BARASHENKOV, V.S.

AUTHOR: BARAŠENKO, V.S., STACHANOV, I.P., ALEKSANDROV, JU.A. PA - 2076

TITLE: Elastic Small Angle Scattering of Neutrons by Heavy Nuclei. (Uprugoe rassejanie neutronov tjaželymi jadrami na malye ugly, Russian)

PERIODICAL: Zhurnal Eksperimental'noi i Teoret.Fiziki, 1957, Vol 32, Nr 1, pp 154-156 (U.S.S.R.)
Received: 3 / 1957 Reviewed: 4 / 1957

ABSTRACT: The latest works on the scattering of fast electrons by hydrogen confirm the conclusions of the meson theory concerning the extensive distribution of the electric charge in the nucleon. This charge distribution is due to a "cloud" of charged mesons round a central nucleus. Under the influence of an exterior field the distribution of electric charge in the nucleon will change. Above all, a polarization of the homologously charged meson cloud and of the nucleus in the nucleon can be expected and the neutron will then probably receive an induced electric dipole moment $\vec{p} = \alpha\vec{E}$, a fact which becomes apparent by an abnormal behavior of the differential cross section of the scattering of neutrons by heavy nuclei into small angles. If it is assumed in first rough approximation that the meson field of a neutron in an exterior electric field $\vec{E} = \vec{k}V/z$ (with $\mathcal{H} = 1$) can be

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described by the statistical equation:

$$\left[\nabla^2 + (e/c\hbar)^2 E^2 z^2\right]\varphi - (mc/\hbar)^2\varphi = (4\pi/c)g\delta(\vec{r}),$$ it applies for the induced electric dipole moment that

$$\vec{p} = -\frac{e^2 g^2}{\hbar^2 c^2} E \int z^2 \frac{\exp(-2mcr/\hbar)}{r^2} d^3 x + O(E^2).$$

Therefrom it further results that

$$\alpha(\hbar c/g^2) = (e\hbar/mc^2)^2 \pi/3m = 2{,}1.10^{-41}.$$

In consequence of electric polarization the neutron is subjected to an additional scattering of the COULOMB field of the nucleus. Polarization scattering attains its maximum if the collision parameter is restricted by the condition R d a. Here $R = 1{,}5.10^{-13} A^{1/3}$ denotes the radius of the nucleus and $a = 0{,}53.10^{-8} Z^{1/3}$ the radius of the electron cloud. For the energy of the interaction between neutron and nucleus it is in this case true that

$$H(\vec{r}) = U(\vec{r}) - \mu(iZ/2r^3)(\hbar e/mc)^2 \sigma \left[\vec{r}\,\nabla\right] - \alpha Z^2 e^2\, 1/r^4.$$

The first term denotes the pure nuclear forces and the second

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term describes the interaction between the magnetic moment σ of the neutron and the COULOMB field of the nucleus (SCHWINGER'S scattering). Polarization scattering is evaluated here by means of BORN'S approximation and the here found expression for the differential cross section of the elastic bundles of a bundle of non-polarized neutrons on a nucleus is given. The results found by means of this formula are demonstrated in a diagram and in a table. Polarization scattering occurs like SCHWINGER'S scattering on the occasion of scattering into small angles. The measurements are carried out with the best success within an angular range of Θ 3° up to 10° where nuclear scattering still depends only to a small extent on the angle. Polarization scattering, on the occasion of scattering of neutrons of low energy, makes a considerable distribution to $\sigma(\Theta)$ and declines relatively slowly with increasing Θ.

ASSOCIATION: Not given
PRESENTED BY:
SUBMITTED:
AVAILABLE: Library of Congress

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103520019-0"

AUTHOR BARASHENKOV, V.S. PA - 2689

TITLE: Concerning the Construction of a phenomenological scattering matrix with non local interaction.
(O postroyenii fenomenologicheskoy matricy rasseyaniya s ne-lokal'nym vzaimodeystviyem. Russian)

PERIODICAL Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol.32, Nr.2, pp. 368 - 369 (U.S.S.R.)
Received 5/1957 Reviewed 6/1957

ABSTRACT The following work demonstrates the proposition that one can construct a unitary and macroscopic causal expression for the S-matrix without the introduction of additional series with unclear physical meaning and with vague convergance. For this purpose one writes the S-matrix in the following form:

$$S=\sum_{n=0}^{\infty}((-i)^n/n!))\int_{-\infty}^{+\infty}P^*\{H_1H_2 \ldots H_n\}d^4(x_1x_2\ldots x_n).$$

$$H_i=H(x_i)=-ie\int\varphi^*(x_1)A(x_2)\varphi(x_3)\sum_{i=1}^{3}F_i(x_1x_2x_3)\delta(x_i-x)d^4(x_1x_2x_3)$$

If one applies the expression

$$H_i=-ie\int\varphi_p^*(x_i)A_k(x_i)\varphi_q(x_i)\{\Phi_1(k+q,q)+\Phi_2(p,q)+\Phi_3(p,p-k)\}d^4(pqk),$$

$$\varphi_p^*(x_i)=\varphi^*(p)e^{-ipx_i};\ \varphi_q(x_i)=\varphi(q)e^{iqx_i};\ A_k(x_i)=A(k)e^{ikx_i}$$

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103520019-0"

Concerning the Construction of a phenomenological scattering matrix with non local interaction. PA-2689

for Operator H_i (whereby $\varphi^*(p)$, $\varphi(q)$, $A(k)$, ϕ_i implies the Fourier-Components of the operators $\varphi^*(x)$, $\varphi(x)$, $A(x)$ and of the Formfactor F_i), then one can calculate the matrix elements according to the same rules as in the theory of local interaction. An expression for the matrix element of self-energy of field A is explicithy stated. In the space-time domain $e_{ij}^2=(\bar{x}_i-\bar{x}_j)^2-c^2(t_i^2-i_j)^2 < 0$ $e_{ij}^2 \gg \lambda^2$ (whereby the constant λ determines the characteristic dimension in the theory) the above mentioned operator P does not differentiate itself from time ordering operator P because one can define the operator within these domains in relativistic invariant ways. But within the scope of the microscopic $e_{ij}^2 \lesssim \lambda$ is the definition of operator P in relativistic invariant ways to be generalized. This generalization is vastly arbitrary, a suitable term for the Matrixelement of selfenergy is offered and given a short discussion. The above mentioned S-matrix suffices in the area of macroscopic space-time for the conditions of causality. One dan demonstrate the unitary in the same manner as for an S-matrix without formfactor. (Without illustration).

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Concerning the Construction of a phenomenological scattering matrix with non local interaction. PA - 2689

ASSOCIATION
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SUBMITTED 6.8.1956
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Glavnoye upravleniye po ispol'zovaniyu atomnoy energii

AUTHOR BARASHENKOV V.S. PA - 2972

TITLE Concerning some possibilities of formulation of a relativistically invariant theory of extended particles (O vosmozhnostyakh postroyeniya relyativistki-invariantnoy teorii protyazhennykh chastits.-Russian)

PERIODICAL Zhurnal Eksperim. i Teoret. Fiziki 1957, Vol 32, Nr 3, pp 566 - 569 (USSR)
Received: 6/1957 Reviewed: 6/1957

ABSTRACT The present paper examines various problems of the theory of extended particles on the basis of the example of the classical (non-quantized) theory of the dynamically not deformed extended particles which are in interaction The theory has no HAMILTONIAN- like structure, but may be formulated by the LAGRANGE variables $x_k, \dot{x}_k, A_\mu, \dot{A}_\mu$ and also by the HAMILTONIAN variables

$$x_k, p_k, A_\mu, \pi_\mu .$$

1. The LAGRANGIANS and the HAMILTONIAN Variables. The present paper inteads to investigate also the possible covariant formulations. The following equations of motion of the particles and the field are easily obtained from

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Concerning some possibilities of formulation of a relativistically invariant theory of extended particles.

a variation principles:

$$m_i du_{i\alpha}/dS_i - u_{i,} \int_{-oo}^{+oo} F^{\alpha\beta}(x)G(x - x_i)d^4 x = 0$$

$$\delta^2 A_{\alpha}(x)/\delta x_\mu \delta x^\mu + \sum_i e_i \int_{-oo}^{+oo} G(x - x_i)\, u_{i\alpha}\, d s_i = 0.$$

In the non-local theory, the expression in $\delta S = \int \delta L(t)dt=0$ under the integral sign may be represented in two essentially different forms. Also an analogous expression is given for a "HAMILTONIAN".

2. The many-time formulation of the equations of motion: The theory within the framework of the many-time formalism of DIRAC-FOCK-PODOL'SKIY may be generalized relativistically. For this purpose the HAMILTONIAN system of equations known from local theory is generalized. The equations are written down here explicitly.

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3. The Impossibility of transition to equations for only one time is proved in short.
4. In conclusion the conditions of the compatibility of many-time equations are dealt with in short. If only one of the equations of motion contains a non-vanishing from function, this inavoidably leads to an incompatible system of equations.
(No Illustrations)

ASSOCIATION: Academy of Science of the U.S.S.R.
PRESENTED BY: -
SUBMITTED: 12. 2. 1956.
AVAILABLE: Library of Congress.

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BARASHENKOV, V. S., B. M. BARBASHEV, BUBELEV, E. G. and MAKSIMENKO, V. M.

"Multiple Production of Heavy Particles in Two Nucleon Collisions," Nuclear Physics, Vol. 5, No. 1, Jan '[illegible] (North Holland Publ. Co, Amsterdam)

BARASHENKOV, V. S.)
BARBASHEV, B. M.) Joint Inst. of Nuclear Research, Theoretical Physics Lab.,
BUBELEV, E. G.) Dubna, USSR

Abst. - The probabilities of particle production in nucleon-nucleon collisions at an energy of E = 5 GeV have been calculated using Fermi's statistical theory and by taking into account the conservation of baryon number, strangeness, isobaric spin as well as strong resonance pion-nucleon interaction in the T = 3/2, P = 3/2, state. Various effective space volumes in which secondary particles are produced are considered.

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103520019-0"

SOV/89-5-4-7/24

AUTHORS: [illegible]reshenkov, V. [illegible], Van Shu-fen', Tolstov, K. D.

TITLE: Collisions of Protons With an Energy of 9 BeV With Nucleons (Stolknoveniya protonov s energiyey 9 Bev s nuklonami)

PERIODICAL: Atomnaya energiya, 1958, Vol 5, Nr 4, pp 45[illegible]-454 (USSR)

ABSTRACT: The nuclear emulsion NIKFI-R, which has a thickness of layer of $\sim 4[illegible]0\mu$, was bombarded with protons of ≈ 9 BeV (synchrophasotron of the Ob"yedinennyy institut yadernykh issledovaniy (United Nuclear Research Institute)). From 27[illegible] stars 39 were counted as p,p-collisions and from [illegible] stars [illegible] were counted as p,n-collisions. Three of the 39 stars could be fixed as being elastic p,p-collisions. The following further values were obtained by counting (average number of the particles taking part in the p,p- and p,n-collisions respectively):

$\overline{n}_p$ [illegible].8 ± 0.[illegible]

$\overline{n}_n$ = 2.8 ± 0.6

$\overline{n}_p^{(s)}$ [illegible] ± 0.[illegible] (s) fast particles

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SOV/89-5-4-[illegible]/24

[illegible] Protons [illegible] an Energy of 9 BeV With Nuclei

$$\bar{n}_n^{(s)} = 2.5 \pm 0.6 \quad (s) = \text{fast particles}$$

The angular distribution for $n_p^{(s)}(\Theta)$ is recorded graphically. The average loss of energy for the forming of ions at p.n-collision amounts to about 60% of the energy of the primary protons.

