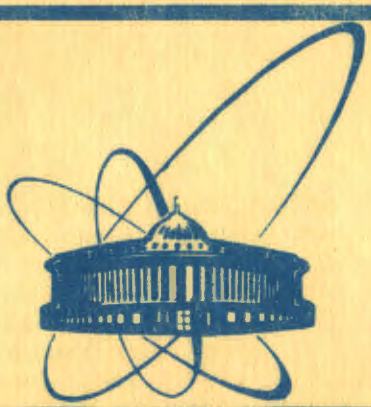

сообщения
объединенного
института
ядерных
исследований
дубна

E2-83-816

V.V.Uzhinskii, Z.Omboo

ANALYSIS OF SPECIFIC NUCLEUS-NUCLEUS SCATTERING PROCESSES

1983

As is well known, in the hadron-nucleus collisions the processes take place which have no analogy in hadron-hadron interactions. They are due to a possibility for a particle produced on one nuclear nucleon to interact with another nucleon. The first astonishing fact of the investigations of these processes was that particles interact with another nucleon very seldom. It gave rise to the main idea of the present high energy physics - the idea about formation time of produced particles. What new idea can the research of nucleus-nucleus interactions give us? To answer this question, we have to say what is the main difference between hadron-nucleus and nucleus-nucleus collisions. Many physicists hope that nucleus-nucleus interactions can be represented as a combination of hadron-nucleus collisions. But they cannot show correctly that it is true. Others believ to think that in nucleus-nucleus interactions we can obtain very hot nuclear matter. But they cannot say how often these states will be realized.

Only the eikonal model can answer at present how many processes in nucleus-nucleus interactions have analogy in hadron-nucleus collisions and how often specific nucleus-nucleus scattering processes (SNNSP) take place. For the first time it was done in paper[1] for ^{4}He^{4}He-scattering. Then it was shown for ^{12}C^{12}C-collisions[2]. As was pointed out in ref.[1] SNNSP are the processes represented by the edge graphs of two-coloured graphs like those shown in Fig.1 (more usual pictures see in Fig.2). Knowing them, one can estimate the mean distance between the centres of particle production and, using the radius of confinement forces, find at what energies these interactions will look like single ones. It is an interesting task, but an aim of our paper is to find "usual" features of SNNSP. For this purpose we have used the calculation scheme proposed in ref.[1] and for modelling of elementary interactions we have took the Levchenko-Nikolaev model[3]. The investigation was performed for the processes shown in Fig.1. We have supposed that each nucleon with equal probabilities may be a proton or a neutron, and that nucleons from different nuclei have equal momentum 15.75 GeV/c in CMS.

First of all we were interested in the multiplicity distributions presented in Fig.3. As can be seen, in the processes a and b (Fig.1) the part of events with multiplicity of negative particles (pions) close to zero is very small. Besides, in these

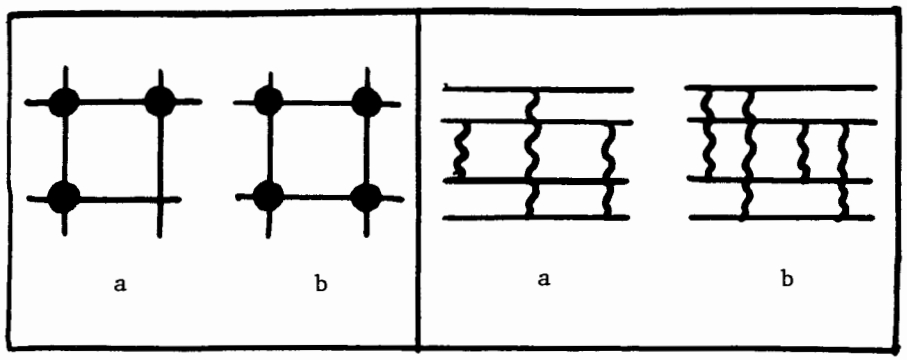

Fig.1. Graphs representing two specific nucleus-nucleus scattering processes.

