KHRISTIANOVICH, S.A.

Christianovich, S. A., and Yuriev, I. M. Subsonic gas flow past a wing profile. Appl. Math. Mech. [Prikl. Mat. Mekh.] SSSR. Prikl. Mat. Mech. 11, 105–118 (1947). (Russian English summary)

The authors present a method of constructing a circulatory flow past a closed profile under the assumption of Chaplygin's simplified equation (the so-called [illegible] case). They seem to be unaware of the fact that this problem was already solved by the reviewer [Tech. Notes Nat. Adv. Comm. Aeronaut., no. 969 (1945); these Rev. 7, 407] and in a more general way by Gelbart [Tech. Notes Nat. Adv. Comm. Aeronaut., no. 1170 (1947); these Rev. 8, 417]. [Solutions identical with Gelbart's were published by Lin, Quart. Appl. Math. 4, 291–297 (1946); and by Germain, C. R. Acad. Sci. Paris 223, 532–534 (1946); these Rev. 8, 418. 237.] The last section of the paper [illegible] Joukowsky's theorem in the framework of the [illegible] approximation.

L. Bers (Syracuse, N.Y.)

Source: Mathematical Reviews, Vol. 9 No. 9

KHRISTIANOVICH, S.A.

Khristianovich, S. A. [illegible] [approx]imate integration of the equations of a supers[onic gas] flow. Appl. Math. Mech. [Akad. Nauk SS[SR]. Prikl.] Mat. Meh.] 11, 215–222 (1947). (Russian. [illegible] summary)

The author uses [illegible] of the differential equations of a plane [illegible] gas flow which he has given several [illegible] available to the reviewer. Trudy [illegible] Inst., no. 543 (1941)]. These equations [illegible] (1) $\varphi_\xi = -\chi^{\frac{1}{2}}\psi_\xi$, $\varphi_\eta = +\chi^{\frac{1}{2}}\psi_\eta$, (2) $2\xi = [illegible]$, where φ is the velocity potential, ψ the stream [function], θ the inclination of the velocity vector and χ and [σ' are] functions of the dimensionless speed variable λ which [equ]als 1 for the critical speed. These functions are given [by] the formulas

$$(3)\qquad \chi = \frac{\lambda^2 - 1}{\nu - \lambda^2}, \qquad \sigma' = [illegible] = \int_1^\lambda \left(\frac{\lambda^2 - 1}{1 - \lambda^2/\nu}\right)^{\frac{1}{2}} \frac{d\lambda}{\lambda},$$

where $\nu = (\gamma+1)/(\gamma-1)$, [$\gamma$ be]ing the exponent in the pressure-density relation, and [C i]s a constant. If a solution of (1) is known, the corresponding flow in the physical (x, y)-plane can be determined by quadratures.

The main idea of the present paper is to replace the relation $\chi = F(\sigma')$ given by (3) by another relation which permits one to obtain the general integral of (1) in closed form. The second order equations resulting from (1) may be reduced to the Euler equation $\psi_{\xi\eta} + [k/(\xi+\eta)](\psi_\xi + \psi_\eta)$ [cf. Darboux, Leçons sur la Théorie Générale des Surfaces, v. 2, 2d ed., Paris, 1915] if the (χ, σ') relation is of the form (4) $\chi^{\frac{1}{2}} = A(\sigma' + C)^{2k}$. The author treats the cases $k = 1$, $k = -1$. In the case $k = 1$ the [con]stants A, C may be chosen so as to obtain a good app[roxi]mation to the actual (χ, σ') [rel]ation (3) for the range [illegible] $M < 2.2$ of the Mach number M. In case $k = -1$ [a good] approximation is obtained [for] $2.2 < M < 3.5$. If $k = [illegible]$ [the gener]al solution of (1) is given [by] $\psi = [f_1(\xi) + f_2(\eta)] [illegible]$ [for k] $= -1$ the identical expression is obtained for φ [illegible] [functio]ns f_1 and f_2 are in both [cas]es arbitrary.

The author then dis[cusses] [illegible] the formulas for the tran[sformatio]n to the physical [plane] [illegible] [u]sing the density-speed [rela]tion must be modified [illegible] [u]se of the (χ, σ') relation [with] $k = \pm 1$. Finally, the [general i]ntegral of the simplified equations (1) is used to ob[tain solu]tions of various boundary value problems in closed fo[rm]. In these problems the gas flow is determined by the following data: values of φ and ψ on two characteristics, Cauchy data along a curve, values of φ and ψ along a characteristic and the presence of a free boundary, values of φ and ψ along a characteristic and the presence of a fixed boundary. *L. Bers* (Syracuse, N. Y.).

[illegible] Mathematical Reviews, Vol 7 No. 7

4600

Khristianovich, S. A.,

KHRISTIANOVICH, S. A., and others.

Prikladnaia gazovaia dinamika; pod red. S. A. Khristianovicha. Moskva, 1948. 145 p., diagrs.

Bibliography: p. 144.

Title tr.: Applied gas dynamics.

QA930.K5

SO: Aeronautical Science and Aviation in the Soviet Union, Library of Congress, 1955

KHRISTIANOVICH, S. A.

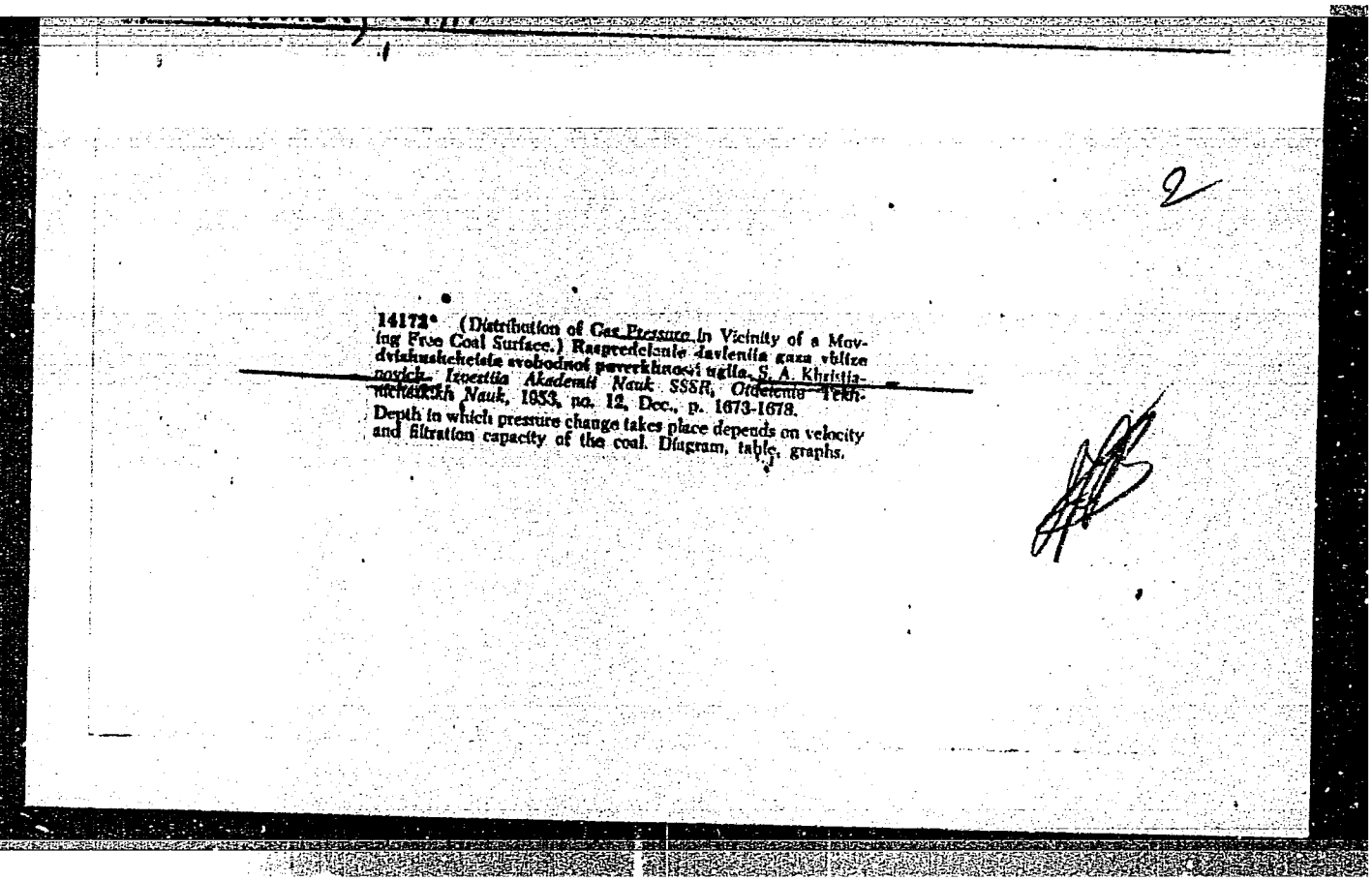
USSR/Scientists - Aerodynamics Aug 51

"Scientific Heritage of N. Ye. Zhukovskiy," Acad S. A. Khristianovich

"Iz Ak Nauk SSSR, Otdel Tekh Nauk" No 8, pp 1137-1151

Report, delivered 19 Mar 51 at meeting dedicated to 30th anniversary of N. Ye. Zhukovskiy's death, reviews latest 7-vol publication of scientist's complete works in hydraulics, theory of machines and mechanisms, theoretical and applied mechanics, aerodynamics, etc. Bibliography lists 68 titles, mostly Zhukovskiy's works.

205T101



14172* (Distribution of Gas Pressure in Vicinity of a Moving Free Coal Surface.) Raspredelenie davlenia gaza vblize dvizhushcheisia svobodnoi poverkhnosti uglia. S. A. Khristianovich. *Izvestiia Akademii Nauk SSSR, Otdelenie Tekhnicheskikh Nauk*, 1953, no. 12, Dec., p. 1673-1678.
Depth in which pressure change takes place depends on velocity and filtration capacity of the coal. Diagram, table, graphs.

USSR .

The gas-ejection wave [from coal]. S. A. Khristianovich. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk* 1953, 1079-83.—An attempt is made to draw a wave-model of coal ejection by the expansion of compressed adsorbed gas after the coal is crushed. The gas adsorbed on the inner surfaces of the coal pieces which are not broken down by the ejection is assumed not to participate in the wave formation because of the time requirements for the gas evolution. Math. equations are developed for gas travel, the reduced pressure wave, of the gas evolved and of the air wave.
W. M. Sternberg

USSR

The breakdown wave of coal. S. A. Khristianovich. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk* 1953, 1689–99.—A math. derivation is given of the expression for coal comminution in gas ejection from a coal deposit, based on the assumption that the gas ejection is the primary cause of the coal breakdown, while the static pressure in the deposit merely initiates the process. W. M. Sternberg

ROMANENKO, S.V.; KHRISTIANOVICH, S.A., akademik.

Flow of viscous gases in cylindric tubes in the presence of convective heat exchange. Dokl.AN SSSR 91 no.6:1289-1292 Ag '53. (MLRA 6:8)

1. Akademiya nauk SSSR (for Khristianovich).
(Fluid mechanics) (Heat--Convection)

KHRISTYANOVICH, S.A., akademik.

N.E.Zhukovskii's scientific heritage. Trudy po ist.tekh. no.4:3-25 '54. (MLRA 7:9)
(Zhukovskii, Nikolai Egorovich, 1847-1921)

KHRISTIANOVICH, S.A.; ZHELTOV, Yu.P.