[illegible] G. Bobelev, V. M. Mal'tsev, and Ten-Gyn assisted in the theoretical calculations. L. V. Kirillova and V. A. Belyakov assisted in experiments. There are [illegible] figure, [illegible] table, and [illegible] references, [illegible] of which are Soviet.

SUBMITTED: [illegible] [illegible], 1958

[illegible]

BARASHENKOV, V. S., BELYAKOV, V. A., BUBELEV, E. G., MALTSEV, V. M., TOLSTOV, K. D.
TEN GYN, and WHAG SHOU FENG.

"Multiple Production of Particles in Collisions between 9 GeV Protons and Nucleons," Nuclear Physics, vol. 9, no. 1, Nov.1958. (No Holland Publ. Co.)

Joint Inst. Nuclear Research Lab Theoretical Physics and High Energy Lab, Dubna.

Abstract: Some theoretical calculations pertaining to multiple production of particles in nucleon-nucleon collisions at 7-10 GeV were presented in ref. 1. Some preliminary experimental results obtained by irradiating photographic emulsions with proton beam from the synchrocyclotron of the Joint Inst Nuclear Research were given in ref 2. In the present paper we compare the theoretical results of ref. 1 with the results of some new experiments. 372 stars, of which 50 were classified as proton nucleon collisions, were recorded in NIKFI-R photographic emulsions along the tracks of 9 GeV protons accelerated in the JINR proton synchrocyclotron. The mean number of charged particles created in these collsions was 3.6 0.5. The angular distribution of fast particles ~~created in these collisions~~ is obtained. As a whole the experimental results agree with the statistical theory of multiple particle production within the limits of the experimental errors. Some discrepancy is evident in the small angle range and may be due to the contribution of non-central impacts and to asymmetry of the angular distribution in the c.m.s.

POLAND/Nuclear Physics - Elementary Particles. C.

Abs Jour : Ref Zhur - Fizika, No 7, 1959, 14836

Author : Barashenkov, V.S., Maltsev, V.M.

Inst : Joint Institute for Nuclear Research

Title : Multiple Production of Unstable Particles in Pion-Nucleon Collisions

Orig Pub : Acta phys. polon., 1958, 17, No 2-3, 177-182

Abstract : The Fermi statistical theory leads too large a number of produced strange particles. A model is proposed in which the relative fraction of the produced pions, nucleons, strange particles, and anti-particles is in better agreement with experiment. It is proposed that the statistical equilibrium for K mesons is established in a three dimensional volume with a radius $r_K = \hbar/m_K c$, and for other particles in a three dimensional volume with a radius

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APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103520019-0"

BARASHENKOV, V. S.

POLAND/Nuclear Physics - Elementary Particles. C

Abs Jour : Ref Zhur Fizika, No 1, 1960, 395

Author : Barashenkov, V.S., Maltsev, V.M.

Inst : Joint Institute for Nuclear Research

Title : On the Magnitude of Strange Particle Production Cross Section in Nucleon-Nucleon Collisions at Cosmotron Energy

Orig Pub : Acta phys. polon., 1958, 17, No 6, 397-400

Abstract : Using statistical theory methods the authors have calculated the momentum spectra and the probability of production of pions, nucleons, and strange particles in NN collisions at E = 3 bev. The theoretical cross section of production of K mesons is approximately three times greater than the experimental value (Referat Zhur Fizika, 1958, No 7, 15013). It is

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APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103520019-0"

BARASHENKOV, V.S.

Interaction of K-mesons, pions, nucleons, and hyperons. Zhur. eksp. i teor. fiz 34 no.4:1014-1015 Ap '58. (MIRA 11:5)

1.Ob"yedinennyy institut yadernykh issledovaniy.
(Nuclear reactions) (Particles, Elementary)

56-34-4-43/60

AUTHOR: Barashenkov, V. S.

TITLE: On the Interaction Between K-Mesons, Pions, Nucleons and Hyperons (O vzaimodeystvii K-mezonov, pionov, nuklonov i giperonov)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol 34, Nr 4, pp 1016-1017 (USSR)

ABSTRACT: According to the author's opinion the following is very probable: The results obtained from a comparison between the calculations according to statistical theory and experiment for a wide energy interval indicate a relative value of the constants of the interactions between these particles. As, at present, opinions differ as to the amount of interaction between pions and K-mesons on the one hand and hyperons on the other, as well as between K-mesons and nucleons, also indirect information on these interactions is of great interest. The author bases upon the well-known experimental fact of the strong interaction between pions and nucleons ($g^2/4\pi\hbar c \gg 1$). If strong interaction between pions and nucleons (or K-mesons and nucleons) is assumed, the following possibilities for the selection of spatial volumes for the "compound particle" exist. 1 - The statistical equilibrium between all secondary par-

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On the Interaction Between K-Mesons, Pions, Nucleons and Hyperons 56-34-4-43/60

ticles occurs in one and the same columne V_1. In this case the portion of the strange particles formed (compared to nucleons and pions) by far exceeds the portion expected experimentally. 2.- The statistical equilibrium of nucleons, pions and K-mesons occurs in one and the same volume V_1, but the equilibrium for the hyperons occurs in a smaller volume. In this case the part of the strange particles formed approaches the experimental value. However, the ratio between the number of the strange particles formed in nucleon nucleon collisions and the K and K⁻ mesons at E_3 6,2 BeV has the value $N^+/N^- \sim 3$. 3. The volume in which the equilibrium for the K mesons occurs is greater than the corresponding volume for nucleons and pions. In this case neither the part of the strange particles formed nor the value of the ratio N^+/N^- agrees with the experiment. The results of the statistical theory of the multiple production of particles can be made to agree with the experiment only if a weak interaction of K-mesons with pions and nucleons is assumed. In this case the statistical equilibrium for the K-mesons occurs in a smaller spatial volume than in the case of pions and nucleons. The best agreement is attained on the

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assumption of the symmetric interaction of pions with the nucleons and hyperons ($V = V_2$) according to Gell-Mann (Ref 5). Finally, the author thanks D.I.Blokhintsev for many discussions, M.A.Markov, B.V.Medvedeva, V.I. Ogiyevetskiy for critical remarks, and K.D. Tolstov for the discussion of the experiments. There are 7 references, 1 of which is Soviet.

ASSOCIATION: Ob"yedinennyy institut yadernykh issledovaniy (United Institute of Nuclear Research)

SUBMITTED: January 8, 1958

1. Mesons--Nuclear reactions 2. Protons--Nuclear reactions

AUTHORS: Blokhintsev, D. I., Barashenkov, V. S., Grishin, V. G. SOV/56-35-1-59/59

TITLE: The Diffraction Scattering of Fast Particles (Diffraktsionnoye rasseyaniye bystrykh chastits)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol. 35, Nr [illegible] pp. 311 - 312 (USSR)

ABSTRACT: The structure of elementary particles may be studied by investigation of the elastic scattering of any radiation by these particles. Hitherto only the investigations carried out by the Hofstadter (Khofshtadter) group concerning the scattering of electrons on nuclei and nucleons are known, they permit the determination of the form factor of the electric charge and of the magnetic moment. But also the analysis of the elastical scattering of other particle types makes it possible to obtain important information concerning the structure of the nucleons and nuclei. This paper investigates, as an example, the scattering of negative pions on nucleons. For the sake of simplicity, the dependence of the interaction on the spins and the

"charge exchange" are neglected. Moreover, it is assumed that the real part of these phases is equal to zero: $\mathrm{Re}\,\eta_1 = 0$. The exact solution of this problem will be published later. A diagram demonstrates the values of $\mathrm{Im}\,\eta_1$ for the scattering of negative 1,3 BeV pions. For high energies the quasiclassical approximation may be used with a high degree of approximation. The numerical values of the cross section which were calculated according to the quasiclassical theory agree rather well with the results of previous papers and this is one of the arguments in favor of the applicability of the quasiclassical approximation. For the average square "pion radius" of a nucleon the value $(0,82 \pm 0,06).10^{-13}$ cm was found; it corresponds (within the limits of experimental errors) to its value for E = 5 BeV. The example investigated in this paper is a special case of the so-called inverse problem of the scattering theory: from the given scattered wave the interaction potential is to be determined. The authors thank K. Danilov for his help in numerical computations. There are 2 figures and 6 references, 2 of

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The Diffraction Scattering of Fast Particles SOV/[illegible]

which are Soviet.

ASSOCIATION: Ob"yedinennyy institut yadernykh issledovaniy (United Institute of Nuclear Research)

SUBMITTED: April 2?, 1958

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21(1) PHASE I BOOK EXPLOITATION SOV/2414

Barashenkov, V. S., and Huang, Nien-ning

Secheniye vzaimodeystviya nuklonov pri energii 9 Bev (Interaction Cross Section of 9-Bev Nucleons) Dubna, 1959. 5 p. XEROX COPY, No. of copies printed not given.

Sponsoring Agency: Ob"yedinennyy institut yadernykh issledovaniy. Laboratoriya teoreticheskoy fiziki.

No contributors mentioned.

PURPOSE: This paper is intended for nuclear physicists.

