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Discussion

Wolfendale, A.W.: Have you considered the effect of the cover material over apparatus on the polarization?

Clark, G.: If there is no anomalous scattering of the μ-mesons, then the effect is small. Since the interactions at high energy are primarily magnetic, the polarization follows the scattered momentum and the depolarization effect is proportional to the angular scatter.

JOURNAL OF THE PHYSICAL SOCIETY OF JAPAN Vol. 17, SUPPLEMENT A-III, 1962
INTERNATIONAL CONFERENCE ON COSMIC RAYS AND THE EARTH STORM Part III

III-5-2. Polarization of Cosmic Ray Muons

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It has been calculated[1-8] and established experimentaly, that the cosmic ray muons are partially polarized in longitude. According to the theoretical estimations the measured polarization depends on the energy spectrum of π-mesons and, in part, on the ratio of the productions of the K^+-mesons and π^+-mesons. The dependence of the cosmic ray muons polarization on their energies has been investigated in the paper[9]. But our prelimenary data given in the above-mentioned paper have a large statistical errors. We continued our measurements of the cosmic ray muons polarization underground with a larger and improved arrangement shown in Fig. I, to get more precise data.

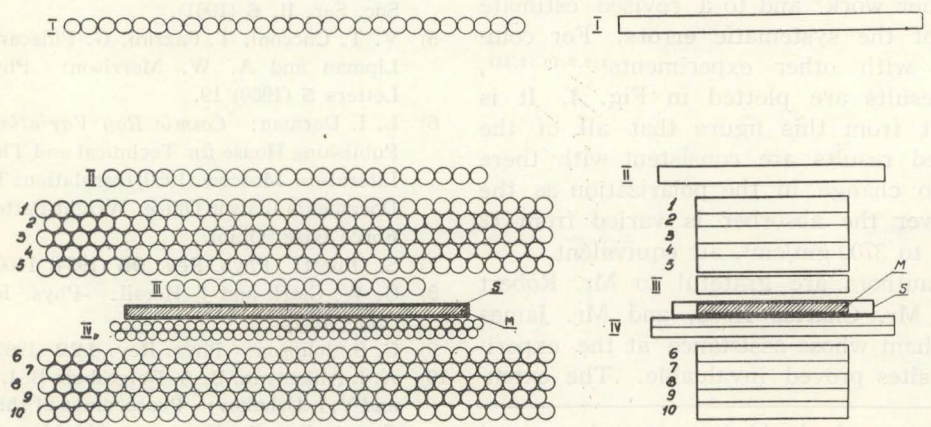

Fig. 1. The experimental arrangement.

All the trays consist of Geiger counters. The muons with the entering momentum 2.1 Bev/c stopped in the copper absorber M ($52 \times 28 \times 2$) cm^3 are detected by anticoincidence I+III−IV. The muon directions are determined by hodoscope I, II, III. The decay electrons are registered by a hodoscope system of countertrays 1-10 operating with a high voltage pulse supply in time interval 1-4,5 mcsec. after the stopping of muons. A constant clearing potential -100 v. is applied to all the counters of trays 1-10 and therefore they are insensitive to the muons. A tpyical decay event is shown in Fig. 2.

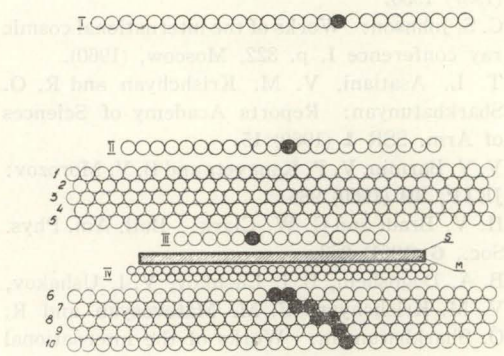

Fig. 2. A typical event of decay.