[Formation of vertical fractures by means of a highly viscous liquid] Obrazovanie vertikal'nykh treshchin pri pomoshchi ochen'-viaskoi zhidkosti; doklady na IV Mezhdunarodnom neftianom kongresse v Rime. Moskva, Izd-vo Akad.nauk SSSR, 1955. 33 p.
(Petroleum engineering) (MLRA 8:9)

Khristianovich, S.A.

Fuel

42. ROOF COLLAPSE IN MINE WORKINGS. Barenblatt, G.I. and Khristianovich, S.A. (Izv. Akad. Nauk SSSR, Otdel. Tekh. Nauk [Bull. Acad. Sci. U.S.S.R., Sect. Tech. Sci.], Nov. 1955, 73-86). An analysis is made of the distribution of stresses and displacements in strata attending the gradual collapse of roof under the influence of mine workings. A new boundary condition is introduced which eliminates from the calculation infinite tensile stresses and physically impossible deformations along the contour line of workings. The fact that coal possesses essentially different elastic properties than the overlying rock formations, is also taken into account. In the undisturbed seam the stress acting on the coal is equal to the product of the mean specific gravity of the overlying strata and the depth below the surface. In the vicinity of a working additional stress comes into play necessitated by the roof curvature. In this region coal exists in the plastic state. Calculations are made of the distribution of stresses in the plastic and in the elastic regions of the seam. S.M.R.

USSR/Geology - Petroleum FD-2740

Card 1/1 Pub 41 - 1/16

Author : Zheltov, Yu. P. and Khristianovich, S. A., Moscow

Title : Hydraulic rupture of oil bearing strata

Periodical : Izv. AN SSSR, Otd. Tekh, Nauk 5, 3-41, May 1955

Abstract : Studies the hydraulic rupture of oil bearing strata. Since there is a lack of experimental data the investigation was based on many hypotheses and suppositions. Presents information on rock pressures, horizontal fissures, faults and effect of wedges. Concludes that pressure, which must always be exerted on the rupturing fluid for the formation of a horizontal fissure is dependent upon the differential between the local rock pressures near the well and that of the strata pressures. The size of the horizontal fissures depends on rock pressure and the position, stability and productiveness of the clay layer. Faults on the other hand, are formed by the rupture of the filtering fluids and when the angular rock pressure is smaller than their vertical pressure. Drawings, graphs and formulae. Eight references, 7 USSR

Institution : Institute of Petroleum, Academy of Sciences USSR.

Submitted : April 5, 1955

KHRISTIANOVICH S.A.

STECHKIN, B.S., akademik; KHRISTIANOVICH, S.A., akademik; otvetstvennyy red.; KLENNIKOV, V.M., red.izdatel'stva; PAVLOVSKIY, A.A., tekhn.red.

[Gas turbine installations; gas turbines] Gazoturbinnye ustanovki (gazovye turbiny). Moskva, Izd-vo Akad.nauk SSSR, 1956. 33 p. (MIRA 10:12)

(Gas turbines)

KHRISTIANOVICH, S. A.

GRIB, A.A., (Moskva); RYABININ, A.G. (Moskva); KHRISTIANOVICH, S.A. (Moskva).

The reflection plane shock wave in water from a free surface. Prikl. mat.i mekh.20 no.4:532-544 Jl-Ag '56. (MLRA 10:2)

(Shock waves)

KHRISTIANOVICH, S.A.(Moskva)

The shock wave at considerable distance from the site of detonation. Prikl. mat. i mekh. 20 no.5:599-605 S-O '56. (MLRA 10:3)
(Shock waves)

KHISTIANOVICH, S. Academician

"In the Path of Our Glorious Predecessors," The Svoiet Artificial Earth Satellite, 1957, p. 32

KHRISTIANOVICH, S.A.; ZHELTOV, Yu.P.; BARENBLATT, G.I.

Mechanism of hydraulic fracturing of formations. Neft.khoz. 35 no.1:44-53 Ja '57. (MLRA 10:2)

(Oil wells) (Petroleum engineering)

KHRISTIANOVICH, S.A.

AUTHOR: None given

26-12-32/49

TITLE: Anniversary Celebration Meeting of the AN, USSR (Yubileynaya sessiya Akademii nauk SSSR)

PERIODICAL: Priroda, 1957, No 12, pp 107-111 (USSR)

ABSTRACT: On 1 November 1957, the USSR Academy of Sciences held a celebration meeting in the Moskva State University on the occasion of the 40th anniversary of the October Revolution. Academician K.V. Ostrovityanov in his opening speech "Triumph of Lenin's theory of the socialist revolution" pointed out the great success attained by the Soviet Union in the development of socialist economics, culture and scientific research. Academician A.N. Nesmeyanov, President of the AN, USSR told the audience about the achievements of science under the guidance of the Communist party. On the following day a general assembly discussed the foundation of the Siberian branch of the AN, USSR. It was pointed out by Academician M.A. Lavrent'yev that the Soviet government had assigned near Novosibirsk an area of 1,100 ha for the construction of 13 scientific research institutes. The Institute of Mathematics with a computing center which will be equipped with 4 high-speed electronic machines to cover the needs of industry and scientific establish-

Card 1/3

ments. The institute will be headed by Academician S.L. Sobolev. The main task of the Institute of Physics will be the construction of new types of elementary particle accelerators, the institute will be headed by the prominent Doctor of Physico-Mathematical Sciences G.I. Budker. The Institute of Thermophysics will work on problems of the utilization of atomic energy for peaceful purposes and construction of electric power stations, its director will be I.I. Novikov, Doctor of Technical Sciences. The Institute of Chemical Kinetics and Combustion will be headed by A.A. Koval'skiy, Doctor of Chemical Sciences. The Siberian branch will also open an Institute for Inorganic Chemistry whose main task will be the handling of problems concerning the chemical properties of elements connected with the release of nuclear power. Doctor of Chemical Sciences A.V. Nikolayev was appointed director of this institute. The development of the automation of industrial processes will be handled by a special institute headed by Member-Correspondent of the AN of the Ukrainian SSR, K.B. Karandeyev. Academician M.A. Lavrent'yev was appointed director of the Siberian Institute of Hydrodynamics. An important part is reserved for the Institute of Theoretical and Applied Mechanics with Academician S.A. Khristianovich as director. The In-

stitute of Geology and Geophysics will be headed by Member-Correspondent of the AN, USSR, A.A. Trofimuk. The Institute of Cytology and Genetics will handle the problems of chemical and physical influences on heredity and the cytological princ-iples of it. Member-Correspondent of the AN, USSR, N.P. Dubi-nin was appointed director. The Institute of Experimental Bio-logy and Medicine will be headed by E.N. Meshalkin, Doctor of Medical Sciences. Also an Institute of Economics and Statistics and an Institute of High Tension is projected. Academician M.A. **Lavrent'yev**, who was elected chairman of the Siberian branch of the Academy of Sciences and vice-president of the AN, USSR, gave a detailed description of the science center in Siberia, which will also comprise an entire settlement for the scientists and their families, with schools, hotels, etc. In the vicinity, an experimental plant will be constructed for the development of modern scientific instruments. Academician P.L. Kapitsa mentioned three facts which in his opinion will ensure the success of the Sibirian branch of the AN, USSR. They are: the enthusiasm of the young Soviet scientists, ex-cellent equipment of the research establishments and good liv-ing conditions for all scientific workers.

There is one Slavic (Russian) reference.

AVAILABLE: Library of Congress

Card 3/3

RYZHOV, O.S.; KHRISTIANOVICH, S.A. (Moskva)

Nonlinear reflection of weak shock waves. Prikl.mat. i mekh. 22 no.5:586-599 S-O '58. (MIRA 11:11)
(Shock waves)

KHRISTIANOVICH, S. A., ZHELTOV, Y. P., BARENBLAT, G. I., and MAKSIMOVICH, G. K.

"Theoretical Principles of Hydraulic Fracturing of Oil Strata,"

Report submitted at the Fifth World Petroleum Congress, 30 May - 5 June 1959. New York City.

KHRISTIANOVICH, S.A. (Novosibirsk)

"Mechanical Problems Concerning Fracturing of Oil-Bearing Strata."

report presented at the First All-Union Congress on Theoretical and Applied Mechanics, Moscow, 27 Jan - 3 Feb 1960.

KHRISTIANOVICH, S.A. (Novosibirsk) RYZHOV, O.S. (Moscow) GRIB, A.A. (Leningrad)

"Short Wave Theory"

report presented at the First All-Union Congress on Theoretical and Applied Mechanics, Moscow, 27 Jan - 3 Feb 1960.

10.1410
26.2114

31281
S/124/61/000/010/013/056
D251/D301

AUTHORS: Grib, A.A., Ryzhov, O.S. and Khristianovich, S.A.

TITLE: Theory of short waves

PERIODICAL: Referativnyy zhurnal. Mekhanika, no. 10, 1961, 28-29, abstract 10 B155 (Zh. prikl. mekhan. i tekhn. fiz, 1960, no. 1, 63-74)

TEXT: Weak shock waves are considered. It is noted that for a series of problems devoted to the interaction of shock waves, acoustic approximations give a qualitatively untrue picture of the phenomena. In many cases of the established motion, sharp changes of the parameters of flow occur in narrow regions adjoining the shock front. Such flows the authors call "short-waves". In the case of plane-parallel flow, the differential equations for dimensionless functions are deduced. Flow not explicitly dependent on time and also some more general flows are considered. The differential equation defining the position of the shock front is deduced. With

Card 1/2

X

Theory of short waves

the help of this equation, and making use also of the integrals of the short-wave equations, the authors find the law of motion of the explosive wave. Comparison of the epures thus constructed with those calculated by computer gives satisfactory results. With the help of short-wave theory, the problems of the reflection of shock-waves from a fixed wall and from a free surface are solved. It is assumed that the angle of incidence of the wave is small. [Abstracter's note: Complete translation]

Card 2/2

X

KHRISTIANOVICH, S.A.

Studying the hydraulic fracturing mechanism. Trudy Inst. geol. i razrab. gor. iskop. 2:159-165 '60. (MIRA 14:5)
(Oil wells—Hydraulic fracturing)

BITSADZE, A.V., red.; VEKUA, I.N., red.; KUDRYAVTSEV, L.D., red.; MIGIRENKO, G.S., red.; RABOTNOV, Yu.N., red.; KHRISTIANOVICH, S.A., red.; ALEKSANDROVSKIY, B.M., red.; NAZARYANTS, T.M., red.; VYALYKH, A.M., tekhn. red.; LOKSHINA, O.A., tekhn. red.

[Some problems in mathematics and mechanics] Nekotorye problemy matematiki i mekhaniki. Novosibirsk, Izd-vo Sibirskogo otd-nie AN SSSR, 1961. 265 p. (MIRA 15:2)

1. Akademiya nauk SSSR. Sibirskoye otdeleniye. (Mathematics) (Mechanics)

LAVRENT'YEV, M.A., otv.red.; MIKHAYLOV, G.K., red.; BITSADZE, A.V., red.; VEKUA, I.N., red.; DZHANELIDZE, G.Yu., red.; LUR'YE, A.I., red.; MANDZHAVIDZE, G.F., red.; MIKHAYLOV, G.K., red.; SKDOV, L.I., red.; SOBOLEV, S.L., red.; SOKOLOVSKIY, V.V., red.; KHRISTIANOVICH, S.A., red.; SHERMAN, D.I., red.; RYVKIN, A.Z., red.izd-va; VOLKOVA, V.V., tekhn.red.

