ZEL'DOVICH, Ya. B.

USSR/Nuclear Physics - Neutrino Charge   21 Aug 53

"Neutrino Charge of Elementary Particles," Ya. B.
Zel'dovich, Corr-Men, Acad Sci USSR, Inst of Chem
Phys, Acad Sci USSR

DAN SSSR, Vol 91, No 6, pp 1317-1320

Strongly believes: 1) Double beta-decay with the
expulsion of 2 electrons but without emission of 2
neutrinos does not occur. 2) The spectrum of
positrons produced in decay of μ+ mesons does not
contradict the assumption that the 2 neutral

275T86

particles produced in this decay are identical and
obey the Pauli principle. 3) Decay of μ+ into e+
and quanta without the expulsion of 2 neutral par-
ticles with spin 1/2 does not occur. Discusses the
problem of whether still other charges exist that
are conserved as electrical, nuclear, and neutrino-
like forms. Acknowledges advice of N. N. Bogolyubov,
V. B. Berestektskiy, I. Ye. Tamm, and L. P. Feokti-
stov. Presented 2 Jul 53.

ZEL'DOVICH, Ya. B.

USSR/Nuclear Physics - Beta decomposition

Card 1/1   Publ 43 - 8/97

Authors   : Zel'dovich, Ya. B.

Title   : Utilization of permissible beta-conversions for the determination of the reaction which causes beta-decomposition

Periodical   : Izv. AN SSSR, Ser. fiz. 18/2, 243-246, Mar-Apr 1954

Abstract   : It is noted that the beta-conversion of any nucleus depends upon the reaction which causes beta-decomposition. In order to explain the nature of the Fermi reaction in beta-decomposition (selection between the scalar S and a vectorial V), the author measured the correlation between an electron and a neutrino (photon) during the decomposition of N_{13} and O_{15} nuclei, where 75% of the decompositions are due to the Fermi reaction and only 25% are due to tensorial reactions. A perfectly reliable evaluation of matrix elements was found to be possible only in the case of beta-conversions of specular nuclei, the states of which prior and after the beta-conversions are distinguished by the fact that the proton in the first is substituted by a neutron in the second. Fifteen references: 1 USSR; 2 Dutch; 1 Swiss and 11 USA (1950-1953). Table.

Institution   : Academy of Sciences USSR, Institute of Chemical Physics

Submitted   : March 11, 1954

Zel'dovich, YA. B.

USSR/Physics - Neutrinos

Card 1/1   Pub. 118 - 1/8

Authors   : Zel'dovich, Ya. B.; Luk'yanov, S. Yu.; and Smorodinskiy, Ya. A.

Title   : Properties of a neutrino and the double β-decomposition

Periodical : Usp. fiz. nauk 54/3, 361-404, Nov 1954

Abstract   : Experimental and theoretical studies of neutrino properties (indivisibility,
             evenness, spin and mass) are described. The reactions ($n \to p + e^- + \bar{\nu}$ and
             $p \to n + e^+ + \nu$) leading to the formation of neutrinos are analyzed in the light
             of the quantum theory with application of Pauli's matrix transformations for
             the Dirac equation describing the wave function ψ. The probability of a double
             β-decomposition (simultaneous formation of $\bar{\nu}$ & ν) is theoretically establish-
             ed and experiments performed by various investigators with the help of analy-
             zers and the method of scintillations are described and analyzed. Thirty-nine
             references 3-USSR (1935-1954). Tables; graphs; diagrams.

Institution :   ...

Submitted   :   ...

ZEL'DOVICH, Ya. B.

USSR/Nuclear Physics

Card   : 1/1

Authors   : Zel'dovich, Ya. B. Memb. Corres. of Acad. of Sc. USSR

Title   : On the theory of γ-mesons

Periodical   : Dokl. AN SSSR, 97, Ed. 2, 225 - 228, July 1954

Abstract   : A theory of π-mesons, which are considered as nuclear particles, is dis-
                 cussed. The article is primarily devoted to the analysis and criticism
                 of the π-meson theory as developed by Fermi and Young. Four references.

Institution   : ...

Submitted   : April 26, 1954

ZELDOVICH, Ya. B.

USSR/Physics

Card   : 1/1

Authors   : Zeldovich, Ya. B., memb. corres. of the Acad. of Scs. of the USSR

Title   : About decomposition of charged π-mesons.

Periodical   : Dokl. AN SSSR, 97, Ed. 3, 421 - 424, July, 1954
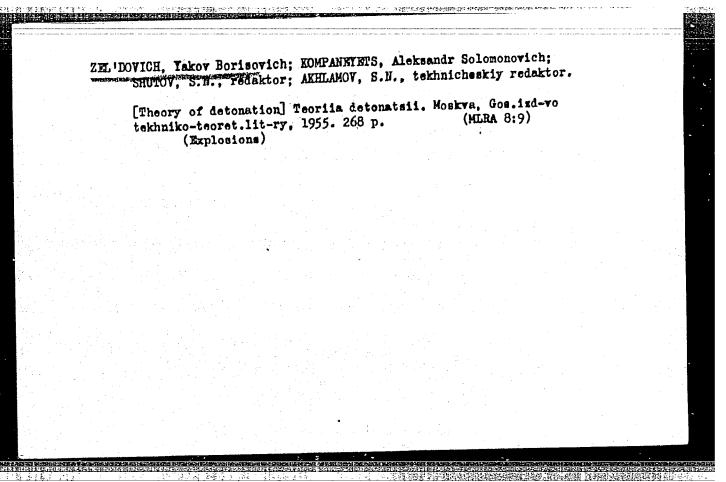
Abstract   : Analyzes π-meson decomposition of a special type, i. e., $\pi^+ \rightleftharpoons \pi^0 + e^+ + \nu$, which, under normal conditions, occurs very seldom (1 in 2.10 cases), but can be observed in a retarding block during work with an artificial powerful beam of mesons, when a very characteristic picture of the above mentioned type of decomposition can be seen, i. e. π^0 decomposes into 2γ-quanta with approximately 65 Mev of energy per quantum; e^+ is stopped and extinguished giving, also 2γ-quanta with an energy of 0.5 Mev per quantum. Gives a mathematical analysis for the probability of the type of decompositions discussed in the light of quantum mechanics. Fourteen references. Diagrams.

Institution   : ...

Submitted   : ...

ZEL'DOVICH, Yakov Borisovich; KOMPANEYETS, Aleksandr Solomonovich;
SHUTOV, S.N., redaktor; AKHLAMOV, S.N., tekhnicheskiy redaktor.

[Theory of detonation] Teoriia detonatsii. Moskva, Gos.izd-vo
tekhniko-teoret.lit-ry, 1955. 268 p.   (MLRA 8:9)
          (Explosions)

USSR/Nuclear Physics -- Meson Field   *Zeldovich, Ya. B.*   FD-3348

Card 1/1   Pub. 146-20/28

Author   : Gershteyn S. S. and Zeldovich Ya. B.