The experiment has been carried out with and without a depolarizing field to test the asymmetry of the arrangement. For this purpose the absorber was placed inside a solenoid S which creates a magnetic field of 80 gauss during alternate 30 minute periods. The measurements were carried out by means of two analogous arrangements. The obtained experiment resuts and their mean square errors are given in Table I.

The ratio $R\,(\text{on}) = 1.12 \pm 0.018$ shows the arrangement asymmetry. This asymmetry may be explaned by the difference between the minimum ranges necessary for the detection of the upward and downward electrons and by the difference between the efficiencies of the conuters 1-5 and 6-10, which are not transposed mutually.

Assuming the value of the two component neutrino theory parameter $\xi = -1$, we have calculated the polarization P by the formula

$$P = K\frac{R-1}{R+1}$$

where K is the coefficient depending on the experimental arrangment configuration and the spectrum of the decay electrons.

For our arrangement the coefficient K calculated by the machine at the Computer Centre of the Armenian Academy of Sciences is equal $K = 2.243$. The value of polarization P, given in Table I, is obtained substituting

$$R = \frac{R(\text{off})}{R(\text{on})}$$

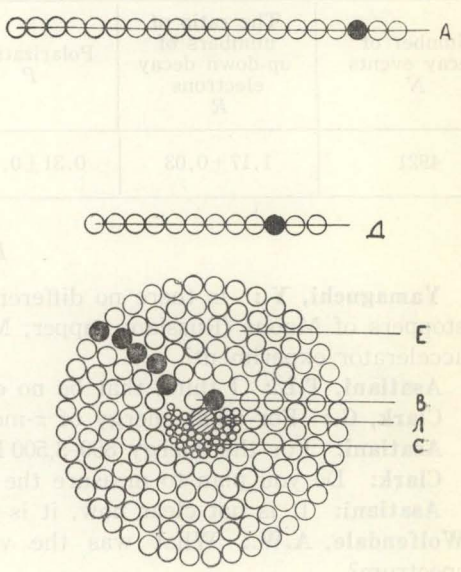

Fig. 3.

Table I.

Measurement	Number of decay events N	The ratio of numbers of up-down decay electrons R	$\frac{R\,(\text{off})}{R\,(\text{on})}$	Polarization P
Without field (off)	16290	1.35 ± 0.017	1.20 ± 0.03	0.25 ± 0.03
With field (on)	14920	1.12 ± 0.018		

in the above formula and taking into account the corrections related to the angular distribution of muons and their depolarization before entering the copper absorber. The calculation[1] of the pion generation spectrum exponent γ corresponding to our polarization gives

$$\gamma = 1.95^{+0.1}_{-0.3}$$

These experimental results indicate that for the investigated region of the muon momenta the part of muons produced from the decay of K-mesons is insignificant. At present we are measuring with this arrangemens also the polarization of low energy muons, and not until the experiment is complement by the results of these measurements can any final conclusion be drawn.

Recently, we have taken up the continution of the experiment reported at the Moscow conference[9]. The experimental results obtained up-to-date by this arrangement are given in Table II (the measurements have been not completed yet).

Table II.

Number of decay events N	The ratio of numbers of up-down decay electrons R	Polarization P
4921	1,17±0,03	0.31±0,05

The authors are thankful to B.I. Luchkov, B. A. Dolgoshein, I. I. Goldman, and S. A. Kheifets for helpul discussions.

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Discussion

Yamaguchi, Y.: Is there no difference in observed asymmetries due to the different stoppers of Muons (Russian: cupper; MIT: brass)? Has this point been checked in accelerator experiment?

Asatiani, T.L.: I think that be no difference.

Clark, G.: For what energy of π-mesons $\gamma = -1.9 \pm 0.3$?

Asatiani: For the energy 800–3,500 Bev.

Clark: Do you plan to measure the polarization at higher energies?

Asatiani: It is not clear now, it is interesting, but very difficult.

Wolfendale, A.W.: What was the value used for the exponent of the production spectrum?

Asatiani: $\gamma = 2.62$ for the diff. spectrum of π-s.