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-4-24. Observation of Air-Shower Cores Near Sea Level

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An array of 27 ionization chambers has been used to observe the density distribution of particles near the axis of small air showers ($N=10^5$). The results for the first ten events (near hits) can be described by Nishimura-Kamata distributions with age parameter, s, greater than one. A cloud chamber at the center of the array was used to measure the intensity of the mu-meson and of the nuclear-interacting components. The statistics of the first ten events permit only rough determinations of these intensities.

The lateral distribution of particles incident from the air has been measured for individual showers by means of pulses generated by the passage of the particles through ionization chambers. Since the ionization chambers have thin aluminum walls, the transition effect is small. A plane view of the arrangement of the chambers is shown in Fig. 1. A trigger was provided by a coincidence between two scintillators that were placed between chambers 5 and 16 and the central array. The increase of particle density with decreasing distance from the shower axis together with the rapid increase of number of showers with decreasing size gave the usual bias in favor of showers striking near the scintillators and hence near the array of ionization chambers.

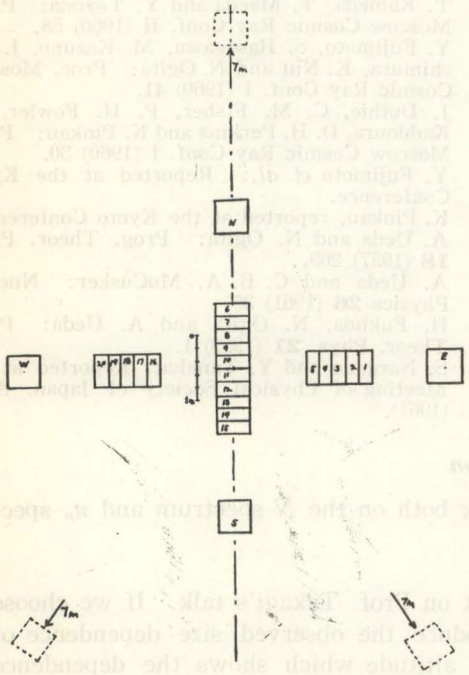

Fig. 1.

The range of pulse heights that could be measured was extended by changing the amplifier gain at the instant the pulses reached their maxima. Thus, pulse heights corresponding to a range from one particle per chamber to several hundred per chamber could be read with usable accuracy.

The Nishimura-Kamata distributions were used as empirical curves for the lateral distribution of particles. The effect of the finite area of the detectors was introduced. The best fit to the data, both for shower size and for shower location, was found by visual inspection.

During the first period of seven weeks operation ten showers that struck within about two meters of the center of the array triggered the array. A preliminary evaluation of these ten showers shows that their density distribution can be described by Nishimura-Kamata distributions with age parameter, s, between 1.2 and 1.5 for distances equal to or less than a few meters from the center of symmetry. The size of these showers (again using the Nishimura-Kamata distributions) was in the region of 1 to 5×10^5 particles. Two of the events are illustrated in Figs. 2 and 3. The curves represent the particular distributions that were chosen to represent these two events.

A multiplate cloud chamber containing a total of 5 inches of lead plates and shielded from the electron-photon component by lead

absorber above the cloud chamber was operated below the center of the array. The dimensions of the illuminated region were 0.25 by 0.8 m in the horizontal plane. The chamber was triggered by the ionization chamber trigger. The photographs are being analyzed for the mu-meson and the nuclear-interacting components in cases where the showers struck close enough to the ionization chamber array so that the position and size of the shower were determinable as above (about two meters maximum distance from the center of the cloud chamber).

The results for the ten events that have been analyzed thus far are shown in Fig. 4. Showers of all sizes from 1 to 5×10^5 particles are put in a single group, since the smallness of the number of events analyzed to date does not justify subdivision. It is seen from the figure that the density of mu-mesons is about 5 m^{-2}, which is about 12% to 1.5% of the electron density at two meters from the axis. The energy of these mu-mesons is greater than 4×10^8 ev. The intensity of the nuclear component with energy greater than about 10^{10} ev is about six times less than the intensity of the mu-component in the region of a few meters from the axis. The statistical uncertainties are large and will be improved as the main body of data is analyzed.

All events thus far can be described by a distribution with a single "core", *i.e.*, a single axis of symmetry.

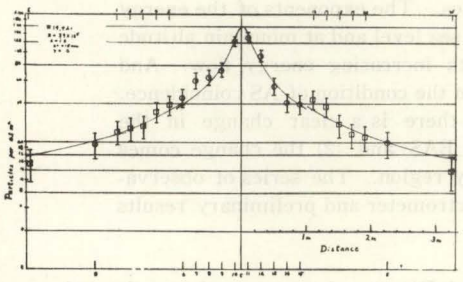

Fig. 2.

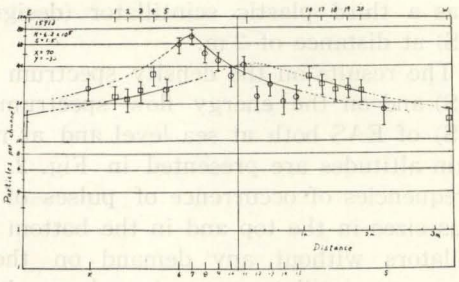

Fig. 3.

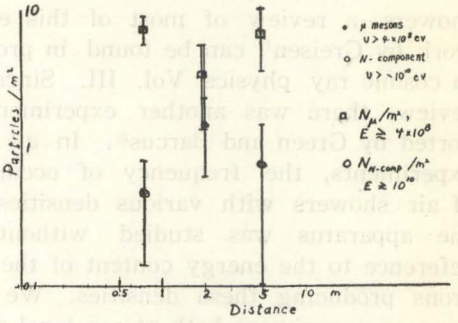

Fig. 4.

Discussion

Tanaka, Y.: As far as the lateral distribution within a few metre from the axis is concerned, deviation from the theoretical curve with single *s*-value is expected for several reasons. Your result seems to be in good agreement with the result of Tokyo experiment.