Fig.2. Processes a and b of fig.1 are redrawn in another form.

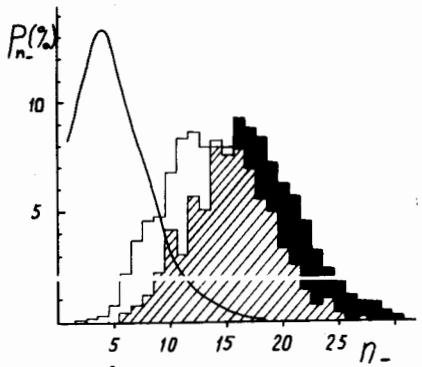

Fig.3. Multiplicity distributions of negative particles in pp interactions and in a, b processes of fig.1 at $\sqrt{s_{NN}}$ = = 31.5 GeV (solid line, light and shadowing hystogram, shadowing and black hystogram, respectively).

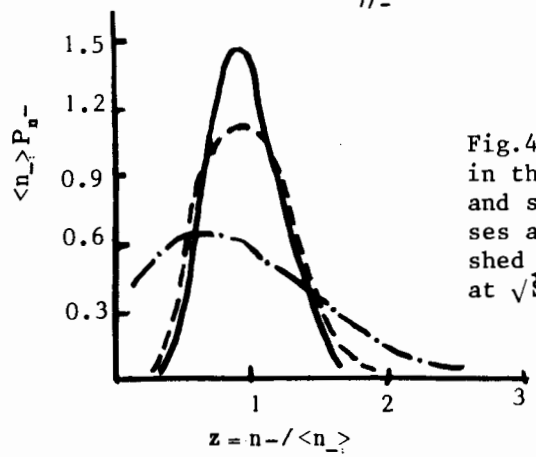

Fig.4. Distributions of fig.3 in the KNO-scaling form. Dashed and solid lines for the processes a and b of fig.1. Dot-dashed line, for pp-interactions at $\sqrt{s_{NN}}$ = 31.5 and 22 GeV.

processes the distributions do not obey the same KNO-scaling law as in pp interactions, though they satisfy the KNO-scaling hypothesis (see Fig.4). It is the first feature of SNNSP.

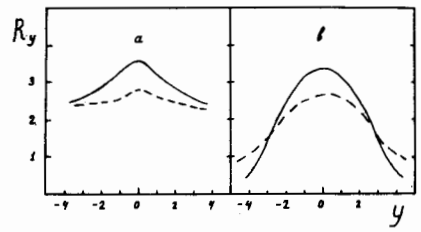

Fig.5. Ratios of particle densities in a, b processes of fig.1 (solid and dashed lines respectively) to the pp ones as the functions of the rapidity: a) $R^-(y)$, b) $R^+(y)$.

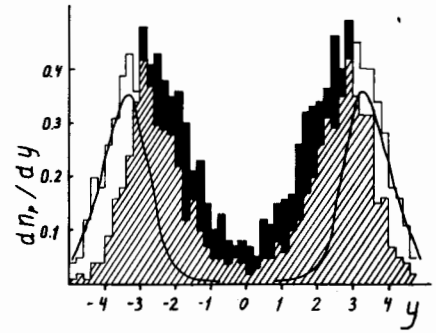

Fig.6. Proton densities in pp interactions and a, b processes as the functions of y (solig line, light and shadowed hystogram, shadowed and black hystogram, respectively).

