possibly be due to a contribution from K-μ decay. There is no reason to believe that the number of K^+ and K^- is the same, and it is conceivable that the helicity is opposite in the K-μ decay from that in the π-μ decay.

LYUBIMOV : It is rather strange that the negative muon polarization is bigger. If it had been the other way around it would be more understandable.

GOLDHABER : The μ asymmetry is the same in the K-μ decay as it is in the π-μ decay. That is an experimental fact.

LYUBIMOV : There are more K^+ in the cosmic rays than K^-. In a measurement by a group with Alikhanian and others the polarization of μ mesons is shown to increase with increasing energy from 15 MeV to 1.5 BeV. It increases from 10 to 40%, over that range. This increase may possibly be explained by K-mesons.

A DETERMINATION OF THE LIFETIME OF THE μ^+ MESON

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(presented by H. Muirhead)

The lifetime of the μ^+ meson was measured using the apparatus depicted in Fig. 1. Positive pions were stopped in a sulphur target contained in a cup-shaped scintillation counter, 3. The counter had an effective solid angle of 3.4π steradians for the detection of decay electrons from the decay sequence π-μ-e.

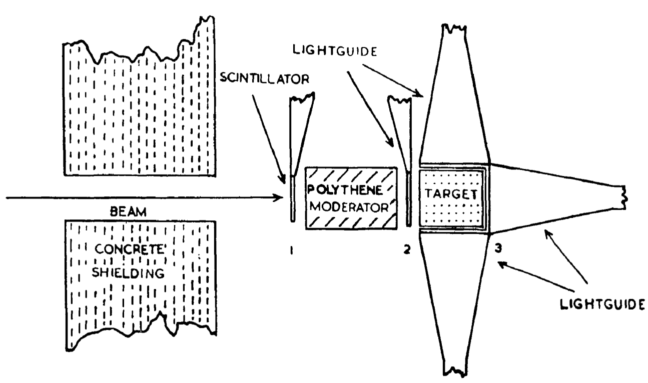

Fig. 1 Apparatus used in measuring the $\mu^{\pm}$ lifetime.

The scintillator was viewed by three photo-multipliers; coincident pulses from any two of the photomultipliers were accepted as decay events.

The time interval between the arrival of the pion, (coincidence from counters 1 and 2), and the appearance of the decay electron in counter 3 was measured by means of a timesorter, and the data was registered on a kicksorter.

Just over a million counts were recorded and analyzed. A feature of the experiment was the high signal to noise ratio (1,400 at 1μsec after the arrival of the pion, falling to 38 at 9μsec.). Uncertainties in the background, therefore, were not troublesome in the analysis of the data.

The channels on the kicksorter were calibrated in terms of time to an accuracy of 2 parts in a 1,000. As a test of the stability of the apparatus a total of 16 calibrations were made over a period of ten days.

The highest and lowest calibrations differed by 6 parts in a 1,000.

In Fig. 2 the data is presented in the form of (number of counts at time t)$\times$exp. (t/τ) *vs.* (time). A value of 2.225$\pm$0.006 μsec was obtained for the lifetime, τ, of the μ^+ meson. This figure compares favourably with other experimental values (Table I), but is lower than that calculated by Berman and by Kinoshita and Sirlin from data on β-decay.

Table I. Values of μ^+ lifetime in μsec

Experiment : (in μsec)	Calculated
2.22 $\pm$0.02 [1]	2.33$\pm$0.05 [6]
2.20 $\pm$0.015 [2]	2.31$\pm$0.05 [7]
2.225$\pm$0.006 [3]	
2.211$\pm$0.003 [4]	
2.208$\pm$0.004 [5]	

