CHARACTERISTICS OF ANOMALOUSLY HIGH MULTIPLICITY COSMIC RAY INTERACTIONS.

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Six events with the number of secondaries ranging from 250 to several thousands have been registered by means of the installation consisting of a thin graphite target above and under which were placed photolayers followed by the usual lead X-ray film and emulsion chambers. Data concerning the number of secondaries and their angular distribution are given. A comparison of the variance of the angular distribution with that obtained at accelerator energies is made.

It was planned to create the experimental installation described in paper [I] at cosmic ray station (3340 m above sea level) of HEPI of Kazakh Academy of Sciences. The altered version of such full-automatic installation has been created in I984 [2] . It consists of a replaceable target, the X-ray film and emulsion chambers (XREC) and of the ionization calorimeter (total absorber spectrometer) with the area being equal to 44 m^2. While this installation was putting into the operation an experiment using XREC consisting of the graphite target of 5 cm thickness above and under which were placed photolayers followed by the layer of lead of 3 cm thickness and by other photopackets was in progress. Each photopacket contained two sheets of bilateral X-ray film RT-6 and one sheet of nuclear emulsion R-2T. The aim of the experiment was the searching of high multiplicity cosmic ray interactions the existence of which was indirectly confirmed by extensive air showers (EAS) data analysis (see, for instance, [3]). The idea of this experiment has been proposed in [4] , where, in particular, the ground for the choice of a target thickness has been made.

The total exposure time and the area of the installation are equal to 83.8 m^2 year. Under the target we have registered 6 dark spots which could not be explained by trivial reasons: mechanical action on the X-ray films or electrization processes. The fact that the spots are formed by charged relativistic particles is confirmed by the examination of nuclear emulsion under a microscope. One does not able to find by the naked eye any dark spots on the X-ray film placed above the target. This means, that if there exists some microstructure of EAS, the particle density will be less than 200 particles per I mm^2. At present only the photomaterial placed under the target has been treated utterly.

The scanning of X-ray films was performed by means of laser beam of 20 microns in diameter on the special installation created at HEPI of Kazakh Academy of Sciences [5]. The calibration of readings (calculation of darkness density and charged particles density) was made by control X-ray film which were obtained by fixed flux of charged particles from a radioactive source, by dark spots from electromagnetic cascades with known darkness density, and also by direct comparison of readings with the number of particles registered in nuclear emulsion. Some characteristics of the events found are given in the table.

Table.

I	2	3	4	5	6
240	750	3800	I040	2500	950
0.4±.08	0.32±.08	0.48±.06	0.3I±.07	0.35±.06	0.33±.07

The number of particles in the spots was evaluated by the dependence of their number N(⩽R) in a circle of radius R on the value of R (Fig.I). The variance of the angular distribution has been found as follows. If H is the height from the generation point to the observation level, R_i - is the distance of i-th particle from the centre of gravity of all secondaries, then R_i/H $tg\theta_i$, where θ_i is the emission angle of i-th particle in the laboratory system, and $\log R =$ $= \log \tan \theta_i + \log H$ distribution is actually the angular distribution of secondary particles in $\log \tan \theta_i$ coordinates displaced for the given event by the constant value log H (Fig.2).

If the registered dark spots are actually the result of inelastic interactions, then one can evaluate the lowest limit for primary energy. Considering the secondaries as pions and assuming that the coefficient of inelasticity is equal to unit as well as that transverse and longitudinal momenta in CMS are equal, we get $E_{o\ min} \cong 800$ Tev, if $P_{\perp} = 0.4$ GeV/c. Fig.3 shows the dependence of the variance σ of the angular distribution on primary energies according to the data of [6].

The value of the variance of the summarized angular distribution for all six events is also shown. Fig.4 gives the dependence of σ on the multiplicity of secondaries $n_{\pm}$ at 200 GeV and at more high energy. One can see, that σ -values do not depend within experimental errors on the multiplicity of secondaries, but they are systematically lower than those at our energies. We emphasize once again that if the observed dark spots in X-ray film are produced by inelastic interactions in the target, then these events not only confirm the existence of high multiplicity inelastic interactions, but also show that the variance of the angular distribution of secondaries can be essentially changed at superhigh primary energy.