Title   : Meson corrections in the theory of beta-decay (Letter to the editor)

Periodical   : Zhur. Eksp. i Teor. Fiz., 29, No 5, 698-699, 1955

Abstract   : A criticism of the article by R. J. Finkelstein and S. A. Moszkowski,
                (Phys. Rev., 95, 1695, 1954) with particular emphasis on that the
                computation does not take under consideration the normalization of
                the wave function of the nucleon nor the beta-transition of a meson.
                Meson corrections are introduced by using the invariant theory of
                perturbation with a pseudoscalar bond of the π-meson with the nucleon.
                Eight references, including 6 foreign.

Institution : --

Submitted   : June 8, 1955

ZELDOVICH, Ya. β.

USSR/Miscellaneous – Book review

Card 1/1   Pub. 118 – 14/14

Authors   : Zeldovich, Ya. B.

Title   : About the S. Larin report entitled, "Anomalous Beta-Ray Diffusion and the
              Conglomeration Hypothesis of Elementary Particles"

Periodical : Usp. fiz. nauk 55/1, 147-148, Jan 1955

Abstract   : Critical review is presented of the S. Larin report entitled, "Anomalous
              Beta-Ray Diffusion and the Conglomeration Hypothesis of Elementary Parti-
              cles". The statement by Larin that charged particles with a mass exceeding
              the mass of an electron exist in beta-radiation is corrected and it is
              pointed out that such particles should originate during the absorption of
              rigid gamma quanta by materials having higher atomic number, analogous to
              the formation of electron-positron pairs. Two USSR references (1954).

Institution : ....

Submitted   : ....

GANDEL'MAN, G.M.; ZEL'DOVICH, Ya.B.

Determination of the limit of applicability of quantum electrodynamics by measuring the magnetic moment of electrons. Dokl.AN SSSR
105 no.3:445-447 N '55.   (MLRA 9:3)

1. Chlen-korrespondent AN SSSR (for Zel'dovich); 2. Institut
khimicheskoy fiziki Akademii nauk SSSR.
            (Electrons) (Quantum theory)

ZEL'DEVICH, Ya. B.

USSR/Acoustics - Sound Vibrations and Waves, J-2

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 35547

Author: Zel'devich, Ya. B.

Institution: None

Title: Motion of Gas Under the Influence of Short-Duration Pressure (Shock)

Original
Periodical: Akust. zh., 1956, 2, No 1, 208-308

Abstract: Analysis of the propagation of a plane shock wave and the motion beyond the wave front, occurring in a gas under the influence of a strong short-duration external pressure. A determination is made of the law of attenuation of the wave and of the distribution of pressure, density, and velocity that should prevail after the pressure is removed, or in the limit, that should be arrived at asymptotically after a time that is large compared with the duration of the external pressure. The solution obtained is self-modelling and is characterized by a power-function dependence of

USSR/Acoustics - Sound Vibrations and Waves, J-2

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 35547

Abstract: the amplitude of the wave on the time and on the path passed by
the wave; however, unlike the analogous problem of explosion,
the exponent is obtained not from dimensionality considerations,
but by integrating the ordinary differential equations. An
analysis is made of the unique situation pertaining to the equa-
tions of conservation of momentum and energy in the asymptotic
solution, and also of the problem of the conditions under which
such motion can be practically realized.

Card 2/2

ZEL'DOVICH, Ya.B.

SUBJECT   USSR / PHYSICS
AUTHOR   ZEL'DOVIČ,JA.B.
TITLE   On the Decay and the Mass Difference of Heavy Neutral Mesons.
PERIODICAL Žurn.eksp.i teor.fis, 30, fasc.6, 1168-1169 (1956)
            Issued: 8 / 1956   reviewed: 10 / 1956

In a certain distance from the place of the production of θ-particles the
linear combination of θ_s and θ_a contains not only θ but also $\bar{\theta}$. Here
$\theta_s = (\theta + \bar{\theta})/\sqrt{2}$ and $\theta_a = (\theta - \bar{\theta})/\sqrt{2}$. The quantity of $\bar{\theta}$-particles changes with
distance like a damped sinus function the period of which depends on the dif-
ference of the masses θ_s and θ_a.

The present work shows an analogous periodicity for the decay $\theta \rightarrow \mu + \pi + \nu$
and studies the problem of the order of magnitude of the mass difference of θ_s
and θ_a. The interaction constants g_1 and g_2 causing the decay of θ in
$\mu^+ \pi^- \nu$ and in $\mu^- \pi^+ \nu$ respectively need not be equal. The decay of θ in μ^-
and μ^+ is characterized by g_1 and g_2 respectively. In a bundle of θ-particles,
which is to be considered as a mixture of θ_s and θ_a, the ratio of the probabil-
ity of a decay with production of μ^+ and μ^- fluctuates as a function of the

ratio of the g-values and the phases of θ_s and θ_a. The number of $\mu^{\pm}$ -mesons
changes in the course of time like . Here m_s and m_a denote the

$$\left| (g_1 + g_2) \exp(im_s - w_s)t \pm (g_1 - g_2)\exp(im_a - w_a)t \right|$$

ZEL'DOVICH, Ya.B.

CARD 1 / 2   PA - 1461

Here the special case of a twodimenional motion is investigated, in which
$v_z = 0$ as well as v_x and v_y depend only on x and y. The liquid is assumed to be
incompressible (div $\vec{v}$ = 0). In this case the problem can be solved rigorously.
In accordance with the example set by G.K.BATCHELOR, Proc.Roy.Soc.201 A, 405
(1950) the equations are set up in quasistationary approximation and with the
neglect of the shifting current and the density of the free charges. Here
c = 1 in the HEAVISIDE system (without 4π), φ - scalar potential, $\vec{A}$ - vector po-
tential, div.$\vec{A}$ = 0, $\vec{J}$ - current, div. $\vec{J}$ = 0, r - specific resistance of the
liquid. The equations are: $rj = E + [\vec{v}\vec{H}]$; $\vec{H}$ = curl; $\vec{E} = (\partial A/\partial t) - \nabla \varphi$: J = curl $\vec{H}$ = $\Delta \vec{A}$.
From this system there follows $(\partial A/\partial t) + [\vec{v} \text{ curl } \vec{A}] = r \Delta A + \nabla \varphi$. To this equation
the operation curl is applied after which follows the case of the twodimensional
motion of the incompressible liquid. On this occasion the following equation,
which corresponds exactly to the heat conduction equation in a moved liquid:
$\partial H_z/\partial t + v_x(\partial H_z/\partial x) + v_y(\partial H_z/\partial y) = dH_z/dt = r \Delta H_z$ is derived.
If exterior fields are lacking H becomes smaller. If H_z is a maximum in any par-
ticle (?, or domain?) the maximum is flattened.

ZEL'DOVICH, Ya.B

AUTHOR: ZEL'DOVIĆ,JA.B.

PA - 2028

TITLE: The Perturbation Theory for the Onedimensional Problem of
            Quantum Mechanics and the Method developed By LAGRANGE.