[Problems in the mechanics of solids] Problemy mekhaniki sploshnoi sredy; k semidesiatiletiiu akademika N.I.Muskhelishvili. Moskva, 1961. 577 p. (MIRA 14:3)

1. Akademiya nauk SSSR.
(Mechanics, Analytic) (Elastic solids)

S/042/61/016/002/005/005
C 111/ C 222

AUTHORS: Belotserkovskiy O. M., Kibel' I. A., Moiseyev N. N., Khristianovich S. A., Chushkin P. I., and Shmyglevskiy Yu. D.

TITLE: Anatoliy Alekseyevich Dorodnitsyn (on the occasion of his 50th birthday

PERIODICAL: Uspekhi matematicheskikh nauk, v. 16, no. 2, 1961, 189-196

TEXT: A. A. Dorodnitsyn was born on December 2, 1910 in the district Tula. In 1931 he finished the study at the Mining Fuculty of the Petroleum Institute Groznyy. Since 1935 he worked in the Glavnaya geofizicheskaya observatoriya (Geophysical Main Observatory) in Leningrad under the leading of I. A. Kibel' (school of N. Ye. Kochin). In 1939 -- candidate of physical-mathematical sciences. Since 1941 he was in the Tsentral'nyy aerogidrodinamicheskiy institut imeni N. Ye. Zhukovskogo (Central Aerohydrodynamic Institute imeni N. Ye. Zhukovskiy). In 1942 -- Doctor dissertation "Boundary layer in a compressible gas". In 1953 -- member of the Academy of Sciences of the

Card 1/3

Anatoliy Alekseyevich Dorodnitsyn ... S/042/61/016/002/005/005
C 111/ C 222

USSR. Since 1955 he is the director of the Vychislitel'nyy tsentr Akademii nauk SSSR (Computing Center of the Academy of Sciences USSR). Educational activity: 1939-1940 -- docent at the Chair of Higher Mathematics in the Leningrad Mining Institute; 1944-1946 - Professor at the Chair of Theoretical Aerodynamics of the Moskovskiy aviatsionnyy institut imeni S. Ordzhonikidze (Moscow Aviation Institute imeni S. Ordzhonikidze). Since 1947 - Professor and leader of the Chair of Gas Dynamics of the Moskovskiy fiziko-tekhnicheskiy institut (Moscow Physical-Technical Institute). Furthermore - President of the Komissiya po vychislitel'noy tekhnike AN SSSR (Committee of Computing Technics of the Academy of Sciences USSR); member of the Komitet po Leninskim premiyam (committee for Lenin Prizes); president of the ekspertnaya komissiya VAK po avtomatizatsii i priborostroyeniya (Committee of Specialists of the VAK for Automatization and Construction of Equipment) Chief editor of the "Zhurnal vychislitel'noy matematiki i matematicheskoy fiziki (Journal of computing mathematics and mathematical physics). A. A. Dorodnitsyn participated in the following congresses: Sweden in 1957; USA in 1958; France in 1959; Poland in 1959; Spain in 1958;

Card 2/3

Anatoliy Alekseyevich Dorodnitsyn ... S/042/61/016/002/005/005
C 111/ C 222

Switzerland in 1960. His papers contain essential contributions in the domains: dynamic meteorology, gas dynamics and applied mathematics.

The authors mention N. Ye. Zhukovskiy and S. A. Chaplygin. There is a list containing the publications of A. A. Dorodnitsyn (1936-1960) with 23 titles and a photo of him.

Card 3/3

KHRISTIANOVICH, Sergey Alekseyevich

Steam and gas installations. Nauka i zhizn' 29 no.1:15-18 Ja '62. (MIRA 15:3)

(Steam turbines) (Gas turbines)

KHRISTIANOVICH, S. A.

"Asymptotic methods in the theory of shock waves."

report submitted for 11th Intl Cong of Applied Mechanics, Munich, W. Germany, 30 Aug-5 Sep 64.

ACCESSION NR: AP4042027

S/0030/64/000/006/0021/0025

AUTHORS: Khristianovich, S. A. (Academician); Zhukov, M. F. (Doctor of technical sciences)

TITLE: Low temperature plasma generators

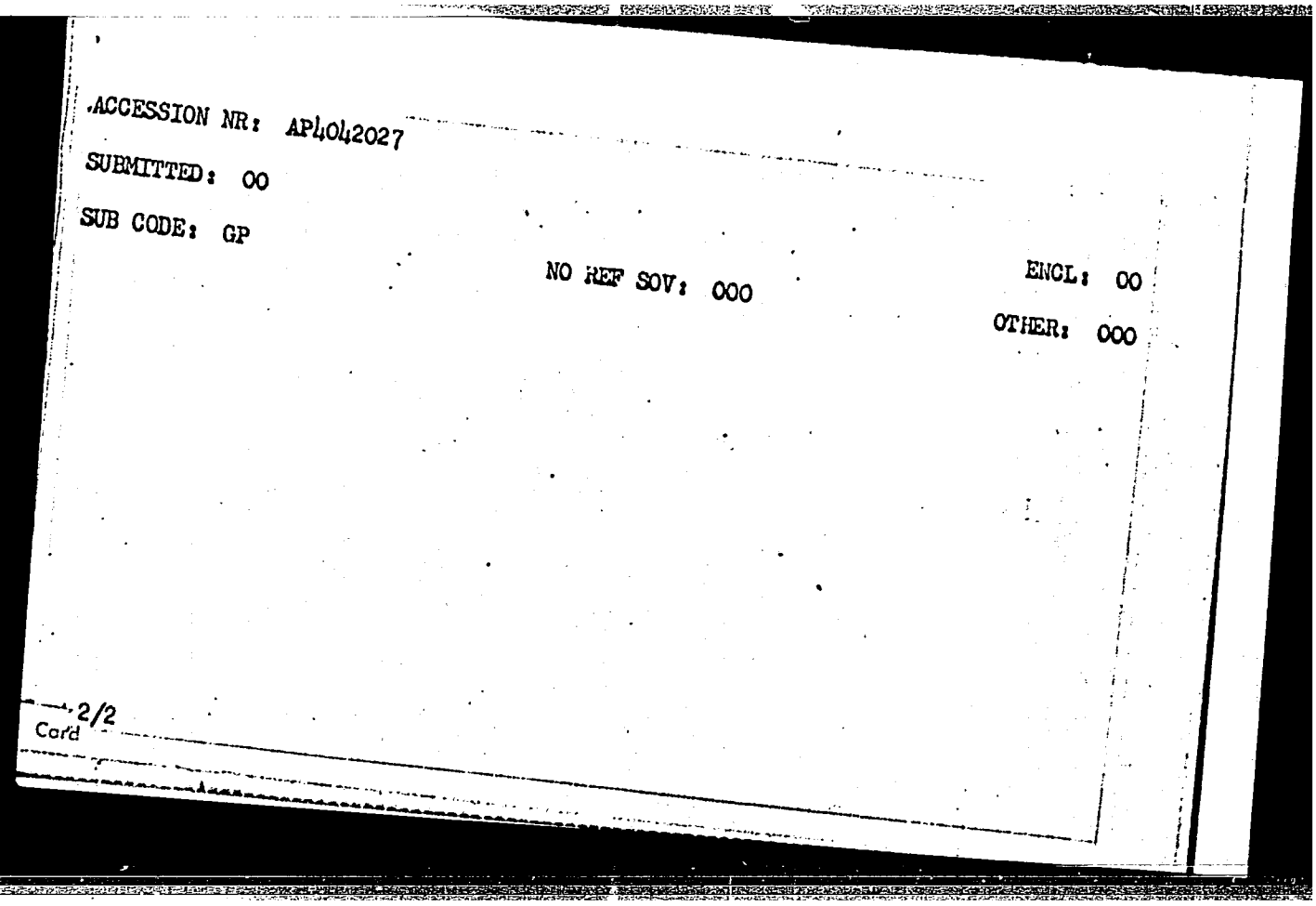
SOURCE: AN SSSR. Vestnik, no. 6, 1964, 21-25

TOPIC TAGS: arc jet, plasma, coaxial electrode, discharge current, arc length

ABSTRACT: The details of an arc jet for producing low temperature plasmas were presented. The arc is vortex stabilized between two coaxial copper electrodes but is shown to oscillate with variable lengths at kilocycle frequencies. The stability of the arc is improved upon increasing the discharge current and consequently reducing the arc length. Simple nondimensional expressions are derived, relating the arc power to gas mass flow rate and the potential drop across the arc in a multiatomic gas with the current. The volt-ampere characteristic curves agree closely with the experimental results. Orig. art. has: 5 figures and 2 formulas.

ASSOCIATION: Institut teoreticheskoy i prikladnoy mekhaniki (Institute of Theoretical and Applied Mechanics)

Card 1/2



ACCESSION NR: AP4042027

SUBMITTED: 00

SUB CODE: GP

NO REF SOV: 000

ENCL: 00

OTHER: 000

2/2
Card

KHRISTIANOVICH, S.A.; SHEMYAKIN, Ye.I. (Novosibirsk)

Dynamic compressibility of hard rocks and metals. PMTF no.3: 9-15 My-Je '64. (MIRA 17:6)

KHRISTIANOVICH, S.A., akademik; ZHUKOV, M.F., doktor tekhn. nauk

Low-temperature plasma generators. Vest. AN SSSR 34 no.6: 21-25 Je '64 (MIRA 17:8)

KHRISTIANSEN, G. B.

USSR/Nuclear Physics - Cosmic Rays
Particles, Elementary

21 Nov 49

"Absorption Spectrum of Penetrating Particle Currents of Wide Atmospheric Showers in Cosmic Rays," G. T. Zatsepin, I. L. Rozental', S. A. Slavatinskiy, G. B. Khristiansen, L. A. Shyvayev, Phys Inst imeni Lebedev, Acad Sci USSR, 3 pp

"Dok Ak Nauk SSSR" Vol LXIX, No 3

Employed usual method of variation of area of counters, connected in coincidence scheme, and method of variation of "coincidence multiples," to determine subject spectrum and clarify nature of penetrating particles. Submitted 22 Jul 1949 by Acad D. V. Skobel'tsyn.

158T76

KHRISTIANSEN, G. B.

