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SEARCH AND RESEARCH MULTIBARYON CLUSTERING IN HADRON-NUCLEAR COLLISION AT HIGH ENERGY

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Аннотация. *Ушбу ишда бирламчи импульслари 40 ва 300 ГэВ/с бўлган $\pi^{-}C$ ва $p^{20}Ne$-таъсирлашувларида ҳосил бўлувчи кўпбарионли протон кластерларининг таҳлил натижалари тавсия этилган.*

Калит сўзлар. *Деконфайнмент, ранг, кварк-глюон плазмаси, барион кластери, адрон, протон, импульс.*

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Аннотация. *В работе представлены результаты анализа образования многобарионных протонных кластеров в $\pi^{-}C$ и $p^{20}Ne$-взаимодействиях при 40 и 300 ГэВ/с.*

Ключевые слова. *Деконфайнмент, цвет, кварк-глюонная плазма, барионный кластер, адрон, протон, импульс.*

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Abstract.*The results obtained by analyzing the production of multibaryon clusters in $\pi-C$ and $p^{20}Ne$ interactions at moments of 40 and 300 GeV/c, respectively, are presented.*

Keywords. *deconfinement of colors and reception quark-gluon plasmas, baryon cluster, hadron, proton, moment.*

The introduction of concept of distances in space of 4-speeds has allowed to give definition and to find out four-dimensional clusters in this space [2,7]. Under cluster the group of particles with u_i is understood, distance between which b_{ik} is much less, than average distance between particles on all phase volume of reaction. The algorithm of allocation of cluster and presence(finding) of the cluster's centre V, around of which the particles which are included in cluster are grouped is described in jobs [5-9]. Distance between the cluster's centre and point u_k of set in system $b_{ik} = -(V - u_k)^2$ of coordinates V = 0 is equal: $b_k=2T_k/m_k$ where T_k - kinetic energy of a particle in relation to stationary cluster centre. The average importance $<b_k>$ have

appeared in various reactions identical. In jobs [7,8] with the help of a relativistic-invariant method of the analysis of hadron-nuclear and nucleus - nuclear reactions in variable b_{ik} two types of baryon cluster with $<b_k>_1=0.140$ and $<b_k>_2=0.280$ were selected. Is shown, that clusters such as 1, characterized $<b_k>_1=0.140$, have universal properties in considered interactions in interval 4 ÷ 40 GeW/s. It, in turn, specifies that the process of education of clusters characterizes fundamental properties hadronic of a matter. In this connection allocation of cluster should be connected with searches of condition of the strongly exited nuclear matter. If clusters to consider as products of disintegration quasi-stationary of condition, average kinetic energy of particles which are included in cluster, $<T_k>=m_k<b_k>/2$, characterizes its temperature. For pionic cluster is received [10] $<T_k>=150$ MeW, and for baryon $<T_k>_1=70$ MeV and $<T_k>_2=130$ MeV [8].

The purpose of the given job is the search and research of education baryon cluster in π^-C- and $p^{20}Ne$-interactions at 40 and 300 GeV/c, accordingly. The allocation baryon cluster was carried out with the help of universal binary B-algorithm [11], based on the relativistic-invariant approach in space of relative 4-speeds.

The experimental material on $p^{20}Ne$-collision is received with the help 30-inch bubble chambers, irradiated in diffraction a bunch(beam) of protons with a moments 300 GeV/c on the accelerator of Fermi National acceleration Laboratory (Batavia, USA). The secondary protons were effectively identified in an interval of moments $0.13\leq p\leq 1.2$ GeV/c. Data on π^-C -interactions are received with help 2 meter propanoic (C_3H_8) bubble chamber LHE JINR, irradiated on Serpukhov accelerator in bunch(beam) negative pion with pulses 40.00±0.24 GeV/c. In this chamber the protons were effectively identified in an interval of pulses $0.14\leq p\leq 0.75$ GeV/c. At construction proton cluster from consideration were excluded so-called "evaporating" protons, it is protons with $p<0.175$ GeV/c for pion-carbon collision, and $p<0.2$ GeV/c for a proton-neon of interactions.