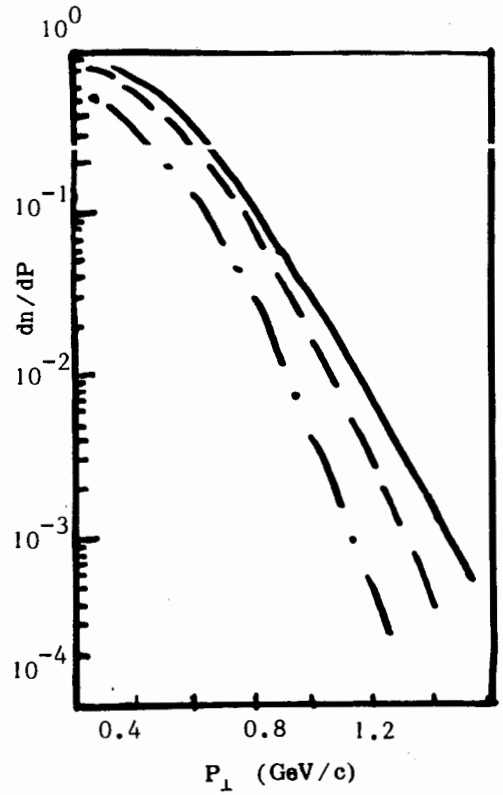

Fig.7. Distributions of protons according to the transverse momentum in pp interactions and a, b processes of fig.1 (dot-dashed, dashed and solid lines, respectively).

To find others, let us look for the ratios of rapidity distributions $R(y) = \frac{dn_{a(b)}}{dy} / \frac{dn_{pp}}{dy}$, given in Fig.5. From them we see that R(y) at y ~ 0 are close to multiplicity of elementary interactions and that functions $R^+(y)$ are not like $R^-(y)$. It occurs due to protons which according to fig.6, move to the central region on SNNSP. In the rescattering processes they get large transverse momenta (Fig.7). So protons with large $P_\perp$ in the central rapidity regione can be an

indicator of SNNSP. It is the prediction of the trivial eikonal model, which do not take into account the interactions between particles produced in different centres. We think that investigations of these interactions having no analogy in hadron-hadron and hadron-nucleus collisions can give new useful information.

REFERENCES

1. Uzhinskii V.V. JINR, P2-81-780, Dubna, 1981; Omboo Z., Uzhinskii V.V. JINR, E2-83-250, Dubna, 1983.
2. Zadorozhnij A.M. et al. JINR, P2-83-544, Dubna, 1983.
3. Levchenko B.B., Nikolaev N.N. Preprint MPI-PAE/PTh.41/81, München, 1981; Yad.Fiz., 1982, 36, p.453; Yad.Fiz., 1983, 37, p.1016.

Received by Publishing Department
on December 5, 1983.

Ужинский В.В., Омбоо З. E2-83-816

Анализ специфических процессов ядро-ядерного рассеяния

Характеристики двух процессов, которые могут иметь место в dd -взаимодействиях при высоких энергиях, помимо обычных - однократного, двух независимых нуклонных соударений и двух последовательных нуклонных соударений - анализируются в предположениях, что только нуклоны могут взаимодействовать. Показано, что отношение плотности частиц по быстротам в таких процессах к соответствующей плотности в NN -процессах в центральной области близко к среднему числу элементарных взаимодействий; распределения по множественности в таких процессах подчиняются КНО-скейлингу, который не такой же, как в pp -соударениях; индикатором таких процессов могут быть протоны, испускаемые с большими поперечными импульсами в центральной области.

Работа выполнена в Лаборатории ядерных проблем ОИЯИ.

Сообщение Объединенного института ядерных исследований. Дубна 1983

Uzhinskii V.V., Omboo Z. E2-83-816

Analysis of Specific Nucleus-Nucleus Scattering Processes

Characteristics of two processes which can take place in dd interactions at high energies besides the usual single one, two independent nucleon collisions and two sequence nucleon collisions are analysed in the assumptions that only nucleons can interact. It is shown that the ratio of rapidity density of particles in such processes to that in NN processes in the central region is close to the mean number of elementary interactions; multiplicity distributions in these processes obey the KNO-scaling which is not the same as in pp-collisions; an indicator of these processes may be the protons emitted with large transverse momentum in the central region.

The investigation has been performed at the Laboratory of Nuclear Problems, JINR.

Communication of the Joint Institute for Nuclear Research. Dubna 1983