To allow definitive conclusions to be drawn on the dependence of the asymmetry on gelatin content, we are continuing the experiment to improve our statistics.

In addition we processed 1198 π^+-μ^+-e^+ decay events in 4-fold diluted emulsions containing triethanolamine $(C_2H_4OH)_3N$. The events in which the μ^+-meson stopped in the emulsion surface (the thickness of the end zones was taken as 50 μ of unexposed emulsion) were excluded. The number of unseen decay electrons was 10. In those cases the asymmetry coefficient equals 0.182 ± 0.058.

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OBSERVATION OF NUCLEAR-ACTIVE PARTICLES OF COSMIC RADIATION WITH ENERGY $\geqslant 10^{13}$ ev.

E. A. MURZINA, S. I. NIKOL'SKII, and V. I. IAKOVLEV

P. N. Lebedev Physics Institute, Academy of Sciences, U. S.S.R.

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In Autumn 1957 we measured the flux intensity of high-energy nuclear-active particles of cosmic radiation at 3860 m above sea level.

The detector of nuclear-active particles consisted of seven ionization chambers surrounded by lead (Fig. 1). Six chambers (1 — 6) 150 cm in length, 25 cm wide, and 15 cm high formed the upper part of the detector. This was shielded from above and below by ~45 g/cm² of lead. The dimensions of the lower ionization chamber (7) were 150 × 150 × 15 cm. A graphite absorber of varying thickness (40, 63, 100 g/cm²), covered by 2 cm of lead, was placed above the detector. This was intended to reduce the contribution of the electron-photon component accompanying the nuclear-active particles. Five groups of cylindrical ionization chambers were placed around the detector to record extensive air showers accompanying the high-energy nuclear-active particles in the depth of the atmosphere. The sensitivity and total area of these chanbers made it possible to detect all events in which nuclear-active particles were accompanied by extensive air showers with total number of particles $\geq 3 \times 10^3$.

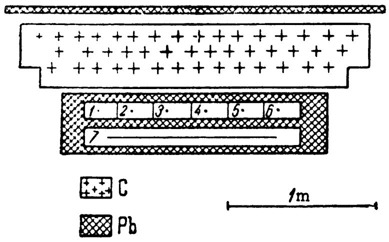

FIG. 1. Detector of nuclear-active particles. Side view.

The size of bursts in all chambers was automatically recorded whenever the ionization in both layers of the nuclear-active particle detector exceeded that due to 1000 relativistic particles. An estimate of the energy of nuclear-active particles producing the observed bursts was facilitated by the fact that we could assume, from the ratio of radiation lengths in lead and graphite, that the majority of nuclear interactions occurred in the graphite, while the electron-photon component, originating in the decay of π^0 mesons, multiplied in the layer of lead of a given thickness. Assuming that 30% of the energy of the nuclear-active particle is carried away by π^0 mesons in a single nuclear interaction and in the ensuing nuclear cascade in a slab of graphite 100 g/cm² thick, we obtain from the electromagnetic cascade theory the following relation between the energy of a nuclear-active particle E and the number of relativistic particles N detected in the ionization chamber under 90 g/cm² of lead:

$$E = N \cdot 10^9 / 0.35 \ln 0.015 N.$$

This expression is valid for $5 \times 10^{11} \leq E \leq 2 \times 10^4$ ev.

An analysis of the experimental data showed that nuclear-active particles with energy $\geq 2 \times 10^{12}$ ev are accompanied in $81 \pm 3\%$ of the cases by extensive air showers with the number of particles $> 3 \times 10^3$. Nuclear-active particles of $\geq 1.5 \times 10^{13}$ ev are accompanied by such showers in $83 \mp 4\%$ of the cases. This shows that the particles are accompanied by extensive air showers almost independently of their energy.

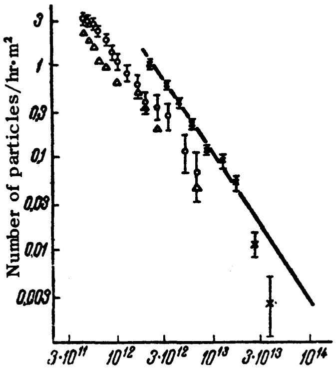

FIG. 2. Integral energy spectrum of nuclear-active particles; o and △ – data of reference 2. The energy of detected particles and the detection efficiency was estimated for the data of reference 1 according to reference 2, and a correction for the difference of observation levels was applied. ×) results of the present experiments.

The integral energy spectrum of nuclear-active particles observed at 3860 m above sea level is shown in Fig. 2. The energy of the particles detected in the experiment was determined according to the relation given above. The detection efficiency was found by comparing the number of ionization bursts under layers of graphite of different thickness. It can be seen from the figure that, in the energy region 10^{12} to 10^{13} ev, the energy spectrum is given by the formula $F(>E) \sim 1/E^{1.53 \pm 0.07}$, which is in agreement with the energy spectrum of the primary cosmic radiation in the corresponding energy range.[1]

It is interesting to note that considerably fewer particles with energy $\geq 3 \times 10^{13}$ ev were found than it could be expected if the similarity between the spectra of nuclear-active particles and of the primary cosmic radiation were extended to that region. The probability that the discrepancy between the observed and expected number of nuclear-active particles with energy $\geq 3 \times 10^{13}$ ev can be explained by statistical fluctuations is less than 3%. This result indicates clearly that the character of nuclear interactions changes at $\sim 3 \times 10^{14}$ ev.[3] According to this assumption, primaries of $> 3 \times 10^{14}$ ev lose their energy on the production of secondary particles in the first interaction and are absorbed in the atmosphere sooner than particles of lower energies.

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ELASTIC SCATTERING OF 5 TO 22 Mev POSITIVE PIONS BY CARBON

V. G. KIRILLOV-UGRIUMOV, L. P. KOTENKO, E. P. KUZNETSOV, and F. M. SERGEEV

P. N. Lebedev Physics Institute, Academy of Sciences, U.S.S.R.

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The cross sections for the elastic scattering of pions by light nuclei at energies above 30 Mev have been obtained experimentally. It was difficult to investigate the scattering of slower pions by the method previously used, although such data are required to give a complete picture of interactions between pions and nuclei. Low-energy pion scattering is naturally studied in light nuclei, where the Coulomb forces are relatively small. We have investigated the elastic scattering of 5- to 22-Mev pions in carbon, using a 750 cm^3 propane bubble chamber.[1] The chamber was irradiated by a positive pion beam from the synchrocyclotron of the Joint Institute for Nuclear Research. The investigated energy interval corresponds to residual pion ranges in propane from 0.125 to 2 g/cm^2. Pions were identified from $\pi \rightarrow \mu \rightarrow e$ decay after stopping in the working material of the chamber. We used 5675 photographs of tracks of pions stopped in the chamber in the analysis. We did not study star production by 5- to 22-Mev pions. It must be noted that the observed scattering of 5- to 22-