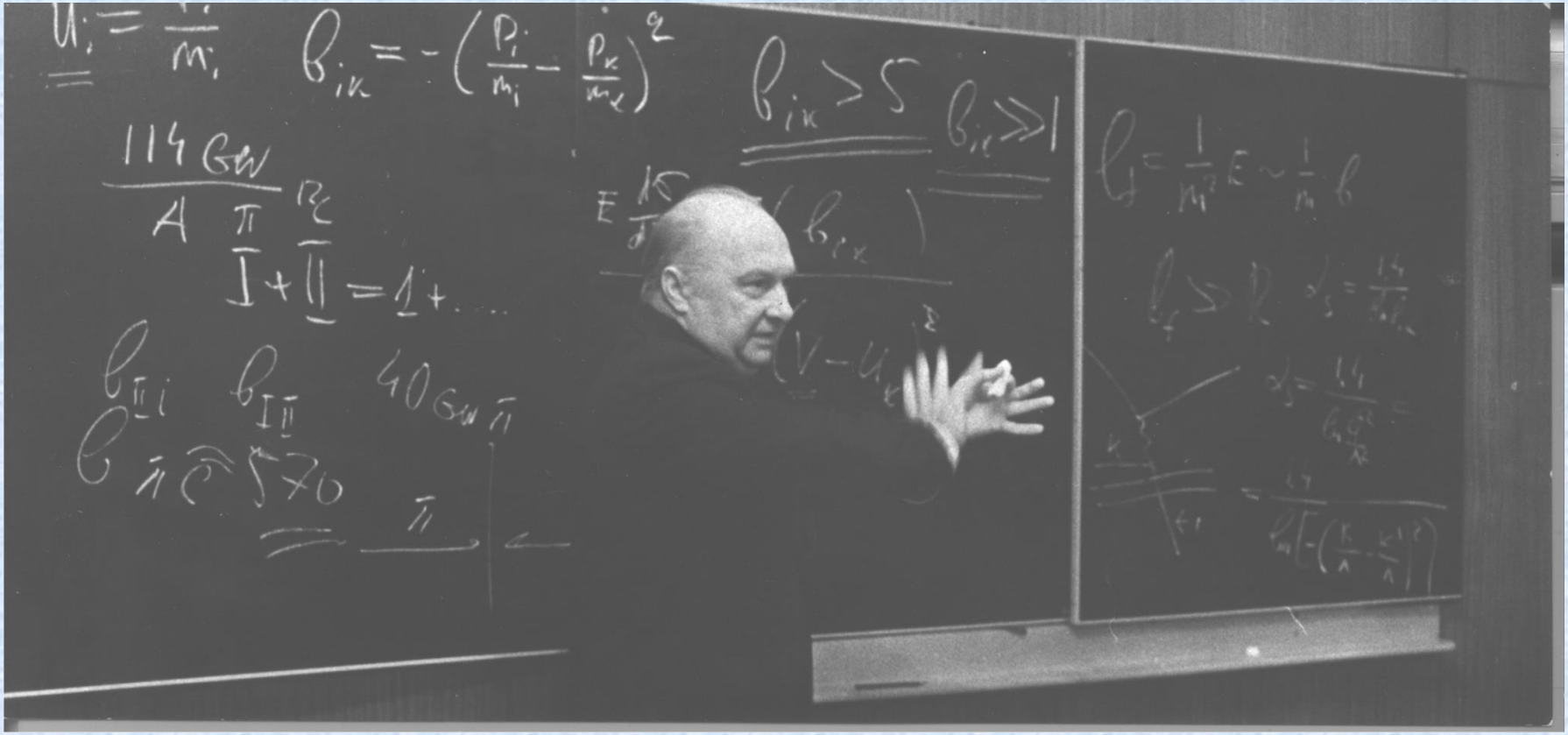
Балдин. Физика. Семинар. Жизнь.