ABSTRACT: In the present report the required regular solution is represen-
            ted in the form of the sum of two solutions (a regular and a non-
            regular one) of the unperturbed problem with variable coefficients:
            $\varphi_a(r) = c_a(r)\varphi_{0a}(r) + c_b(r)\varphi_{0b}(r)$. Such a representation is univo-
            cal, and for the coefficients simple equations are obtained thanks
            to the application of an additional LAGRANGE condition
            $(\dot{\varphi}=c_a\varphi_{0a}+c_b\varphi_{0b}$ with $\dot{\varphi} = d\varphi/dr$. All functions, among them also
            $c_a(r)$ and $c_b(r)$ depend only on the one independent variable r. The
            method suggested here furnishes the known expressions for the
            modification of energy in the discrete spectrum (in first approxi-
            mation) and for the modification of the phase of scattering in
            the continuous spectrum. The method furnishes most illustrative
            expressions for the modification of the wave function itself re-
            sulting from the perturbation. In the discrete spectrum an inter-
            esting expression for the modification of energy (in second approx-

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PA - 2028

The Perturbation Theory for the Onedimensional Problem of Quantum Mechanics and the Method developed by LAGRANGE.

imation) is besides obtained in form of a double integral.

Here the spherically symmetric problem of the quantum mechanics of a particle is investigated. After separation of the angle variable and after introduction of $\varphi = r\Psi$ (where Ψ denotes the wave function) the problem of the determination of the value of the angular momentum l is reduced to an equation taking the form:

$-(\hbar^2/2m)\ddot{\varphi} + V(r)\varphi - E\varphi = (H - E)\varphi = 0$. Besides the potential $V(r)$ here includes also the centrifugal potential $\hbar^2 l(l+1)/2mr^2$. The equation of second order has two linearly independent solutions: one of them can be chosen in such a manner that in the case of small r the regular solution $\varphi_a \sim r^{l+1}$ applies. The second solution φ_b behaves in the case of small r like $\varphi_b \sim r^{-1}$. The second solution actually satisfies the equation everywhere except in the case of $r = 0$. Therefore the solution of every (?) physical problem satisfies a regularity condition, i.e. the solution is built up from regular functions of the type φ_a.

Card 2/3

PA - 2028

The Perturbation Theory for the Onedimensional Problem of Quantum Mechanics and the Method developed by LAGRANGE

In the perturbation theory a solution of the type φ_a is to be found for the potential $V(r)$ on the condition that $V(r) = V_0(r) + v(r)$ applies (where $v(r)$ is small) and that the equation for $V_0(r)$ is solved.

At first the case of the continuous spectrum is investigated. The corresponding expressions for δ_a and δ_b can be found elementarily and are here written down. Also the integral expressions for c_a and c_b are given. In conclusion the discrete spectrum is discussed in short.

ASSOCIATION: Institute for Chemical Physics of the Academy of Science in the USSR.

PRESENTED BY:
SUBMITTED:
AVAILABLE: Library of Congress

Card 3/3

ZEL'DOVICH, Ya. B.

CARD 1 / 2   PA - 1451

SUBJECT	USSR / PHYSICS
AUTHOR	ZEL'DOVIC, JA.B.
TITLE	The Development of the Theory of Anti-Particles, the Charges of Elementary Particles, and the Properties of Heavy Neutral Mesons.
PERIODICAL	Usp.fis.nauk, 59, fasc.3, 377-398 (1956)
	Issued: 9 / 1956 reviewed: 11 / 1956

Particles and anti-particles: At first DIRAC'S theory and the hole-theory are discussed. With the discovery of the positron the total symmetry between particles and anti-particles became apparent. However, the world by which we are surrounded, is not explicitly charge-symmetrical (immense numbers of electrons, but positrons exist only on certain special conditions). However, this apparent charge symmetry is due only to the asymmetry of initial conditions, for in the vacuum electrons and positrons are equally stable. Next, the theory developed by PAULI and WEISSKOPF and its applicability to positive and negative pions is demonstrated. The "conceptions back ground" and "holes" are described as confusing and obsolete. The formulae of the present theory (second quantization) are explained without resorting to mathematical reasoning. Next, the discovery of the antiproton by the SEGRE group with the 6 BeV-accelerator and the importance of the π^0-decay for the theory of the antiproton are dealt with. According to the author's opinion the experimental discovery of the neutron is now about to follow.

The nuclear and the neutrino charge as well as the theorem of the equivalence of mass and energy: To each elementary particle a nuclear charge is ascribed

CARD 2 / 2   PA - 1451

Usp.fis.nauk, 52, fasc.3, 377-398 (1956)

uniquely. The conservation of the nuclear charge is in direct connection with the problem of the equivalent of mass and energy. The main difference between proton and antiproton, neutron and antineutron is characterized by the sign of the nuclear charge and not by the sign of the electric charge. Several strict rules of selection are pointed out. The theories developed by DIRAC and MAJORANA for the difference between neutrino and antineutrino are discussed. Though the existence of a neutrino charge is probable, further experimental proves are necessary.

The strange particles: Here only the known facts concerning the neutral hyperon Λ^0 and the neutral meson θ^0 are discussed. The excited state of the nucleons is mentioned and so is the inner connection between the slow decay of Λ - and θ - particles. The inner difference between $\pi^{\pm}$ and π^0, θ and Θ is demonstrated on the basis of the polarization of the vacuum caused by these particles. In conclusion the particular features of θ-mesons, above all the mass difference of $\theta_s = (\theta + \bar{\theta})/\sqrt{2}$ and $\theta_a = (\theta - \bar{\theta})/\sqrt{2}$ are discussed.

INSTITUTION:

ZEL'DOVICH, Ya.B.

Artificial flash in the upper atmosphere (from "Scientific Ameri-
can," v.194, no.5, 1956). Usp.fiz.nauk 60 no.1:161-162 S '56.
(Nitrogen oxides)   (Ionosphere)

ZELMANOV, I.L., SEMENOV, N.N., STEPANOV, B.M., SHEMBEL, B.K., DOMPANEETZ, A.C., (U.SS.R.)

Some considerations on the operation o
ofhigh current linear accelerators.

CERN-Symposium on High Energy Accelerators and Pion Physics.

Geneva 11-23 June 56
ln Branch #5

ZEL'DOVICH, Ya. B. and KOGARKO, S. M. and N. N. SIMONOV

"An Experimental Investigation of Spherical Detonation of Gases."
Sov. Phys. - Tech Phys. No. 8, 1957, pp. 1689-1713 12 refs.

Translation. Theoretical and experimental results with discussion of testing equipment and applications.

C-3

ZEL'DOVICH, Ya.B.
ZELDOVICI, I.B.

RUMANIA/Nuclear Physics - Elementary Particles

Abs Jour : Ref Zhur - Fizika, No 2, 1958, No 2849

Author   : Zeldovici, I.B.
Inst   : Not Given
Title   : Development of the Theory of Anti-particles Charges of
            Elementary Particles and Properties of Heavy Neutral Mesons

Orig Pub : An. Rom.-Sov. Ser. mat.-fiz., 1957, 11, No 2, 52-71

Abstract : Translation from the Russian. See Referat Zhur Fizika, 1957,
            No 3, 5861

Card   : 1/1

ZEL'DOVICH, Ya.B.