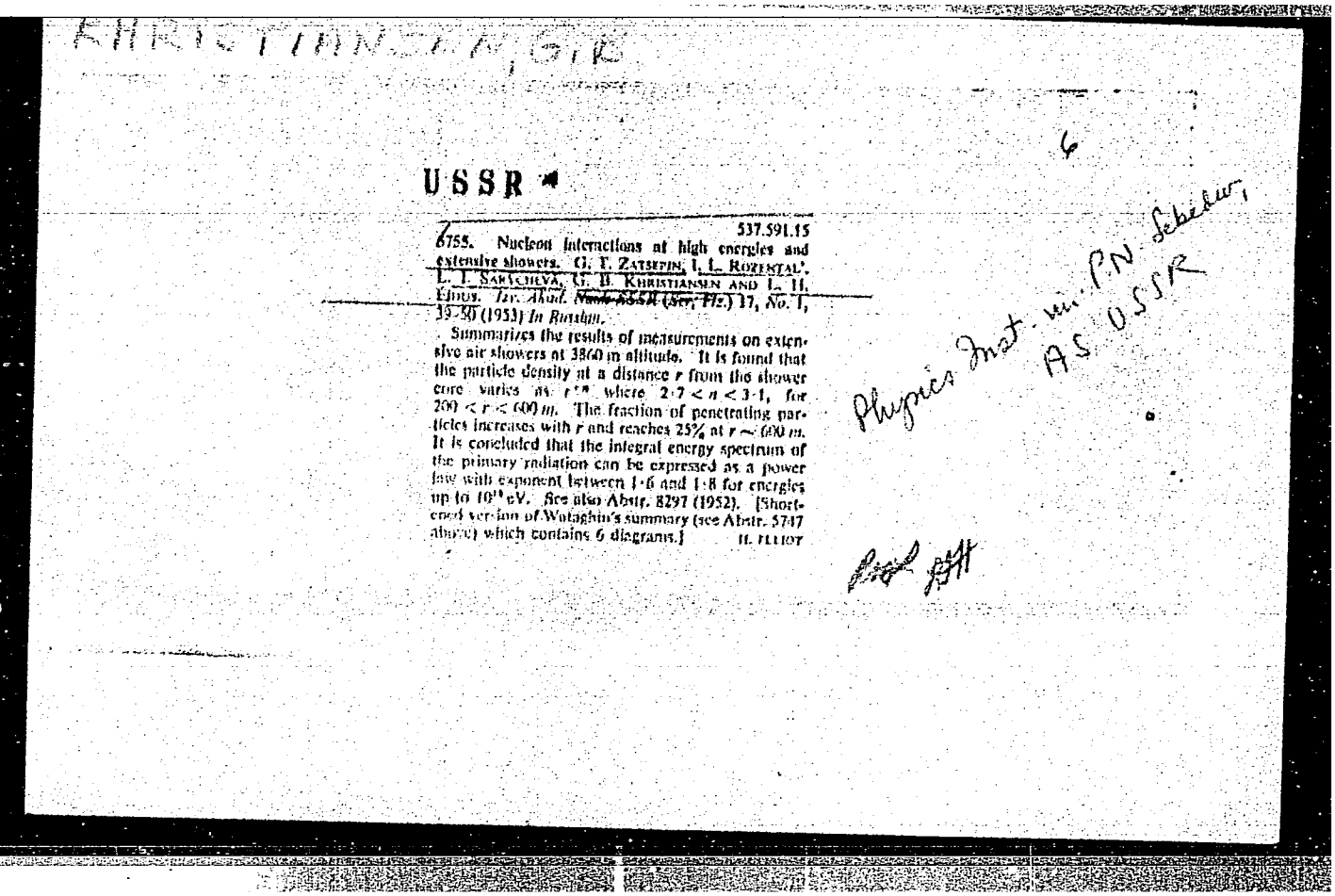
6640 Observations on Atmospheric Cosmic-Ray Showers Wider than 1000 m. G. T. Zatsepin, I. L. Rozental', V. P. Zakharova, N. G. Khrebet, and G. B. Khristiansen. Doklady Akad. Nauk S.S.S.R. 74, 29-32(1950) Sept. 1. (In Russian)

Very wide atmospheric showers were studied at 3860 m. using a method proposed by Skobel'tsyn and Zatsepin (Doklady Akad. Nauk. S.S.S.R. 73, 1157(1950) as a decisive test of the hypothesis on the special structure of these showers. A hodoscopic group of counters was placed midway between two groups of counters distant 1000 m. from each other. Anticoincidences, marked by the silence of the central group when the lateral ones recorded coincidences, were counted. The high percentage of anticoincidences observed proved that the structure of these showers was essentially different from that described by the cascade theory of the usual atmospheric showers.

KHRISTIANSEN, G. B.

Khristiansen, G. B. -- "The Spatial Distribution of Charged Particles in Extensive Atmospheric Showers." Cand Phys-Math Sci, Physics Inst, Acad Sci USSR, Moscow 1953. (Referativnyy Zhurnal--Fizika, Jan 54)

SO: SUM 168, 22 July 1954



USSR

537.591.15

6755. Nucleon interactions at high energies and extensive showers. G. T. ZATSEPIN, I. L. ROZENTAL', L. T. SARYCHEVA, U. B. KHRISTIANSEN AND L. H. ELIOT. *Izv. Akad. Nauk SSSR (Ser. Fiz.)* 17, *No.* 1, 39–50 (1953) *In Russian.*

Summarizes the results of measurements on extensive air showers at 3860 m altitude. It is found that the particle density at a distance r from the shower core varies as r^{-n} where $2{\cdot}7 < n < 3{\cdot}1$, for $200 < r < 600$ m. The fraction of penetrating particles increases with r and reaches 25% at $r \sim 600$ m. It is concluded that the integral energy spectrum of the primary radiation can be expressed as a power law with exponent between 1·6 and 1·8 for energies up to 10^{15} eV. See also Abstr. 8297 (1952). [Shortened version of Watagbin's summary (see Abstr. 5747 above) which contains 6 diagrams.] H. ELLIOT

6

Physics Inst. im. P.N. Lebedev, AS USSR

KHRISTIANSEN, G. B.

USSR/Nuclear Physics - Cosmic Rays

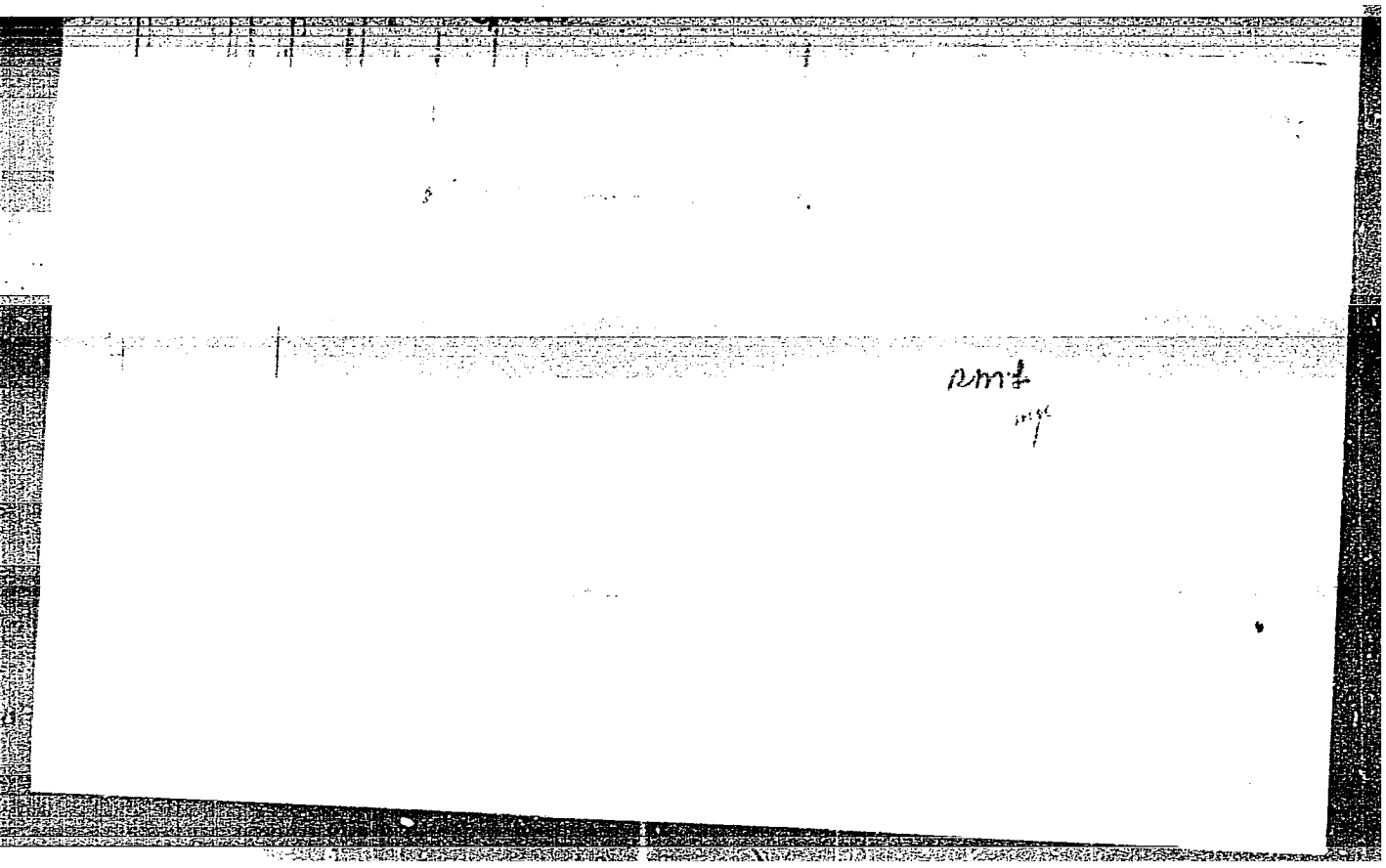
Feb 53

"Wide Atmospheric Showers of Cosmic Rays," N. A. Dobrotin, G. T. Zatsepin, I. L. Rozenthal, L. I. Sarycheva, G. B. Kristiansen, L. Kh. Eydus

Usp Fiz Nauk, Vol 49, No 2, pp 185-242

First showers were observed by D. V. Skobeltsyn in 1929 (Z. F. Physik, 54 (1929)) and later in 1949 he detected gigantic showers on Mt Pamir (3860m) (DAN 67 (1949)). G. T. Zatsepin developed the new theory of wide showers (DAN 67, 1949)) followed by foreign scientists. 78 references, mostly American (18) appended. Indebted to Acad Skobel'tsyn, Ye. L. Feynberg, S. Z. Belenkiy, M. I. Pogoretskiy.

PA 251T57



DOBROTIN, N.A.; ZATSEPIN, G.T.; NIKOL'SKIY, S.I.; SARYCHEVA, L.I.; KHRISTIANSEN, G.B.

Investigation of the interaction of high-and superhigh-energy particles with nucleons and atomic nuclei. Izv.AN SSSR Ser.fiz.19 no.6:666-676 N-D '55. (MLRA 9:4)

1.Fizicheskiy institut imeni P.N.Lebedeva Akademii nauk SSSR i Moskovskiy gosudarstvennyy universitet imeni M.V.Lomonosova.
(Cosmic rays) (Nuclear physics)

USSR/Nuclear Physics - Cosmic Rays

KHRISTIANSEN, G.B.

Card 1/1 Pub. 146-18/28

FD-3346

Author : Abrosimov A. T., Bednyakov A. A., Zatsepin V. I., Nechin Yu. A., Solov'yeva V. I., Khristiansen G. B. and Chikin P. S.

Title : Study of structure of broad atmospheric showers at sea level (Letter to the editor)

Periodical : Zhur. Eksp. i Teor. Fiz., 29, No 5, 693-696, 1955

Abstract : A detailed study was carried out in Moscow during the summer of 1953 of the spacial distribution of various components of broad atmospheric showers at short distances from the shower axis by using the method of correlated hodoscopes. The preliminary results of these studies are presented in graphs. Indebted to G. T. Zatsepin and N. A. Dobrotin for discussions and to G. V. Bogoslavskiy, B. V. Subbotin and M. S. Tulyankina for assistance in measurements. Five references.

Institution : --

Submitted : May 3, 1955

563

INTERACTION OF ULTRA HIGH ENERGY PARTICLES WITH NUCLEONS AND ATOMIC NUCLEI. N. A. Dobrotin, G. T. Zatsepin, S. I. Nikol'skii, and G. B. Khristiansen (Academy of Sciences of the USSR and State Univ., Moscow). Nuovo cimento (10) 3, Suppl. No. 4, 635-51 (1956).

