A STUDY OF γ-FAMILIES GENERATED IN NUCLEON-NUCLEUS (NA) AND PION-NUCLEUS (πA) INTERACTIONS

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In the paper the separation of the γ-families generated in NA and πA interactions is realized from the analysis of simulated γ-families. Some characteristics of NA and πA families and the influence of the process of inelastic charge-exchange of charged pions into neutral ones type of $\pi^{\pm}A \to \pi^{o} + \ldots$ are studied.

In the paper the characteristics of γ-families generated in pion-nuclear πA-interactions (π-families) and nucleon-nuclear NA-interactions (N-families) in atmosphere is investigated.

The selecting criteria of π and N-families is proposed from the analysis of γ-families simulated on the basis of scaling CS and CSČ -models.

The CS -model is based on extrapolation to the superhight energies of the interaction characteristics known in the accelerater energies in the assumption of Feynman scaling validity. For that there is made no difference between NA and πA interactions mechanism.

In the CSČ -model the inelastic charge-exchange of leading charge pion into neutral one $\pi^{\pm} \to \pi^{o} + \ldots$ was taken into account. The inelastic charge-exchange probability W is set equal to 0.2 at $x_1 = E_1 / E_o \geqslant 0.5$ (x_1 -Feynman's variable for leading particle, E_o -energy of colliding particle).

The families are considered as a formed mainly in the pion-nuclear interactions (π-families), if the fraction of the energy from pion interactions

$$K^{\pi} = \frac{\Sigma E_{\gamma}^{\pi}}{\Sigma E_{\gamma}} ,$$

where ΣE_{γ}^{π} -the summary energy of the cascades from πA -interactions, was satisfied the relation: $K^{\pi} > 0.5$ .If the value

$$K^{N} = \frac{\Sigma E_{\gamma}^{N}}{\Sigma E_{\gamma}} ,$$

where ΣE_{γ}^{N} -the summary energy of the γ-quanta from nucleon-nuclear cascades, was satisfied the relation: $K^{N} > 0.5$, than such families are considered as a formed in the nucleon-

nuclear interactions (N-families) (ΣE_γ -the total energy of γ-family).

The spatial characteristic of the simulated γ-families $\bar{R} = \sum_{i=1}^{n_\gamma} R_i / n_\gamma$ (where R_i -distanse of γ-quanta from axis of family, n_γ -number of γ-quants in the family) is considered too. The simulated families were selected according to criteria analogous to those in Pamir experiment: the family summary energy $\Sigma E_\gamma = 30 + 500$ TeV, the number of particles $n_\gamma \geqslant 3$, the minimal energy of quanta was equal to $E_\gamma = 2$ TeV, only those quanta is included in families which were found in the round with radius $R = 30$ sm from the center. As we showed in the work /I/, the simulated families with $\bar{R} > 40$ mm mainly consist of the π -families (them fraction compose 70 + 85% for both models), and families for which angles of arrival on plant $\Theta \leqslant 20^\circ$ and $\bar{R} < 20$ mm mainly consist of the N-families. Therefore, those conditions used as a selecting criteria of π and N-families in the work.

The characteristics of simulated γ-families were compared with the experiment "Pamir" data. The film scanning and particle selection were realised within the radius $R = 30$ sm relatively the energy weighted center of γ-family. In the result it were selected $N = 539$ γ-families with energies $\Sigma E_\gamma = 30 + 500$ TeV and number of particles $n_\gamma \geqslant 3$. The minimum energy of the γ-quants in the families was set $E_\gamma = 2$ TeV. At this, the conditions near to experimental in the simulated families were introduced. The registration efficiency of γ-quants $E_\gamma = 2 + 4$ TeV in the energy region change from 0.3 to I.0 . The registration efficiency of γ-families reach I.0 at energy $\Sigma E_\gamma \geqslant 70$ TeV. The error δE in the energy measuring and real spatial resolution of the close situated quants (quants, situated on distanse $r_{I,2} = 40 + 100$ μm with energies $E_I + E_2 = 25 + 50$ TeV, were considered as an unified) were taken account.

In the paper an distributions of families arrived the installation under different angles Θ to vertical investigated. In the experiment the errors of the angles determination for the families arrived under small angles to vertical are large.

The registration probability of γ-quanta decrease in the large angles range $\Theta > 36^\circ$. Therefore, events with angles of arrival situating in interval $9^\circ \leqslant \Theta \leqslant 36^\circ$ were selected for analyse. At this, the error in the angle measuring of the arrival $\Delta\Theta \sim I^\circ$ introduced in the simulated families.

All events divided on the groups of families arrived the installation under angles $\Delta\Theta_1 = 9^\circ + I8^\circ$ (number this families N_I), and arrived under angles $\Delta\Theta_2 = I8^\circ + 36^\circ (N_2)$.

The value

$$F = \frac{P_2}{P_I}$$

where $P_I = N_I/(N_I + N_2)$ -the fraction of families arrived on plant under angles $\Delta\Theta_1 = 9^\circ \div 18^\circ$ and $P_2 = N_2/(N_I + N_2)$ -the fraction of families arrived under angles $\Delta\Theta_2 = 18^\circ \div 36^\circ$ is calculated for families of experiment "Pamir" and simulated families. In consequence an following values F: 0.82 ± 0.08 (CS -model), 1.45 ± 0.15 (CSČ -model) and 1.64 ± 0.16 (experiment) were obtained.

Like that, the experimental data relatively value F agree with CSČ -model.

In the paper the families selected according to selecting criteria of π and N -families ($\bar{R} > 40$ mm and $\bar{R} < 20$ mm) is investigated. At this, for value $\Delta = N_\pi / N_N$, where N_π -number of π -families, N_N -number of N -families the following values were obtained: 0.5 ± 0.07(CS-model), 0.78 ± 0.12 (CSČ-model) and 0.73 ± 0.09 (experiment).

How one can see from analyse of the angulas distributions of γ-families and the correlation between π and N-families, the experimental data are described by CSČ-model in that the inelastic charge-exchange of leading charge pion into neutral one $\pi^\pm \to \pi^0 + \ldots$, was taken account.

REFERENCE

I. S.A.Azimov, E.J.Mulladjanov, H.Nuritdinov, T.S.Yuldash - baev Proc. 18-th ICRC, Bangalor, India 1983, v.5, p.462