40-5-18/20

AUTHOR: BARENBLATT, G.I.,ZEL'DOVICH, Ya.B. (Moscow)
TITLE: On Solutions of Dipole Type in the Problem of the Nonsteady
           Filtering of Gases in the Polytropic Regime (O reshenii tipa
           dipolya v zadachakh nestatsionarnoy fil'tratsii gaza pri poli-
           tropicheskom rezhime)

PERIODICAL: Prikladnaya Mat. i Mekh.,1957,Vol.21,Nr 5,pp.718-720 (USSR)

ABSTRACT: For the nonsteady filtering of gases in the polytropic regime
           there holds for the pressure of the gas a differential equation
           which, under certain indications on the initial distribution
           of the pressure, is equivalent to an integral equation. By this
           integral equation the law of the conservation of the dipole is
           expressed. If now, besides of the initial distribution of the
           pressure at the time t = 0 , the pressure is still prescribed
           at one point for all times, then from the integral equation a
           general integral relation can be derived which gives valuable
           informations on the pressure distribution for arbitrary times.
           That range can be determined where the pressure distribution
           is disturbed, and the boundaries of this range can be explicit-
           ly calculated. The obtained solution is of interest particu-
           larly as an asymptotic representation of the pressure distri-
           bution. An analogy of the given solution interesting for many
           cases can be obtained for the case of axial-symmetric pressure

Card 1/2

On Solutions of Dipole Type in the Problem of the Nonsteady   40-5-18/20
Filtering of Gases in the Polytropic Regime

distribution,
There are no figures, no tables, and 2 Slavic references.

ASSOCIATION: Institut nefti AN SSSR (Petroleum Institute AS USSR)

SUBMITTED: August 20, 1957

AVAILABLE: Library of Congress

Card 2/2

ZEL'DOVICH YA. B.

AUTHOR: Barenblatt, G.I. and Zel'dovich, Ya.B.(Moscow)   40-21-6-17/18

TITLE: On the Stability of Flame Propagation (Ob ustoychivosti
               rasprostraneniya plameni)

PERIODICAL: Prikladnaya Matematika i Mekhanika, 1957, Vol 21, Nr 6,
                                                   pp 856-859 (USSR)

ABSTRACT: The determination of the stability of flame propagation leads
               mathematically to the investigation of the stability of sta-
               tionary solutions of the general kinetic reaction equation of
               diffusion and heat conduction. Such investigations were
               carried out by different authors. Considering the one-dimen-
               sional flame propagation Rosen [Ref 11] obtained the result
               that instabilities of flame propagation are possible and he
               gave approximation criteria for the stability. The authors
               show that Rosen's deductions are based on incorrect suppo-
               sitions, and that the problem of the stability of flame pro-
               pagation was incorrectly solved. In the present paper the
               stability of flame propagation is investigated under the same
               suppositions and it is shown, that in the one-dimensional case
               always exists stability. This result is valid for the pure
               heat propagation of the flame as well as for isothermal, chain-

Card 1/2

40-21-6-17/18

On the Stability of Flame Propagation

shaped flame propagations. There are 2 figures and 12 refe-
rences, 7 of which are Soviet, 4 American, and 1 English.

ASSOCIATION: Institut nefti AN SSSR (Petroleum Institute, AN USSR)

SUBMITTED: August 1, 1957

AVAILABLE: Library of Congress

1. Flame propagation-Stability

Card 2/2

ZEL'DOVICH, YA. B.

56-4-51/52

AUTHOR: ZEL'DOVICH,Ya.B., SAKHAROV,A.D.

TITLE: On the Reactions Caused by Myons in Hydrogen.
(O reaktsiyakh, vyzyvayemykh myonami v vodorode, Russian)

PERIODICAL: Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol 32, Nr 4,
pp 947 - 948 (U.S.S.R.)

ABSTRACT:
If a myon exists, the shape of the potential barrier, by which a
nuclear reaction of slow p- and D nucleons is prevented, changes.
Penetrability of the barrier then increases and the following re-
actions are possible: $p + D = He^3$, $D + D = He^3 + n$, $D + D = T + p$.
If tritium exists, also the following reactions are possible:
$D + T = He^4 + n$, $T + T = He^4 + 2n$, $p + t = He^4$. Experimental data
obtained by L.W.ALVAREZ et al. (lithographic manuscript,
December 1956) show the following result: In natural hydrogen, an
average of one act $p + D = He^3$ corresponds to 150 mesons, in
hydrogen with D-content, 1:300 and 1:20 correspond to 40 and 33
mesons respectively. The energy of the creation of He^3(5,4 MeV)
is taken along by the myon, so that monochromatic myons are ob-
served on the occasion of the reaction. The relatively high
probability of reaction in the natural mixture is explained by the
transition of the meson from hydrogen to the deuteron. The authors
here give a rough evaluation of the transition probability. Next,
the nuclear reaction in the molecule $pD\mu$ is discussed and the

Card 1/2

0

ZEL'DOVICH, Ya. B.

56-5-23/55

AUTHOR
TITLE

ZEL'DOVICH, Ya.B.
Shock Waves with Large Amplitude in Air.
(Udarnye volny bol'shoy amplitudy v vozdukhe.-
Russian)

PERIODICAL

Zhurnal Eksperim. i Teoret. Fiziki 1957, Vol 32, Nr 5,
pp 1126-1135 (U.S.S.R.)

ABSTRACT

The paper under review investigates the state of air
that is compressed by a strong shock wave, while taking
into account both dissociation and ionisation. In
strong shock waves there take place at high temperature
new physical phenomena, namely dissociation, ionisation
and emission of light. In this context, the paper under
review discusses the effects of these phenomena upon
the properties of the air that is strongly compressed
by the shock wave, and also upon the structure of the
shock wave. Brief reference is made to some relevant
previously published papers.
Dissociation and ionization in the shock wave: At
200-600 atmospheres the temperature in the shock wave
rises to 5000-10.000 degrees centigrade and a strong
dissociation of the oxygen molecules and of the nitro-
gen molecules takes place. The air becomes a monoatomic
gas. If the pressure is increased further, the (constant)

CARD 1/3

SC-5-23/55

Shock Waves with Large Amplitude in Air.

dissociation energy plays a lesser and lesser rôle. But already before the dissociation is terminated a noticeable dissociation of the atoms takes place. In the range that is of interest to us, namely T between 1 and 100 eV, a tenfold compression is achieved in the shock wave. Then we have, very roughly, for the velocity D of the shock wave (in cm/sec, p in dyn/cm²) and for the temperature in eV $D = 28\sqrt{p}$ and $T = 10^{-6.75} p^{3/4}$, respectively. At a pressure of $\sim 4.5 \cdot 10^{11}$ the temperature of q00 eV is attained, and then the temperature increases linearly with increase in pressure.

Emission by the shock wave: A result of the ionization of the gas continuous spectra of absorption and emission of light occur. The compressed air becomes nontransparent and radiates in a sufficiently thick layer as a black Body. The compression performance is compared to the energy of radiation.

The next chapter of the paper under review deals with the structure of the wave while taking into account the radiation. If we take into consideration the great difference in masses between electrons and ions,

CARD 2/3

Shock Waves with Large Amplitude in Air.   56-5-23/55

strange effects take place in strong shook waves with
strong ionization. The last chapter of the present paper
discusses in detail the rigorous theory of the structure
of the wave, while taking into account the radiation.
(6 reproductions).

ASSOCIATION: Institute for Chemical Physics, Academy of Sciences of
the USSR.

PRESENTED BY: -
SUBMITTED: 10.6. 1956.
AVAILABLE: Library of Congress.

CARD 3/3

D-7

ZEL'DOVICH, Ya. B.

