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X-RAY FILM CHAMBER WITH CARBON TARGET OF TIEN-SHAN COMPLEX ARRAY

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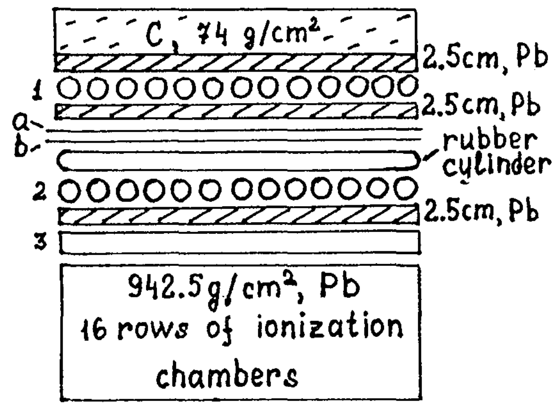
The experiment was carried out at Tien-Shan highmountain station. X-ray films were exposed inside the ionization calorimeter under 74g/cm^2 of carbon and 5 cm of lead. The X-ray film chamber area is 36 m^2. To perform more reliable time selection of events in this experiment moving X-ray films have been used. 50% of events, in which we succeeded to determine incidence time, were identified with corresponding EAS. For such events the size spectrum of associated EAS was derived. Two methods of energy measurement using X-ray films (E_X^γ) and ionization calorimeter (E_{jet}^γ) have been compared. We obtained that $E_x^\gamma / E_{jet}^\gamma = 0.95$. In this work the plot is presented to illustrate energy transfer from selected hadron to electromagnetic component. We find cascades with high energy release into electromagnetic component and in which the hadron component is practically absent.

The experiment was carried out at Tien-Shan hihgmountain station /1/. The complex array included the big ionization calorimeter (BIC), the scintillation set for the size shower (N_e) determination with $N_e \geq 5 \cdot 10^4$, the central hodoscope for the size shower determination with $N_e < 5 \cdot 10^4$, the chronotron for the arrival angles detecting of EAS etc. The big ionization calorimeter consists of the 19 rows of ionization chambers, its thickness is 1040 g/cm^2. The area of calorimeter is 36 m^2. The dead time of recording system of EAS data including calorimeter data was 17.5%. The BIC construction with the X-ray film chamber (X-chamber) is shown in Fig.1. Time selection of the events found in the X-chamber was performed. For this purpose the upper layer of the X-ray film was moved on several centimetres along the lower layer and a special time mark was put on the upper layer. When an electromagnetic casade (EMC) crosses the both layers of the X-ray film, it marks them. Putting then together the two dark spots formed by the same EMC we can find the upper layer shift value along the lower layer. The incidence time was determined by the shift value. The accuracy of incidence time determination is several days in our experiment.



1,2,3-the ionization chambers
a-upper moving layer of X-ray films
b-lower moveless layer of X-ray films

Fig.1.Construction of BIC with X-ray films (side view).

Every day the ionization calorimeter was stopped for several hours for the purpose of the maintenance and checks. To correlate the running time of X-chamber and ionization calorimeter EMC were not recorded on the X-ray films when calorimeter stopped running. That has been made as follows.

As one can see in Fig.1 the rubber cylinders were placed under the X-ray films. They had been pumped up to some surplus pressure, that caused the close contact between X-ray films and the lead plates. If the cylinders were not pumped up, air clearance was formed between the X-ray films and the lead. The EMC electrons are dispersed in the clearance and the marks did not arise.

The ionization calorimeter and the X-chamber run together for 2600 hours. The handled area of the X-ray films is 18.8 m^2. We have determined incidence time at 300 events which have been found in the X-chamber. 50% of these events have been combined with corresponding EAS. Some results of 150-event analysis are presented in this paper.

The X-ray films have been handled by the method used in the Pamir experiment /2/. The energy of EMC has been determined by means of theoretical curves calcucated for primary photon /3/.

The EAS size (N_e) was obtained by scintillation counter data for $N_e \geqslant 5\cdot10^4$. The size of small EAS was determined by hodoscope data according to the following expression

$$N_e \approx 10^3 \frac{K(\theta)}{\sigma_0} \ln\left(\frac{n}{n-m}\right),$$

where σ_0-the hodoscope channel area, $K(\theta)$-a coefficient depending on the arrival angle of EAS, n - the total number of channals, m -the number of fired channals.

The ionization calorimeter data have been handled as follows. The jet corresponding to the event found in the X-chamber have been separated in the ionization calorimeter. For these jets the energy E_{jet} and the energy E^{γ}_{jet} transferred into first electromagnetic peak have been calculated.