For study of a question about an opportunity of education quasi-stationary nucleonic of condition in nuclear interactions the spectra of effective weights proton cluster with various multiplicity n_p in $p^{20}Ne$- and π^-C -collision, received were analyzed on the basis of above mentioned binary B-algorithm (fig. 1 (a, b)). For improvement of presentation of a fig. 1 (a, b) beginning of distributions of effective weights cluster with number of protons np=3,4 and 5 were moved on the left (in the smaller party of weight) on 0.8, 1.5 and 2.8 GeV, accordingly. As it is visible from a fig. 1 (a, b), they represent a number of separate not overlapped one-modal distributions. Let's note, that the spectra of cluster with n_p=2 (fig. 1 (a, b)) have interesting feature consisting in their asymmetry: the first points in both figures demonstrate higher probability of education of these condition, that in turn, emphasizes display of interaction of two protons in a final condition [12]. The interest to this effect is caused by that because of an interdiction Pauli on the contrary, the lowered statistical probability of education of two-proton condition was expected. However experiment shows, that dynamics of interaction in a final condition breaks this statistics. The received distributions approximated by expression representing the sum of function Breit-Wigner, describing birth of resonances, background member who is taking into account multiple birth of particles at energy, close to resonant, and also function describing interference of these two contributions. Analytically approximating function enters the name as follows [13]:

$$F(M) = \frac{\alpha^2}{(M - M_0)^2 + \Gamma^2/4} + \frac{2\alpha\beta(M - M_o)}{(M - M_0)^2 + \Gamma^2/4} + \beta^2, \qquad (1)$$

here first composed function Breit-Wigner; β^2 – background; Second composed - function describing интерференцию of resonant and not resonant birth of particles; M_0 and Γ Designate weight and width of a resonance. The results of approximation are shown in a fig. 1 (a, b) continuous lines. The importance of parameters M_0, Γ, and

also size χ^2 on a degree of freedom are given in the table. Proceeding from tabular of importance of sizes Γ for time of life multinucleon of quasi-stationary condition, we shall receive $t \leq 1.83*10^{-23}$ c, that is comparable in due course passages primary relativistic of particles through nucleuses ^{12}C and ^{20}Ne.

From reduced findings they are visible, that the experimental distributions at all importance n_p are well described by dependence (1). The sizes of weights M_0 and width Γ prospective nucleon quasi-stationary of condition for all importance n_p are shown in a fig. 2 and 3. It is visible, that these sizes grow with growth multiplicity cluster n_p.

Their behaviour well satisfies of linear dependence such as y=a+bx and can be written down as follows:

$$M_0 (n_p) = -0.05+0.99\ n_p\ , \text{GeV} \qquad (2)$$

$$\Gamma (n_p) = 44.1+10.5\ n_{p,}\ \text{MeV} \qquad (3)$$

The numerical importance of parameters (a and b) in the formulas (2) and (3) are received at joint approximation of experimental data for both types collision.

The carried out of analysis shows, that the study clusters in space of 4-speeds basically enables to investigate quasi-stationary state of the strongly exited nuclear matter. More complete and detailed study of this aspect clustering however is necessary. It is necessary to find out a nature of mixing of various condition in one cluster. Only proton mixed condition be can not by virtue of existence of neutrons and isotopic spin.. The mixing of condition with various baryonic charge too is represented obscure. Besides the prospective hypothesis about multibaryon resonant condition means, that should exist and other channels of disintegration, for example, containing besides baryon pions.

References

1. Baldin A.M. - Nucl.Phys. , A434, p.695 (1985).

2. Baldin A.M. - DAN SSSR, 222, 1064 (1975).

3. Bekmirzaev R. et al. - Phys. of Atomic Nuclei Vol.67, 4, 703, (2004).

4. Baldin A.M., Panebratsev U.A, Stavinsky V.S. Preprint JINR, 1-84-185, Dubna (1984).

5. Baldin A.M., Didenko L.A. - In Sat.: JINR Rapid Communications № 3-84, Dubna, JINR, p.5 (1984), JINR Rapid Communications № 8-85, Dubna, JINR, p.5 (1985).

