

Lateral Distribution of Electrons of Air Showers

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ABSTRACT

Lateral distribution of electrons (abbreviated to LDE) of the air showers of size $10^5 \sim 10^6$ was studied within one MU.

The results are summarized as follows:

- i) LDE of the air showers observed is well represented by NKG function except for vicinity of the core,
- ii) LDE measured by thin scintillators does not differ from that measured by thick ones of 50mm thickness.

1 Introduction. Lateral distribution of shower particle is usually approximated by NKG function. However, several authors reported recently that the lateral distribution is not expressed by NKG function of single age parameter, and that number of particles measured by scintillator of 50 mm thickness distorts remarkably the lateral distribution near the core of air showers because of multiplication of the particles in scintillator (1)(2). Basing on these results, change of age parameter with distance from the core and its physical meanings are discussed among some researchers of air showers.

LDE of the air showers within one MU from the core and the effect of thickness of the scintillators on the lateral distribution were studied by the air shower array of Kobe University. The latter is investigated by means of scintillators of various thickness. From the results obtained by these measurements; change of age parameter with the distance from the core (local age parameter) is obtained.

2. Experiment and Results. Nine plastic scintillators of area 1 m^2 and thickness of 50 mm and 67 plastic scintillators of area 0.25 m^2 and thickness of 50 mm were used for the measurement of densities of charged particles of air showers of size $\geq 10^5$, within 1 MU from the core. In addition to these scintillators, scintillators of various thickness were placed among

them to study the effect of the thickness of scintillators on densities of particles (3).

Assuming LDE is expressed by NKG function, NKG function of best fit for individual shower was obtained. The shower array of Kobe University and the method of best fit were reported in detail elsewhere (4).

About ten thousands showers were observed during the period from December 1983 to June 1984.

The average LDE of showers of size $10^5 \sim 10^6$ and less than 30° of zenith angle normalized to the showers of size 10^6 are shown in Fig.1 for several sections of age parameter. Solid line in the figure is NKG function of mean age parameter for the showers classified in each section. Number of particles is corrected for the transition effect using the correction formulae (4).

From the figure, it is pointed out that LDE is well represented by NKG function except for the showers of $1.4 \leq s \leq 1.6$ and for distance within 3 m from the core. Large disparity of showers of the latter from NKG function of the same age parameter is considered to be caused by any small samples of showers, or the inadequateness of the method of best fit for these showers, or any physical reason, but nothing is known now definitely.

In Fig.2, are shown the average LDE of showers, which are measured by thin scintillators and have size $\geq 10^5$, zenith angle $\leq 30^\circ$, and age parameter $1.0 \leq s < 1.2$. The figure indicates that LDE is not different from those in Fig.1.

This result obviously show that the effect of the thickness of scintillators on density measurement is so small that one may safely use thick ones of 50 mm thickness. The local age parameter defined by Capdevielle and Gawin is obtained basing on LDE in Fig.1 and Fig.2 (5). The results are shown in Fig.3 and Fig.4. Local age parameter decreases slowly with increasing distance from the core, and farther than 3 m it is nearly constant, and does not show any tendency of decrease. Furthermore, local age parameter obtained by thin scintillators does not show any remarkable difference from that obtained by the scintillators of 50 mm thickness.

These results reveal that the variation of thickness of the scintillators does not significantly affect the value of age parameter, and that NKG function approximates well LDE.

3. Conclusion. LDE of air showers is approximated well by NKG function except for the neighborhood of the core and for the showers of old age parameter. Change of local age parameter is not recognized but for the vicinity of the core, and this shows the validity of approximation of LDE by NKG function of single age parameter. LDE obtained by thin scintillators does not differ largely from that obtained by those of 50 mm thickness, and this result shows that multiplication and absorption of particles in the scintillators are not so large.

Our results are in disagreement with those of Akeno group with respect to the variation of local age parameter and the