Two methods of the EMC energy measurement using the X-ray films (E^{γ}_{x}) and using ionization calorimeter (E^{γ}_{jet}) have been compared. For this purpose the hadron jets satisfying the following criteria have been selected:

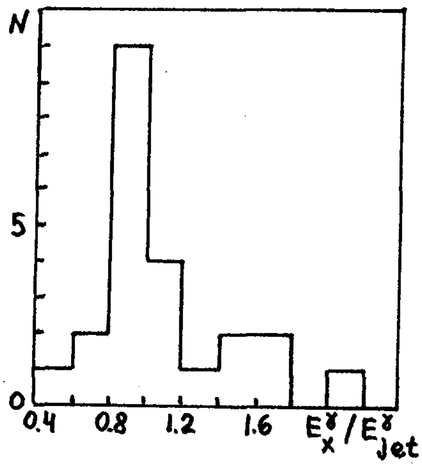
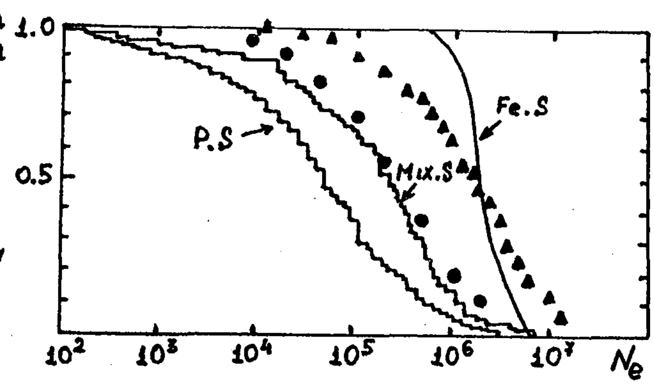


Fig.2.

1. The ionization in the first row chambers is less than that in the second row chambers of the calorimeter. This condition selects the events with a small contribution to the ionization from the cascades caused by low energy particles of EAS.
2. The energy, transferred into the first electromagnetic peak is about half part of the jet total energy. This condition allows us to escape the influence of the secondary interaction in the lead on the determination of the EM peak energy.
3. The shape of experimental electromagnetic peak is close to that of calculating curve for primary photon /4/. There are no obvious secondary interactions.

The 23 events satisfying these conditions have been selected. The ratio of the energy determined by X-chamber (E_X^γ) to the energy determined by the calorimeter (E_{jet}^γ) is presented in Fig.2. The mean value of this ratio is 0.95. According to these data one can say that there is quite good agreement of these two methods of the energy measurement.

The shower size spectrum of associated EAS was derived on the basis of the obtained data. Similar distribution has been obtained in the work performed at the Norikura mountain /5/. Comparision of the results is presented in Fig.3. The shower size of our experiment does agree with the simulation for Mixed primary mass composition and the scaling model /5/ and differs from the Norikura experimental result.



▲ - $\Sigma E_{\gamma,H} \geq 10$TeV, $n_{\gamma,H} \geq 1$, Norikura/5/
— - simulation, S implies a scaling model /5/
● - $\Sigma E_X^\gamma \geq 10$TeV, $n_X^\gamma \geq 1$, our experiment

Fig.3. Normalized integral size spectrum of showers combined with γ,H-families ($\Sigma E_X^\gamma \geq 10$TeV).

Fig.4 shows the E_{jet}^γ - E_{jet} plot for our combined events. We find 16 cascades with high energy release into electromagnetic component and in which the hadron component is practically absent, that is $E_{jet}^\gamma \approx E_{jet}$ Out of them 8 events had equal EMC energies determined by means of both

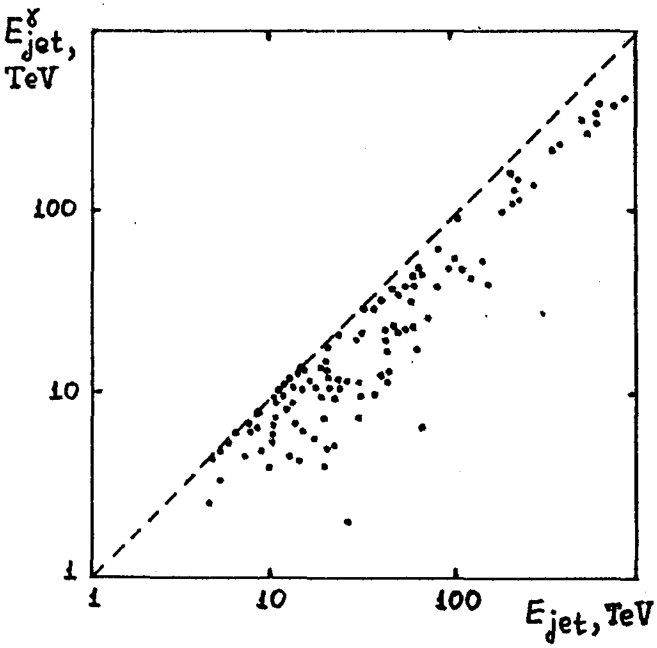


Fig.4.

the X-ray film and the ionization calorimeter (Table 1) that is in these events the hadron energy is transferred most likely into one or two electromagnetic particles mainly. To make the definite conclusion it is necessary to estimate the probability of such events in similar experiments.

Table 1.

No.	ΣE^{γ}_{x}, TeV	E^{γ}_{jet}, TeV	E_{jet}, TeV	n^{γ}_{x}	N_e
1	8.4	9.8	10.4	1	1.6 10^4
2	83.3	87.2	91.7	2	6.3 10^4
3	8.1	4.7	4.9	1	2.9 10^3
4	6.4	7.1	8.1	2	unknown
5	9.8	10.9	11.3	2	4.4 10^4
6	9.2	4.3	4.4	1	1.8 10^5
7	5.5	6.3	6.5	1	3.7 10^4
8	2.9	3.3	3.4	1	1.8 10^4

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