A short review is presented of some of the experiments of Soviet physicists on extensive air showers. Current theories of the showers are discussed, as is the use of hodoscopes in the detection of air showers. The application of air shower data to deductions concerning the interaction of ultra high-energy particles with nucleons and atomic nuclei is reviewed. (B.J.H.)

KHRISTIANSEN, G. B.

21(1) P 2

PHASE I BOOK EXPLOITATION HUN/1911

International Conference on Cosmic Radiation. Budapest, 1956.

International Conference on Cosmic Radiation Organized by the Hungarian Academy of Sciences. Budapest, 1957. 187 p. 200 copies printed.

Sponsoring Agency: Magyar Tudomanyos Akademia

Eds.: E. Fenyves, and A. Somogyi

PURPOSE: This report is intended for geophysicists concerned with cosmic radiation.

COVERAGE: This report contains the papers read at the six plenary sessions of the conference. Some of the problems dealt with include nuclear emulsions, extensive air showers and the program of cosmic ray measurements planned for the International Geophysical Year. Most of the reports are followed by references. Soviet scientists in the field of cosmic radiation who attended the conference are: E.L. Andronikashvili, N.A. Dobrotin, I.I. Gurevich, S.I. Nikolskiy and S.N. Vernov. The articles are written in English, German and Russian without parallel translations.

Card 1/6

TABLE OF CONTENTS:

THIRD SESSION

EXTENSIVE AIR SHOWERS

KHRISTIANSEN, G.B.

AUTHOR: ANTONOV, YU.N., VAVILOV, YU.N., ZATSEPIN, G.T., KUTUZOV, A.A., SKVORTSOV, YU.V., KHRISTIANSEN, G.B. PA - 2665

TITLE: Structure of the Periphery of Extensive Atmospheric Cosmic Ray Showers. (Struktura periferii shirokikh atmosfernykh livney kosmicheskikh luchey, Russian).

PERIODICAL: Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol 32, Nr 2, pp 227-240, Russian)

Received: 5 / 1957 Reviewed: 6 / 1957

ABSTRACT: The present paper investigates the spatial distribution of the different components of a broad atmospheric cosmic ray shower at great distances from its axis (200 - 800 m). For a detailed study of this problem the Pamir-Expedition of the Academy of Science of the U.S.S.R. (summer and autumn 1950 and 1951) used a new method: In different places of the observation plain the flux density of all charged particles (and separate from it that of penetrating particles) was simultanously determined with hodoscopic devices. (Method of correlated hodoscopes).

Summary of results: The shower domain investigated here consists of an electron-photon component and of a penetrating component (apparently myons). With increasing distance from the shower axis the relative share of the penetrating component increases considerably and at a distance r = 800 m the flux density of penetrating particles and of electrons is equal. The spatial distribution of the

Card 1/2

Structure of the Periphery of Extensive Atmo-- PA - 2665
spheric Cosmic Ray Showers.

total flux density of electrons and of penetrating particles is determined by the formula $Q(r) \sim 1/r^n$ with $n \sim 2,0$. On account of the relatively slow decrease of flux densities of shower particles the periphery of the shower plays an essential part in the general balance of the flux of the shower particles. The mechanism of the transition of electrons to the periphery of the shower is reduced to the Coulomb scattering of these electrons by the nuclei of air atoms. The transition of Myons to the periphery of the shower is effected by their Coulomb scattering and also apparently at the expense of the emission angle in the elementary acts of the nucleus cascade process of the positive and negative myons producing these myons. Finally, data on the intensity of primary cosmic particles with extremely high energies of 10^{16} up to 10^{17} eV are given. (10 illustrations)

ASSOCIATION: Physical Institute "P.N.Lebedev" of the Academy of Science of the U.S.S.R.

PRESENTED BY:

SUBMITTED:

AVAILABLE: Library of Congress.

Card 2/2

AUTHOR: Khristiansen, G. B. SOV-120-58-1-9/43

TITLE: On the Measurement of the Resolving Time of Hodoscopes (Ob izmerenii razreshayushchego vremeni godoskopov)

PERIODICAL: Pribory i Tekhnika Eksperimenta, 1958, Nr 1, p.48 (USSR)

ABSTRACT: It is often important in physical experiments to know the mean resolving time of the hodoscopic system being used and also the resolving time of each of the channels of the hodoscope. At the same time the number of channels in contemporary hodoscopic systems may reach a few thousands which, of course, makes it difficult to employ the usual methods of determination of resolving times. A method is now given for the determination of the resolving time of a multi-channel hodoscopic system. Using this method, the mean resolving time of the hodoscope and its various channels can be quickly and conveniently obtained. Suppose the hodoscope consists of n channels, the resolving times of which are $\tau_1, \tau_2 \ldots \tau_n$ and the input to them from the sources of pulses $\nu_1, \nu_2 \ldots \nu_n$.

Card 1/4

On the Measurement of the Resolving Time of Hodoscopes.

In each of the hodoscopic channels the coincidence between the particular source feeding this channel and some standard pulse applied to the whole scheme is recorded. The width of the standard pulse is much less than the resolving time of the channels. Suppose further that the number of standard pulses applied to the hodoscope is C and one observes that m channels operate and the remaining n - m do not. The probability of this happening for given $\tau_1, \tau_2 \ldots \tau_n$ and $\nu_1, \nu_2, \ldots \nu_n$ is given by Eqs.(1) and (4). This expression can be looked upon as a function of the resolving times $\tau_1, \tau_2 \ldots \tau_n$. It is clear that the most probable situation is that in which one has such values for the $\tau_1, \tau_2 \ldots \tau_n$ which, in combination make W a maximum. Let us consider the following special case which is of practical importance. Suppose that $\nu_1 = \nu_n = \nu$ and the resolving times of the channels $\tau_1, \tau_2 \ldots \tau_n$ are distributed symmetrically about a mean value, $\bar{\tau}$, and do not differ very much from this value. Providing m and n-m are sufficiently large the expression (1) takes up the form:

On the Measurement of the Resolving Time of Hodoscopes.

$W(\tau) \sim [1 - \exp(-\tau\nu C)]^m \exp[-\tau\nu C(n - m)]$. The value of τ which makes $W(\tau)$ a maximum is given by:

$$\tau = \frac{1}{\nu C} \cdot \ell n(1 - m/n)^{-1} \quad . \qquad (2)$$

If now one carries out N similar series of measurements (in each series the number of standard pulses being the same and equal to C) and in M of these the given channel came into operation, then the resolving time of this channel is given by the expression:

$$\tau = \frac{1}{\nu C} \ell n(1 - M/N)^{-1} \quad .$$

Card 3/4

SOV-120-58-1-9/43

On the Measurement of the Resolving Time of Hodoscopes.

There are no figures and 3 Soviet references.

ASSOCIATION: Nauchno-issledovatel'skiy institut yadernoy fiziki MGU (Scientific Research Institute for Nuclear Physics of Moscow State University)

SUBMITTED: July 3, 1957.

1. Hodoscopes--Performance 2. Mathematics--Applications

Card 4/4

SOV/120-58-4-7/30

AUTHORS: Bekkerman, I.M., Dmitriyev, V. A., Molchanov, L. P., Khristiansen, G. B., Yarygin, P. I.

TITLE: Ionisation Chambers and an Apparatus for Studying Wide Atmospheric Cosmic Ray Showers (Ionizatsionnyye kamery i apparatura dlya issledovaniya shirokikh atmosfernykh livney kosmicheskikh luchey)

PERIODICAL: Pribory i tekhnika eksperimenta, 1958, Nr 4, pp 31-36 (USSR)

ABSTRACT: A description is given of ionisation chambers 60 litres in volume as well as various elements of the apparatus associated with them, such as pre-amplifier, amplitude analyser, etc. The chambers are made of stainless steel and are in the form of cylinders. The diameter of each cylinder is 250 mm. The cylinder forms the outer electrode. The diameter of the inner electrode, which is made of brass, is 4 mm. The length of the working part of each chamber is 1000 mm. The wall thickness is 2 mm. The pressure in each of the chambers is controlled by special manometers attached to them. The chambers are filled with very pure argon at a pressure of 5 atm. The EHT is applied to the central electrode through a 470 Meg resistor and the output pulse is taken off through a 390 puff capacitor. The capacitance

Card 1/3

Ionisation Chambers and an Apparatus for Studying Wide Atmospheric Cosmic Ray Showers

of the entire chamber is 33 puff and the leakage resistance from the central electrode is 10^{12} ohm. A sectional drawing of the chamber is shown in Fig.2. In this figure 1 is the 390 puff capacitor, 2 is the left insulator, 3 is th chamber, 4 is the central electrode, 5 is the right insulator 6 is the 470 Meg resistor and 7 is the input valve. Fig.3 shows the characteristic curves of a typical chamber. The working region begins at 500 V. The working point actually chosen was at 1200 V. At that voltage the rise time of an electron pulse from the chamber is 30 μ sec. Each chamber is followed by a preamplifier of the type shown in Fig.4. This amplifier has a very low noise level and a wide region of linearity (10 μV to 1 V). The entire system consists of four such chambers in parallel, each of the chambers being followed by a preamplifier. Pulses from the outputs of the four preamplifiers are applied via coaxial cables to a linear adding device and then to a 4-stage amplifier. From the amplifiers the pulses are fed into 4 channels of a discriminator, all the channels being the same. The circuit of the discriminator is shown in full in Fig.6. It converts the

Ionisation Chambers and an Apparatus for Studying Wide Atmospheric Cosmic Ray Showers

measured signal into a signal whose duration is proportional to the amplitude of the measured signal (Refs 6 and 8). The apparatus will record pulses whose amplitudes differ by four orders of magnitude and the minimum pulse corresponds to the transit through a chamber of a single relativistic particle. There are 6 figures and 9 references, of which 4 are Soviet and the rest English.

ASSOCIATION: Zavod "Fizpribor" ("FIZPribor" factory)

SUBMITTED: October 11, 1957.

AUTHOR: Khristiansen, G. B. 56-34-4-27/60

TITLE: On the Spatial Distribution of the Particles in the Extensive Atmospheric Showers (O prostranstvennom raspredelenii chastits v shirokikh atmosfernykh livnyakh)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol. 34, Nr 4, pp. 956 - 961 (USSR)

ABSTRACT: This work investigates the problem of the relative influence of the various factors which cause the spatial divergence of the charged particles in the extensive atmospherical showers: 1) The angular divergence of the secondary particles: a) In the elementary acts of the nuclear cascade process, b) in the acts of the spontaneous decay. 2) The Coulomb scattering (of charged particles) at the nuclei of the air atoms; 3) the Lorentz force caused by the magnetic field of the earth. The author first investigates the spatial distribution of the electrons; he compares the experimental spatial distribution of the electrons (References 1-5) with the theoretical distributions according to Nishimura and Kamata for various degrees of the s-development of an electron-photon avalanche. The spatial distribution of the electrons, composed from the mentioned

Card 1/4

previous works (References 1-5), is illustrated in a diagram. The experimental points fit well on the theoretical curve for s = 1,25 unto distances of r = 3, and do not disagree either with the course of the curve for s= 1,25 for long distances unto r = 7. The agreement between the experimental and the theoretical curve in that wide an interval of the distances of course is not casual and might be traced back to the fact that the energy spectrum of the shower electrons agrees with the energy spectrum of the electron-photon avalanche of the age (vozrast). The spatial divergence of the electrons completely is determined by the Coulomb scattering. If the energy spectrum of the electrons in the shower agrees with the energy spectrum of the electrons in an electron-photon avalanche with the value s = 1,2, then the observed wide spatial divergence of the electrons in the shower can be explained by the Coulomb scattering of the electrons of the single electron-photon avalanches alone. On this occasion the assumption that the cores of these avalanches surpass the main core of the extensive atmospheric shower is not necessary. Subsequently the author investigates the an-

gular distribution of the myons. The spatial distribution of the myons of low energies (which are usually observed in the experiments) esentially depends on the Coulomb scattering of the myons and on their deflection in the magnetic field of the earth. Also the angular divergence of the "ancestors" of the myons in the elementary acts of the nuclear cascade process is of essential importance for the angular divergence of the myons. But the relative influence of all these factors at present cannot be finally determined without additional experimental data (particularly on the spatial distribution of the myons, on their energy spectrum, and on the height of their production in the atmosphere). Of particular interest is the analysis of the data on the spatial distribution of the myons of high energy. The action of the magnetic field of the earth reduces to the spatial separation of the myons according to their energy and charge. Also the Coulomb scattering must be considered in the analysis of these data. Finally the author thanks S.B. Vernov and G. T. Zatsepin for the discussion of the problems investigated here. There are 2 figures and 17 references, 9 of which are Soviet.