USSR/Atomic and Molecular Physics - Gases

Abs Jour   :   Ref Zhur - Fizika, No 1, 1958, 802

Author   :   Zel'dovich, Ya.B.

Inst   :   Physics Institute, Academy of Sciences, USSR.

Title   :   Investigation of the Equation of State with the Aid of
               Mechanical Measurements.

Orig Pub   :   Zh. eksperim. i teor. fiziki, 1957, 32, No 6, 1577-1578

Abstract   :   The author considers the possibility of obtaining the ther-
               modynamic characteristics of a substance at high pressures
               by means of explosions. Here it is taken into account that
               in principle it is possible experimentally to determine the
               the energy $E = E (p,v)$ (p is the pressure and v the speci-
               fic volume). It is shown that knowledge of $E (p,v)$ leads
               directly to the adiabatic equation

Card 1/2

.... the adiabatic.

Card 2/2

ZEL'DOVICH, Ya. B.

Possibility of effective meson catalysis of nuclear reactions.
Zhur. eksp. i teor. fiz. 33 no.1:310-311 Jl '57.   (MLRA 10:9)

1. Fizicheskiy institut im. P.N. Lebedeva Akademii nauk SSSR.
(Nuclear reactions)   (Mesons)

ZEL'DOVICH, YA. B.

56-3-22/59

AUTHOR: Zel'dovich, Ya.B.

TITLE: Cylindrical Acoustic Waves: Automodel Solutions. (Tsilindricheskiye avtomodel'nyye akusticheskiye volny)

PERIODICAL: Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol. 33, Nr 3, pp. 700-705 (USSR)

ABSTRACT: Theoretical sets of solutions of a cylindrical motion with acoustic approximation are given which depend only on one parameter. The sets of solutions are formed by means of superposition of plane waves and can be solved elementarily by means of quadratures. Results were obtained for a motion with finite pressure-drop at the front of an arriving cylindrical wave which coincide with the results of Zababakhin and Nechayev. Above all the pressure of the reflected wave is proved to tend to infinite also with finite distance from the wave center. The maximal pressure is discussed with taking into account the deviation from the acoustic approximation solution in the case of great wave amplitudes. The solution is carried out stepwise as follows:
1) General solution of the cylindrical problem.
2) Solution of model representation.
3) Selection of exponents from initial conditions.
4) Reflexion of "leaving" wave.

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56-3-22/59

Cylindrical Acoustic Waves: Automodel Solutions.

There are 3 figures and 2 Slavic references.

SUBMITTED: March 6, 1957.

AVAILABLE: Library of Congress

Card 2/2

ZEL'DOVICH, YA.B.

56-3-58/59

AUTHOR: Zel'dovich, Ya.B.

TITLE: A Variety of the Theory of Hyperons (Variant teorii giperonov)

PERIODICAL: Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol. 33, Nr 3 (9), pp. 829 - 831 (USSR) (Letter to the Editor)

ABSTRACT: As a basis the author here uses the model proposed by M. Goldhaber (Phys. Rev. , 1956, Vol. 101, p. 431) and G.D'yerdi (Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol. 32, p. 152) which considers hyperons to be composed particles. Accordingly, the hyperons consist of nucleons and K-mesons and the forces connecting these particles depend upon the isotopic spin. For some of the assumptions given here this model leads to the following relation between the masses of the nucleon (N) and the hyperons Λ , Σ , Ξ ; $2 M_{\Xi} + 2 M_N = 3 M_\Lambda + M_\Sigma$. This relation is satisfied better than the relation found by Gell-Mann: $2 M_\Xi + 2 M_N = M_\Lambda + 3 M_\Sigma$. The model investigated here also leads to conclusions concerning hyperons with the strange-ness -3 and, together with the modulus, to even greater strange-ness. For hyperons with the strangeness $S = -1$ $M = M_N + M_K + c + a(t_N t_K) = M_N + b + a(t_N t_K)$ is proposed. Here a, b, c de-

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A Variety of the Theory of Hyperons

note constants and the brackets denote the scalar product of the isotopic spin of the particles mentioned. $a = 152,5$; $b = 459,5$; $c = -506$ is found. (The mass of the electrons is put equal to 1). $M = M_N + 2b + a(t_N t_{2k})$ is true for the hyperons with the strangeness $S = -2$, where the constanst a, b are the same as in the previous formula. The following is here assumed: The interaction of the $\bar{K}$-particles among one another is weak compared to the interaction of the $\bar{K}$-particles with the nucleon. Both $\bar{K}$-particles in a hyperon with $S = -2$ are in the same state, i.e. in the same state as the $\bar{K}$-particle with $S = -1$. In this scheme two charge multiplets with $S = -2$ are possible, namely $t = 1/2$ and $t = 3/2$. The threshold values of the production of hyperons in dependence upon strangeness are given in a table. The conceptions devebped here are accurate only if the spatial spin of all hyperons is equal to 1/2. Further, the hyperons in a system in which all nucleons and K-mesons are assumed to be even, have to be even. There are 1 table and 6 references, 2 of which are Slavic.

Card 2/0   AS   USSR

ZEL'DOVICH, YA. B.

56-4-24/54

AUTHOR: Zel'dovich, Ya. B.,

TITLE: On Nuclear Reactions in Super-Dense Cold Hydrogen (O yadernykh
            reaktsiyakh v sverkhplotnom kholodnom vodorode)

PERIODICAL: Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol. 33, Nr 4, pp. 991-
            -993, (USSR)

ABSTRACT: It is shown that nuclear reactions which take place below the tres-
            hold value in cold hydrogen at density values of 10^4-10^6 g/cm^3
            should be observable with a probability sufficiently high even for
            astrophysical standars. This fact furnishes the limit for the pos-
            sible compression of cold hydrogen, since at a density of $0,7.10^5$
            g/cm^3 a celestial body cannot live longer than 10^8 a. Such a den-
            sity, however, can only be obtained in cold hydrogen under the in-
            fluence of the gravitation of a mass which comes near to that of
            the sun. The reactions p+D, p+T, D+D, D+T can also take place in
            a cold way. They require a small pressure which, however, is still
            much too high for the conditions onthe earth and will most proba-
            bly never be practically obtained. There are 1 table and 3 Slavic
            references.

SUBMITTED: April 29, 1957

AVAILABLE: Library of Congress

Card 1/1

ZEL'DOVICH, Ya. B,

56-6-26/47

AUTHOR: Zel'dovich, Ya. B.

TITLE: The Relation Between the Asymmetry of Decay and the Dipole Moment
             of Elementary Particles (Sootnosheniye mezhdu asimmetriyey raspada
             i dipol'nym momentom elementarnykh chastits)

PERIODICAL: Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, 1957, Vol. 33,
             Nr 6, pp. 1488 - 1496 (USSR)

ABSTRACT: The following chapters were dealt with:
             1.) Asymmetry of a real and virtual decay in a non-relativistic mo-
             del.
             2.) On "odd" molecules.
             3.) Description of the formation particles in the coordinate space.
             For the emission of the non-relativistic particles a simple model
             representation is used, and the wave function of a system in co-
             ordinate representation is set up both for the real and for vir-
             tual decay. It is shown that the asymmetry of the real decay of a
             polarized particle depends upon the imaginary part of the binding
             gradient, whereas the asymmetry of virtual decay and the dipole
             moment depend on the real part of this constant.
             It is further proved that the elementary particles, which, accord-
             ing to Landau, have no dipole moment, are similar to the optically

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56-6-26/47

The Relation Between the Asymmetry of Decay and the Dipole Moment of Elementary
Particles

active molecules of organic chemistry, but not to the molecules
in the double-Λ-state.
A simple system of equations is set up for the probability of vir-
tual decay. There are 8 references, 4 of which are Slavic.