V.V.Burov (BLTP, JINR)

Александр Михайлович Балдин

26 февраля 1926 - 29 апреля 2001



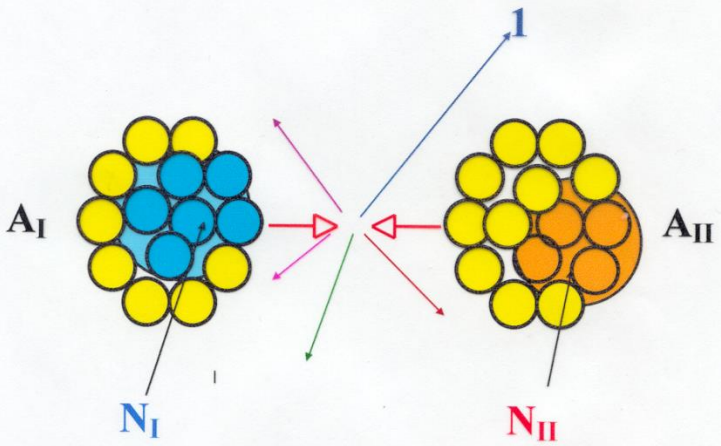
В поисках истины….

А. М. Балдин и А.И. Малахов

26 февраля 2001

Cumulative effect

$$I + II \rightarrow 1 + \ldots$$



$N_{I,II} > 1 \leftarrow$ *CUMULATIVE region*

…с помощью ускорения тяжелых ядер, обладающих более высоким зарядом, можно было бы сравнительно дешевым способом в короткие сроки получить пучки частиц рекордно высоких энергий.

…it is possible to obtain the record high energy particle beams by means of accelerating the heavy nuclei with large charges

январь 1971

АКАДЕМИЯ НАУК СССР

Ордена Ленина

Физический институт им П.Н. Лебедева

…нных
…учения
…при
…зарядных

…днего време-
…х и электрон-
…тиц, обладаю-
…, обладающих
…о, в принципе
…оряемых час-
…ля) большую,
…ое кратности
…нхрофазотро-
…в с энергией
…ргией 20 Гэв,
…е) с энергией 100 Гэв. Возни-
кает …рос, не получатся ли в резуль-
тате сто… …шенью ядер, например, неона,
обладающих эн… …Гэв, пучки вторичных частиц,
полученные пока т… …а Серпуховском ускорителе?
Утвердительный ответ на этот вопрос означал бы, что с помощью ускорения тяжелых ядер, обладающих более высоким зарядом, можно было бы сравнительно дешевым способом в короткие сроки получить пучки частиц рекордно высоких энергий.

Цель настоящей заметки – рассмотреть этот вопрос и сделать определенные предсказания.

Обычно на вопрос о возможности передачи большой энергии составным ядром отдельному (например, сво-

35

The first introduction of the term “cumulative effect”

Выражаю глубокую благодарность С. Б. Герасимову, А. Б. Говоркову и Г. Н. Флерову за обсуждение изложенных соображений. Как мне стало известно, Г. Н. Флеров еще несколько лет назад высказывал мысль о возможных кумулятивных эффектах при создании релятивистских ядер.

Поступила в редакцию
11 ноября 1970 г.

Литература

1. Л. И. Седов. Методы подобия и размерности в ме-

Fluctuation of nuclear matter

SOVIET PHYSICS JETP VOLUME 6 (33), NUMBER 5 MAY, 1958

ON THE FLUCTUATIONS OF NUCLEAR MATTER

D. I. BLOKHINTSEV

Joint Institute for Nuclear Research

Submitted to JETP editor July 1, 1957

J. Exptl. Theoret. Phys. (U.S.S.R.) 33, 1295-1299 (November, 1957)

It is shown that the production of energetic nuclear fragments in collisions with fast nucleons can be interpreted in terms of collisions of the incoming nucleon with the density fluctuations of the nuclear matter.

1. INTRODUCTION

THE motion of nucleons in nuclei can result in short-lived tight nucleon clusters, in other words, in density fluctuations of nuclear matter. Since such clusters are relatively far removed from the other nucleons of the nucleus, they become atomic nuclei of lower mass in a state of fluctuating compression.

In their study of the scattering of 675-Mev protons by light nuclei, Meshcheriakov and coworkers[1,2] observed recently certain effects which confirm the existence of such fluctuations, at least for the simplest nucleon-pair fluctuations, which lead to the formation of a compressed deuteron.