COVERAGE: The interaction cross sections σ_{in} of C, N, O, Br and Ag were computed at E = 9 Bev and found to be 240, 260, 290, 900 and 1070 mb respectively. Cross sections σ_{el} and σ_{in} for hydrogen are treated in references 1, 6 and 9. Data from previous works indicated that: 1) the total effective interaction cross section (NN) at E = 9 Bev is $\sigma \simeq 40$ mb (ref. 1); 2) the theoretical value of the mean path of a proton in photographic emulsion Ilford G-5 at E = 5.7 Bev (reference 2) agrees with the experimental value L = 37.6 cm (computed according to optical models), if the distribution of nucleon

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density in nuclei is taken from experiments with fast neutron scattering by nuclei (reference 3) and when the theoretical value for the interaction cross section of an incident nucleon and a nucleon in the nucleus is chosen as $\bar{\sigma} \simeq$ 32 tb, which also agrees with the experimental value σ = 31.3 $\pm$ 1.5 tb at E = 6.15 Bev (reference 4); 3) similar computations based on optical models show an accuracy within a few percent of $\bar{\sigma} = \sigma$ - where σ is the interaction cross section of free nucleons - if the distribution of neutron density in nulei is taken from experiments with fast neutron scattering by these nuclei at E $\gtrsim$ 1 Bev (reference 6). The predication of similar conclusions at E =9 Bev is made by the authors. Figure 1 shows a curve of the computed values of the mean free path L = L (σ) of a 9-Bev proton in photographic emulsion NIKFI-R at σ = $\bar{\sigma}$. This curve differs by only a few percent from an analogous curve L = L ($\bar{\sigma}$), computed for the case where σ = 30 tb. The theoretical value [length] of the path equals the experimental value, L = 37.1 $\pm$ 1.0 cm (ref 1), if $\bar{\sigma} = \sigma$ = 30 $\pm$ 5.5 tb. A rougher experimental value L = 34.7 $\pm$ 1.5 cm, given in reference 8 and figure 1, results in a proton-nucleon cross-section value of $\bar{\sigma} = \sigma \simeq 33^{+5}_{-3}$ tb. The values obtained for σ are near the total proton-proton interaction cross section at E = 6.15 Bev (reference 4). The number of component atoms ($\mathcal{N}$ .10^{-22} per cm^3) in photographic emulsions Ilford G-5 and NIKFI-R was $\mathcal{N}_H$ = 3.37, 2.93; $\mathcal{N}_C$ = 1.36, 1.39; $\mathcal{N}_N$ = 0.29, 0.37; $\mathcal{N}_O$ = 1.02, 1.02; and $\mathcal{N}_{Ag}$ =

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1.02, 1.02 respectively. Results of this investigation together with those of reference 9 show that the optical method may be successfully used to describe interactions of elementary particles at $E = 1$ Bev. At $E \gg 1$ Bev, nucleon-nucleus interaction cross sections proved sensitive to the form of diffusivity of the nuclear boundary. In this respect, interactions with a collision parameter of the order of a nuclear radius make a major contribution and offer new possibilities for the experimental study of a diffusion nucleus. The authors thank P. Markov, K. Tolstov, E. Tsyganov, M. Shafranova, and N. Bogachev. There are 9 references: 4 Soviet and 5 English.

TABLE OF CONTENTS: None Given

AVAILABLE: Library of Congress

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S/058/61/000/012/024/083
A058/A101

AUTHOR: Barashenkov, V. S.

TITLE: Optical analysis of fast nucleon and pion interation with nucleons and nuclei

PERIODICAL: Referativnyy zhurnal, Fizika, no. 12, 1961, 118, abstract 12B629 (V sb. "Probl. sovrem. teorii elementarn. chastits", no. 2, Uzhgorod 1959, 142-148)

TEXT: Interaction of fast particles with nucleons and nuclei is characterized by the absorption coefficient $K(r; T) \simeq k(T)\rho(r)$ and the refractive index $N(r; T) \simeq n(T)\rho(r)$, where $\rho(r)$ is the density of the nuclear material at distance r from the center of the nucleon or nucleus, and T is the kinetic energy of the particle. The values of these coefficients are determined by means of comparison with experimental interaction cross section-data. For $T \sim 1$ Bev, $n(T) \sim k(T)$. With increasing energy $n(T) \rightarrow 0$ and $k(T) \rightarrow$ const; interaction in this case has a typical diffraction character. The distribution of nuclear material $\rho(r)$ in nucleons and in nuclei, and the mean square radius

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21 (8)

AUTHORS: Barashenkov, V. S., Belyakov, V. A., SOV/89-7-4-12/28
Van Shu-fen', Glagolev, V. V., Dolkhazhav, N., Kirillova, L. F., Lebedev, R. M., Mal'tsev, V. M., Markov, P. K., Tolstov, K. D., Tsyganov, E. N., Shafranova, M. G., Yao Ch'ing-hsieh

TITLE: The Interaction of Fast Nucleons With Nuclei of the Photo-emulsion NIKFI-R

PERIODICAL: Atomnaya energiya, 1959, Vol 7, Nr 4, pp 376-377 (USSR)

ABSTRACT: The present paper deals with the interaction between 9 Bev-protons, which were accelerated in the beam of the synchro-phasotron of the Ob"yedinennyy institut yadernykh issledovaniy (Joint Institute of Nuclear Research), and the nuclei of a photoemulsion of the NIKFI-R type. The results of these measurements are shown by a table. On the basis of the data thus found it is possible to draw several conclusions as to the mechanism of the interaction between a fast proton and a nucleus. If the primary nucleon-nucleus collision is an interaction between nucleon and channel, the velocity of the center of mass in an interaction of silver and bromine with the channel will be considerably less than in an interaction with light nuclei. Therefore, also the number of s-particles

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must be considerably greater. In the experiment, the numbers of s-particles for light and heavy nuclei are, however, nearly the same. This is explainable on the basis of the cascade mechanism of interaction, in which the energy of the s-particles decreases rapidly in cascade collisions. The multiplicity of the particles produced decreases simultaneously. In the case of the greater number of g-particles, nucleons are concerned, which may be explained by the cascade mechanism of nucleon - nucleus interaction. Also the agreement between the transversal momentum $p_{g\perp p}$ for g-protons originating from interactions with light and heavy nuclei points in the direction of the interaction cascade mechanism. Besides, a search was made for strange particles by employing the method of investigating according to areas. The cross section of the production of k^+-particles with an energy of $E \leqslant 140$ Mev in a medium-weight nucleus of the photoemulsion amounts to $(5 \pm 2)10^{-27}$ cm^2. Besides, the amount of the production cross section, the wide angular distribution of the k-mesons, as well as other facts indicate that a noticeable fraction of

The Interaction of Fast Nucleons With Nuclei of the Photoemulsion NIKFI-R SOV/89-7-4-12/23

slow strange particles is produced in an intranuclear cascade process. Furthermore, the medium-weight energy losses of a fast nucleon are evaluated in the case of a single nucleon-nucleon collision. A 9Bev-proton gives up an average of (5.1 ± 0.8) Bev to a medium-weight nucleus of the photoemulsion, which amounts to (60 ± 10) % of its initial energy. 4.05 Bev are used for the production of pions, and 1.05 Bev are transferred to the nucleons of the nucleus. As a proton in an medium-weight nucleus undergoes approximately 2 collisions, the proton, in one single nucleon-nucleon collision, loses $\Delta E = 35 \pm 10$ % of its initial energy. By means of other measurements of the pion energy spectrum carried out independently of the present paper in a nucleon-nucleus collision $\Delta E = 40 \pm 10$ % is obtained. The statistical theory of multiple production furnishes $\Delta E = (40 - 50)$ %. The authors thank G. Beznogikh, V. Vaksina, Z. Kuznetsova, and N. Metkina for their help in the measurements, and L. Popova for his assistance in analysing measuring results. There are 1 table and 1 reference.

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BARASHENKOV, V. S.

V. S. Barashenkov and B. M. Barbashov

"The Electrical Polarizability of the Meson Cloud in the Nucleon"

Nuclear Physics, 9, No. 3, Jan. 1959, 426-428 (North Holland Publishing Co., Amsterdam)

Joint Institute of Nuclear Research, Laboratory of Theoretical Physics, Dubna, USSR

21(7)

AUTHORS: Barashenkov, V. S., Huang Nien'-ning SOV/56-36-3-26/71

TITLE: The Nonuniqueness of the Phase Analysis of Proton-Proton Collisions (Neodnoznachnost' fazovogo analiza proton-protonnykh stolknoveniy)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 3, pp 832-834 (USSR)

ABSTRACT: In a number of papers the analysis of high energy nucleon-nucleon scattering experiments were carried out on the basis of the phenomenological optical model (Refs 1-4), and in references 1, 2, and 4 it was further assumed that

$Re\ \eta_l \ll Im\ \eta_l$ holds for the real part of the complex phase η_l.

Also the authors of this paper proceed from this model and develop a method for phase shift analysis of pp-collisions at energies of $E \lesssim 10$ Bev on the further assumption that in the case of a spatial distribution of the absorption coefficient $K = K(E^*;r)$ it holds for the refraction coefficient $N(E^*;r) = 1 + N_o(E^*;r) \approx 1$ and that for nucleon-nucleus interaction

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$K(E;r) = k(E)\,\rho(r)$ and $\varkappa_0(E;r) = n(E)\,\rho(r)$, where $\rho(r)$ denotes the density of nuclear matter. For $E \sim 1$ Bev it was found that the refraction- and absorption coefficients are of the same order of magnitude. The cross sections calculated by the authors agree within the error limits with experimentally obtained values. Thus, at E = 10 Bev, $\sigma_t = 30.10^{-27}\text{cm}^2$ is found for the total scattering cross section, and $\sigma_{in} = 23.0.10^{-27}\text{cm}^2$ is found for the inelastic scattering cross section, which is in agreement with the values determined at Dubna (Ref 7). For other energies the authors obtained the same result as Grishin, Saitov and Chuvilo (Ref 3). Further results for $1.5 \leq E \leq 10.0$ Bev are contained in tables 1 and 2. In conclusion, the authors thank D. I. Blokhintsev for discussions, and I. V. Chuvilo for discussions and critical remarks. There are 1 figure, 2 tables, and 7 references, 4 of which are Soviet.

ASSOCIATION: Ob"yedinennyy institut yadernykh issledovaniy (United Institute for Nuclear Research)

SUBMITTED: September 1, 1958

21(7) SOV/56-36-3-50/71

AUTHORS: Barashenkov, V. S., Mal'tsev, V. M.

TITLE: The Production of Strange Particles in (pp)-Collisions at Energies of 3 Bev (Rozhdeniye strannykh chastits v (pp)-stolknoveniyakh pri energii 3 BeV)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 3, pp 933 - 934 (USSR)

ABSTRACT: In a number of earlier papers the authors developed a statistical theory of the multiple production of strange particles. For (πN)-collisions satisfactory agreement with the experiment is found if the energies of colliding particles are high. Nowadays experimental verification of theoretical computations of (pp)-collisions is also possible. For the inelastic (pp)-collision cross section at 3 Bev 26 mb is assumed, which, according to references 1-3, results in a calculated production cross section for K^+-particles $\sigma^+ = 1.0$ mb for $V=V_2$ and $\sigma^+=0.05$ mb for $V=V_3$. The calculated production cross section for all strange particles is $\sigma_{st} = 1.5$ mb ($V= V_2$)

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The Production of Strange Particles in (pp)-Collisions at Energies of 3 Bev SOV/56-36-3-50/71

and 0.07 mb ($V=V_3$). Experimentally, Baumel et al. (Ref 7) obtained the following for the K^+-production cross section (momentum: 1.9 m_π, m_π = 140 Mev, $\theta = 180^o$ in c.m.s., (pp)-collision at 3 Bev): $\sigma_{exp} = (4.5 \pm 0.9).10^{-32} cm^2$/steradian/Mev, ($\sigma^+ = 0.2$ mb). On the assumption of an isotropic angular distribution in the c.m.s. the present paper obtains a similar value for all momenta for $V=V_2$ $\sigma^+ = 0.33$ mb and for $V=V_3$. This value, however, deviates by several orders of magnitude from the value calculated for $V=V_3$ only on the basis of statistical weights and without using σ_{exp} and the momentum distribution. There are 9 references, 2 of which are Soviet.

