сообщения
объединенного
института
ядерных
исследований
дубна

E2-92-530

A.G.Galperin, A.S.Pak*, V.V.Uzhinskii

SLOW PARTICLE MULTIPLICITY DISTRIBUTIONS FOR ^{197}Au + Em INTERACTIONS

*HEPI, Alma-Ata, Kazakhstan

1992

Гальперин А.Г., Пак А.С., Ужинский В.В. E2-92-530
Распределения по множественности медленных частиц во взаимодействиях ^{197}Au + Em

Представлены распределения по множественности медленных (*g* и *b*) частиц во взаимодействиях ядер золота с ядрами фотоэмульсии, рассчитанные в модели Андерссона, Оттерлунда, Стенлунда (АОС). В распределениях наблюдаются 3 пика.

Работа выполнена в Лаборатории вычислительной техники и автоматизации ОИЯИ.

Сообщение Объединенного института ядерных исследований. Дубна 1992

Galperin A.G., Pak A.S., Uzhinskii V.V. E2-92-530
Slow Particle Multiplicity Distributions for ^{197}Au + Em Interactions

Multiplicity distributions of slow (*g*- and *b*-) particles in aurum + emulsion interactions calculated in the generalized Andersson — Otterlund — Stenlund (AOS) model are presented. 3 bumps in distributions are observed.

The investigation has been performed at the Laboratory of Computing Techniques and Automation, JINR.

Communication of the Joint Institute for Nuclear Research. Dubna 1992

In experiments with nuclear photoemulsion slow particles, the so-called g- and b-particles, are distinguished among other fragments in the laboratory system. They are named grey and black in accordance with visible density of particles tracks. The b-particles are mainly protons with $E < 30$ Mev. They are as a rule attribute to evaporation products of the nuclear residuals. The more energetic "grey" ones concerned in the so-called "fast stage" of interaction are correlated with the number of original collisions.

In the AOS model [1,2] the above dependence between the g - particles yield and the number of intaractions of fast particle with nucleon inside the nucleus is taken into account. The main assumption is an original interaction initializes the generation of m secondary nucleons inside the nucleus with the probability

$$P_1(m) = (1 - x)\, x^m. \tag{1}$$

Herewith the probability of yield of m nucleons in the ν original interactions becomes

$$P_\nu(m) = C^m_{\nu+m-1}\, (1 - x)^\nu\, x^m, \tag{2}$$

$$m = m_1 + m_2 + \ldots + m_\nu.$$

Each of these m nucleons can hit the energy interval of g - particles registration with probability α and can be registered, if the nucleon is charged, as g - particle. The probability of knocked out nucleon to be charged is determined by charge Z and mass number A of the target nucleus.

Therefore the distribution over g - particle number in hadron nucleus interactions is given by

$$P(n_g) = \sum_{\nu=1}^{A} \sum_{m=n_g}^{\infty} \sum_{g=n_g}^{m} \Pi(\nu)\, P_\nu(m)\, C^g_m\, \alpha^g\, (1 - \alpha)^{m-g} \cdot C_g^{n_g}\, (Z/A)^{n_g}\, (1 - Z/A)^{g-n_g}, \tag{3}$$

where $\Pi(\nu)$ is the distribution over the number of interactions of projectile hadron - nucleon inside the nucleus.

The authors of the AOS-model have postulated the Poisson distribution for b - particles because the correspondence between n_b and $k=m-g$ (the number of slow secondary nucleons) cannot be determined directly.

$$B_k(n_b) = \exp(-\langle N_b(k)\rangle)\, \langle N_b(k)\rangle^{n_b}/n_b! \tag{4}$$

$$\langle N_b(k)\rangle = \langle N_b\rangle_{sat}(1 - \gamma^k).$$

A general g- and b - particles multiplicity distribution for hadron-nucleus interactions becomes

$$P(n_g, n_b) = \sum_{\nu=1}^{A} \sum_{m=n_g}^{\infty} \sum_{g=n_g}^{m} \Pi(\nu)\, P_\nu(m)\, C^g_m\, \alpha^g\, (1 - \alpha)^{m-g} \cdot C_g^{n_g}\, (Z/A)^{n_g}\, (1 - Z/A)^{g-n_g}\, B_{m-g}(n_b) \tag{5}$$

The finiteness of the number of nucleons is not taken into account in eqs. (1) - (4), so power expansion (5) is unlimited.

A good description of slow particles multiplicity distributions and correlation dependences in hadron - nucleus interactions at high energy can be reached by fitting the model parameters x, α, $\langle N_b\rangle_{sat}$, γ separatly for light (C,N,O) and heavy (Ag, Br) emulsion components.