We recall in this connection reports in earlier works[3,4] that high-energy nucleons can split nuclei into "supra-barrier" fragments, i.e., fragments with an energy much larger than their binding energy and the energy of the Coulomb barrier. However, there was a lack of quantitative experimental data on which to base the theoretical analysis.

Some authors related this curious process, without foundation, to hypothetical long-range nuclear forces. Others tried to connect it with nuclear many-body forces.

The experimental data on the emission of high-energy deuterons from light nuclei give support to the idea that "supra-barrier" fragments are produced also by direct collision of an incoming nucleon with a tight nucleon cluster that results from density fluctuations of the nuclear matter. We offer in the following a quantitative argument in favor of the production of fast deuterons and other "supra-barrier" fragments by such fluctuations.

Concerning the nuclear many-body forces, it should be noted that, according to existing estimates,[5] there is no reason to believe that they are considerably stronger than the two-body forces. At the instant of dense clustering both paired and collective interactions may take place. However, at present there exists no experimental information which would allow an explanation of this interaction, or in particular allow a determination of the relative contributions of the paired and the collective interactions.

2. INTERACTION OF DEUTERONS WITH FAST PROTONS

It was shown experimentally[1,2] that scattering of 675-Mev protons by deuterium produces, in addition to scattered nucleons, a small number of undestroyed deuterons of high energy (up to 660 Mev). This shows that in such collisions the nucleon imparts an appreciable fraction of its momentum to the deuteron as a whole.

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ИНСТИТУТ
ЯДЕРНЫХ
ИССЛЕДОВАНИЙ
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Р1 - 5819

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В.Б.Радоманов, В.Н.Рамжин, В.А.Свиридов,
В.С.Ставинский, М.И.Ячута

НАБЛЮДЕНИЕ ПИОНОВ
ВЫСОКОЙ ЭНЕРГИИ
ПРИ СТОЛКНОВЕНИИ РЕЛЯТИВИСТСКИХ
ДЕЙТОНОВ С ЯДРАМИ

1971

ЛАБОРАТОРИЯ ВЫСОКИХ ЭНЕРГИЙ

The first experimental data

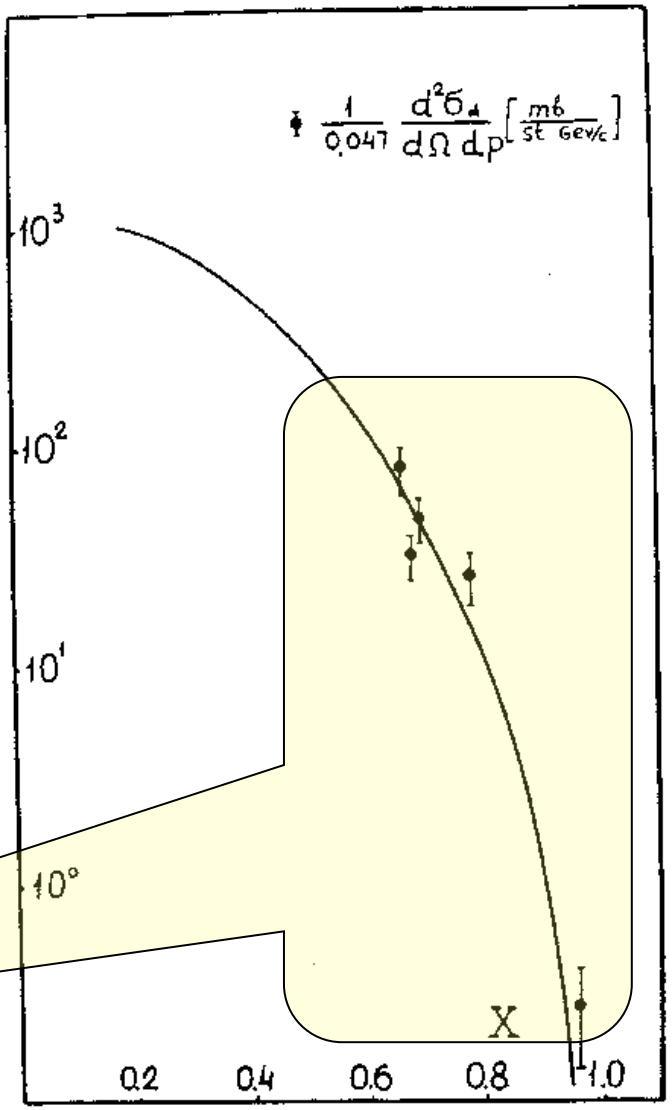


Рис. 3. Сравнение экспериментальных данных по сечению рождения пионов дейтронами с теоретической функцией, описывающей сечение рождения пионов протонами.