ASSOCIATION: Ob"yedinennyy institut yadernykh issledovaniy (Joint Institute for Nuclear Research)

SUBMITTED: October 27, 1958

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21(7) SOV/56-36-4-59/70

AUTHORS: Barashenkov, V. S., Huang Nien-ning

TITLE: Interaction Cross Section of 9 Bev Nucleons (Secheniye vzaimodeystviya nuklonov pri energii 9 BeV)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 4, pp 1319-1321 (USSR)

ABSTRACT: N. P. Bogachev et al. (Ref 1) obtained a value of $\sigma = 40$ mb for the total (NN)-interaction cross section at E = 9 Bev. By using the experimental data of the proton range in photoemulsions it is, however, possible to obtain much more accurate values. An investigation of the mean ranges of protons in photoemulsion Ilford G-5 at E = 5.7 Bev gives an L-value that agrees well with that determined (by means of an optical model) theoretically (L = 37.6 cm). This results in $\sigma \approx 32$ mb, which also agrees well with the experimental value $\sigma = (3[illegible].3 \pm 1.5)$ mb at E = 6.[illegible] Bev. For investigations at E = 9 Bev in NIKFI-R emulsions (with $\sigma = \bar{\sigma}$) a figure shows the course of the function $L(\sigma)$. If $\sigma = \bar{\sigma} = (30^{+1}_{-0.5})$ mb, the theoretical L-value is equal to the experimental value: L = (37.1 $\pm$ 1.0) cm. To a rougher experimental

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value $L = (34.7 \pm 1.5)$ cm (Ref 8) there corresponds a (aN) cross section of $\sigma = \sigma = (33^{+5}_{-3})$ mb. Calculation of the σ_{in}-values for C, N, O, Br, and Ag at E = 9 Bev gives 240, 260, 290, 900, and 1070 mb, respectively. These results show that the optical model can be used with success for the purpose of describing the interaction of elementary particles at E ≥ ... Bev. The authors in conclusion thank P. Markov, K. Tolstov, and E. Tsyganov for discussions and N. Bogachev for his valuable remarks. There are 1 figure and 9 references, 4 of which are Soviet.

ASSOCIATION: Ob"yedinennyy institut yadernykh issledovaniy (United Institute for Nuclear Research)

SUBMITTED: January 3, 1959

21(1)

AUTHORS: Blokhintsev, D. I., Barashenkov, V. S., Barbashov, B. M.

SOV/56-36-5-73/76

TITLE: The Electromagnetic Structure of the Proton and of the Neutron (Elektromagnitnaya struktura protona i neytrona)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 5, pp 1611-1612 (USSR)

ABSTRACT: The experimental results of the distribution of charge and magnetic moment in the nucleon are known to be in sharp contradiction to meson-theoretical calculations. The authors of the present "Letter to the Editor" are, however, of the opinion that the difficulties are mainly due to an inaccurate interpretation of the fact that the usual interpretation of Hofstadter's experiments is actually neither unique nor accurate, but only possible. The discrepancy said to exist between the distribution law of meson charge density according to Yukawa ($\sim e^{-\alpha r}/r^2$) and the experimental one ($\sim e^{-\beta r}$) is of no real importance

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because the ranges of applicability of these expressions are quite different. Proceeding from the expressions found by Salzman (Ref 1) for the total charge density $\rho(r) = \rho_{\pi}(r) + \rho_k(r)$ and from the magnetic moment of the meson cloud $m(r) = m_{\pi}(r) + m_k(r)$ (one-pion state), the cutoff method is briefly investigated, and for the electric radius of the pion cloud $\langle r_e^2 \rangle_{\pi} = 0.19(\hbar/\mu_{\pi}c)^2$, and for the magnetic radius $\langle r_m^2 \rangle = 0.40(\hbar/\mu_{\pi}c)^2$ is obtained; for the charge of the pion cloud $Q_{\pi} = 0.76$ e and for the magnetic moment $m_{\pi} = 1.25\ e\hbar/2Mc$ is obtained. The distribution of charge and magnetic moment in the core amounts to $\rho_k(r) = (Q_k/8\pi a^3)e^{-r/a}$ and $m_k(r) = (m_k/8\pi a^3)e^{-r/a}$; Q_k denotes the charge of the core, and m_k - its magnetic moment. It is known from experiments that for the neutron

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$\langle r_e^2 \rangle_n \approx 0$; the anomalous magnetic moment of the nucleon was experimentally determined as being $m_N = \tau_3 \cdot 1.85 e\hbar/2Mc$. $Q_k = (1 + \tau_3)/2 - Q_\pi$. Thus $\langle r_e^2 \rangle_p = \langle r_m^2 \rangle_n = \langle r_m^2 \rangle_p = (0.7f)^2$ is obtained, which agrees well with the experiment. A figure shows the charge distribution d(r) for proton and neutron and their cores. The statement made by the authors shows that the result obtained by Hofstadter may be considered to agree very satisfactorily with the results of the meson theory. There are 1 figure and 4 references.

ASSOCIATION: Ob"yedinennyy institut yadernykh issledovaniy (Joint Institute of Nuclear Research)

SUBMITTED: March 5, 1959

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21 (7)

AUTHORS: Barashenkov, V. S., Mal'tsev, V. M. SOV/56-37-3-58/62

TITLE: On the Resonance Interaction of π-Mesons

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 37, Nr 3(9), pp 884 - 886 (USSR)

ABSTRACT: For the explanation of the ($\pi^- p$) cross section maximum near E = 1 Bev a number of authors developed the hypothesis of pion-resonance interaction. It also serves the purpose of explaining the great multiplicity in the case of the nucleon - antinucleon annihilation of pions and the inelastic ($\pi^- p$) scattering at $E \geqslant 1$ Bev. The authors of the present "Letter to the Editor" show, however, that the assumption of a ($\pi\pi$) resonance interaction in all these cases (Refs 1-8) is not stringent, because the experimental results may also be explained in a different manner. In this connection the authors investigate the conclusions to be drawn from the assumption of a ($\pi\pi$) resonance interaction for the inelastic interaction of particles at $E \gg 1$ Bev, when many pions are produced. As a concrete example the inelastic ($\pi^- p$) collision at E = 5 Bev is investigated. Without assuming ($\pi\pi$) resonance interaction, this case has already been dealt with in reference 9. On the basis

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of the results obtained there it is found that the following holds:

Theoretical variant	Number of prongs of the star		
	2	4	6
No (ππ)interaction	0.98 ± 0.12	0.99 ± 0.16	2 ± 1.14
With (ππ)interaction (Dyson; S=0,T=0)	1.21 ± 0.15	0.83 ± 0.13	0.49 ± 0.28
With (ππ)interaction (Takeda; S=0,T=1)	1.38 ± 0.17	0.71 ± 0.11	0.64 ± 0.36

As shown by the above compiled data, the theoretical results, without taking account of a (ππ)interaction, are well able to represent the experimental results. Consideration of the latter (especially in the Takeda variant) only makes them worse. According to the theory without (ππ)interaction the fraction of strange particles produced in inelastic (π^-p) collisions amounts to 8.6% (5.5% K^+ and 0.3% K^-). According to Dyson this fraction amounts to 6.4, and according to Takeda only to 5.7%. Experimentally, however, among 110 inelastic stars only 4 cases of a

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production of strange particles were found (i.e. 3.6%). According to reference 10, however, it appears to be very probable that among the remaining 106 stars there were also such in which, though those strange particles were produced, they were not disintegrated within the chamber and were therefore not recorded. There are 1 table and 11 references, 2 of which are Soviet.

ASSOCIATION: Ob"yedinennyy institut yadernykh issledovaniy (Joint Institute of Nuclear Research)

SUBMITTED: May 20, 1959

21 (1)

AUTHORS: Blokhintsev, D. I., Barashenkov, V. S., Barbashov, B. M.

SOV/53-68-3-5/11

TITLE: The Structure of Nucleons (Struktura nuklonov)

PERIODICAL: Uspekhi fizicheskikh nauk, 1959, Vol 68, Nr 3, pp 417-447 (USSR)

ABSTRACT: In chapter 1 (introduction) the authors discuss Yukawa's Theory of nucleon interaction by means of a meson field as well as the physical model of a nucleon represented by figure 1 with core, pion, and K-meson shell; the core dimension is given as amounting to $\sim\hbar/Mc = 2.1\cdot10^{-14}$ cm. In the following chapter 2 the methods of investigating particle structure are dealt with. Besides the recoil effect the inelastic interaction processes are discussed in detail. Table 1 shows the statistical errors of cross section measurements of inelastic collisions of p and n with Fe-nuclei at high energies for four energy intervals. The "gray" and "black" domains in the nucleon are dealt with (Fig 2). Some other methods are mentioned and a table shows the wave lengths of various rays. In chapter 3 the electromagnetic structure of the nucleon is theoretically dealt with, and the theory developed by Chew and Low is especially taken into account. Table 3

APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103520019-0"

represents the distribution of the electric charge in the pion cloud of the nucleon. The most important experimental results are given separately for proton and neutron. Chapter 4 is entitled "Critical Remarks and an Analysis of the Experiments Carried out by Hofstadter"; in the individual parts the limits of electrodynamics, the part played by inelastic processes, and the analysis of the scattering of electrons on protons and neutrons is discussed. Figure 6 shows the electromagnetic structure of protons and neutrons in form of diagrams. The curves $d_p(r)$ and $d_n(r)$ were taken from papers by Hofstadter. Chapter 5 deals with some structural effects of nucleons. Two problems connected with the electromagnetic structure of nucleons are discussed: the electric polarizability of the electron cloud in the nucleon according to Chew; the factor α of $\vec{p} = \alpha\vec{E}$ is given as amounting to $4\cdot10^{-43}$ cm^3 $\leq \alpha \leq 1.4\cdot10^{-42}$ cm^3, which is lower than the value given by Yu. A. Aleksandrov. In the second part of this chapter the electromagnetic mass of the nucleons and the stability of protons (according to reference 59) are investigated. Chapter 6 deals with theoretical experiments carried out for the purpose of interpreting the electromagnetic structure of the central nucleon ranges. Whereas in the preceding chapters the peripheral ranges of nucleons were dealt with, the following chapters deal with the theory of central parts. Individually, the influence of strange particles, the contribution of nucleon-antinucleon pairs (according to I. Ye. Tamm, figure 8), and some details of the theory of the form factors and dispersion relations are dealt with. Chapter 7 deals with the nuclear structure of nucleons. Several problems connected with the electromagnetic interaction of nucleons in the nucleus (nucleons among themselves, nucleons with pions, K-mesons, and antinucleons) are investigated. The cores of the nucleons are briefly dealt with (several experimental results obtained at the OIYaI (Joint Institute of Nuclear Research) are given. - Figure 10: Histograms of pp- and pn-collisions at 9 Bev (proton synchrotron) are given. The optical model of the nucleon is discussed in detail and so is pion-pion interaction. In chapter 8 the authors deal with the theory of the optical nucleon model: the equation for pion-nucleon scattering is given and discussed, and so are the conditions for the occurrence of a complex potential. Chapter 9 finally gives quite a short summary. The material of this survey is mainly of Western origin. There are 12 figures, 5 tables, and 60 references, 27 of which are Soviet.