6. Baldin A.M., Baldin A.A. - In Sat.: JINR Rapid Communications, № 17-86, Dubna, JINR, p.19 (1986).

7. Armutliyski D. et al - In Sat.: JINR Rapid Communications, № 4 (24) -87, Dubna, JINR, p. 5 (1987).

8. Baldin A.M. et al - Nucl.Phys. 49, 1034 (1989).

9. Baldin A.M. et al - Nucl.Phys. 44, 1209 (1986).

10. Grishin V.G. et al, JINR Preprint P1-89-838, Dubna, (1989).

11. Badalyan N.N. et al, JINR Rapid Communications 1 [75] -96, 27 (1996).

12. Migdal A.B., JETP 28, 3, 10 (1955); K.M.Watson, Phys.Rev., 88, 1163 (1952).

13. Baldin A.M., Grishin V.G., Didenko L.A. et al. JINR Preprint P1-90-263, Dubna (1990).

14.Шарипов, Ш. С. (2017). Personality model of modern taecher. *Eastern european Scientific Journal–Germany*, 93-96.

15.Orishev, Jamshid (2021) "PROJECT FOR TRAINING PROFESSIONAL SKILLS FOR FUTURE TEACHERS OF TECHNOLOGICAL EDUCATION," *Mental Enlightenment Scientific-Methodological Journal*: Vol. 2021 : Iss. 2 , Article 16.

16.Orishev, J. (2020). ГЛОБАЛЛАШУВ ДАВРИДА ПЕДАГОГЛИК МАСЪУЛИЯТИ . *Научно-просветительский журнал "Наставник"*, *1*(1).

17.Ismailov T.J, Tagaev X, Kholmatov P.K, Yusupov K.Y, Alkarov K.Kh, Orishev Zh.B Karimov O.O. (2020). Cognitive-Psychological Diagram Of Processes Of Scientific And Technical Creativity Of Students. *International Journal of Advanced Science and Technology*, *29*(08), 3669-3677.

18.Bekmirzaev, R. N., Sultanov, M. U., Holbutaev, S. H., Jonzakov, A. A., & Turakulov, B. T. (2020). Multiplicity outputting of hadrons in cc-interactions at the momentum 4.2 a gev/c with different collision centralities. *ACADEMICIA: An International Multidisciplinary Research Journal*, *10*(10), 900-907.

19.Bekmirzaev, R. N., Kladnitskaya, E. N., Muminov, M. M., & Sharipova, S. A. (1994). *Rapidity Distributions of π-Mesons in (d, α, C) Ta Interactions at 4, 2 GeV/c per Nucleon* (No. JINR-R--1-94-376). Joint Inst. for Nuclear Research.
20.Bekmirzaev, R. N., Kladnitskaya, E. N., Muminov, M. M., & Sharipova, S. A. (1995). Rapidity distributions of protons in|(p, d, α, c) interactions at 4, 2 GeV/c per nucleon. *Yadernaya Fizika*, *58*(9), 1642-1648.
21.TAYLANOV, N., BEKMIRZAEV, R., HUDOYBERDIEV, A., SAMADOV, M. K., URINOV, K. O., FARMONOV, U., & IBRAGIMOV, Z. K. (2015). Dynamics of magnetic flux penetration into superconductors with power law of voltage-current characteristic. *Uzbekiston Fizika Zhurnali*, *17*(3), 126-130.
22.Olimov, K., Bazarov, E. K., Bekmirzaev, R. N., Lutpullaev, S. L., Olimov, A. K., Petrov, V. I., ... & Yuldashev, B. S. (2007). Production of cumulative protons in high-energy hadron-nucleus and nucleus-nucleus interactions. *Physics of Atomic Nuclei*, *70*(4), 709-711.

