

## ANALYSIS OF THE HADRON COMPONENT IN E.A.S.

OBSERVED AT 700 g.cm<sup>-2</sup> BY A SCALE BREAKING MODEL

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## ABSTRACT

The Tien Shan experimental results about the hadron component in E.A.S. with sizes  $10^4$ - $10^6$  are analysed with help of a scale breaking model. It is shown that the secondary particles multiplicity depends on the interaction energy stronger as predicted from accelerator experiments and the primary mass composition is rich on protons at energies  $10^5$ - $10^6$  GeV

1. Introduction Hadrons in extensive air showers provide direct informations about high energy interactions.

In the rule the biases pertaining to different shower array arrangements have a relative large influence for the basic phenomenological characteristics of the E.A.S. hadron component.

In this situation, the problem of the correct comparison between model calculated and experimental characteristics is of great importance for the reliability of the derived conclusions about the high energy interaction characteristics.

This is why we take carefully into account the triggering conditions of the Tien Shan array and the characteristic procedures for the statistical data treatment.

2. Method The characteristics of the E.A.S. hadron component were calculated on the basis of a scale breaking model under the assumption of a pure proton primary composition.

Details on the model of simulation are given in the proceedings of this conference (HE 5.4-8) and in ref (1).

The different observables computed from simulation charac-

terize the "pure development" of the showers.

Then, to be compared with the results obtained in Tien Shan experiment, pseudo-experimental values were determined with help of the IMEAT algorithm which takes into account all internal characteristics of this array.

By this way we obtained results for showers with fixed sizes  $10^4$ - $10^6$  and with average zenith angle  $\theta = 22^\circ$

### 3. Results

The dependences of hadron numbers  $N_h(>E_h)$  on the shower size were analysed in the size interval  $10^4$ - $10^6$  and at Tien Shan observation level.

Simulations were made for different threshold energies for the hadrons:  $E_h > 0.6$ ; 1 and 10 TeV.

It is seen in fig. 1 that the experimental dependences (2-4),  $N_h \sim N_e^\alpha$  for  $E_h > Tr$ , are much steeper than those predicted from the adopted Scale Breaking Model.

Their comparison with the results

obtained by Erlykin et al. (2) and the analysis of the both models show that the main reason for the discrepancies between the experimental and calculated curves lies in the adopted energy dependence of the secondary particles multiplicity:

$$\langle n_s \rangle = \alpha + \beta \ln s + \gamma (\ln s)^2 \quad (1)$$

For a better agreement with experiment, it is necessary to adopt a stronger energy dependence of the multiplicity. Indeed, our determination of  $\langle n_s \rangle$  coming from the p-p̄ collider is equivalent to  $E^{0.13}$  whereas the multiplicity used in ref. (2) takes into account the p-air interaction and is  $\langle n_s \rangle \propto E^{0.25}$ .

On fig. 2 are shown the integral energy spectra of hadrons for different fixed sizes and at observation level 700 g.cm<sup>-2</sup>

It is seen that the calculated integral spectra  $N_h(>E_h)$  become as expected harder with the rising of the size  $N_e$ .

The shape of the hadron energy spectra in E.A.S. is well described with calculation results, carried out with help of the used scale breaking model (1).

The correct agreement for the shape of these spectra is a good indication for the predominance of protons in the primary mass composition at energies  $10^5$ - $10^6$  GeV.

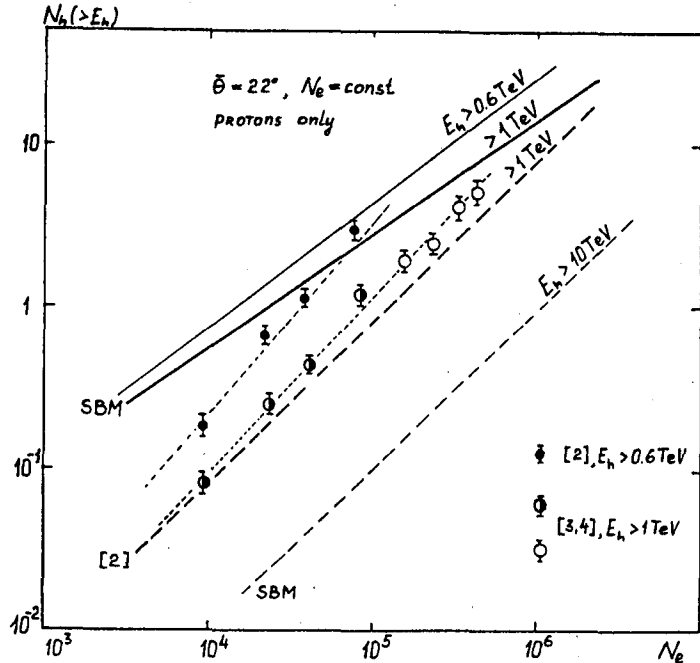


fig. 1

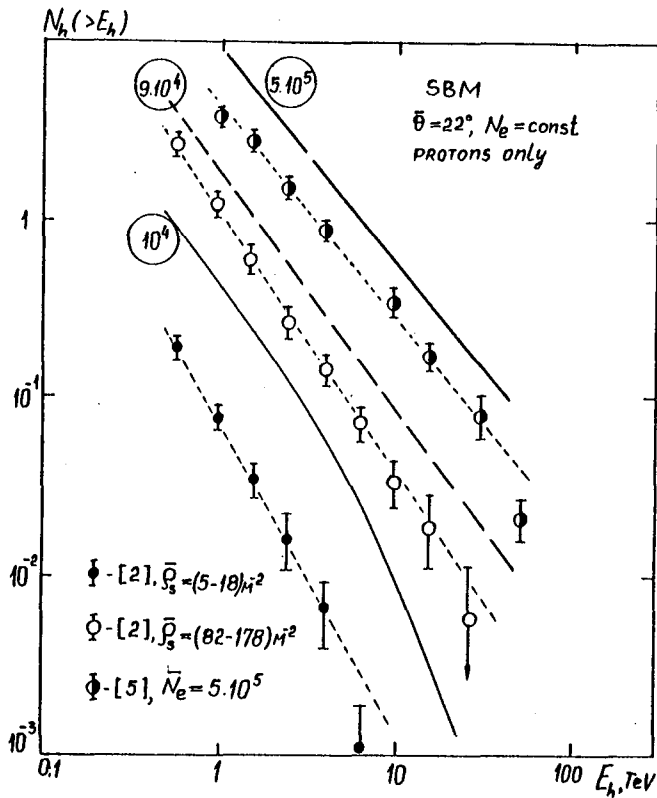


fig. 2

#### 4. Conclusions

The analysis of Tien Shan hadron component data on the basis of the used scale breaking model shows that the average multiplicity  $\langle n_s \rangle$  of secondary particles increases essentially more than predicted by the p-p collider,  $\langle n_s \rangle \propto E^{0.13}$ , under the supposition that the protons play the main role (5-6) in the primary mass composition for energies  $10^5$ - $10^6$  GeV.

#### References.

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