On the Spatial Distribution of the Particles in the Extensive Atmospheric Showers 56-34-4-27/60

ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: November 11, 1957

1. Atmosphere--Analysis 2. Particles--Scattering

Card 4/4

AN/Christiansen G. B.

SOV/56-34-5-4/61

AUTHORS: Abrosimov, A. T., Goryunov, B. N., Dmitriyev, V. A., Solov'yeva, V. I., Khrenov, B. A., Khristiansen, G. B.

TITLE: The Structure of the Extensive Atmospheric Showers at Sea Level (Struktura shirokikh atmosfernykh livney na urovne morya)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol. 34, Nr 5, pp. 1077-1089 (USSR)

ABSTRACT: This paper investigates the lateral distribution of electrons, nuclear active and nuclear passive particles in extensive air showers containing from 4.10^4 to 4.10^5 particles at sea level by means of correlated hodoscopes. These measurements were carried out from April to May of 1954 in Moscow. The authors used the hodoscopes K-6 of L. N. Korablev. At first the measuring device is discussed, which gave a sufficiently exact distribution of the density of the charged particles near the axis of any registered shower. By means of these data it is possible to determine the individual properties of the shower, - the position of its axis and the number of the particles. As zero approximation of the position of the

Card 1/3

The Structure of the Extensive Atmospheric Showers at Sea Level

axis the center of the region of maximal density of particle flux was taken. Also the determination of the second approximation is discussed in a few words, but the use of this second approximation is practically not necessary. The second characteristic of the shower - the total number N of the particles, was found after determining the position of the axis. Therefore the total number of the particles in the central region of the shower was used as a standard of the total number of particles. The experimental data concerning the spacial distribution of all charged particles may be approximated by the function $kNr^{-1}e^{-r}/R$ with R = (60 6) m for the region $2 \ll r \leqslant R(n-1)$ and by the exponential function $k_1 Nr^{-n}$ for the region $r \gg R(n-1)$ with $n=2,6 \pm 0,4$. The coefficients K and k_1 are found from the normalizing conditions of the function of spacial distribution. The hodoscopic device was also used for the determination of the number of the registered extensive showers with a fixed number N of particles. The energy flux of the shower is concentrated in a small region possessing a small radius of the order of several metres from the axis of the extensive air shower. The whole of the experimental facts may be explained by the idea of equilibrium

The Structure of the Extensive Atmospheric Showers at Sea Level SOV/56-34-5-4/61

between the electron component and the nuclear active component with low energies on one hand and by the energy-flux of the nuclear avalanche (lavina) of the shower core on the other hand. There are 7 figures, 4 tables, and 20 references, 12 of which are Soviet.

ASSOCIATION: Fizicheskiy institut im. P.N. Lebedeva Akademii nauk SSSR (Physics Institute imeni P.N. Lebedev, AS USSR)
Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: December 3, 1957

1.Particles(Airborne)--Measurement 2.Electrons--Distribution
3.Electrons--Properties 4.Mathematics--Applications

Card 3/3

21(0)

AUTHORS: Kulikov, G. V., Khristiansen, G. B. SOV/56-35-3-11/61

TITLE: On the Spectrum of Extensive Atmospheric Showers Corresponding to the Number of Particles (O spektre shirokikh atmosfernykh livney po chislu chastits)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol 35, Nr 3, pp 635 - 640 (USSR)

ABSTRACT: In the present paper the authors describe the experimental results concerning the distribution of air showers with respect to the number of particles; investigations were carried out in May 1954 on sea-level. They concerned showers with a total number of 2.10^4 - 2.10^5 particles. The hodoscope- arrangement of counters used is schematically shown by figure 1 and is described in the following. The electronic computer of the computation center of MGU (Moscow State University) was available for the purpose of solving mathematical problems. The measuring space was divided into 3 concentrically arranged ranges:

Card 1/4

1) central range, circular in shape, $S_1=78m^2$ (for $N > 8.10^4$); $S_2=400m^2$, quadratic (for $N > 1,6.10^5$) and $S_3=576m^2$, also quadratic (for still larger N)(Probability of recording > 95%). Figure 2 shows the results obtained by this work as well as those of reference 7 ($10^6 < N < 10^8$) in form of a diagram in double logarithmic scale. It shows the connection between the number of showers F (with a number of particles > N) with N. ($F[cm^{-2}sec^{-1}steradian^{-1}]$). For the range $10^5 \lesssim N \lesssim 10^6$ the following was found: Number of particles N in the shower

	$0,8.10^5$	$1,6.10^5$	$3,2.10^5$	$6,4.10^5$	$8,0.10^5$	$12,8.10^5$
Number of showers with number of particles > N	157	276	138	46	24	6

Card 2/4 The results show that in the case of numbers of particles

varying in range between 10^6 and 10^7 the probability for the occurrence of an irregularity in the shower size distribution curve is very great. Theoretical deliberations seem to show that for cosmic rays with energies $> 10^{16}$eV a galactic or metagalactic origin may be assumed. In conclusion the authors thank Professor S.N.Vernov for his valuable advice and discussions, G.S.Roslyakov for supervising work at the computation center of MGU, and V.I.Solov'yeva and D.S.Stel'makh for their cooperation. There are 2 figures, 1 table, and 12 references, 8 of which are Soviet.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: April 22, 1958

24(5)

AUTHORS: Guseva, V. V., Zatsepin, G. T., Khristiansen, G. B.

SOV/56-35-4-1/52

TITLE: On the Angular Distributions of Broad Atmospheric Showers of High Energy (Ob uglovom raspredelenii shirokikh atmosfernykh livney vysokikh energiy)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol 35, Nr 4, pp 833-837 (USSR)

ABSTRACT: The present paper deals with experimental investigations of the angular distribution carried out for the purpose of determining the absorption coefficients of high-energy showers (primary particle energy $\gtrsim 10^{17}$eV). The experiments were carried out in an altitude of 3860 m above sea-level. The authors used a cylindrical cloud chamber (illumination depth 6 cm) which had an effective surface of 615 cm^2. The cloud chamber was synchronously connected with a system consisting of many counters (hodoscope arrangement); the photographic equipment was arranged so that the optical axis of the stereoscopic camera formed an angle of 30^0 with the vertical. The counters were arranged in 5 groups so that there was a horizontal distance of

Card 1/3

500 m between each of the first three, whilst the 4. and 5. were 300 m above and under the central group respectively. 5 m above the central group the Wilson chamber was located. The results obtained by the investigation are shown partly by table 3 and figure 4. A total of 75 showers was investigated. Results show that, contrary to the usual opinion, such showers have already passed the maximum of their development in altitudes of several 1000 m above sea-level.

In conclusion, the authors thank H. A. Dobrotin and N. G. Birger for their assistance and advice, and E. S. Levit for helping to carry out measurements. There are 4 figures, 3 tables, and 7 references, 6 of which are Soviet.

On the Angular Distributions of Broad Atmospheric Showers of High Energy . . SOV/56-35-4-1/52

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR
(Physics Institute imeni P. N. Lebedev of the Academy of Sciences, USSR)
Moskovskiy gosudarstvennyy universitet
(Moscow State University)

SUBMITTED: January 7, 1958

Card 3/3

KHRISTIANSEN, G. B.

A STUDY OF THE SPATIAL DISTRIBUTION FUNCTION OF ELECTRONS AND THE DENSITY OF ENERGY FLUX OF THE ELECTRON-PHOTON COMPONENT IN EXTENSIVE AIR SHOWERS
N.N. Goryunov, V.A. Dmitriyev, G.V. Kulikov, YU.A. Nechin, G.B. Khristiansen

1. The spatial distribution of density of energy fluxes of the electron-photon component was determined from transition curves in lead obtained for different distances from the shower axis; the spatial distribution of particle fluxes was obtained by the method of correlated hodoscopes.

2. The spatial distribution of the density of energy flux of the electron-photon component was obtained up to r = 60 m from the shower axis in extensive air showers with the total number of particles $N = 10^4 - 2 \times 10^6$. The form of the function is independent of the strength of the shower and, if we approximate this function by a power law of the type r^{-n}, we obtain

$n = 1.2 \pm 0.2$	$0.3 < r < 1$ m
$n = 1.5 \pm 0.2$	$1 < r < 10$ m
$n = 2.0 \pm 0.3$	$10 < r < 60$ m

Report presented at the International Cosmic Ray Conference, Moscow, 6-11 July 1959

KHRISTIANSEN, G. B.

SEA-LEVEL STUDIES OF THE HIGH-ENERGY NUCLEAR-ACTIVE COMPONENT OF EXTENSIVE AIR SHOWERS

S.N. Vernov, N.N. Goryunov, V.A. Dmitriyev, G.B. Kulikov, Yu.A. Nechin, G.B. Khristiansen

1. High-energy nuclear-active particles were detected by large bursts produced in ionization chambers by these nuclear-active particles during passage through a composite filter of lead and graphite. The use of a composite filter permits firstly, of separating, in the best possible fashion, the ionization produced in the chambers by the electron-photon component (which appears in the filter due to nuclear-active particles) from the ionization created b the electron-photon component of the shower coming from the air. On the other hand, the use of such a filter gives rise to a situation when the ionization in the chambers turns out to be proportional to the total energy transferred from the nuclear-active particle to the electron-photon component in the filter. So, the energy of a nuclear-active particle can be determined from the burst in the ionization chamber on the basis of rather general considerations.

Report presented at the International Cosmic Ray Conference, Moscow, 6-11 July 1959

KHRISTIANSEN, G. B.

THE SPECTRUM OF EXTENSIVE AIR SHOWERS ACCORDING TO THE NUMBER OF PARTICLES, COEFFICIENT OF ABSORTION OF EXTENSIVE AIR SHOWERS
G.V. Kulilov, N.M. Nesterova, S.I. Nikolsky, G.B. Khristeansen, A.E. Chudakov

1. Utilizing the method of correlated hodoscopes, which permits determining the position of the axis and the number of particles in a shower, we have obtained data on shower spectra level and at sea level.
2. At 3860 m above sea level and the interval of particle-number variation in the shower from 3×10^4 to 10^7, thespectrum is well approximated by power law N^{-X}, where $X = 1.6\text{-}0.1$. At sea level there is a greater probability that the spectrum will be irregular in the range $10^6 < N < 10^7$ (for $<10^4$ $N < 10^6$ $x=2.1^{r}\text{-}0.s$,and for $N = 10^7 < X = 1.5\text{-}0.2$.
3. The shower absorption coefficient obtained from a comparsion of absolute number of showers with a number of particles greater than that given at mountain altitude and at sea level, amounts to $M=1/(180\text{-}20)$ g/cm^2.