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S/089/60/009/004/007/020
B006/B070

24.6900

AUTHORS: Barashenkov, V. S., Syan' Din-chan

TITLE: Beams of High-energy Gamma Quanta 19

PERIODICAL: Atomnaya energiya, 1960, Vol. 9, No. 4, pp 300 - 301

TEXT: The ordinary method of producing hard gamma rays is to use electron accelerators. Gamma rays of up to 1.06 Bev can be produced in this way (Stanford linear accelerator). Large proton accelerators as, e.g., the proton synchrotron of OIYaI (Joint Institute of Nuclear Research) in Dubna produce high-intensity beams of still harder gamma rays. The main gamma source in such accelerators is the decay of neutral pions generated by collisions of the accelerated protons and the target nucleons. Statistical calculations showed that the mean number of gamma quanta produced per nucleon - nucleon collision is equal to the number of charged pions produced in such collisions (Fig. 1). The gamma quantum distribution can be described by the following expression:

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$W_{\gamma}(k;\Theta) = 2 \int_{K}^{p_{max}} W_{\pi}(p;\Theta)\, dp/\sqrt{p^2+\mu^2} \simeq 2 \int_{k}^{p_{max}} W_{\pi}(p;\Theta) dp/p$. $W_{\pi}(p;\Theta)$ describes the π^o distribution, p - momentum, Θ - the angle of emission of the neutral pions produced in the nucleon - nucleon collisions; k and Θ in the W_{γ} function denote the energy and the angle of emission of the gamma quanta in the laboratory system; $K = \sqrt{k^2(1+k_o^2/k^2)-\mu^2}$; k_o - gamma energy in the rest system of the neutral pion, μ - the π^o mass. This formula holds for $k \gtrsim 0.5$ Bev, but may be used for rough estimates also for $k \simeq 0.2$ Bev. Since the experimental values of $W_{\pi}(p;\Theta)$ for the proton synchrotron of OIYaI are not yet known, the authors calculated this function by using the statistical theory of the multiple production for a kinetic energy of the accelerated protons of 10 Bev. Figs. 2 and 3 show the calculated spectra and the angular distribution of the gamma quanta. $W_{\gamma}(k) = 2\pi \int_{0}^{\pi} W_{\gamma}(k;\Theta) \sin\Theta\, d\Theta$; $W_{\gamma}(\Theta) = \int_{0.2}^{k_{max}} W_{\gamma}(k;\Theta) dk$. Fig. 4 shows

$W_{\gamma}(k;\Theta)$ for different Θ. The normalization $2\pi \int_0^{\pi} \sin\Theta \, d\Theta \int_0^{k_{max}} W_{\gamma}(k;\Theta)dk = 1$ was chosen for $W_{\gamma}(k;\Theta)$. As the diagram shows, most of the gamma quanta are emitted in the region of small angles. The intensity of the radiation decreases rapidly with increasing energy of the gamma quanta. The authors thank M. A. Markov for suggesting the topic, for discussions, and for advice. They thank V. I. Veksler for comments and discussions. There are 4 figures and 2 references: 1 Soviet and 1 US.

SUBMITTED: April 4, 1960

X

S/089/60/009/006/006/011
B102/B212

24.6900 (1191, 1395)

AUTHORS: Barashenkov, V. S., Hsien Ting-ch'ang

TITLE: Production of fast-neutrino beams

PERIODICAL: Atomnaya energiya, v. 9, no. 6, 1960, 489-490

TEXT: In the past various tests have been made with fast neutrinos; some have been made to check experimentally if, at high energies, the weak interaction will change over to a strong interaction. High-energy neutrino beams are produced in powerful proton accelerators, such as the proton synchrotron in Dubna and the 30-Bev accelerator in Geneva. Neutrinos are produced during the decay of charged pions formed through the collision of fast nucleons. The energy spectrum and the angular distribution of these neutrinos may be calculated if the energy spectrum and the angular distribution of pions produced in NN collisions are known. In general, this problem is very difficult but can be simplified if only fast neutrinos and small angles (θ_ν) are considered. Here, neutrinos with $E > 1$Bev and θ_ν of a few degrees are considered. The use of a neutrino detector with an area of $S_D \sim 1\ m^2$ located several meters

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from the target justifies such an approximation. If $W_\pi(p;\theta)$ represents the momentum distribution of the charged pions (θ is measured to the direction of flight of the primary protons), then the neutrino spectrum at a distance L from the target will be given by

$$W_\nu(E;\theta;L) = a \int_{>aE/m} W_\pi(p;\theta)\left[1-\exp\left(-\frac{L}{l}\frac{m}{p}\right)\right]\frac{dp}{p}$$ with $a = m^2/(m^2-\mu^2)$; m denotes the pion mass, μ the muon mass, and $l = \tau c \cdot 10^{-2} = 7.68$ (τ represents the pion lifetime; L is given in meters). Fig. 2 shows neutrino spectra for $\theta = 0^\circ$ in the laboratory system. Neutrino spectra are only slightly dependent on the angle; this is also apparent in Fig. 3, where the total neutrino flux is shown as a function of L for $E > 1$ Bev and $E > 2$ Bev at $\theta = 0^\circ$ and $\theta = 3^\circ$. The limits of the neutrino flux at $L = \infty$ are given by

θ	$W_\nu^{(1)}(\theta,\infty)$	$W_\nu^{(2)}(\theta,\infty)$
0°	1.5	0.18
3°	1.4	0.16

(see Fig. 3). At a distant of L = 30 m, $1.1 \cdot 10^{-8}$ neutrinos will pass

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B102/B212

through 1 cm^2 of detector area per inelastic NN collision event; at $L = 50$ m, $0.6 \cdot 10^{-8}$ neutrinos; and at $L = 100$ m, $0.27 \cdot 10^{-8}$ neutrinos. The authors thank M. A. Markov, R. Asanov, and I. Polubarinov for discussions. There are 3 figures and 6 references: 4 Soviet-bloc and 2 non-Soviet-bloc. The reference to the English-language publication reads as follows: R. Sternheimer. Phys.Rev. 99, 277 (1955).

SUBMITTED: June 22, 1960

X

Card 3/4

BARASHENKOV, V.S.; VAN-PEY [Wang-P'ei]; MAL'TSEV, V.M.

Pulse distribution of particles generated in E = 9 Bev. inelastic NN-collisions. Zhur.eksp.i teor.fiz. 38 no.2:650-652 F '60. (MIRA 14:5)

1. Ob"yedinennyy institut yadernykh issledovaniy.
(Collisions (Nuclear physics))

S/053/60/072/001/003/005
B013/B060

AUTHOR: Barashenkov, V. S.

TITLE: Interaction Cross Sections of High-energy Particles 19

PERIODICAL: Uspekhi fizicheskikh nauk, 1960, Vol. 72, No. 1, pp. 53 - 74

TEXT: Most of the latest information concerning the interaction cross sections of high-energy particles was obtained with accelerators in Brookhaven, Berkeley, and Dubna. Only a minor part comes from experiments with cosmic rays. Experimental data on the interaction cross sections of particles of different kinds at energies of $E \geqslant 0.8$ Bev are discussed and interpreted in the present paper. Phenomena arising in the high-energy range exhibit a number of characteristics which are, however, the same for the interaction of different kinds of particles. Tables 1-3 give experimental data concerning the interaction cross section of nucleons on the basis of data given in Refs. 1-30. The more important among them are illustrated in Fig. 1. The curves drawn here can be used for the interpolation of experimental data. The experimental

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values of (πN) interaction cross sections are given in Tables 4-6 (Refs. 31-40,42-48,84,90), and the more important among them are illustrated in Fig. 2. Table 7 and Fig. 3 show the now known values of ($\bar{p}$p)-interaction cross sections, on the strength of data from Refs. 9 and 55. Tables 8-10 and Fig. 4 contain experimental values of the interaction cross sections of charged K-mesons with nucleons, on the strength of data from Refs. 59-60. Information on the interaction of π^-- and K-mesons with π-mesons is at the present state of research only available from the analysis of indirect experimental data (Refs. 61-67,72,89). The following is dealt with in the theoretical interpretation of experimental data: stability of interaction cross sections at high energies (Refs. 68,69); equality of interaction cross sections of particles with antiparticles (Refs. 70-72); dependence of the cross sections on isotopic spins - Figs. 1,2,4-6 (Refs. 72,78,79); dependence of the cross sections on the spins of colliding particles (Refs. 72,79-81). The experimental and theoretical data supplied afford a fairly clear qualitative picture of the behavior of interaction cross sections of nucleons, antinucleons, π- and K-mesons with nucleons in the energy range E≈(1-10) Bev. Quantitative data are, however, insufficient in a number

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B013/B060

of cases. The author finally points out two problems of basic importance. One of these raises the question as to how far the total cross section, the elastic and the inelastic cross sections remain constant at $E \to \infty$. The other one concerns the research of possible perturbations of the equality of interaction cross sections of particles and antiparticles. An annex deals with the mean free path of fast particles in photoemulsion - Fig. 7, Table 11 (Refs. 27,72,86-88). D. V. Shirkov is mentioned. There are 7 figures, 11 tables, and 91 references: 23 Soviet.

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S/020/60/134/001/003/021
B019/B060

26.1420

AUTHORS: Barashenkov, V. S., Syan' Din-chan

TITLE: The Real Part of the Amplitude of Elastic Scattering at High Energies 19

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol. 134, No. 1, pp. 65-67

TEXT: The authors refer to the "summation rule" (1) established in a paper by M. Goldberger and others, and derive formula (2) for the interaction cross section in agreement with experiments according to which the interaction cross section of high-energy particles remains constant or, at least, does not increase. By considering (2) the series representation (3) is then obtained with the aid of dispersion relations for the real part of the elastic scattering amplitude. The representation (4) of the elastic scattering cross section is then used to obtain formula (6) for the real part of the elastic scattering amplitude. The latter formula shows that the real part of the amplitude grows more

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The Real Part of the Amplitude of Elastic Scattering at High Energies

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slowly than the energy E, and that the coefficients A_1 and B_1 in (3) are vanishing. On the basis of formulas (5) and (6), the authors conclude from an analysis of data now available on pion-nucleon interaction that the coefficients A_0 and B_0 in (3) should be likewise vanishing. Values are, however, given for B_0 that were calculated from experimental data of the cross section for various energies (2 to 5 Bev), which differ largely from zero. These diverging results are discussed, and the relation Σ_2 = const/E^2 is obtained for the contribution of non-diffraction scattering to the elastic scattering cross section. $D_{\pm}$ = const·-0.3·10^{-13} cm is given for the real part of the amplitude. In connection with the measurement of the elastic pion-nucleon interaction cross section at very small angles, the authors mention a paper by P. K. Markov et al. (Ref. 5), and also papers by I. Ya. Pomeranchuk (Ref. 4) and S. Z. Belenkiy (Ref. 6) are referred to. They thank D. V. Shirkov and Chzhou Guan-chzhao for their critical remarks. There are 6 references: 5 Soviet and 1 US.

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The Real Part of the Amplitude of Elastic Scattering at High Energies

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B019/B060

ASSOCIATION: Ob"yedinenyy institut yadernykh issledovaniy (Joint Institute of Nuclear Research)

PRESENTED: April 21, 1960, by N. N. Bogolyubov, Academician

SUBMITTED: April 8, 1960

Card 3/3

BARASHENKOV, V.S.; MAL'TSEV, V.M.