Table

Importance of parameters Γ and M_o and χ^2/n

n_p	Type of interaction and initial pulse of a shell					
	$P^{20}Ne$, 300 GeV/c			π^-C, 40 GeV/c		
	M_0, GeV/c	Γ, MeV	χ^2/n	M_0, GeV/c	Γ, MeV	χ^2/n

2	1,94 ± 0,01	65 ± 2	1,2	1,92 ± 0,01	72 ± 9	1,0
3	2,93 ± 0,01	70 ± 7	1,1	2,92 ± 0,01	72 ± 7	0,9
4	3,93 ± 0,01	87 ± 15	0,5	3,91 ± 0,01	95 ± 14	1,3
5	4,89 ± 0,02	103 ± 26	0,4	4,89 ± 0,02	104 ± 31	0,2

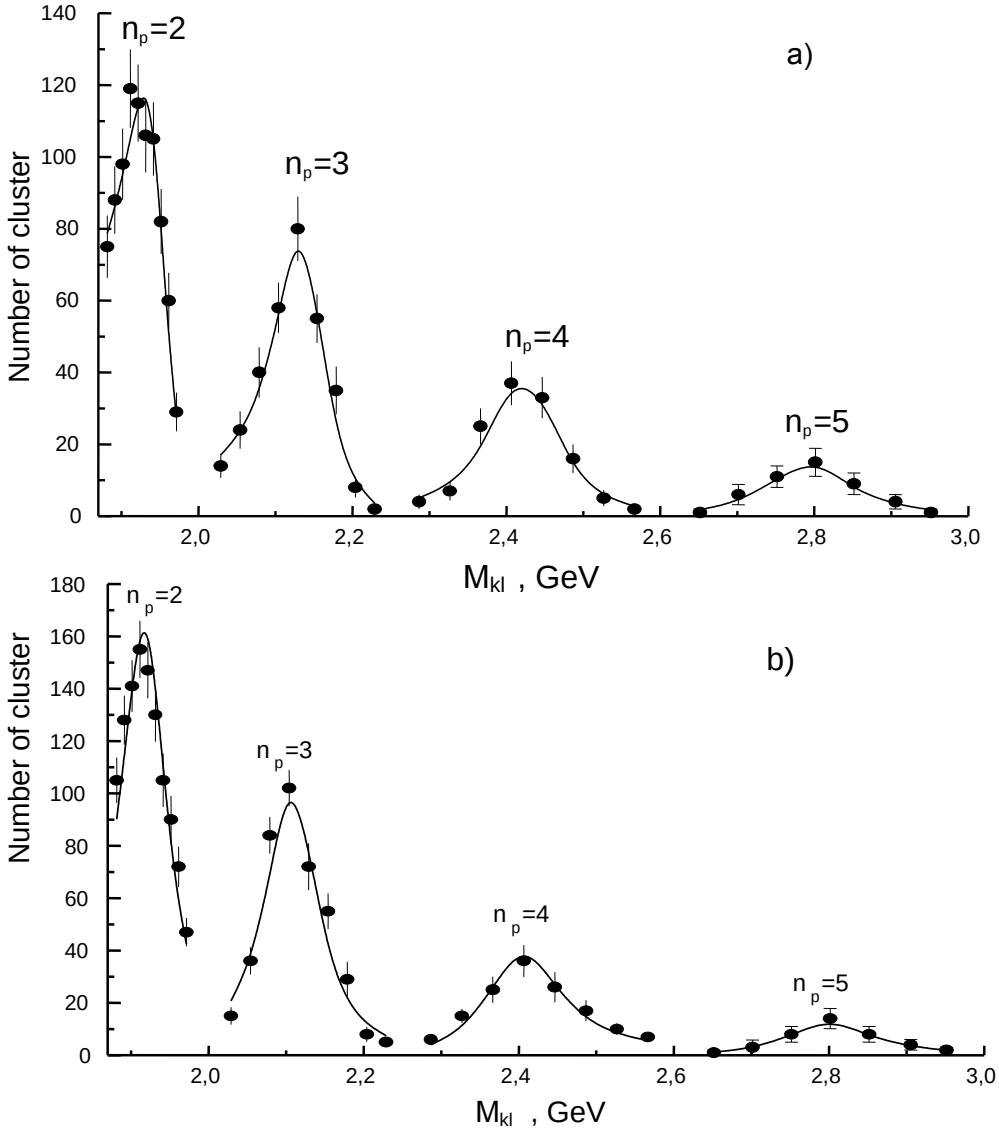

Fig. 1. Distribution proton cluster with different multiplicity n_p to effective weights M_{kl} in $p^{20}Ne$-(a) and π^-C-collision. Continuous lines of approximation of experimental data by dependence (1).