В настоящий время в ИФВЭ проводится эксперимент ФЛУКТОН

!

ЯДЕРНАЯ ФИЗИКА
JOURNAL OF NUCLEAR PHYSICS
т. 18, вып. 1, 1973

КУМУЛЯТИВНОЕ МЕЗОНООБРАЗОВАНИЕ

А. М. БАЛДИН, С. Б. ГЕРАСИМОВ, Н. ГИОРДЭНЕСКУ, В. Н. ЗУБАРЕВ, Л. К. ИВАНОВА, А. Д. КИРИЛЛОВ, В. А. КУЗНЕЦОВ, Н. С. МОРОЗ, В. Б. РАДОМАНОВ, В. Н. РАМЖИН, В. С. СТАВИНСКИЙ, М. И. ЯЦУТА

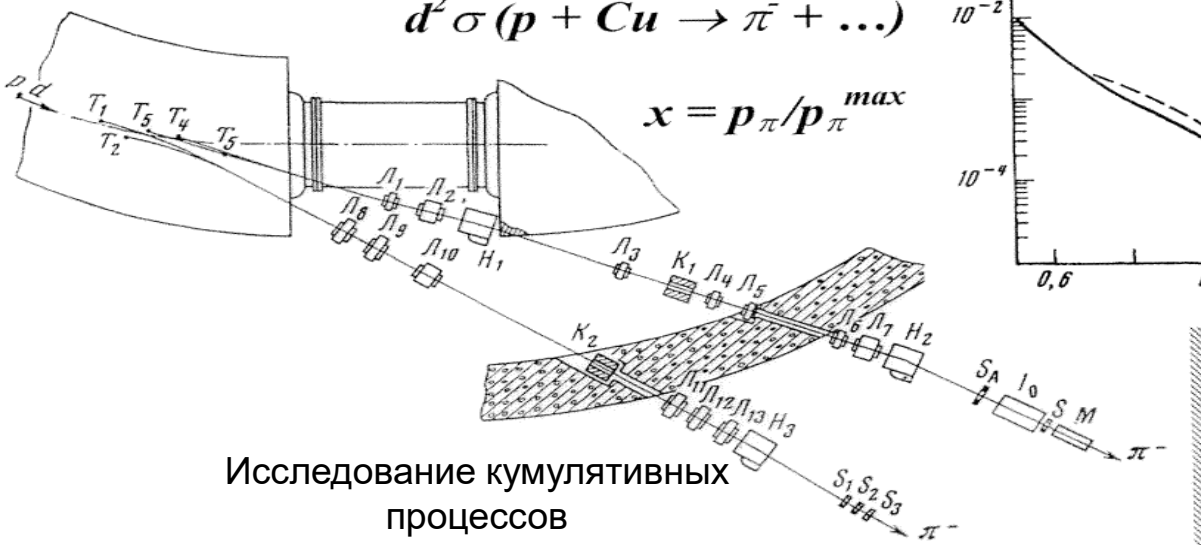
ОБЪЕДИНЕННЫЙ ИНСТИТУТ ЯДЕРНЫХ ИССЛЕДОВАНИЙ

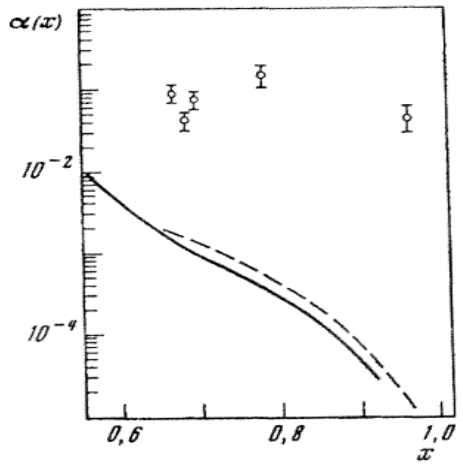
(Поступила в редакцию 5 февраля 1973 г.)