[Generation of deuterons in the interaction of fast nucleons with nuclei] Obrazovanie deitonov pri vzaimodeistvii bystrykh nuklonov s iadrami. Dubna, Ob"edinennyi in-t iadernykh issl. 1961. 8 p. (MIRA 15:1)
(Deuterons) (Nuclear reactions)

BARASHENKOV, V.S.; SARANTSEVA, V.R., tekhn. red.

[Elastic interactions of particles at high energies] Uprugie vzaimodeistviia chastits pri bol'shikh energiiakh. Dubna, Ob"edinennyi in-t iadernykh issl., 1961. 117 p. (MIRA 15:3)

(Nuclear reactions)

24.6900 (1138,1191,1559,1558)

S/017/61/009/001/001/002
B133/B201

AUTHOR: Barashenkov, V. S.

TITLE: Inelastic interactions between high energy particles (A review at the All-Union Inter-university Conference on the Field Theory and the Theory of Elementary Particles: Uzhgorod 1960)

PERIODICAL: Fortschritte der Physik, v. 9, no. 1, 1961, 29-41

TEXT: The author states that it is only by the introduction of new concepts that the traditional theory can be made to fit the results obtained by means of accelerators both in the U.S. and the USSR. To begin

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B133/B201

Inelastic interactions between...

are, however, markedly unsymmetrical. This means that collisions are possible also in the absence of a statistical equilibrium. The theory will give the experimental result only if one distinguishes between central and peripheral collisions following a suggestion by D. I. Blokhintsev (Ref. 5: D. I. Blokhintsev, V. S. Barashenkov, B. M. Barbashov, Uspekhi fiz. nauk, 68, 417 (1959)). According to measurements conducted at Dubna, over 50 % of the inelastic collisions must be peripheral ones. To obtain the right angular distribution also for pN collisions one assumes in accordance with I. E. Tamm (Ref. 7: I. E. Tamm, The materials of the 9-th annual Conference on High Energy Physics, Kiev 1959) that the nucleon which emits the peripheral meson passes into an excited isobaric state which, in its turn, decays independently. The following formula is derived for the energy distribution of peripheral mesons:

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$$q(\varrho;\varepsilon)=\frac{3}{\pi^2\gamma^2\beta^3}\left(\frac{f}{\mu}\right)^2\varepsilon\left\{\int_0^\infty\frac{v(p^2+\varepsilon^2/\gamma^2\beta^2)}{\omega_p^2}p^2J_1(p\varrho)\,dp\times\right.$$

$$\times\int_0^\infty\frac{v(q^2+\varepsilon^2/\gamma^2\beta^2)}{\omega_q^2}q^2J_1(q\varrho)\,dq-$$

$$\left.-\int_0^\infty\frac{v(p^2+\varepsilon^2/\gamma^2\beta^2)}{\omega_p^2}p\,J_0(p\varrho)\,dp\cdot\int_0^\infty\frac{v(q^2+\varepsilon^2/\gamma^2\beta^2)}{\omega_q^2}q(q^2+\mu^2)J_0(q\varrho)\,dq\right\},$$

Here, $v(k^2)$ denotes the form factor of the meson field source; $\omega_k^2 = k^2 + \varepsilon^2/\gamma^2\beta^2 + \mu^2$; μ is the pion mass. $q(\varrho,\varepsilon)$ is the number of mesons with the energy ε at a distance ϱ from a fast nucleon. The recent measurements have not confirmed the necessity of assuming a resonance ($\pi\pi$) interaction. (Cf. Table II). In case of an annihilation of slow antinucleons, however, this assumption simplifies the theory (Table III). The Dubna results refute the statistical theories that assume for the multiple

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G/017/61/009/001/001/002
B133/B201

Inelastic interactions between...

production of K and $\bar{K}$- particles to take place in a volume smaller than that of the other particles. Observations on cosmic rays with energies $E = 10^9$ Bev have confirmed the necessity of taking peripheral interactions into account. It is yet to be decided upon whether a cascade interaction takes place at energies $E \gg 10$ Bev between fast particles and atomic nuclei, or a unified excited compound system is formed, which further decays into separate particles. There are 7 figures, 3 tables, and 25 references: 9 Soviet-bloc and 16 non-Soviet-bloc. The 3 most recent references to English-language publications read as follows: V. S. Barashenkov, V. M. Maltsev, E. K. Mihul, Nuclear Phys. 13, 583 (1959); V. S. Barashenkov, Nuclear Phys. 15, 486 (1960); N. Horwitz, D. Miller, I. Murray, R. Tripp, Phys. Rev. 115, 472 (1959).

ASSOCIATION: Joint Institute of Nuclear Research, Laboratory of Theoretical Physics, Dubna (USSR)

Card 4/6

S/017/61/009/001/002/002
B133/B201

24.6900 (1139,1191,1557,1395)

AUTHOR: Barashenkov, V. S.

TITLE: Small-angle elastic scattering of high-energy particles. (A review at the All-Union Inter-university Conference on the Field Theory and the Theory of Elementary Particles; Uzhgorod, 1960)

PERIODICAL: Fortschritte der Physik, v. 9, no. 1, 1961, 42-49

TEXT: (pp) scattering experiments conducted with 8.5 Bev at Dubna show, for small angles, an elastic scattering cross section which is much larger than would correspond to the optical model. Theoretically, this means that the real part of the elastic scattering amplitude D(E) for $\vartheta = 0$ is different from zero. The behavior of D(E) is therefore theoretically studied for energies E >1 Bev. In the dispersion relation, all such terms as approach infinity faster than or like E are found to be vanishing. As a result,

$$D^0_- - D^0_+ - \frac{4f^2}{\mu} + \frac{\mu}{2\pi^2}\int_\mu^\infty \frac{dE}{k}\,[\sigma_+(E) - \sigma_-(E)] = 0\,, \quad (2)$$

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holds for the elastic scattering of nucleons. Here, $D_{\pm}^{0} \equiv D_{\pm}(\mu)$; μ is the pion mass; $k = \sqrt{E^2 - \mu^2}$; $\sigma_{\pm}$ are the total cross sections for the interaction of charged pions with protons. Similarly,

$$D_{+}^{0} - D_{-}^{0} - 2f^2 \frac{M}{\mu} + \frac{1}{2\pi^2}\frac{M}{\mu} i \int_{0}^{M} \frac{dE}{k}[\sigma_{-}(E) - \sigma_{+}(E)] + \frac{1}{2\pi^2}\frac{M}{\mu}\int_{M}^{\infty}\frac{dE}{k}[\sigma_{-}(E) - \sigma_{+}(E)] = 0, \qquad (3)$$

follows for nucleon-nucleon scattering. Here, $D_{\pm}^{0} = D_{\pm}(M)$; M is the nucleon mass; $k = \sqrt{E^2 - M^2}$; $\sigma_{\pm}$ are the total cross sections for (pp) and ($\bar{p}$p) interactions. These relations allow $\sigma_{\pm}$ to be calculated in the nonphysical region. The numerical calculation of $D_{\pm}$ has been performed according to a program by I. Kukhtina at the Computer Center of the Academy of Sciences, USSR, using a Strela computer. (Cf. Fig. 1). The limit value of $D_{\pm}$ for high energies is

$$D_\pm = \frac{1}{2}\,(D^0_- + D^0_+) + \frac{f^2}{M} - \frac{1}{4\pi^2}\int\limits_\mu^a \frac{E\,dE}{k}\,[\sigma_+(E) + \sigma_-(E)] + \frac{a\sigma}{2\pi^2}, \quad (4)$$

where a follows from the relation $\sigma_+ = \sigma_- = \sigma$ for $E \geqslant a$. $D_\pm$ for high energies also becomes constant in case of scattering of nucleons or antinucleons by nucleons:

$$D_\pm = \frac{1}{2}\,(D^0_\pm + D^0_\pm) - \frac{2M^2-\mu^2}{2M\mu} - \frac{1}{2\pi^2}\,\frac{M}{\mu}\,i\int\limits_0^M dE\,\frac{E}{k}\,\sigma_+(E) + \sigma_-(E)] -$$

$$- \frac{1}{2\pi^2}\,\frac{M}{\mu}\int\limits_M^a dE\,\frac{E}{k}\,[\sigma_+(E) + \sigma_-(E)] + \frac{\sigma\cdot a}{2\pi^2}\,\frac{M}{\mu}, \quad (6)$$

a follows from the relation $\sigma_+ = \sigma_- = \sigma$ for $E \geqslant a$. Since the $(N\bar{N})$ cross section is only known up to 3 Bev, experiments are being conducted at Dubna and "Sophy" with 8.5 and 6.15 Bev. The elastic (pp) cross section has already been calculated (Cf. Fig. 4). The elastic scattering at high energies can be also analyzed phenomenologically. Then, the scattering amplitude, developed by Legendre polynomials, reads:

$$A(\theta) = \frac{\lambda i}{2} \sum_{l=0}^{N} (2l + 1)(1 - e^{2i\eta_l}) P_l(\cos\theta) \qquad (9)$$

The complex phases appearing therein are determined experimentally. The complex refraction coefficient $\varkappa(r) = n(r) + ik(r)$ is connected with η_l by

$$\eta(\varrho) = \int_0^\infty \varkappa\left(\sqrt{\varrho^2 + s^2}\right) ds, \qquad (10)$$

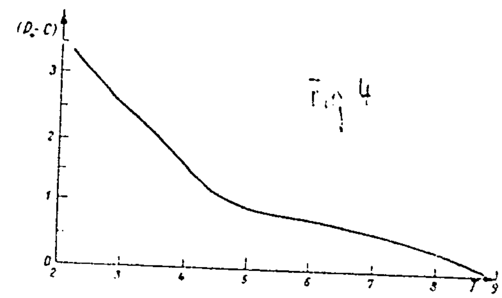
This equation is important for the interaction with nuclei, where $\varkappa(r)$ is known from electron scattering. More important for the interaction of elementary particles is the inverse equation

$$\varkappa(\varrho) = -\frac{2}{\pi} \frac{d}{d\varrho^2} \int_{\varrho}^{\infty} \eta(r) \frac{r\,dr}{\sqrt{r^2 - \varrho^2}}. \qquad (11)$$

It has been also obtained independently at the Budapest Physics Institute by Domokos and Sebastyan (Ref. 9: G. Domokos, A. Sebastyan, Explicit solution of the inversion problem in a phenomenological optical model (to be published)). There are 5 figures and 12 references: 7 Soviet-bloc. The 3 most recent references to English-language publications read as follows: D. I. Blokhintsev, V. S. Barashenkov, V. G. Grishin, Nuovo Cimento 9, 249 (1958); D. Ito, S. Minami, H. Tanaka, Nuovo Cimento 9, 208 (1958); T. D. Spearman, 'The pion-nucleon coupling constant' preprint 1960.

ASSOCIATION: Joint Institute of Nuclear Research, Laboratory of Theoretical Physics, Dubna (USSR)

Legend to Fig. 4: Energy dependence of the real part of the elastic (pp) scattering amplitude $D_+(T)$. Lab. system T in Bev. D_+ in units of 10^{-13} cm. C is a constant.



