ON A POSSIBILITY OF INELASTISITY PARTIAL COEFFICIENT K_γ DETERMINATION IN πC AND πPb INTERACTIONS AT 10^{14} EV (EXPERIMENT "PAMIR" I)

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The investigation of hadron-nuclear interactions in "Pamir" experiment is carried out by means of X-ray emultion chambers of two types: carbon (C) and lead (Pb) ones [1].

While comparing the results from the chambers of both types [2] it was found a discrepancy in $\langle n_h \rangle$ and $\langle E_h^{(\gamma)} R \rangle$ values.

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* This article only

Here $\langle n_h \rangle$ is an average hadron multiplicity normalized to one γ-h-family fitted the following selection criterion A: $\sum E_\gamma \geq 100$ Tev, $n_h \geq 0$, $E_h^{(\gamma)} \geq 4$ Tev; $\langle E_h^{(\gamma)} R \rangle$ is a space-energetic characteristics of hadrons in families fitted the criterion B: $\sum E_\gamma \geq 100$ Tev, $n_h > 3$, $E_h^{(\gamma)} \geq 4$ Tev; $E_h^{(\gamma)}$ is the energy registrated in hadron block. n_h values are corrected on interaction probability in each chamber.

Tables I and II represent our experimental results, where ν and χ parametres defined as

$$\nu = \frac{\langle n_h \rangle_{Pb}}{\langle n_h \rangle_c} \quad (1) \quad ; \quad \chi = \frac{\langle E_h^{(\gamma)} R \rangle_{Pb}}{\langle E_h^{(\gamma)} R \rangle_c} \quad (2)$$

Table I

	N_{fam}	$\langle n_h \rangle$	$\beta - 1$
C	169	3.0 ∓ 0.2	1.0 ∓ 0.1
Pb	41	4.2 ∓ 0.3	1.1 ∓ 0.1
ν	-	1.4 ∓ 0.2	

Table II

	N_{fam}	E R Tev mm
C	33	350 ∓ 30
Pb	22	455 ∓ 70
χ	-	$1,3 \mp 0,2$

N_{fam} is a number of families in C and Pb chambers fitted the above mentioned criteria, β-1 is a slope of integral energy spectrum of hadrons from families selected by A-criterion

In the present paper we connect the observed discrepancy between $\langle n_h \rangle$ and $\langle E_h^{(\gamma)} R \rangle$ in C and Pb chambers with the difference in values of effective coefficients of energy transfer to the soft component K_{eff} for C and Pb chambers. The following considerations can be a ground of this suggestion:

1) It is known that a probability of hadron registration (in case of power like spectrum) is equal to $\langle K_\gamma^{\beta-1} \rangle$. Thus, the ratio of multiplicities

$$\nu = \frac{\langle n_h \rangle_{Pb}}{\langle n_h \rangle_c} = \frac{\langle K_\gamma^{\beta-1} \rangle_{Pb}}{\langle K_\gamma^{\beta-1} \rangle_c}$$

As $\beta - 1 \simeq 1$ (see Table I) we have:

$$\nu = \langle K_\gamma \rangle_{Pb} / \langle K_\gamma \rangle_c \quad (3)$$

2) $\langle E_h^{(\gamma)} R \rangle$ value can be written down as $\langle K_\gamma \rangle \langle E_h R \rangle$ (in case of K_γ independent of E_h). Hence: $\chi = \langle K_\gamma \rangle_{Pb} / \langle K_\gamma \rangle_c$ (4).

To test this considerations some simulations on nuclear electromagnetic cascades in the atmosphere were made on the basis of fireball scaling model (S-model) [3]. Hadrons passage through the chamber was immitated in the simulations. For each hadron the value of K_γ coefficient was found by means of $f(K_\gamma)$ distribution function taken in the form of $f(K_\gamma) \sim K_\gamma^\alpha \cdot \exp(-K_\gamma/\beta)$ [4]. The parametres α and β define the momenta of this distribution. Two series of simulation with various $\langle K_\gamma \rangle$ values were carried out. One of them with $\langle K_\gamma \rangle = 0.17$ immitated the situation in C-chamber, the other-with $\langle K_\gamma \rangle = 0.30$ in Pb-chamber. The latter value is greater than the real one in Pb-chamber, was chosen especially to emphazise the effects connected with K_γ variations. The ratio of simulation values of $\langle K_\gamma \rangle$ is equal to

$$\langle K_\gamma \rangle_{Pb} / \langle K_\gamma \rangle_{C} = 1.76 \qquad (5)$$

A hadron was considered registrated one in case of $E_h^\gamma = K_\gamma E_h \geq 4$ Tev.

For $\langle E_h^{(\gamma)} R \rangle$ determination we selected the families with number of registrated hadrons $n_h > 3$. Table III represents the obtained results.

Table III

	N_{fam}	$E_h R$ Tev mm
C	126	285∓20
Pb	275	510∓15
χ		1,80∓0.1

Table IV

	N_{fam}	$\langle n \rangle$	$\beta - 1$
C	505	2.3∓0.1	0.9∓0.05
Pb	505	3.9∓0.1	1.0∓0.05
ν		1.7∓0.1	

As it is seen from Table III

$$\chi = \langle E_h^{(\gamma)} R \rangle_{Pb} / \langle E_h^{(\gamma)} R \rangle_{C} = 1.80 \pm 0.10 \qquad (6)$$

and that is in good agreement with value (5).

The incoming to the installation hadron families with $n_h > 3$ and $\sum E_h \geq 250$ Tev were selected to calculate ν parametre. The last condition provides registration of the same events in both sets of simmulation (in "both chambers").

Table IV represents the obtained values of mean multiplicities and energy spectra slope. ν value which is equal to 1.70 ± 0.10 is also in agreement with the given ratio of $\langle K_\gamma \rangle$(5). Thus, the experimental estimation of χ and ν values in the two types of chambers gives an opportunity to get a ratio of $\langle K_\gamma \rangle$ coefficients for lead and carbon nuclei.

Returning to preleminary experimental evaluations of χ and ν parametres (Table 1) one can see that the coefficients ratio turned to be roughly equal to 1.2 ÷ 1.5. This ratio corresponds to K_γ coefficients for pion-nuclear interactions as the majority of hadrons in families are π-mesons.

Experiments carried out in the low energy range yield that K_{π^0} partial inelastic coefficient dependence on atomic number of target nucleus is described as $K_{\pi^0} \sim A^\alpha$. Using this dependence and $\langle K_\gamma \rangle_{Pb} / \langle K_\gamma \rangle_C$ value we can estimate α-index at energy $\sim 10^{14}$ ev. Here we should bear in mind, that $K_\gamma^{Pb} \simeq K_{\pi^0}^{Pb}$, while K_γ^C can considerably differ from K_{π^0}. However, it was shown in simulations [5] K_γ value in carbon chamber in $E_h^{(\gamma)}$ energy range from 3 up to 30 Tev is similar to K_{π^0} value in pion-nucleon interactions. In such case

$$\frac{\langle K_\gamma \rangle_{Pb}}{\langle K_\gamma \rangle_C} \simeq A^\alpha_{Pb} \quad \text{and} \quad \alpha \simeq 0.06 \pm 0.02.$$ This value is not in contradiction to α-measurings at lower energies

and confirms a possibility of the suggested method.

To determine α-value with 20% accurancy it is necessary to have approximately 100 families with $\Sigma E_\gamma \geq$ 100 Tev in each chamber as well as to make precise simulations of connection between partial K_{π^0} and effective K_γ inelasticity coefficients in chambers of both types.

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