SUBMITTED: July 1, 1957

AVAILABLE: Library of Congress

Card 2/2

56-6-44/47

AUTHOR: Zel'dovich, Ya.B.

TITLE: The Electromagnetic Interaction Connected with the Non-conservation of Parity (Elektromagnitnoye vzaimodeystviye pri narushenii chetnosti)

PERIODICAL: Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, 1957, Vol. 33, Nr 6(12), pp. 1531-1533 (USSR)

ABSTRACT: Up to the discovery of the nonconservation of parity it was assumed that the interaction of an elementary particle with spin 1/2 with a weak electromagnetic field is fully described by the following 3 terms: $q\varphi$, $\mu(\vec{\sigma}\vec{H})$, a div $\vec{E} = 4\pi a \rho$. Here $\vec{\sigma}$ denotes spin, q the charge, μ the magnetic moment. The constant ρ characterizes the field of a "spherical condenser" which is outside equal to zero, but enters into interaction with a charge ρ inside the condenser. In the well-known work by Li (Lee) and Yang concerning the nonconservation of parity the possibility of an electric dipole moment, i.e. the interaction $d(\vec{\sigma}\vec{E})$ is pointed out. If, however, with the nonconservation of parity the invariance with respect to the combined inversion (and consequently also with respect to the reversing of time) is conserved, a dipole moment is impossible according to Landau (reference 3),

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The Electromagnetic Interaction Connected with the Nonconservation   56-6-44/47
of Parity.

for with a reversal of time $\vec{\sigma}$ changes its sign, but $\vec{E}$ does not.
The question however arises as to what electromagnetic inter-
actions, which are allowed in the conservation of parity, become
possible in the theory of combined inversion? The interaction
$(\vec{\sigma}\vec{A})$ is not permitted according to gauge invariance, and
$b(\vec{\sigma}\Delta\vec{A}) = b(\vec{\sigma} \text{ rot } \vec{H}) = (4\pi b/c)(\vec{\sigma}\vec{J})$. Here $\vec{J} = \rho\vec{v}$ denotes the
density of the current inducing the magnetic field $\vec{H}$. With the
conservation of parity this term would be pseudoscalar ($\vec{\sigma}$ -
pseudovector, $\vec{J}$ - vector), and it could not be introduced into
the expression for energy. On the other hand, $\vec{\sigma}$ and $\vec{J}$ change
their signs in the case of time inversion. The moment of force
corresponding to such an interaction energy amounts to $\vec{M}$ =
= $(4\pi b/c) [\vec{\sigma}\vec{J}]$. Such an interaction is obtained immediately
from the model of the virtual decay of the investigated particle
A with the spin 1/2 into a particle B with spin 0 and into a
particle C with spin 1/2. If this decay depends on a weak inter-
action in which parity is not conserved, 2 particles may be
produced simultaneously both in the S and in the P-state. Round
the spin axis of the particle A there exists a ring of elementary
magnets, of virtual particles C with a spin in the direction
of the equator. There is no electric dipole moment. From the

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The Electromagnetic Interaction Connected with the Nonconservation 56-6-44/47
of Parity.

point of view of the classification of the magnetic properties
of a particle, the interaction (∂ rot $\vec{H}$) obviously corresponds
to no magnetic multipole; it is here described as "anapole".
In order to understand the significance of an "anapole" the
transformation of energy into the form ($\partial\vec{J}$) is of essential
importance: An "anapole" enters into interaction only with such a
current as passes exactly that point at which the particle
is located. Consequently, the exterior field of the "anapole"
is equal to zero. In this respect an "anapole" is analogous
to a sperical condenser. However, the anapole is a vector and
has a certain direction. The classical shape of an anapole may
be imagined as being like a wire spiral bent so as to form a ring.
The current passing through the spiral produces a magnetic field
only in the interior of the torus. Upon a stiff torus exterior
magnetic fields do not exercise any effect, but they do so in
the case of a torus imerged in an electrolyte. The anapole
moment of the elementary particles is of the order of magnitude
of the product of the magnetic moment with the Compton-length
$\hbar/mc$ and the square of the dimensionless constant of the weak

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The Electromagnetic Interaction Connected with the Nonconservation 56-6-44/47
of Rarity.

interaction f^2, i.e. the anapole moment is of the order $10^{-26}\mu$.
Anapole interaction is a direct example contradicting the
claim that combined inversion and gradient invariance lead to
the conservation of spatial invariance in electrodynamics.
There are 6 references, 4 of which are Slavic.

Submitted: September 26, 1957

AVAILABLE: Library of Congress

Card 4/4

ZEL'DOVICH, Ya. B.

56-7-65/66

AUTHOR   ZEL'DOVICH,Ya.B.
TITLE   On the Possible Efficacy of the Mesonic Catalysis of Nuclear Reactions
            (O vozmozhnoy effektivnosti mezonnogo kataliza yadernykh reaktsiy
            - Russian)

PERIODICAL Zhurnal Eksperim.i Teoret.Fiziki,1957, Vol 33,Nr 7,pp 310-311 (USSR)

ABSTRACT   An experimental confirmation of the possibility existing in principle
            (L.W.Alvarez et al.Phys.Rev.Vol.103,pp 1127,1957) of a catalysis of
            a nuclear reaction between two simply charged ions (p,d,t) by a ne-
            gative meson is now available. This meson brings about an approxima-
            tion of the nuclei which are in reciprocal reaction. The meson is not
            used up by the nuclear reaction. If a myon falls into a liquid p+d
            mixture, the probability of reaction is not more than some hundreds
            per meson. This low degree of probability is due to the ratio between
            the average time needed for the production of a meson molecule (pdμ,
            ddμ) and the life of the molecule. We ask ourselves, however, whe-
            ther in nature there do not exist long-lived mesons, and whether such
            long-lived mesons cannot cause a practically undamped nuclear react-
            ion among the hydrogen isotopes? A definite negative answer can be
            given to the first-mentioned question. In all conceivable reactions
            there is a probability that the meson forms on the helium nucleus
            on the occasion of nuclear reactions. Because of the positive charge
            of the system He μ other nuclei (among them also hydrogen) are not
            able to attain sufficient approximation to this system, and the me-
            son is eliminated with respect to the catalysis of nuclear reaction.

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On the Possible Efficacy of the Mesonic Catalysis of 56-7-65/66
Nuclear Reactions.