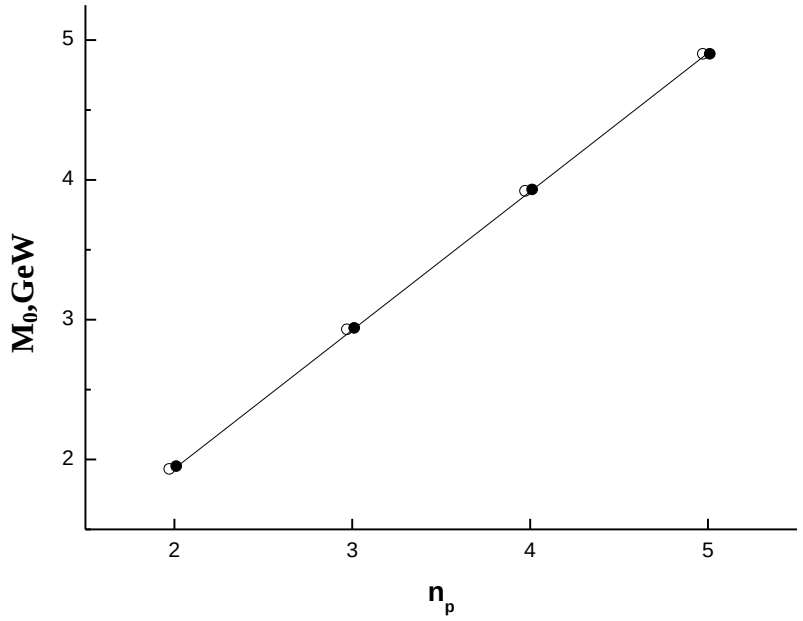

Fig. 2. Dependence weight of cluster M_0 from multiplicity of protons in them np. Continuous line result of approximation by dependence (2) .Light circles – π^-C; dark circles – $p^{20}Ne$.

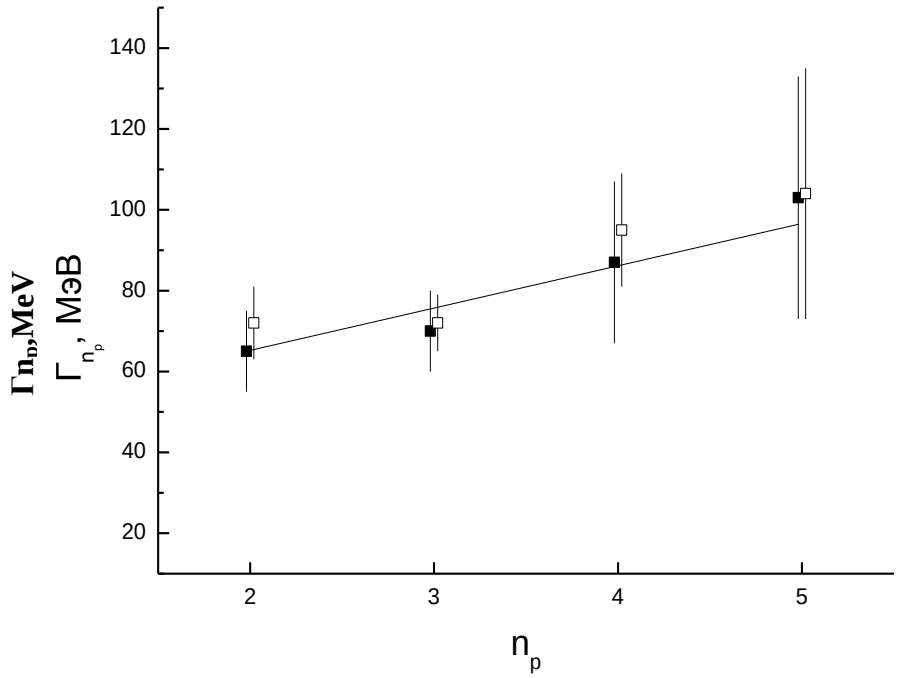

Fig. 3. Dependence width of cluster Γ from multiplicity of protons in them n_p. Continuous line result of approximation by dependence (3). Light circles – π^-C; dark circles – $p^{20}Ne$.