The analysis of such events will of course be continued.

References

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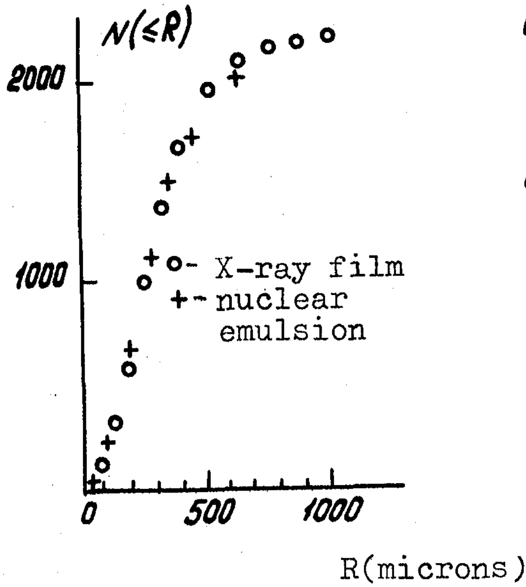

Fig .I

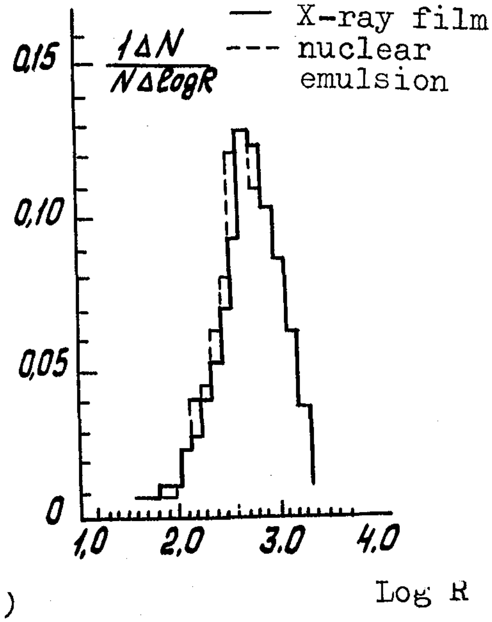

Fig.2

Fig.2. The angular distribution of charged particles for one of the events.

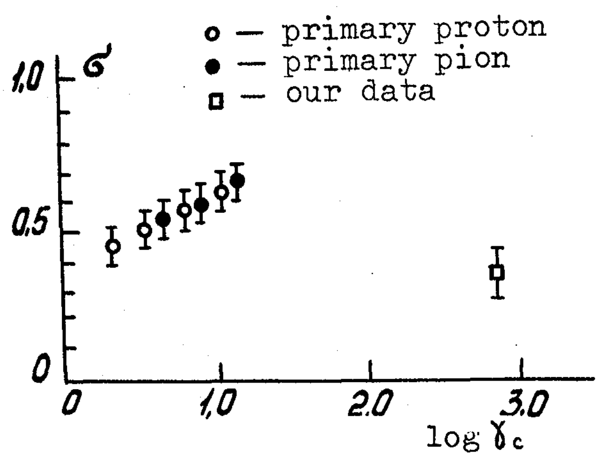

Fig.3

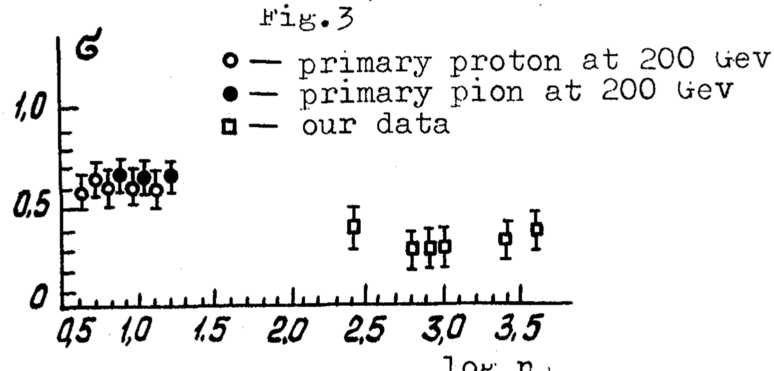

Fig.4