APPROVED FOR RELEASE: 06/06/2000 CIA-RDP86-00513R000103520019-0"

79357

S/089/61/010/002/007/018
B102/B209

24.6900

AUTHORS: Barashenkov, V. S., Mal'tsev, V. M., Mikhul, E. K.

TITLE: The mechanism of the interaction between fast nucleons and nuclei

PERIODICAL: Atomnaya energiya, v. 10, no. 2, 1961, 156-158

TEXT: At present, two diverging suppositions on the mechanism of interaction between 9-Bev protons and nuclei are existing: a) Simultaneous interaction with the entire nuclear matter "tube", b) intra-nuclear cascade interaction. In order to clarify which of the two suppositions gives a better description of the experimental facts, the authors calculated the 9-Bev nucleon interaction according to the intra-nuclear cascade theory and compared the results with experiments. Calculations were made after the Monte Carlo method with relativistic three-dimensional kinematics, consideration of the many-particle production in collisions between fast particles and

89357

The mechanism of the ... S/089/61/010/002/007/018
B102/B209

Comparison between calculated and measured (Refs. 1,2) data is given graphically and in tables. Fig. 1 shows the angular distribution of shower particles for a) light and b) heavy nuclei; Fig. 2 shows the same for cascade particles. Fig. 3 illustrates the energy distribution of the cascade particles (relative number of particles versus kinetic energy) for a) light and b) heavy nuclei.

Table 1

Mean number of particles produced in one inelastic nucleon-nucleon collision

Particle	light nuclei		heavy nuclei	
	theor.	exp.	theor.	exp.
shower	2.9	3.0 ± 0.2	4.1	3.5 ± 0.3
cascade	1.5	1.4 ± 0.1	4.0	4.1 ± 0.5
evaporated	3.5	3.3 ± 0.1	5.6	6.1 ± 0.6

Table 2

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39357

The mechanism of the ...

S/089/61/010/002/007/018
B102/B209

Mean kinetic energy of the particles produced in one inelastic collision between a proton and a medium-weight photo-emulsion nucleus (given in Bev)

Particle	theor.	exper.
shower protons	2.5	3.0 ± 0.5
shower pions	0.52	0.63 ± 0.1
cascade protons	0.15	0.120 ± 0.012
cascade pions	0.048	0.040 ± 0.003

The name shower particles is applied to nucleons with 0.5 - 9 Bev and pions with 0.08 - 8 Bev, the name cascade particles to nucleons of 0.03 - 0.05 Bev and pions of 0.15 - 0.08 Bev. Particles of lower energies are termed "evaporated". As may be seen, the results concerning shower and cascade particles agree with each other, also for evaporated particles with black tracks. Thus, the results of the present investigations speak in favor of the intra-nuclear cascade mechanism for the case of energies of 9 Bev and less. There are 3 figures, 2 tables, and 6 references: 4 Soviet-bloc and

Card 3/6

The mechanism of the ...

S/089/61/010/002/007/018
B102/B209

2 non-Soviet-bloc.

SUBMITTED: July 14, 1960

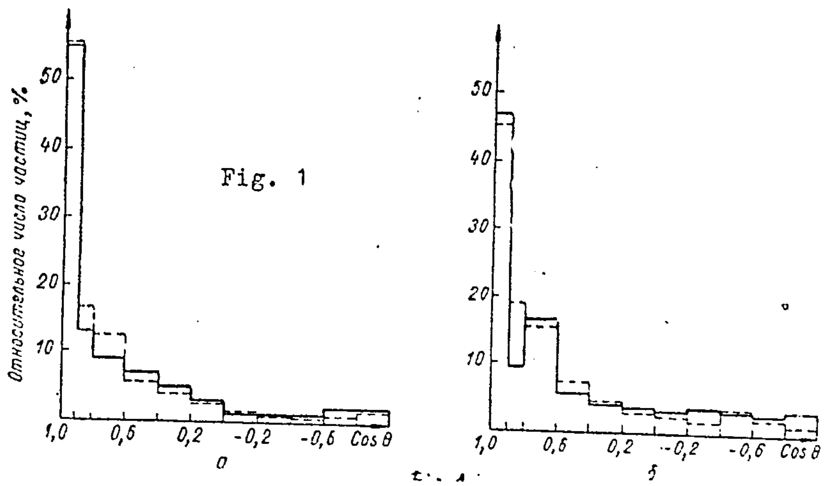

Fig. 1

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BARASHENKOV, V.S.

International conference on the theoretical aspects of phenomena involving very high energies. Atom. energ. 11 no.3:262-264 S '61. (MIRA 14:9)

(Nuclear research--Congresses)

BARASHENKOV, V.S.

Interaction of π-mesons in the Fermi statistical theory. Zhur. eksp. i teor. fiz. 40 no.5:1313-1315 My '61. (MIRA 14:7)

1. Ob"yedinennyy institut yadernykh issledovaniy.
(Mesons)

BARASHENKOV, V.S.

Author's corrections and supplementary remarks on the article" Cross sections of the interaction of high energy particles." Usp.fiz.nauk 73 no.3:589-590 Mr '61. (MIRA 14:6)

(Particles, Elementary)

BARASHENKOV, V. S.; KEYSER, G. Y.; OGREBA, A. A.

"Compton Effect on Nucleon, Nucleon Polarizability"

report presented at the Intl. Conference on High Energy Physics, Geneva, 4-11 July 1962

Joint Institute for Nuclear Research, Laboratory of Theoretical Physics

BARASHENKOV, V.S.; PATERA, I.

[Cross sections of antinucleon production] Secheniia rozhdeniia antinuklonov. Dubna, 196?. 12 p.
(MIRA 16:10)
(Nuclear reactions)

40262

24500

S/089/62/013/003/001/007
B102/B104

AUTHORS: Barashenkov, V. S., Mal'tsev, V. M.

TITLE: Particle production at very high energies

PERIODICAL: Atomnaya energiya, v. 13, no. 3, 1962, 221-227

TEXT: The numbers of particles produced in inelastic (NN) and (πN) collisions in the energy range $1-30^3$ Bev were estimated, in connection with the design of 10 and 100 Bev accelerators. The following conclusions were reached with respect to the multiplicity of particle production in such collisions: (1) the heavy-particle production probability amounts to about 25% of the pion production probability. (2) When the energy $T \gg 1$ Bev, the total number of particles produced remains nearly constant whatever the type of particles colliding with the target nucleons. The pions produced in (pp) and (pn) collisicns decay partly in the immediate vicinity of the target, giving gamma quanta (π^0, $\tau \simeq 10^{-16}$ sec), and partly at a distance of 10-100 m, giving neutrinos and muons ($\pi^{\pm}$, $\tau \simeq 10^{-8}$ sec): hence the intensities of the γ, ν and μ beams are studied as functions of the energy and of distance from the target. (a) γ-quanta. At high bombarding
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proton energies, the number of γ-quanta of energy greater than a given value K emitted at an angle θ is

$$\Gamma(K,\theta,T) = 2\bar{n}_\gamma(T)\int_K^{p_{max}(T)} dq \int_q^{p_{max}(T)} \Pi(p,\theta,T)\frac{dp}{p},$$ where Π is the π^0 momentum distribution and $\bar{n}_\gamma(T) = 2\pi\int_0^\pi \Gamma(0,\theta,T)\sin\theta d\theta$. For very large energies, the solid angle in which the quanta are emitted is very small ($\theta \simeq 0^o$). (b) neutrinos. The total number of neutrinos having $E > K$ is given by the analogous expression

$$V(K;\ \theta;\ L;\ T) = \frac{\bar{n}_\gamma(T)}{b}\int_K^{\frac{1}{2}p_{макс}(T)} dq \int_{q/b}^{p_{макс}(T)} \Pi(p;\ 0;\ T)\left[1 - \exp\left(-\frac{L}{7,68}\frac{m}{p}\right)\right]\frac{dp}{p}, \quad (8).$$

L[m] is the distance from the target, θ the angle measured from the proton beam, $b = 1 - (\mu/m)^2$, μ and m are the muon and pion mass, $\bar{n}_\nu(T) = \bar{n}_{\pi^\pm}(T) \simeq \bar{n}_\gamma(T)$, and $\bar{n}_\nu(T) = 2\pi \int_0^\pi V(0,\theta,\infty,T)\sin\theta d\theta$. (c) muons. The expression

$$M(K;\ 0;\ L;\ T) = \frac{\bar{n}_\mu(T)}{b} \cdot \int_K^{p_{Makc}(T)} dq \int_q^{\left(\frac{m}{\mu}\right)^2 q} \Pi(p;\ 0;\ T)\left[1 - \exp\left(-\frac{L}{7.68}\frac{m}{p}\right)\right]\frac{dp}{p}, \qquad (11)$$

is obtained, where $\bar{n}_\mu(T) = \bar{n}_{\pi^\pm}(T)$ is the mean number of muons produced per inelastic (NN) collision. $\bar{n}_\mu(T) = 2\pi \int_0^\pi M(0,\theta,\infty,T)\sin\theta d\theta$. In no case was the background intensity taken into account. There are 6 figures and 1 table.

SUBMITTED: October 14, 1961

Card 3/3

40102
S/048/62/026/008/018/028
B104/B102

24.6700

AUTHORS: Barashenkov, V. S., and Mal'tsev, V. M.

TITLE: Mechanism of interaction between fast particles and nuclei

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 26, no. 8, 1962, 1069 - 1074

TEXT: Cascades produced by interaction of 9 Bev protons with nuclei are calculated. To compare the results with experimental data the calculations are made for light and heavy photoemulsion nuclei (N_7^{14} and Nb_{41}^{94}). After interaction the particles are classified according to their energy as s-particles (shower particles), g-particles (cascade particles, gray tracks), and b-particles (particles with black tracks). The energy range for the NN interaction was divided into five intervals (9 - 4.5, 4.5 - 1.5, 1.5 - 1, 1 - 0.5, < 0.5 Bev) and that of the πN interaction into four (8 - 3, 3 - 1, 1 - 0.5, < 0.5 Bev). The calculation was made following the scheme shown in Fig. 1. The results showed good agreement with experimental data. The interaction in the range ≤ 9 Bev is an intranuclear cascade and the

Card 1/2

S/048/62/026/008/018/028
B104/B102

Mechanism of interaction between ...

... is assumed to be true of higher energies. There are 7 figures and 3 tables.

ASSOCIATION: Laboratoriya teoreticheskoy fiziki Ob"yedinennogo instituta yadernykh issledovaniy (Laboratory of Theoretical Physics of the Joint Institute of Nuclear Research)

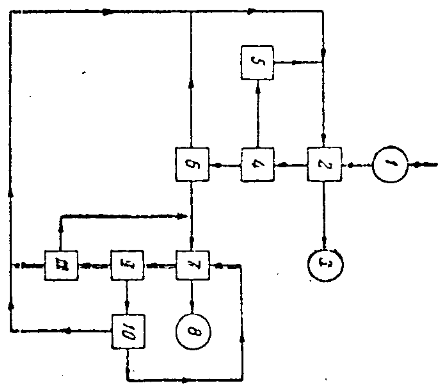

Fig. 1. Calculation diagram.
Legend: (1) Entry of particle into the nucleus, (2) range of the nucleon, (3) characteristics of outgoing nucleons, (4) NN interaction, (5) elastic interaction, (6) inelastic interaction, (7) π meson range, (8) characteristics of π mesons, (9) form of πN interaction, (10) elastic interaction, (11) inelastic interaction.