Измерена вероятность рождения мезонов ускоренными ядрами дейтерия. Энергия вторичных пионов превышает энергию одного нуклона ядра дейтерия. Отношение сечений рождения мезонов ядрами дейтерия к сечению рождения пионов нуклонами при равных энерговыделениях не зависит ни от отношения импульса пиона к максимально возможному по кинематике, ни от энергии первичных дейтронов и равно 0,06. Сама величина отношения и ее энергетическая зависимость не может быть объяснена ферми-движением.

$$\alpha(x) = \frac{d^2\sigma(d + Cu \to \pi^- + \ldots)}{d^2\sigma(p + Cu \to \pi^- + \ldots)}$$

$$x = p_\pi / p_\pi^{max}$$





Исследование кумулятивных процессов

VOLUME 43, NUMBER 24 PHYSICAL REVIEW LETTERS 10 DECEMBER 1979

Energy Dependence of Charged Pions Produced at 180° in 0.8–4.89-GeV Proton-Nucleus Collisions

L. S. Schroeder, S. A. Chessin, J. V. Geaga, J. Y. Grossiord,[a]
J. W. Harris, D. L. Hendrie, R. Treuhaft, and K. Van Bibber
Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720
(Received 25 September 1979)

High-energy charged pions produced at 180° in 0.8–4.89-GeV proton-nucleus collisions have been studied. Both the slopes of the energy spectra and the π^-/π^+ ratios increase rapidly with primary energy up to ~ 3–4 GeV, where limiting values appear to be reached. The dependence on target mass also changes over this energy range. Unlike forward pion-production results, backward pions at these energies do not obey the scaling law suggested by Schmidt and Blankenbecler.

We report on a systematic study of the energy dependence of charged pions produced at 180° in the collisions of 0.8–4.89-GeV protons with nuclei. A principal reason for studying production of energetic pions from nuclei in the backward direction is that in free nucleon-nucleon (N-N) collisions such production is kinematically restricted. Observation of pions beyond this kinematic limit may then be evidence for exotic production mechanisms such as production from clusters.[1-5] Early experiments by Baldin *et al.*[6] using 5.14- and 7.52-GeV protons observed

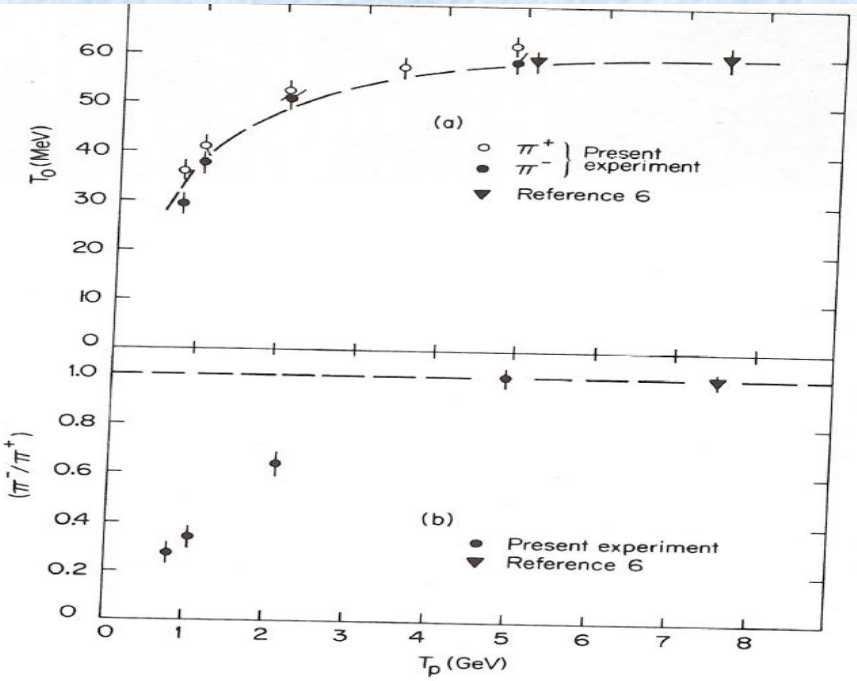


FIG. 1. Energy dependence of (a) T_0 parameter for pions, and (b) the π^-/π^+ ratio at 180° obtained by integrating each spectra up to 100 MeV for p-Cu collisions from 0.8 to 4.89 GeV. The dashed curve in both cases refers to the predictions of the "effective-target" model (Refs. 3 and 4).