The modified distribution (5) was used [3] to interpret nucleus - nucleus interaction data. This modification consists in changing $\Pi(\nu)$ in eq. (5) on the "wounded" nucleon distribution calculated in the Glauber approximation by the DIAGEN code [4]. A good agreement was obtained here at the values of the parameters shown in Tab. 1.

Table 1

	Ag, Br	C, N, O
x	0.838	0.701
α	0.262	0.307
$\langle N_b \rangle_{sat}$	0.94166	0.400
γ	10.00	2.230

The calculated multiplicity distributions for b - and g - particles in ^{197}Au + Em interactions are presented in figs. 1,2. One can see that there are 3 peaks in the multiplicity distribution of b - particles. Analogous peaks are also seen for g-particles. The first one , with lower multiplicity, is interpreted as an interaction with hydrogen, about 20% of all interactions. The second one is connected to interactions of projectile nucleus with nucleus of light component (36 %), and finally the third peak is interpreted as result of interactions with heavy (Ag, Br) component (44 %). This peak prolonged over the maximally reached value n_g= 47. This effect is arisen from unfiniteness of the serie (5).

The calculation by the percolation model [6] gives us more physical results (fig. 2), although the structure of multiplicity distribution of g - particles remains the same. Therefor in the multiplicity distribution of slow particles in the ^{197}Au + Em interactions, one can expect a 3 - peaks structure.

We are thankful to M.M. Chernyavski and M.I. Tretyakova (FIAN, Moscow) for stimulating discussions.

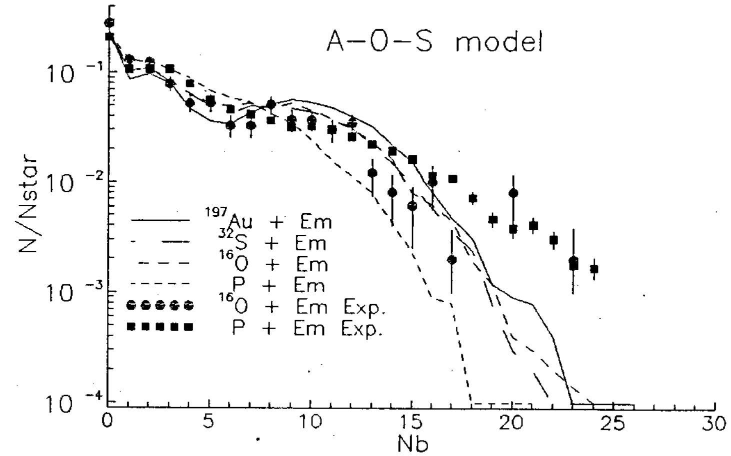

Fig. 1 b-particles multiplicity distributions for nucleus - nucleus interactions at high energies. Lines - our calculations, points - experimental datas [2,5].

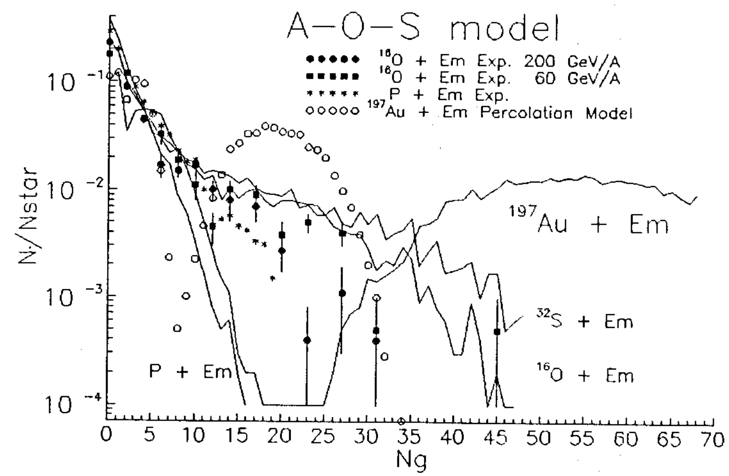

Fig. 2 g-particles multiplicity distributions for nucleus - nucleus interactions at high energies. Lines - our calculations, points - experimental datas [2,5].

References

[1] Andersson B., Otterlund I., Stenlund E. - Phys. Lett., 1978, 73B, p. 343.

[2] Stenlund E., Otterlund I. - Nucl. Phys., 1982, B198, p. 407.

[3] Pak A.S., Serdamba L., Uzhinskii V.V. - JINR Preprint P2-90-113, Dubna, 1990.

[4] Shmakov S. Yu., Uzhinskii V.V., Zadorozhny A.M. - Com. Phys. Comm., 1989, 54, p. 125.

[5] Adamovich et al. - Phys. Lett., 1990, B234, p. 180.

[6] Shmakov S. Yu., Uzhinskii V.V. - JINR Preprint E2-89-511, Dubna, 1989.

Received by Publishing Department
on December 12, 1992.