Proceedings of ICRC 2001: 217 © Copernicus Gesellschaft 2001

ICRC 2001

Core structure of EAS at Akeno

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Abstract. Core structure of EAS (primary energy above 10^{16}eV) has been observed at Akeno since 1991. The experimental data indicates that the fluctuation of particle density near to EAS core increases with shower size more than latter half of 10^6 and muon size more than middle of 10^5. The results were compared with simulation using CORSIKA.

1 Introduction

For the study of ultra high energy particle interaction, we have investigated the EAS core, which seems to mainly reflect the behavior of the interaction. Also the primary composition may influence the core structure. So we aim to establish the phenomenology of the EAS core structure and discuss the high energy interaction and primary composition.

2 Experiment

In the central laboratory in Akeno 1km^2 Array , 64 0.25m^2 Scintillation detectors are placed on a lattice 8×8, and 1m separation(Sakuyama, 1997). The Linearity characteristics of PMT for each detector are measured by using Blue LED and dynamic range is about 4.5 orders. The triggering condition is 3 scintillation detectors should have greater than 100 particles and triggering rate is about 3 per hour.

The information of EAS is obtained from Akeno 1km^2 Array.

3 Data Analysis

The data obtained from March 1993 to May 1999 are analyzed. And shower size > 10^6 and the core hit within 64 scintillation detectors are selected. So, we have analyzed for 131 showers. For the parameter of the core structure, we used the Relative Deviation(RD) that is the ratio between average particle number and standard deviation near to core (1 – 8 m). And relation between shower size or muon size and RD are discussed (Sakuyama, 1997,1999).

4 Results and Discussions

The recent results of relation between RD and shower size are shown in fig.2. It seems to increase as shower size. Using CORSIKA (QGS version) simulation code, assuming the primary particle proton and iron that energy range is 10^{16} eV – 10^{17}eV compared with this result. This time, the particle number and the

sum of energy which are hit within each detector are discussed. The tendency is different from the experimental results. When the particle number is seen, since particle number which enters the detector with the size increases, fluctuation tends to decrease. Though the value of RD tends to similarly decrease with the size, even if the sum of the energy, the value is bigger than RD by particle number. The distribution of the high energy particle seems to affect RD. Of the iron compared to the result of the proton , It is thought, as the proportion of the muon with the high energy is abounding for the value of RD being big. Further examination is necessary in order to compare with the experimental result.

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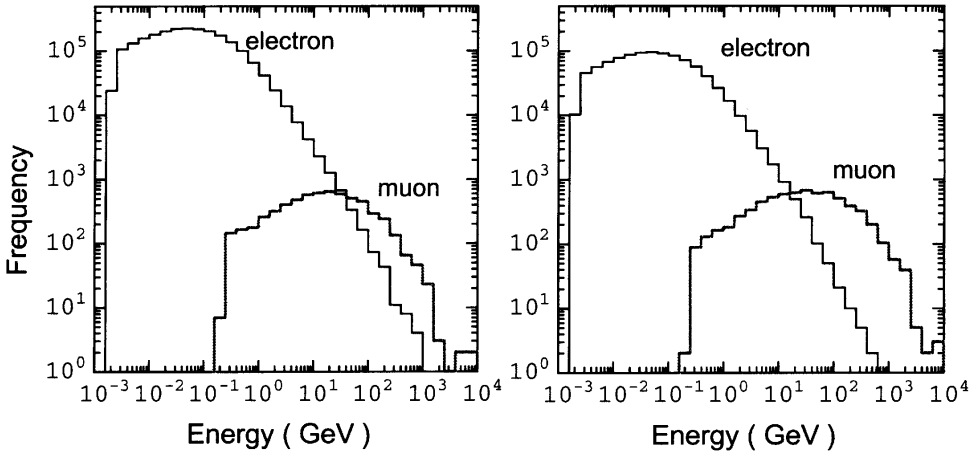

Fig.1 Distribution of energy each of electron(> 3 MeV) and muon(>300 MeV) (simulation results)
left side : Proton primary (Energy : 4.11×10^{16} eV, Shower size : 1.03×10^{7})
right side : iron primary (Energy : 7.71×10^{16} eV, Shower size : 5.87×10^{6})

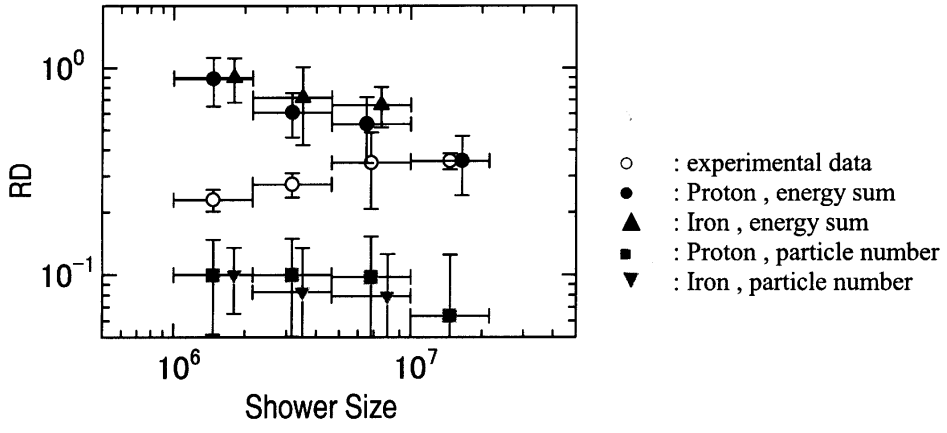

Fig.2 Relation between RD and shower size.