tering mechanism to one where nucleon clusters play an ever increasing role. To isolate the production mechanism further, experiments are required which will measure additional observables such as associated multiplicities and two-particle correlations. However, it is clear that by measuring the production of pions in kinematic regions beyond those available in free N-N collisions, such as at 180° and high energies, one is probing the short-range behavior of nucleons in nuclei. This behavior might manifest itself as large Fermi momenta or nucleon clusters.

Американская гуманитарная помощь кумулятивному эффекту….

Флуктон

Файерболл

SRC

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14

[a]Present address: Institut de Physique Nucléaire de Lyon, Lyon, France.
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Много теорий красивых и нужных…

Cumulative particle production

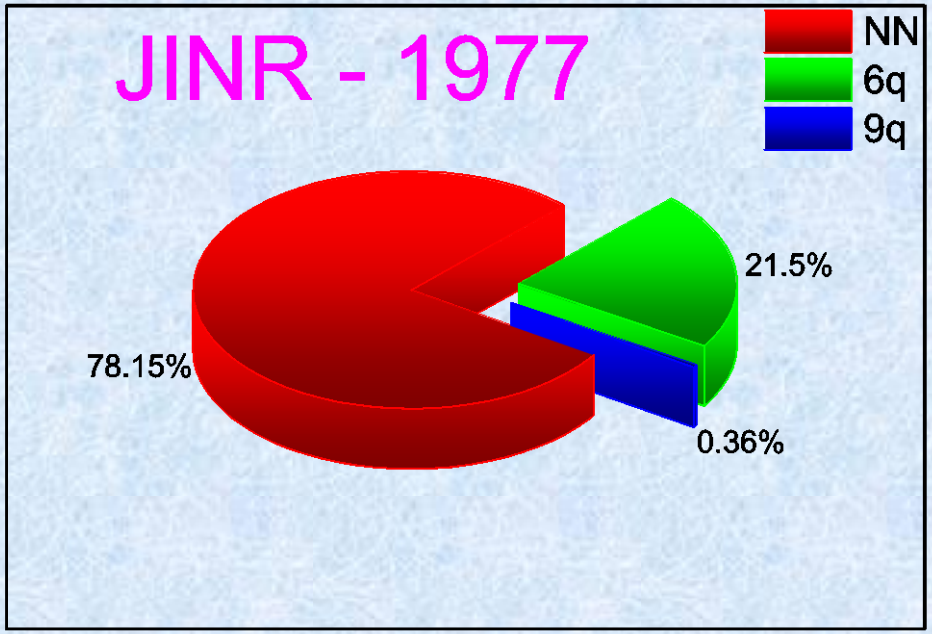
Theory and Experiment

- ***Fermi motion (I.S.Shapiro,…)***
- ***Resscattering (V.B.Kopeliovich, G.I. Lykasov,…)***
- ***Tube Model (F.Takagi, …)***
- ***Model of the Fireball (U.M.Zinoviev,…)***
- ***Diquark Model (S.Fridriksson,…)***
- ***Correlated Clusters (CC) (T.Fujita, V.I.Komarov,…)***
- ***Short Range Correlations (L.Frankfurt, M. Strikman…)***
- ***Fluctons (D.I.Blokhintsev, A.V.Efremov, V.V.Burov, V.K.Lukyanov, A.I.Titov, …)***
- ***Multiquark Systems (A.V.Efremov, V.V.Burov, V.K.Lukyanov, A.I.Titov, V.A.Matveev, J.P. Vary, H.J. Pirner, G.I. Lykasov,…)***
- ***Experiment (V.S.Stavinsky, A.I.Malakhov, L.S.Zolin, Yu.A. Panebratsev, L.S.Azhgirei, G.A.Leksin, S.S.Shimansky, A.G. Litvinenko, L.S. Strunov, N.Piskunov, E.A. Strokovsky, …)***