Card 2/2

S/056/62/042/001/034/048
B125/B102

AUTHORS: Barashenkov, V. S., Blokhintsev, D. I., Wang Jung, Mikhul, E. K., Huang Tsu-chan, Hu Shih-k'o

TITLE: Inelastic high-energy pion nucleon interactions

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 42, no. 1, 1962, 217-223

TEXT: The calculations of peripheral inelastic πN interactions (two types of interactions) at $E > 1$ Bev recently made in Dubna in the single-meson approximation were compared with experimental results. If the number of pions produced (Diagram A of Fig. 1) is even, then the pion production is the main process in the peripheral collision which with odd number (diagram B) is accompanied by the production of a single pion in the scattering of a virtual meson from a nucleon. It is sufficient to study processes A and B whose interaction cross sections are

S/056/62/042/001/034/048
B125/B102

Inelastic high-energy pion nucleon ...

$$\sigma_{2n}(E) = g^2 \frac{1}{8\pi^2 v} \int_0^{q_{max\,n}} \frac{q^2 dq}{q_0 p_0 \omega} \sigma_{\pi\pi}^{(2n)}(Q) K(Q) \times$$
$$\times \left\{ \frac{1}{4pq} \ln\left(1 + \frac{4pq}{2p_0 q_0 - 2pq - 2M^2 + \mu^2}\right) - \frac{\mu^2}{(2p_0 q_0 - 2M^2 + \mu^2)^2 - 4p^2 q^2} \right\}, \quad (1)$$

and

$$\sigma_{2n+1}(E) = \frac{1}{4\pi^3 v} \int_0^{P_{max\,n}} \frac{P^2 dP}{p_0 \omega} \int_{\sqrt{P^2 + (M+\mu)^2}}^{E - \sqrt{P^2 + m_n^2}} K(S)\, \sigma_{\pi\pi}^{(2n)}(S)\, dP_0 \times$$
$$\times \frac{\sigma_{\pi N}(p) \sqrt{(R^2 - M^2 - \mu^2)^2 - 4M^2\mu^2}}{(2P_0 p_0 - M^2 - R^2 + \mu^2)^2 - 4P^2 p^2}. \quad (2)$$

When calculating the single-meson approximation the authors combined all $\pi\pi$-interactions in the upper nodes of the diagrams A and B. The ratios of the cross sections for even and odd numbers of mesons at the same energies E_0 of the primary meson are given in Table 1. The core of the nucleon can be determined from the type of the production of an odd number of mesons at high primary-particle energies. When using the N-collision cross section of 23 mb calculated with a πN-interaction

Card 2/4

constant g^2 = 14.5 one obtains 40 mb for the cross sections of the processes A and B. The calculated values of the multiplicity of the particles produced and the angular and energy distributions of the recoil nucleons are compared with the experimental data. The peripheral -interaction with single-meson exchange proves to be the decisive mechanism. The experimental data are not reliable and the contribution of multi-meson processes to the transfer of large momenta which might be of importance, has hitherto not been studied. The authors thank N. N. Govorun, Kim Ze Pkhen, and P. Libl, collaborators of the Vychislitel'nyy tsentr (Computer Center) of the Joint Institute of Nuclear Research for their help in the numerical computations and Hsien Ting-ch'ang for discussions of the methods of calculating the charge distribution in the statistical theory. There are 7 figures, 2 tables, and 11 references: 7 Soviet-bloc and 4 non-Soviet bloc. The three references to English-language publications read as follows: D. I. Blokhintsev. CERN Symposium II, 155, 1956; Proc. of the 1960 Ann. Int. Conf. on High Energy Phys. at Rochester, Univ. of Rochester, 1960; L. Rodberg. Phys. Rev. Lett, 3, 58, 1959.

ASSOCIATION: Ob"yedinennyy institut yadernykh issledovaniy (United Institute of Nuclear Research)

SUBMITTED: July 24, 1961

Fig. 1: The most important types of the diagrams A and B in inelastic N-scattering and the less important diagrams A' and B'.

E, BeV	$\sigma_1 \sigma_2$	$\sigma_3 \sigma_4$
2	0,1	
7	0,15	
100	1	0,25
1000	2	0,5

TABLE 1

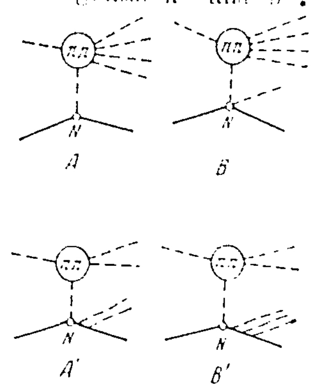

FIG. 1

BARASHENKOV, V.S.; MIHUL, E.K.; HUANG TZE-TZAN

Cross section for strange particle generation. Acta physica Pol 20 no.8:657-661 '61.

1. Joint Institute for Nuclear Research, Laboratory of Theoretical Physics, Dubna U.S.S.R.

BARASHENKOV, V.S.; MATISEV, V.M.

Effective cross section for reaction $(p,p\pi^+)$. Acta physica Pol 22:Suppl.:173-178 '62.

1. Joint Institute for Nuclear Research, Laboratory of Theoretical Physics, Dubna, U.S.S.R.

L 17214-63 EWT(m)/BDS AFFTC/ASD

ACCESSION NR: AP3005297 S/0056/63/045/002/0381/0383

AUTHORS: Barashenkov, V. S.; Blokhintsev, D. I.; Mikhul, E. K.; Patera, I.; Semashko, G. L. 56 55

TITLE: Momentum spectrum of baryons 19 in inelastic collisions between fast pions and nucleons

SOURCE: Zhur. eksper. i teoret. fiz., v. 45, no. 2, 1963, 381-383

TOPIC TAGS: baryon, momentum spectrum, pion-nucleon collision, pion-pion collision, SIGMA hyperon, LAMBDA hyperon

ABSTRACT: It is shown that the reason for the double peak observed in the Λ and Σ hyperon momentum spectrum in inelastic collisions between fast pions and nucleons at energies close to 10 BeV is a direct consequence of the resonant interaction between the primary negative pion and the intermediate particle that transmits the bulk of the interaction in peripheral pion-nucleon collisions. Similar double

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L 17214-63

ACCESSION NR: AP3005297

maxima in the spectrum of the recoil nucleons can be attributed to resonance pion-pion interaction. Orig. art. has two figures.

ASSOCIATION: Ob"yedinenny*y institut yaderny*kh issledovaniy (Joint Institute of Nuclear Research)

SUBMITTED: 25Apr63 DATE ACQ: 06Sep63 ENCL: 00

SUB CODE: PH NO REF SOV: 003 OTHER: 006

Card 2/2

BARASHENKOV, V.S.; BLOKHINTSEV, D.I.; MIKHUL, E.K. [Mihul, E.]; PATERA, I.; SEMASHKO, G.L.

Pulsed spectrum of baryons in inelastic collisions of fast pions with nucleons. Zhur. eksp. i teor. fiz. 45 no.2:381-383 Ag '63. (MIRA 16:9)

1. Ob"yedinennyy institut yadernykh issledovaniy. 2. Sotrudnik Instituta yadernoy fiziki v Bukhareste (for Mikhul).
(Baryons) (Mesons) (Collisions (Nuclear physics))

BARASHENKOV, V.S.; DEDYU, V.I.

[Testing of dispersion relations in the region of small angles and high energies] Proverka dispersionnykh sootnoshenii v oblasti malykh uglov i bol'shikh energii. Dubna, Ob"edinennyi in-t iadernykh issledovanii, 1964. 8 p. (MIRA 17:4)

1. Institut matematiki Moldavskoy Akademii nauk, Kishinev (for Dedyu).

BARASHENKOV, V.S.; MAL'TSEV, V.M.; PATERA, I.[1]

[Inelastic particle interactions at high energies] Neuprugie vzaimodeistviia chastits pri bol'shikh energiiakh. Dubna, Ob"edinennyi in-t iadernykh issl., 1964. 134 p. (MIRA 17:4)

1. Institut fiziki, Praga (for Patera).

BARASHENKOV, V.S.; BOYADZHIYEV, A.V.; KULYUKINA, L.A.; MAL'TSEV, V.M.

Cascade interactions between particles and nuclei in the high-energy region. Atom. energ. 16 no.6:515-517 Je '64. (MIRA 17:7)

L 4462-66 EWT(1)/EWT(m)/FCC/T/EWA(m)-2/EWA(h) GW

ACC NR: AP5024620 SOURCE CODE: UR/0048/65/029/009/1631/1633

AUTHOR: Barashenkov, V.S.; Yeliseyev, S.M.

36

B

ORG: Theoretical Physics Laboratory, Joint Institute for Nuclear Research (Laboratoriya teoreticheskoy fiziki Ob"yedinennogo instituta yadernykh issledovaniy)

TITLE: Theoretical analysis of the interaction of elementary particles with atomic nuclei in the 10-1000 BeV energy region /Report, All-Union Conference on Cosmic Ray Physics held at Apatity 24-31 August 1964/

19

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 29, no. 9, 1965, 1631-1633

TOPIC TAGS: primary cosmic ray, secondary cosmic ray, pi meson, high energy particle, particle production, heavy particle,

ABSTRACT: Production multiplicities and energy, angular, and transverse momentum distributions of shower particles produced in 27-3500 BeV collisions of nucleons with C^{12}, Al^{27}, and Ga^{70} nuclei have been calculated, and the results are compared with cosmic ray observations. The development of the intranuclear cascades was calculated by methods previously employed at accelerator energies by one of the present authors (V.S.Barashenkov) and others (Nucl. Phys., 24, 642, 1961; 55, 79, 1964). The following additional assumptions were employed in the calculations: 1) 80 % of the secondaries produced in each inelastic interaction with a nuclear nucleon are pions, and 20 % are heavy particles; and 2) the multiplicity and the energy and angular distributions

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of the secondaries depend only on the energy of the colliding particles and not on the nature of the colliding particles or the secondaries. The inelastic scattering was calculated with the optical model. Satisfactory agreement is shown with the experimental data. Poor agreement with certain more accurate angular distribution data is ascribed in part to systematic energy errors in nuclear emulsion data and in part to neglect of the exceptional role of nascent nucleons in the elementary act. A qualitative explanation for the previously unexplained bimodality of the angular distribution of shower particles in the log tan θ scale is found in the bimodality of the angular distribution of the particles produced in elementary acts within the nucleus. Orig. art. has: 2 figures and 3 tables.

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BARASHENKOV, V.S.

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1. Laboratoriya teoreticheskoy fiziki Ob"yedinennogo instituta yadernykh issledovaniy.

BARASHENKOV, V.S., doktor fiz. - matemat. nauk

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1. Ob"yedinennyy institut yadernykh issledovaniy, Dubna.