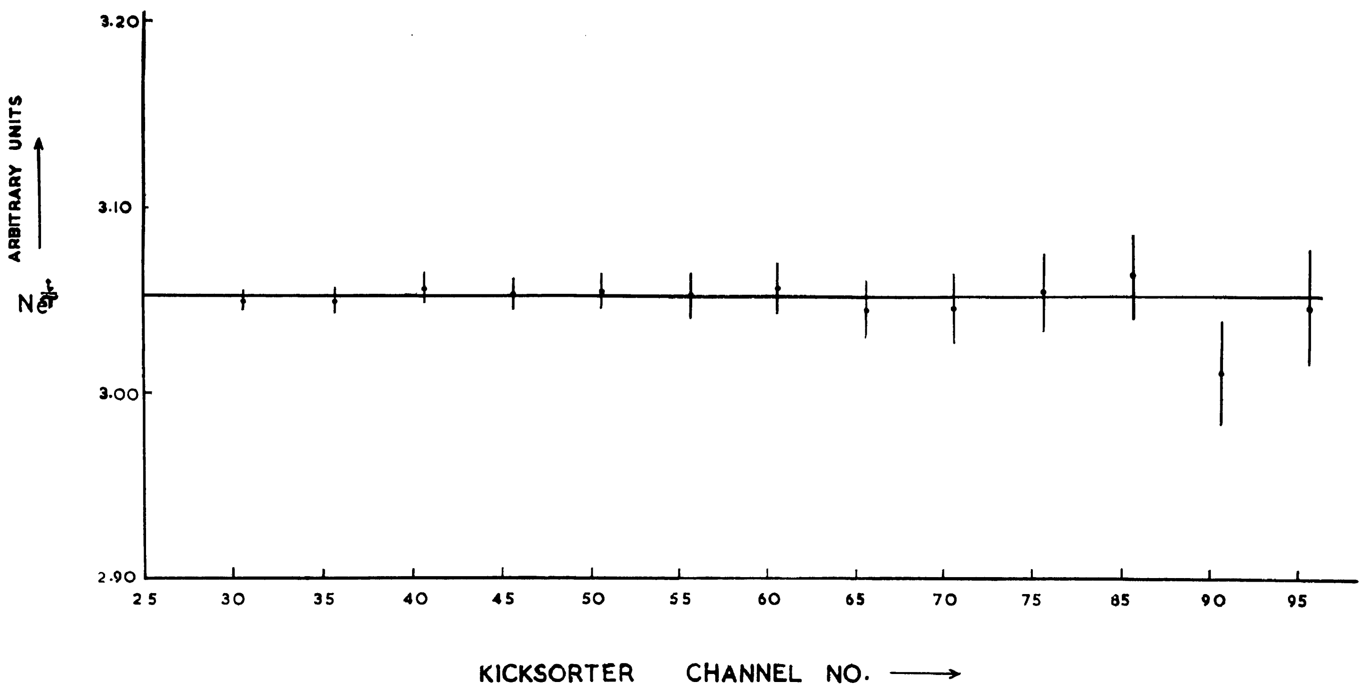

Fig. 2 μ^+ lifetime data. Zero time = Channel 21.5. 1 k.s. channel = 0.1273 μsec.

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DISCUSSION

ANDERSON : What effect will it have on the result if you alter the background by a factor of two or so?

MUIRHEAD : We think we know how to determine the background in this experiment. It should fall away with time but if we assume, for example, that it is flat all the way across, the lifetime becomes 2.223 μsec. I should have mentioned that we analyze our data over a region from about one microsecond to 10 microseconds.

SWANSON: When you measure a time distribution with a time to pulse height converter, you do not really measure a time distribution, but rather the distribution of time intervals between the start count and the first stop count. Among other things, this means that even if you have no background at all, the decay rate that you get on your converter differs from the true decay rate by the instantaneous stop rate in the stopping counter. Was this kind of correction put in?

MUIRHEAD: A correction like that was made.

HIGH ENERGY GAMMA-RAYS FROM MUON CAPTURE

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In the course of a search for effects which might be responsible for the anomalous peak near Fe in the decay rates of bound negative muons, we have observed an energetic delayed non-ionizing radiation associated with muons stopping in a thin (4 g/cm^2) target. Stopping cosmic-ray muons are identified with a scintillator and Čerenkov counter telescope, and delayed pulses are detected in a 46 cm deep×46 cm diameter liquid scintillation counter separated from the target by an anticoincidence counter of high efficiency. (See Fig. 1.) The delayed pulses have the following characteristics: (1) The energy spectrum contains 10 events from 8 to 10 MeV, 10 events from 10 to 15 MeV, and 5 events from 15 to 20 MeV, compared with 210 events below the neutron binding energy of about 8 MeV; (2) The mean lives observed for Fe and Cu agree with the known muon capture life-times to within 30%; (3) The total background from the bremsstrahlung of decay electrons and from accidentals is less than 15%, as determined from a study of positive muon decays during the same run; (4) The majority of the events cannot be due to fast neutrons, since pulses with about the same energy and time characteristics and with about the right rate were also seen in one run in a large water Čerenkov counter whose threshold for proton recoils was 490 MeV. (See Figs. 2 and 3.)

The effect is tentatively ascribed to a hitherto-unobserved high-energy gamma radiation associated

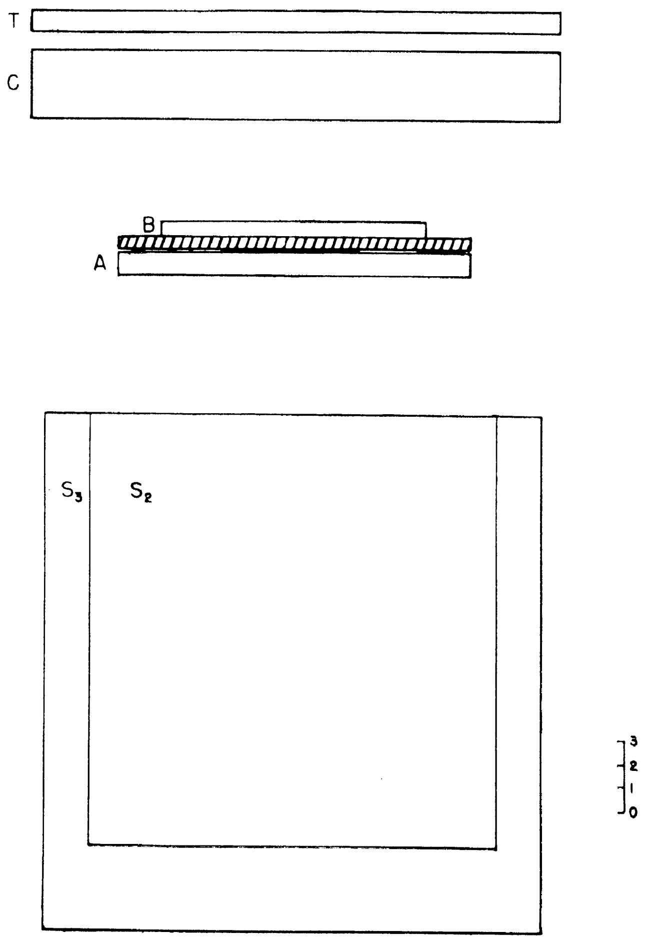

Fig. 1 Disposition of counters. T, B, A, and S_2 are liquid or plastic scintillators. C is a Čerenkov counter. S_3 is not used. Muons stopping in the target (shown cross-hatched) are selected by a combination $T\bar{C}B\bar{A}$, where the bar denotes anticoincidence. Delayed events in S_2 having no A or B are studied. Pulses from all counters except T are presented on an oscilloscope.