values of muon energies at sea level, 0.2, 0.3, 0.55, 1.05, 1.4, 1.55 Bev. The total number of pictures of the $\mu \rightarrow e$ decay for these measurements is over $4 \cdot 10^4$. The results are cited in the table.

The degree of polarization was calculated from the experimental data by numerical integration and also with the help of the computer "Ural" at the Lebedev Institute of Physics, USSR Ac. of Science. In the right column of the table the expected theoretical values of the muon polarization as calculated by Berezinsky are given[3]). They were received on the assumption of the muon generation by π-mesons with a mov. detailed consideration, then in works by Hayakawa and Goldman[4,5]) of the π-meson generation spectrum at energies up to 10 Bev.

5. From the experimental data the increase in the degree of polarization with the change of muon energy from (0.2–0.5) Bev to (1.4–1.55) Bev is characterized by the factor 1.5–0.18. The authors are thankful to Prof. Alikanian for his attention to this work.

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INTERNATIONAL CONFERENCE ON COSMIC RAYS AND THE EARTH STORM Part III

III-5-5. The Spectrum of Cosmic Ray Muons and Protons Near Sea Level*

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Introduction

The momentum spectra of the fast particles at sea level are fundamental constants of cosmic rays. By comparing them with other spectra, such as the primary spectrum, information can be gained on nuclear processes at high energy.

Experimental Arrangement

The experiments have been carried out using the Durham Cosmic Ray Spectrograph. This instrument comprises four detecting arrays, two above and two below a large electromagnet (Fig. 1). Each array consists of a tray of geiger counters and eight layers of neon flash tubes. When operated at maximum current the maximum detectable momentum is ~700 Gev/c. Measurements were made on the momentum spectrum of muons using this arrangement. Two experiments were performed to measure the proton flux; in the first, covering the momentum range 0.8–29 Gev/c, a layer of lead was placed above array D and protons were recognised by their absorption. In the second experiment an IGY neutron pile was operated above D and the proton flux was found from the numbers of neutrons produced by proton interactions.

Results

The muon and proton spectra are shown in Fig. 2. The pion production spectrum has been derived from the muon spectrum; representing it by a power law, $N_\pi(p) \propto p^{-\gamma}$, γ is sensibly constant and equal to 2.64 ± 0.05 between 4 and 100 Gev/c. Below 4 Gev/c

* This paper was combined with III-5-21 and presented by A. W. Wolfendale.

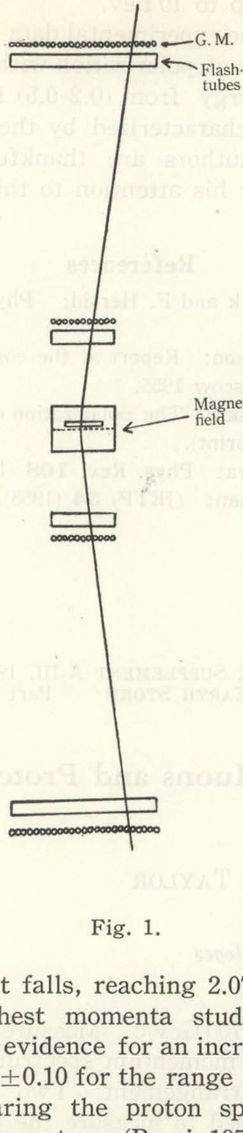

Fig. 1.

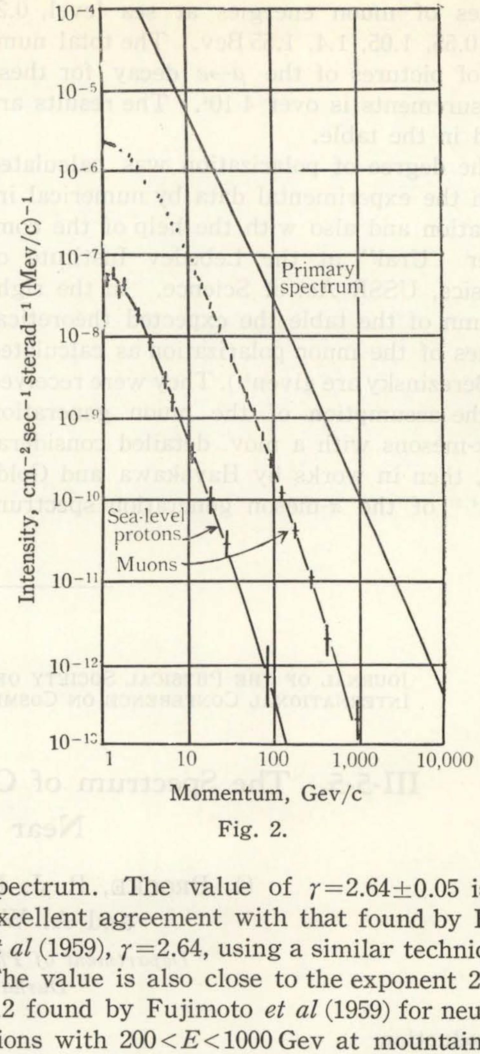

Fig. 2.

the exponent falls, reaching 2.07 at 2 Gev/c. At the highest momenta studied there is some slight evidence for an increase in slope; thus $\gamma=2.67\pm0.10$ for the range 70–700 Gev/c.

By comparing the proton spectrum with the primary spectrum (Rossi, 1959-Fig. 2) the attenuation length for the nucleonic component can be derived. Assuming that the spectrum of neutrons above 3 Gev/c is identical with that of protons, the attenuation length is found to vary smoothly with momentum, from 130 ± 5 g/cm² at 3 Gev/c to 100 ± 10 g/cm² at 100 Gev/c.

Conclusions

The quantity of greatest importance is probably the exponent of the pion production spectrum. The value of $\gamma=2.64\pm0.05$ is in excellent agreement with that found by Pine *et al* (1959), $\gamma=2.64$, using a similar technique. The value is also close to the exponent 2.8 ± 0.2 found by Fujimoto *et al* (1959) for neutral pions with $200<E<1000$ Gev at mountain altitudes. The Bristol group (Duthie *et al*, 1961-private communication) find an exponent of 3.5 ± 0.2 for neutral pions but this refers to higher energies, $400<E<1500$ Gev and the present work cannot be regarded as inconsistent with this result.

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