Report presented at the International Cosmic Ray Conference, Moscow, 6-11 July 1959

KHRISTIANSEN, G. B.

A STUDY OF THE MU-MESON COMPONENT NEAR THE AXIS OF AN EXTENSIVE AIR SHOW

S.N. Vernov, B.A. Khrenov, G.B. Khristiansen

1. The method of correlated hodoscopes was applied in a study of the following characteristics of the high-energy mu-meson component in extensive air showers at sea level

a) the spatial distribution of mu-meson fluxes,
b) the energy spectrum of mu-mesons,
c) the dependence of the number of mu-mesons of high energy on the total number of particles in the shower, N.

2. The spatial distribution of mu-meson fluxes is of the folowing form for showers with $N \geq 10^5$: (2) I/r^n, $n = 1 \pm 0.2$ for $2 \text{ m} \leq r \leq 8 \text{ m}$; $n = 0.96 \pm 0.14$ for $8 \text{ m} \leq r \leq 100 \text{ m}$

Irregularities are observed near the shower axis in the spatial distribution of mu-meson fluxes. These irregularities, which consist in the appearances of groups of spatially correlated mu-mesons, can by no means be explained by Poisson fluctuations in the distribution of meon trajactories.

Report presented at the International Cosmic Ray Conference, Moscow, 6-11 July 1959

KHRISTIANSEN, G. B.

STUDYING THE CORE STRUCTURE OF AN EXTENSIVE AIR SHOWER BY MEANS OF A DIFFUSION CHAMBER

S.N. Vernov, Z.X. Sturgalskiy, G.B. Khristiansen

1. By using a diffusion chamber with an of 80 x 80 cm^2 and a sensitive layer 6 cm high operating in conjunction with detector of extensive-air shower cores, a study was made of shower structure in the immediate vicinity of the axis.

2. A large number of cases were observed of the axis of an extensive air shower entering the diffusion chamber. In these cases we obtained the spatial distribution of the particles relative to the direction of the axis.

3. The spatial distribution of the particle flux for showers with $N \geq 10^5$ is the form: $P(2) \sim I/r^n$ $n = 0.6 \pm 0.1$ for $5\ cm < r < 30\ cm$; $n = 1.0 \pm 0.1$ for $30\ cm < r < 3\ m$.

4. The angular distribution of shower particles in a circle of radius 40 cm with the centre in the axis of the extensive shower, is seen to be very well represented as to relatively large angles $\theta \geq 5^0$. Even at these small distances from the axis, the mean direction of the particle flux makes an angle of the order of several degrees with the direction of the axis.

report presented at the International Cosmic Ray Conference, Moscow, 6-11 July 1959.

5. The experimental data on spatial and angular distribution are explainable in the framework of the nuclear-cascade picture of the development of a shower with account taken of the finite value of energy E_o of elementary electron-photon avalances created by π^- -mesons and even ignoring the angular distribution of π^- -mesons in nuclear interaction.

Report presented at the International Cosmic Ray Conference, Moscow, 6-11 July 1959.

KHRISTIANSEN, G. B.

GENERAL DESCRIPTION OF THE MOSCOW UNIVERSITY ARRANGEMENT FOR THE STUDY OF EXTENSIVE AIR SHOWERS AND PRELIMINARY RESULTS OBTAINED BY IT

S.N. Vernov, G.B. Khristiansen, A.T. Abrosimov, N.N. Goryunov, V.A. Smitrieva, G.V. Kulikov, Yu. A. Nichin, S.P. Soklov, V.I. Soloveva, K.I. Soloviev, Z.S. Sturgalsky, B.A. Khrenov

I. In the late 1957, at the Moscow State University an arrangement was put into operation for multipurpose studies of extensive air showers of cosmic rays.

2. The arrangement is a complex assembly of simultaneously operating physical instruments (some 5000 Geiger-Muller counters covering an area of over 100 m^2, and some 150 ionization chambers of various shapes covering an area of 13m^2, and a diffusion chamber of area 0.64m^2) and appropriate electronic equipment and photographic devices to record the instrument readings when an extensive air shower passes through the arrangement. Most of this equipment is located in a speacially erected building. Three rooms of this building (~60 sq. m. in area each) have light roofing of not more than 1.5 g/m^2 and two rooms (25 m^2 and 80 m^2) are situated underground at a depth corresponding to 20 and 40 metres water equivalent.

Report presented at the International Cosmic Ray Conference, Moscow 6-11 July 59

31519
S/627/60/002/000/001/027
D299/D304

3,2410 (1559, 2205, 2705, 2805)

AUTHORS: Vernov, S. N., Khristiansen, G.B., Abrosimov, A. T., Goryunov, N. N., Dmitriyev, V. A., Kulikov, G. B., Nechin, Yu. A., Sokolov, S. P. (deceased), Solov'yeva, V. I., Solov'yev, K. I., Strugals'kiy, Z. S., and Khrenov, B. A.

TITLE: General description of the setup used for studying extensive air showers and the provisional results obtained

SOURCE: International Conference on Cosmic Radiation. Moscow, 1959. Trudy. v. 2. Shirokiye atmosfernyye livni i kaskadnyye protesessy, 5-16

TEXT: A complex experimental setup was installed at Moscow State University, consisting of a simultaneously operating physical apparatus plus the corresponding radiotechnical equipment and photographical recording devices. The setup incorporates over 5000 Geiger-Müller counters (forming a hodoscope), about 150 ionization

Card 1/7

31519
S/627/60/002/000/001/027
D299/D304

General description of the setup...

chambers and a large diffusion chamber. The setup is designed for a comprehensive and simultaneous investigation of all the basic components (electrons and photons, nuclear-active particles and μ-mesons) of extensive air showers at sea level. The setup was designed in 2 different configurations: the first at the end of 1957, and the second at the beginning of 1959. Below, only the results obtained by means of the first setup are considered. The setup was located in a special building and in 10 mobile laboratories. The showers were registered by the system of hodoscoped counters. Part of the counters were shielded (those for detecting the nuclearactive particles and the μ-mesons) and the other counters were not shielded. The ionization chambers served to determine the lateral distribution of the electron-photon component and of the nuclearactive component. The microstructure of the electron component was studied by means of the diffusion chamber. Special measures were taken to ensure continuous and prolonged operation of the setup. The main units of the setup were automatically controlled, in particular the supply units and the photography system. The operation of the setup (as a whole) was controlled (triggered) by a selection system; in parti-

Card 2/7

General description of the setup ...

cular, the showers were selected in accordance with the density of the electron flow and of the μ-mesons. The setup was in operation for about 2500 hours, yielding a large amount of experimental data which are still being processed. The probability theory (Baye's theorem) was used for determining the (x,y)-axes and the number of particles N of the shower; in addition the distribution function f(r) as well as other distribution functions were determined (r denoting distance). The values of x, y and N were found by means of a special electronic simulator. The density distribution of electrons and mesons was determined by means of formula

$$W(\rho) = \prod_i \left[1 - \exp(-\rho\sigma_i)\right]^{m_i} \cdot \exp\left[-\rho\sigma_i(n_i - m_i)\right]$$

where m_i is the number of counters which operate over an area σ_i, and n_i - the overall number of such counters. The energy E of the electron-photon component was determined by means of ionization

Card 3/7

General description of the setup ...

chambers, shielded with lead (up to 6 cm thick). A very comprehensive picture of the particles and energies was obtained for showers whose axes fell within the system of 128 cubic detection chambers. The setup permits observing the central part of an atmospheric shower, whereby its several layers are simultaneously observed; this corresponds to the individual observation of the electron-photon, nuclearactive and μ-meson components. The processed material already yielded a fairly detailed picture of the structure of extensive air showers at sea level. Thus, the lateral distribution of particle flow in the individual showers was ascertained. It was found that the lateral distribution varies (in the 1 to 25 m range) from shower to shower; the average distribution is, in the range of 5 cm to 100 m, as follows:

$$\rho(r) = \begin{cases} \dfrac{K_1 N}{r^{0,6}} & K_1 = 3,3 \cdot 10^{-3},\ 0,05 < r < 0,3 \text{ m} \end{cases}$$

(cont'd)

Card 4/7

General description of the setup ...

$$\left(\frac{K_2 N}{r} \cdot e^{-\frac{r}{60}} \right), \quad K_2 = 2 \cdot 10^{-3}, \quad 0{,}3 < r < 100 \text{ m}$$

The lateral distribution of the electron-photon components also fluctuates from shower to shower. At distances smaller than 1.5 m, these fluctuations are particularly sharp. The nuclearactive components also exhibits considerable energy fluctuations. The fluctuations in the high-energy μ-mesons were not yet analyzed. The energy of the electron-photon component E_{eph} was calculated for a shower with number of particles equal to $(2.7 \pm 0.2) \cdot N\beta$, where β is the critical energy for air (72 Mev). The above value was obtained with an accuracy of appr. 30%. It was found that the energy of the nuclearactive component $E_n \cong (0.5 \text{ to } 1.0) E_{eph}$. This value is, however, subject to considerable fluctuations and the experimental data are as yet insufficient to determine the contribution of the

Card 5/7

General description of the setup...

nuclearactive component in showers. In addition, the above-mentioned fluctuations severely delimit the choice of a theoretical model for the development of showers. Particular attention was devoted to the structure of the shower in the immediate vicinity of its axis, where the particles of highest (for the particular shower) energy should be concentrated. This led to the discovery of a new effect: Groups of particles (from 4 to 20) travel in narrow beams (not exceeding 8 cm in diameter) in the neighborhood of the axis (or along the axis itself), whereby their lateral distribution shows that the beams are not due to Poisson fluctuations. The new effect can be explained as follows: Either the beam is the core of a "young" electron-photon shower which originates from a high-energy π^0-meson at a certain distance from the apparatus, or the beam consists of μ-mesons. These two possibilities are discussed. The observed irregularity in the lateral distribution of μ-mesons in the vicinity of the shower axis might be related to the new effect. There are 6 figures and 2 tables.

4

Card 6/7

31519
S/627/60/002/000/001/027
D299/D304

General description of the setup ...

ASSOCIATION: Nauchno-issledovatl'skiy institut yadernoy fiziki MGU, Moskva (Scientific Research Institute of Nuclear Physics Moscow State University, Moscow)

Card 7/7

KHRISTIANSEN, G.B.

(2)

31522
S/627/60/002/000/004/027
D299/D304

3,2410 (1559, 2205, 2705)

AUTHORS: Kulikov, G. V., Nesterova, N. M., Nikol'skiy, S. I., Solov"yeva, V. I., Khristiansen, G. B., and Chudakov, A.Ye.

