LATERAL DISTRIBUTION OF CHARGED PARTICLES IN EAS

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1. Introduction. The calculations of lateral distribution of charged particles which allow for the finitness of energy of γ-quanta /1-3/, the inhomogeneity of the atmosphere /3,4/ and the experimental selection of EAS /5/ are needed to interpret correctly the experimental data /6,7/.

In /8,9/ calculations have taken into account the effect of finitness of energy of γ-quanta which produce the partial electron-photon cascades by substituting KR_m instead of R_m in NKG approximation where K has been found to be 0.56 from comparison with the experimental data. In /5,10-12/ new results on the lateral distribution of electrons in the partial cascades from γ-quanta have been obtained. The analysis /5/ of results /11,12/ showed that the coefficient K can be regarded as a constant with the error of 5-10%. In /5/ the calculations have been carried out for such values of K as 0.75; 1, and $K = 1-0.5(1-y/16)$ for $y \leq 16$ and K=1 for $y > 16$ where $y = \ln(E_\gamma/1\ \text{GeV})$. The last approximation of K was found to be most adequate from the comparison with the experimental data /6/ and it is used in this calculation. In /5/ the inhomogeneity of the atmosphere, muons and experimental selection were taken into account. In /5/ the calculation were done for EAS with size $Ne = 10^7$ at sea level. In this paper we extend the calculation on Ne from 10^5 to 10^7 for sea level and for Akeno level (920 $g.cm^{-2}$).

2. Model and Method. The calculations were carried out in terms of the quark-gluon string model for hadron-hadron interactions /13-15/. The lateral distributions were calculated for primary protons and nuclei with A= 4,14,31,56 and the normal compositionΣ. The energy spectrum index

was taken $\gamma_1 = 1.7$ at $E_1 \leq 3.10^{15}$ eV and $\gamma_2 = 2.2$ at $E_2 \geq 10^{16}$ eV with smooth change between these two energies. The method includes the calculations of the two-dimensional functions and correlation matrixes for fixed Eo following by use of Bayes theorem and gaussian approximation for calculated functions to get the functions for fixed Ne and the zenith angle θ /16,17/. To allow for experimental selection the calculated functions for fixed Ne and θ were integrated on Ne and θ /5/. The experimental errors were taken into account by summing the physical correlation matrix with the matrix of errors, which consist of errors of $\sigma_{Ne}/N_e = 25\%$, $\sigma_{\rho_e}/\rho_e = 15\%$ and $\sigma_r/r = 10\%$ where ρ_e- density of electrons and r is distance from the shower axis. The approximation $R_m = 1.1\ R_m$ have been used to allow for the inhomogeneity of the atmosphere. The density of > 0.3 GeV muons and additional 27% of muon density to take into account the decay electrons and δ -electrons (according to our analysis and /18/) were added to electron density to get charged particle density.

3. Results and Conclusions. In Fig. 1 the calculated lateral distributions of charged particles for sea level are shown together with the experimental data /6/. One can see that in the limits of experimental errors the normal and proton primary compositions may agree with the experimental data /6/. Fig. 2 shows the analogous calculated functions for 920 g/cm^2 and Akeno experimental results /7/. To get the better agreement this time one should use a more steep electron lateral distribution ih pure electron-photon cascades from γ-quanta than we have used. But our conclusion about primary composition made for sea level data is kept.

The authors wish to thank Prof. G.B.Khristiansen for informative discussions.