The probability of fusion was calculated according to a method by
Migdal. Also formulae for the final state of the meson after nuclear
reaction were derived, and some numerical data were given. A non-
decaying meson might furnish an average of 8 neutrons on the occa-
sion of the reaction d+d and 1oo neutrons on the occasion of the re-
action d+t. The reactions d+d= He^3+n and t+t=He^4 +2n, by the way,re-
duce the neutron yield. The adhesion of the meson to the helium can
easily be observed by means of a hydrogenium bubble chamber. On the
occasion of collisions with electrons the myon is not stripped from
the helium.
(No illustrations)

ASSOCIATION   Physical Institute "P.N.Lebedev" of the Academy of Sciences of the
              (Fizicheskiy institut im. P.N. Lebedeva Akademii   U.S.S.R.
              nauk SSSR)
PRESENTED BY
SUBMITTED   29.4.1957
AVAILABLE   Library of Congress.
Card 2/2

ZEL'DOVICH, YA.B.

53-3-6/6

AUTHORS: Zel'dovich, Ya.B.,   Rayzer, Yu.P.

TITLE: Shock Waves with a Large Amplitude in Gases (Udarnyye volny bol'shoy amplitudy v gazakh)

PERIODICAL: Uspekhi Fiz. Nauk, 1957, Vol. 63, Nr 3, pp. 613 - 641 (USSR)

ABSTRACT: The present paper investigates the various physical processes taking place on the front of a shock wave as well as their influence upon the internal structure of the front. Particular attention is paid to the radiation and absorption of light and to the heat transfer in the front due to radiation, which are discussed. These phenomena mainly determine the structure, the thickness, and the brightness of the shock wave with large amplitude. In the present survey the technically important problems of the supersonic flow round   wings with shock waves etc. is not investigated.
The work begins with a short survey of experimental methods. The so-called shock tubes are at present being frequently used for these investigations. Hitherto temperatures of up to 20 000° have been attained in shock waves. Another wide-spread method for the production of shock waves is that by explosions. Shock

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53-3-6/6

Shock Waves with a Large Amplitude in Gases

waves are further produced by moving bodies in gases with super-
sonic velocity. The second chapter deals with the shock adiaba-
tic curves. Under conditions of dissociation and ionization here
the direct shock wave (in which the gas moves vertically to the
surface of the front) is investigated in the system of coordinates
connected with the explosion. The next chapters deal with vis-
cous condensation discontinuities, the widening of the front of
a shock wave by the delay excitation of a part of the heat ca-
pacity, the structure of the front of a shock wave in considera-
tion of radiation, the brightness of the front of the shock
waves with large amplitudes. The last chapter deals with heat
conduction due to electrons as well as with the jump of electron
temperature and ion temperature in shock waves with large ampli-
tude. There are 14 figures, 1 table and 74 references, 28 of
which are Slavic.

AVAILABLE: Library of Congress

Card 2/2

47-58-2-2/30

AUTHOR: Zel'dovich, Ya.B., Corresponding Member of the A.S. USSR (Moscow)

TITLE: Anti-Particles (Antichastitsy)

PERIODICAL: Fizika v Shkole, 1958, Nr 2, pp 9-19 (USSR)

ABSTRACT: The author explains in popular language the theory of electrons
                as developed by P.A.M. Dirac in 1928, and the Anti-Particle The-
                ory derived from it, which was proved by the ensuing discovery
                of the anti-particle called "positron". There are 2 figures and
                12 references, 6 of which are Soviet and 6 English.

AVAILABLE: Library of Congress

Card 1/1   1. Anti-particles-Theory   2. Electrons-Theory

ZEL'DOVICH, Ya. B.

47-58-3-6/27

AUTHOR: Zel'dovich, Ya.B., Corresponding Member, AS USSR (Moscow)

TITLE: On the Program of Physics in Secondary Schools (O programmakh sredney shkoly po fizike)

PERIODICAL: Fizika v Shkole, 1958, Nr 3, pp 35-37 (USSR)

ABSTRACT: Though physics and engineering have changed considerably
               during the last 50 years, the school program in physics does
               not show any essential changes. The students attending the
               7th class at the present time will have to deal with many new
               subjects of technical physics in the future, such as the utili-
               zation of atomic energy, thermonuclear hydrogen burning, radio-
               technique, automation, jet aviation, etc. Therefore, the school
               program in physics should be so composed, that the students
               could get an idea on the structure of matter - molecules, atoms,
               electrons, electronic shells of atoms, atomic nucleus and its
               basic parts, protons and neutrons. The active role of physics
               should be pointed out, enabling the creation of new fields in
               engineering. After having given details of desired program
               of physics at school (6th and 7th classes), the author expresses

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On the Program of Physics in Secondary Schools   47-58-3-6/27

his hope that the unconformity between the progress in physics and engineering on the one hand and obsolete school programs on the other hand will disappear in the nearest future.

ASSOCIATION: AN SSSR (The USSR Academy of Sciences)

AVAILABLE: Library of Congress

Card 2/2   1. Physics-Study and teaching

ZEL'DOVICH, Ya. B.

SOV/30-58-8-9/43

AUTHOR: None Given

TITLE: At the Plenary Meetings of Departments (Na obshchikh sobraniyakh otdeleniy)

PERIODICAL: Vestnik Akademii nauk SSSR, 1958, Nr 8, pp. 57-68 (USSR)

ABSTRACT: These plenary meetings were held on June 16-17 with the purpose of nominating candidates for the AS USSR. Scientific lectures were also held. Department of Physical and Mathematical Sciences: The Corresponding Member, AS, USSR, Ya. B. Zel'dovich spoke about the catalysis of nuclear reaction by mesons and the resulting phenomena. This hypothesis of a possibility of such a catalysis was first mentioned in 1954 by A. D. Sakharov and Ya. B. Zel'dovich. Department of Chemical Sciences: V. A. Kargin, Member, Academy of Sciences, USSR, spoke about the tasks and aims of the work of the Council of Scientists (uchenyy sovet) on polymeric compounds; the council consists of 6 sections: for the synthesis of monomers; for the synthesis and kinetics of reactions; for the recovery of polymeric compounds; for materials for aircraft construction and other special polymeric materials; for

SOV/56-34-5-33/61
Rayzer, Yu. P.

AUTHORS:
Zel'dovich, Ya. B., Kompaneyets, A. S.,

TITLE:
On Radiation Cooling of Air. I. (Ob okhlazhdenii vozdukha izlucheniyem. I) General Description of the Phenomenon and the Weak Cooling Wave (Obshchaya kartina yavleniya i slabaya volna okhlazhdeniya)

ABSTRACT:
This paper discusses the approximation theory of the cooling wave and the fact is established that in this layer the temperature abruptly decreases from the initial value to the "temperature of transparency" T_2. A diagram shows the successive changes of the temperature distributions, by taking adiabatic cooling into account. The authors try to find the solution of the nonsteady equations of the radiating heat exchange. These solutions have the form $T(x - ut)$ and correspond to a plane wave propagated with the constant velocity in the gas at the given temperature T_1 and with the density ρ_1. But these equations are not solved by exact solutions of the kind

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On Radiation Cooling of Air. I. General Description of the Phenomenon and the Weak Cooling Wave

$T(x - ut)$. The causes of this fact are discussed. If the cooling wave propagates in expanding air, adiabatic cooling transports the air layers, which were cooled by the radiation into a region of temperatures so low that they become practically transparent. The authors do not investigate the additional absorption of the light at low temperatures due to oxide and dioxide of nitrogen produced in the heated air. Moreover, the intense molecular absorption at low temperatures (which is essential for the ultraviolet radiation with 2000 Å) is neglected. There are two ways of taking the real facts into account. First, it is possible to introduce an additional constant term A (which characterizes adiabatic cooling) into the energy equation. Secondly, it is possible to exclude from the investigation the weakly absorbing gas region which is cooled below the temperature of transparency. In order to determine the radiation flux, the authors apply the diffusion approximation to the exact kinetic equation which takes into account the angular distribution of the radiation in an approximate manner. In a great part of the cooling wave the true radiation density U is very similar to its equilibrium value U_p. In the region with cooled air,

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On Radiation Cooling of Air. I. General
Description of the Phenomenon and the Weak Cooling Wave

however, U is very different from U_p. Lastly, the authors
calculate the special case where T_1 is only a little higher
than T_2. In this case it is possible to find the exact ana-
lytical solution of this problem. There are 3 figures, 1
table, and 6 references, 5 of which are Soviet.