TITLE: Number spectrum of extensive air showers at altitudes of 200 and 3860 m above sea level

SOURCE: International Conference on Cosmic Radiation. Moscow, 1959. Trudy. v. 2. Shirokiye atmosfernyye livni i kaskadnyye protsessy, 87-91

4

TEXT: Number spectra of extensive air showers were investigated in detail at the Physics Institute of the AS USSR and at Moscow State University. The spectra were investigated at an altitude of 3860 m and at sea level. Those at sea level were studied over a range N = $= 4 \cdot 10^3$ to $3 \cdot 10^7$. For showers with small N (10^3 to $5 \cdot 10^4$), the statistical method was used. The apparatus incorporated hodoscoped Geiger-Müller counters, whose disposition is shown in a figure. The experiments yielded the number of anti-coincidences n per unit time

Card 1/4

31522
S/627/60/002/000/004/027
D299/D304

Number spectrum of ...

for counters of different σ_i (σ varied between 0.4 and $1.65 \cdot 10^{-2} m^2$). By comparing the measurements and the calculations, the integral spectrum of the showers was obtained: $F(>N) = 2.5 \cdot 10^{-3} N^{-(1.45 \pm 0.03)}$ $cm^{-2} sec^{-1}$, with $N = 4 \cdot 10^3$ to 10^5. For large N, the spectrum was obtained by individual study of the showers, at sea level. For this purpose, the majority of the counters were disposed in a circle. The position of the axis and the number of particles in each shower were determined by means of the electronic computer "Strela". Thereupon the integral spectrum was found for $N = 8 \cdot 10^4$ to $8 \cdot 10^5$, viz.

$$F(>N,0) = (1{,}95 \pm 0{,}14) \cdot 10^{-10} \left(\frac{N}{10^5}\right)^{-1{,}5 \pm 0{,}1} cm^{-2} sec^{-1} sterad^{-1}$$

Both series of measurements coincide in the range $N \approx 10^5$. In order to determine the absolute number of extensive air showers in the

Card 2/ 4

31522
S/627/60/002/000/004/027
D299/D304

Number spectrum of ...

range $N \geqslant 10^7$, the apparatus was divided into 4 groups of counters. Further, extensive air showers were studied at an altitude of 3860 m. The apparatus was controlled by photomultipliers, recording the Cherenkov radiation [Abstractor's note: See article on p. 47, this Trudy.]. The shower axis and the number of particles were determined by means of a simulator. Showers with $N = 2 \cdot 10^4$ to 10^7 were investigated. From the obtained results, the integral spectrum of showers with $N = 2.5 \cdot 10^4$ to $1.3 \cdot 10^7$ was constructed, viz.

$$P(>N,0) = (4,6 \pm 1,4) \cdot 10^{-11} \left(\frac{N}{10^6}\right)^{-(1,60 \pm 0,15)} \text{ cm}^{-2}\text{sec}^{-1}\text{sterad}^{-1}$$

The absorption length λ of showers was also determined; for showers with $N > 10^5$, $\lambda = 156 \pm 22$ gm/cm^2. There are 4 figures and 2 Soviet-bloc references.

Card 3/4

31522
S/627/60/002/000/004/027
D299/D304

Number spectrum of ...

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR (Physics Institute im. P. N. Lebedev AS USSR); Nauchno-issledovatel'skiy institut yadernoy fiziki MGU (Scientific Research Institute of Nuclear Physics Moscow State University)

Card 4/4

31523
S/627/60/002/000/005/027
D299/D304

3,2410 (2205, 2705, 2905)

AUTHORS: Abrosimov, A. T., Basilevskaya, G. A., Solov"yeva, V.I., and Khristiansen, ~~G. B.~~

TITLE: Study of extensive air showers of ultrahigh energies

SOURCE: International Conference on Cosmic Radiation. Moscow, 1959. Trudy. v. 2. Shirokiye atmosfernyye livni i kaskadnyye protsessy, 92-100

TEXT: Showers with number of particles ranging from 10^6 to 10^8, were investigated by the apparatus of Moscow State University. It is noted that the experiments conducted by the authors yielded, in conjunction with the experiments conducted by V. A. Dmitriyev et al. (Ref. 9: ZhETF, 36, 992, 1959), several new results concerning the energy characteristics of the electron-photon and μ-meson components (Ref. 10: ZhETF, in print). The apparatus consisted of 10 mobile laboratories with 2 types of detectors: of charged- and of penetrating particles; it permitted determining the position of the axis and the number of particles of the shower,

Card 1/5

Study of extensive air ...

provided the axis fell within the limits of the apparatus and the number of particles was sufficiently large. After the axis was found, the number of particles N was determined by the formula

$$N = \frac{1}{n} \sum_{i=1}^{n} N_i$$

where

$$N_i = \rho(r_i)\,\varphi(r_i)$$

$$\varphi(r_i) = r_i e^{\frac{r_i}{60}} \Big/ 2 \cdot 10^{-3};\ r_i \leqslant 96 \text{ m}$$

$$\varphi(r_i) = r_i^{2,6}/0,6;\ r_i > 96 \text{ m}$$

Card 2/5

Study of extensive air ...

$\rho(r_i)$ being the density at the i-th observation point (at a distance r from the axis). The apparatus recorded 1000 showers during a period of operation of 1420 hours, For showers with $N \geqslant 1 \cdot 10^7$, the probability of recording was nearly 100%. During 1484 hours of operation, 75 showers with $N \geqslant 10^7$ and 8 showers with $N \geqslant 3 \cdot 10^7$ were recorded over an area of $7 \cdot 10^4 m^2$; this yielded the following absolute intensity values:

$$I(\geqslant 10^7) = (1.36 \pm 0.2) \cdot 10^{-6} m^{-2} hour^{-1} sterad^{-1}$$

$$I(\geqslant 3 \cdot 10^7) = (1.24 \pm 0.43) \cdot 10^{-7} m^{-2} hour^{-1} sterad^{-1}$$

On this basis, the exponent γ of the number spectrum was calculated, $\gamma = 2.0 \pm 0.35$. For constructing the lateral distribution

Card 3/ 5

4

Study of extensive air ...

function, 200 of the more dense showers were used, with $N \geq 5 \cdot 10^7$; the lateral-distribution functions of the electron and meson components were constructed. The values for the absolute intensity of showers, obtained by the authors, agree with the results obtained by T. E. Cranshaw et al. (Ref. 5: Phil. Mag., 3, 377, 1958) and by G. Clark et al. (Ref. 7: Nature, 180, 406, 353, 1957; Nuovo Cim. Suppl., 8, 623, 1958). The authors compared the experimental lateral-distribution functions of electrons with the theoretical values obtained on the basis of cascade shower theory. After modifying the values of the constants ß and t_0 (entering the formulas of cascade theory), good agreement was found between theoretical and experimental values. The authors conclude that in ultrahigh-energy showers either no equilibrium exists between the electron-photon and the nuclearactive components in the lower atmospheric layers, or that the lateral distribution of electrons is not only determined by Coulomb scattering, but also by angular deviations of particles during the nuclear-cascade processes. There are 5 figures and 17 references: 8 Soviet-bloc and 9 non-Soviet-bloc. The

Card 4/5

31523
S/627/60/002/000/005/027
D299/D304

Study of extensive air ...

4 most recent references to the English-language publications read as follows: T. E. Cranshaw, J. F. de Beer, W. Galbraith, N. A. Porter, Phil. Mag., 3, 377, 1958; T. E. Cranshaw, J. F. de Beer, W. Galbraith, A. M. Hillas. Phil. Mag., 3, 811, 1958; J. Nichimura, K. Kamata, Progr. Theor. Phys., 6, 1958; T. E. Cranshaw, W. Galbraith, Phil. Mag., 2, 797, 804, 1957.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebendeva AN SSSR (Physics Institute im. P. N. Lebedev AS USSR); Moskovskiy gosudarstvenny universitet (Moscow State University)

Card 5/5

KHRISTIANSEN, G.B.

(4)

31526
S/627/60/002/000/008/027
D299/D305

3,2410 (1559, 2206, 1705)

AUTHORS: Vernov, S. N., Goryunov, N. N., Dmitriyev, V. A., Kulikov, G. V., Nechin, Yu. A., Solov'yeva, V. I., Strugal'skiy, Z.S., and Khristiansen, G. B.

TITLE: Study of lateral-distribution function of charged particles and of the energy density of the electron-photon component of extensive air showers

SOURCE: International Conference on Cosmic Radiation. Moscow, 1959. Trudy. V. 2. Shirokiye atmosfernyye livni i kaskadnyye protsessy, 117-122

TEXT: The data obtained by means of the diffusion chamber and the hodoscoped counters permit determining the particle distribution in the neighborhood of the shower axis as well as at large distances from it. These data can be used for determining the number of particles and the position of the axis to an accuracy of approximately 1 m by means of the hodoscoped counters, and to an accuracy of several centimeters if the axis lies within the limits of the diffu-

Card 1/5

31526
S/627/60/002/000/008/027
D299/D305

Study of lateral-distribution ...

sion chamber. The electron-photon component at large distances from the axis was studied by means of large ionization chambers, shielded with lead. During 1000 hours of operation, 28 cases were recorded of the axis (of showers with number of particles $N \geqslant 10^5$) passing through the core detector. All these showers were investigated in detail with respect to distribution and energy of particles. The cases most favorable for analysis are those, in which the shower axis lies in the diffusion chamber. In all, 7 such cases were recorded. For each of these showers, the lateral-distribution function of particle density was constructed for distances ranging from 5 cm to 1 m from the shower axis. It was found that the form of the distribution function varied from shower to shower in the core region. In that region, a peculiar feature of particle distribution was observed, namely a narrow beam (4 cm in diameter) of particles, consisting of a large number (4 to 15) of particles with collinear tracks. From data obtained by means of the hodoscoped counters and knowing the position of the shower axis, it is possible to construct the distribution function of charged particles up to a distance of r = 25 m. from the axis, for each individual

Card 2/5

31526
S/627/60/002/000/006/027
D299/D305

Study of lateral-distribution ...

shower. Then the experimental distribution functions were compared with the theoretical functions of Nishimura and Kamata. The results of the comparison are shown in a table. A difference was noted in the form of the distribution of the energy flux of the electron-photon component in the individual shower at a distance of $r \sim 1$ m, and at large distances from the axis; this is due to local fluctuations in the form of the energy distribution in the core. In each of the investigated showers, the energy flux of the electron-photon component was found within a radius of 25 m; it turned out that the electron-photon component energy-flux was stronger (on the average) in showers with small s, than in showers with large s (s being the "age parameter"). The system of counters permitted recording showers with number of particles $N = 10^4$ to 10^7. The data yielded by the diffusion chamber were used for constructing the distribution function for distances $r < 1$ m from the shower axis. The conclusion was reached that the form of the electron-photon energy distribution-function does not depend on the number of particles in the shower. Therefore, all the data were referred to a shower with same N, and the average energy-density distribu-

Card 3/5

31526
S/627/60/002/000/008/027
D299/D305

Study of lateral-distribution ...

tion constructed. Approximating this distribution by a power law of type r^{-n}, one obtains for the exponent n the following values (as a function of the distance r from the axis):

$n = 1,2 \pm 0,2, \quad 0,1 < r < 1$ m

$n = 1,5 \pm 0,2, \quad 1 < r < 10$ m

$n = 2,0 \pm 0,3, \quad 10 < r < 60$ m

$n = 2,6 \pm 0,2, \quad 60 < r < 1000$ m

4

Further, the mean energy per electron was obtained from experimental and theoretical values (based on the cascade shower theory) of the mean energy as a function of r showed a discrepancy which can be removed by taking into account the effect of nuclear scattering. The experimental values permit calculating the energy of the

4

31526
S/627/60/002/000/008/027
D299/D305

Study of the lateral-distribution ...

electron-photon component, viz. $E_{eph} = 2.5 \beta N$, where β denotes the mean energy loss per unit of depth t. There are 2 figures, 1 table and 6 references: 5 Soviet-bloc and 1 non-Soviet-bloc. The reference to the English-language publication reads as follows: J. Nishimura, K. Kamata. Suppl. Theor. Phys., no. 6, 1958.

4

Card 5/5