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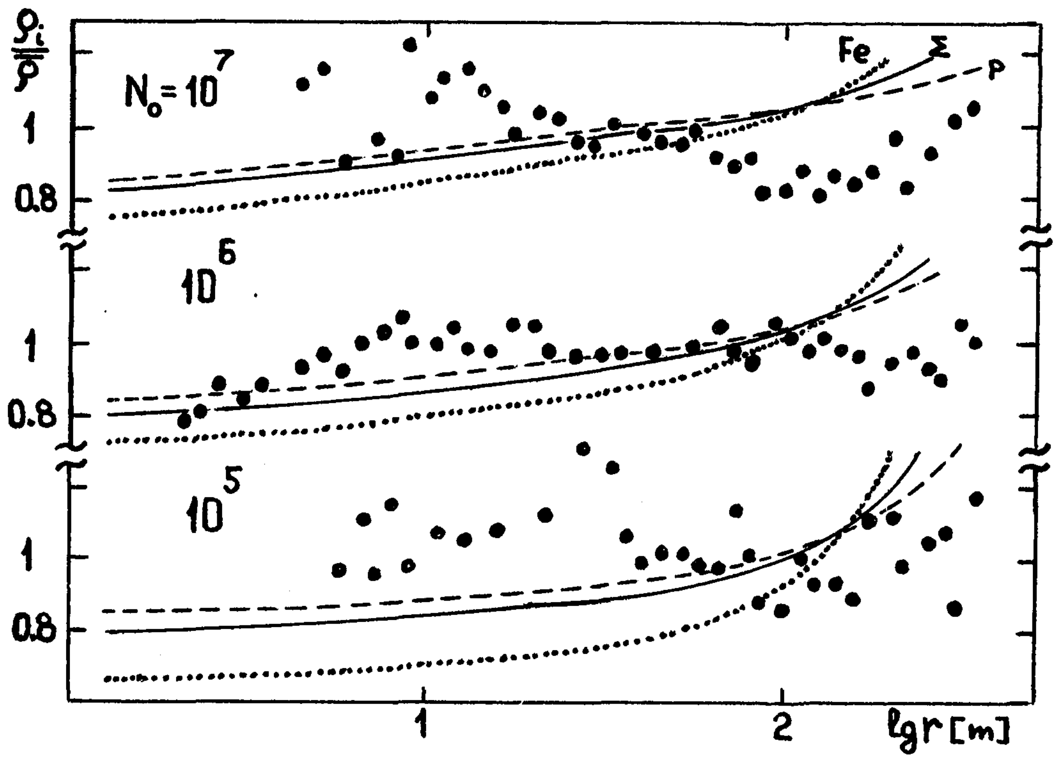

Fig.2. The lateral distribution of charged particles at 920 g cm^{-2}
$(\bar{\rho} \sim (r/r_0)^{-\alpha}(1+r/r_0)^{-\beta},\ \alpha=0.96, \beta=3.06, r_0=91.6\ m)$

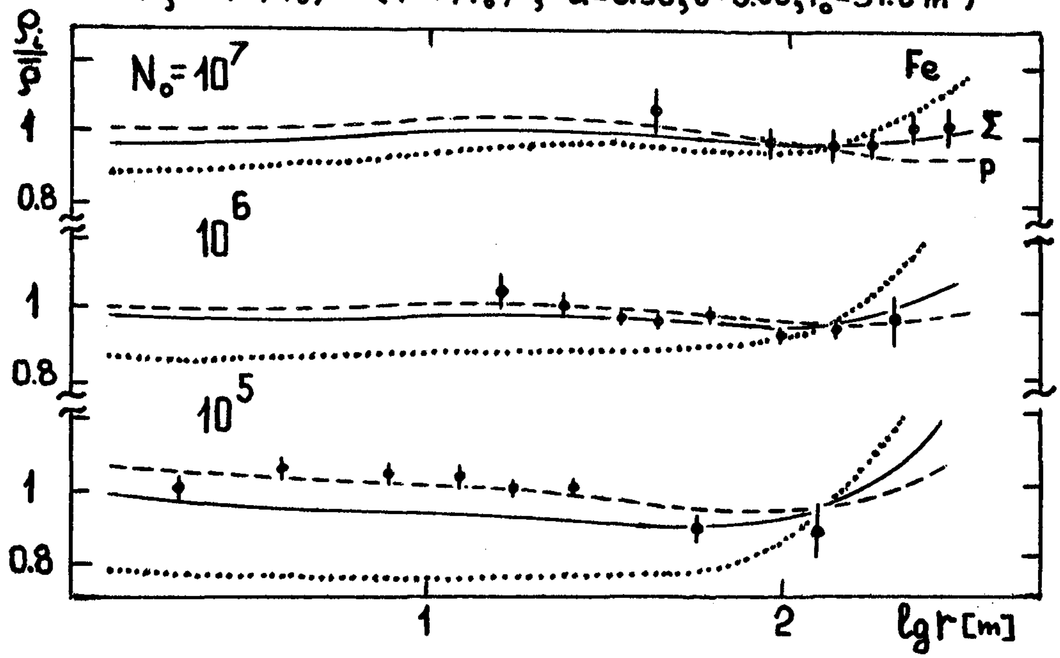

Fig. I. The lateral distribution of charged particles at sea level
$(\bar{\rho} \sim (r/r_0)^{-\alpha}(1+r/r_0)^{-\beta},\ \alpha=0.9, \beta=2.8, r_0=80\ m)$