^{12}C - structure

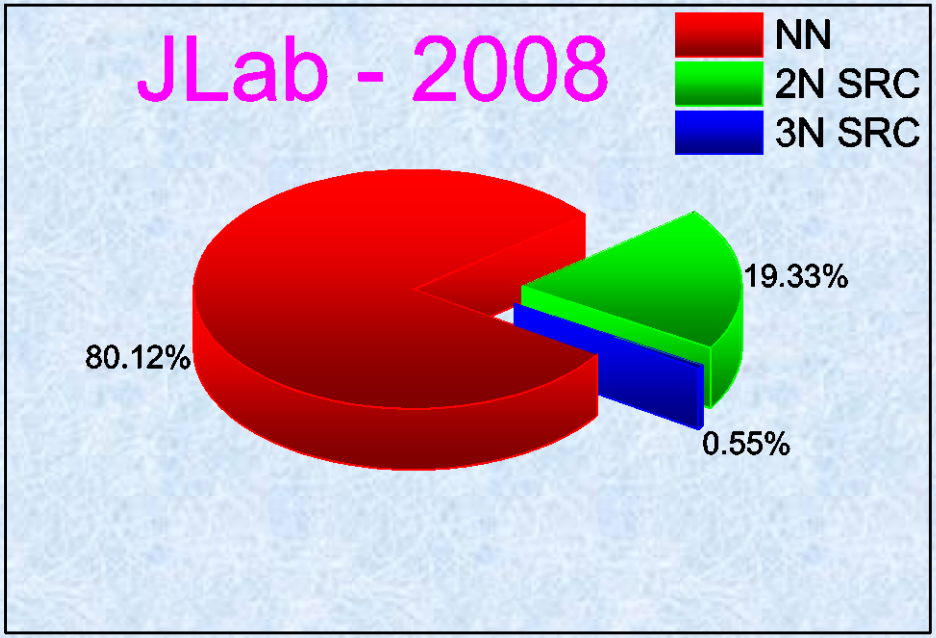
RNP – program at JINR

V.V.Burov., V.K.Lukyanov, A.I.Titov, PLB, 67, 46(1977)



eA – program at JLab

R.Subedi et al., Science 320 (2008) 1476-1478
e-Print: arXiv:0908.1514 [nucl-ex]



Dubna Seminars 1969 - 2018

- The subsequent seminars of this series were devoted to the physics of strong interactions, multiparticle production, relativistic nuclear physics, quantum chromodynamics, cumulative meson production, structure functions, EMC-effect, …
- The laws governing the limiting fragmentation of nuclei and the nuclear reactions with large momentum transfers which were discovered in the early seventies became the main trends in the program of investigations of relativistic nuclear collisions at the
- Synchrophasotron and Nuclotron.

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Baldin ISHEPP XXII. Opening.

Baldin ISHEPP XXII

А.М. Балдин и В.В. Буров

Балдинская Осень

Baldin ISHEPP XVII. Boat Trip.

JOINT INSTITUTE FOR NUCLEAR RESEARCH

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ON HIGH ENERGY PHYSICS PROBLEMS

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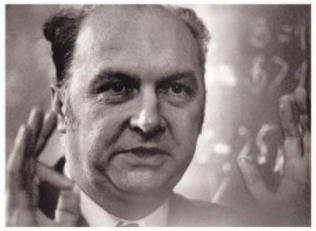

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- Dynamics of multiparticle production
- Polarization phenomena, spin physics
- Studies of exotic nuclei in relativistic beams
- Applied use of relativistic beams
- Accelerator facilities: status and perspectives
- New project NICA/MPD (Nuclotron-based Ion Collider fAcility/ Multipurposed Detector) at JINR
- Progress in experimental studies in high energy centers — JINR, CERN, BNL, JLAB, GSI, etc.

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Школа молодых ученых
Гомель 1977

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