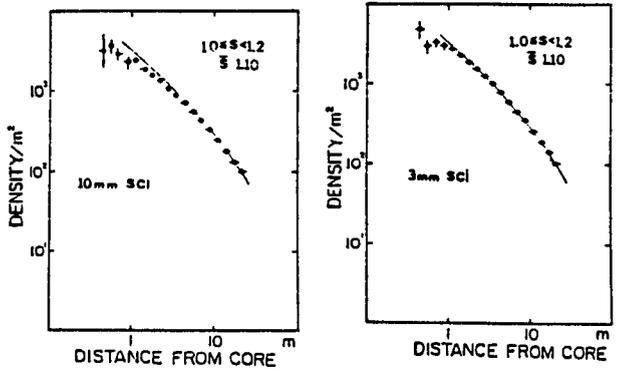
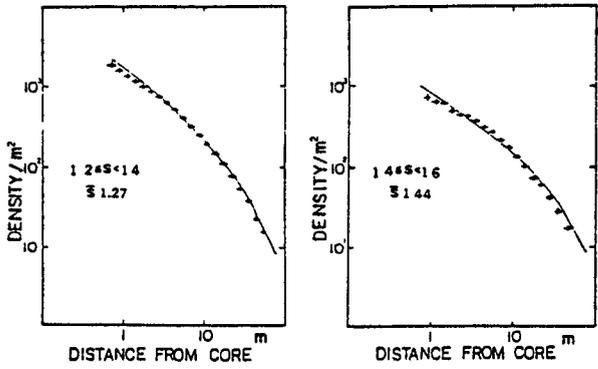
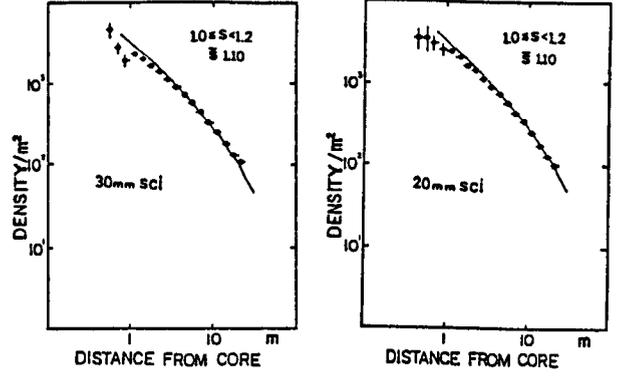
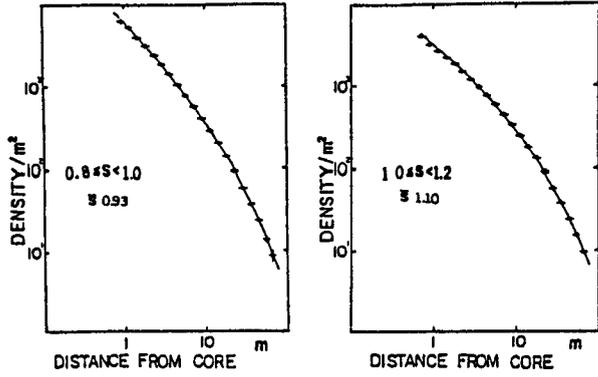


Fig.1

Fig.2

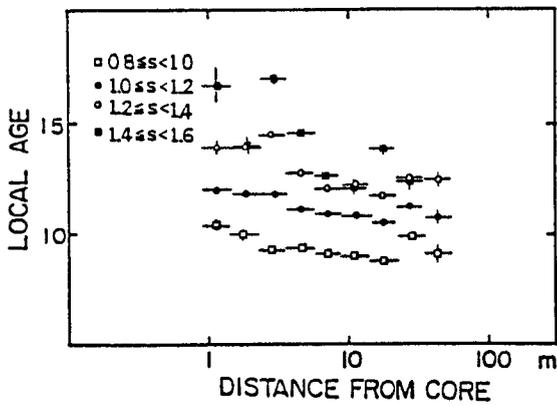


Fig.3

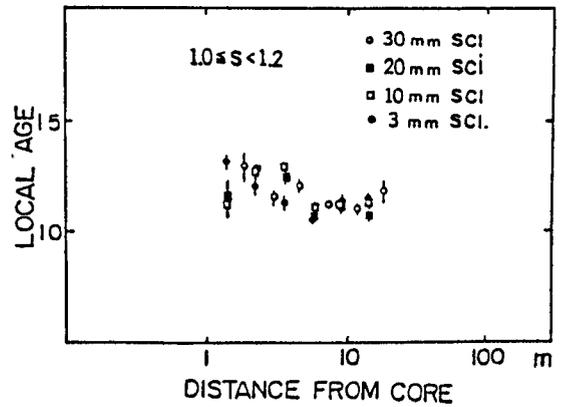


Fig.4

effect of the thickness of scintillators. Disagreement is considered to be caused by large spaces among detectors used by them, and it makes difficult to reveal the detailed information near the core. It is necessary to make spaces of detectors small as possible in order to determine precisely LDE near the core.

References

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