ASSOCIATION: Institut khimicheskoy fiziki (Institute of Chemical Physics)

SUBMITTED: December 20, 1957

1. Air--Cooling   2. Heat transfer--Theory   3. Mathematics
--Applications

Card 3/3

SOV/56-34-6-11/51

AUTHORS: Zel'dovich, Ya. B., Kompaneyets, A. S.,
Rayzer, Yu. P.

TITLE: On Air Cooling by Radiation (Ob okhlazhdenii vozdukha
izlucheniyem)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958,
Vol 34, Nr 6, pp 1447 - 1454 (USSR)

ABSTRACT: The first part of this investigation discussed the cooling
of a great volume of heated air in a qualitative manner,
it dealt with weak cooling waves. This paper, however, deals
with the theory of a strong cooling wave in which the
higher temperature may be infinitely high. This paper has
to determine the radiation flux which moves from the
front of the cooling wave towards infinity and to obtain
the temperature distribution on front of the cooling
wave. One of the following two methods has to be used:
either to introduce a constant term into the energy equation
or to determine from the very beginning the "transparency
temperature" T_2 according to a formula given in the first
part of this investigation. In the latter case one has

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On Air Cooling by Radiation

to assume that the air is absolutely transparent for
$T < T_2$. The first method gives a more complete description
of the temperature distribution because it allows to
investigate the change of the temperature in the cooled
air and to take into account the absorption of the light
in the air. But this method leads to unnecessary mathe-
matical complications at temperatures above the transparency
temperature. It is more advantageous to investigate the
internal structure of the cooling wave according to the
second method; the corresponding energy equation is given
explicitly . The authors investigate the lower part of the
cooling wave where the temperatures are similar to T_2.
At the lower boundary of the cooling wave the density of the
radiation is lower than the equilibrium density. Regardless
of the amplitude of the cooling wave always the lower
boundary of the cooling wave radiates, even at extremely
high temperatures. This conclusion follows from the steadyness
of the profile of the cooling wave. The second part of this
paper calculates the distribution of the temperature in the
cooling wave and the last part of this paper deals with
the lower margin of the cooling wave and with the transition

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On Air Cooling by Radiation

of the cooled air to the transparent zone. The processes taking place in the cooled air zone are essentially instationary and depend on the dimensions, on the hydrodynamic motions, and on the additional mechanisms of light absorption. The authors then investigate the practically important case where the air pressure had not yet decreased to the atmospheric pressure and where the air continues to get cooler by radiation. The processes with adiabatic cooling are quasistationary processes in the whole interesting region. The point where the cooling of the air by radiation ends may be considered as the lower boundary of the cooling wave and the temperature in it - as the transparency temperature for a given value A of the adiabatic cooling. The transparency temperature depends only logarithmically on A and on the amplitude of the cooling wave. The authors thank N.N. Semenov for his stimulating discussions. There are 5 figures and 2 references, 2 of which are Soviet.

Inst. Chem. Physics AS USSR.

Card 3/4?

3

SOV/56-34-6-41/51

AUTHOR: Zel'dovich, Ya. B.

TITLE: The Heavy Neutral Meson: Decay and Way of Detection (Tyazhelyy neytral'nyy mezon: raspad i sposob obnaruzheniya)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol. 34, Nr 6, pp. 1644 - 1646 (USSR)

ABSTRACT: This paper discusses the problem of the possible decay schemes of the ϱ-particle and of the way of its experimental detection. The mass of ϱ, evidently is higher than that of π^c. The transmutations $\varrho \to 2\pi^0$ and $\varrho \to \pi^+ + \pi^-$ are impossible according to considerations on parity. According to N.A. Bethe (Bete) and J.Hamilton (Gamil'ton) the state 0^s cannot give a three-pion annihilation, and therefore the decays $\varrho \to 3\pi^0$, $\varrho \to \pi^+ + \pi^- + \pi^0$ are forbidden. In the case of a decay into 4 pions, they are split up into 2 pairs. The necessary existence of great orbital moments can diminish essentially the probability of the decay $\varrho \to 4\pi$. The decay of ϱ into $\pi^0 + \gamma$ is forbidden like the 0-0 transitions with emission of γ-quanta. The decay $\varrho \to \pi^+ + \pi^- + \gamma$ is allowed and the pair $\pi^+ + \pi^-$ must be in a state with L = 1. The decay

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The Heavy Neutral Meson: Decay and Way of Detection   SOV/56-34-6-41/51

of ϱ into 2γ is allowed, too, in complete analogy to the decay of π^0 into 2γ. In the case of $m_\varrho > 2m_\pi$ the decay with emission of 1γ seems to be more probable. For the decay time, the author expects the value $10^{-18} \div 10^{-20}$ sec. Then the author proposed a method for the detection (from the energy-momentum balance) of cases with single production of ϱ, by the interaction of charged particles. There may be the reaction $p_1 + p_2 = p_3 + p_4 + \varrho$ where p_1 denotes the proton which leaves the accelerator, p_2 - the proton at rest; p_3 and p_4 denote protons, too. The decay of ϱ follows after this process. The author gives the expression
$$A = \left[E_1 + Mc^2 - E_3 - E_4 \right]^2 - c^2 (\vec{p}_1 - \vec{p}_3 - \vec{p}_4)^2 . \text{ When only one } \varrho$$
is produced, there is $A = m_\varrho^2 c^4$. When 2 or more pions are produced, the spectrum of the values of A will be continuous. If a sufficiently narrow line will be observed experimentally the existence of the nuclear-active neutral meson will be demonstrated and it will be possible to measure the mass of this meson. The author thanks V.B.Berestetskiy and L.B.Okun' for

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The Heavy Neutral Meson: Decay and Way of Detection   SOV/56-34-6-41/51

useful indications. There are 5 references, 2 of which are Soviet.

ASSOCIATION: Institut khimicheskoy fiziki Akademii nauk SSSR (Institute for Chemical Physics, AS USSR)

SUBMITTED: March 9, 1958

Card 3/3

SOV/56-35-3-14/61

21(6)
AUTHORS: Zel'dovich, Ya. B., Gershteyn, S. S.

TITLE: The Formation of Hydrogen Mesic Molecules (Obrazovaniye
             mezomolekul vodoroda)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958,
             Vol 35, Nr 3, pp 649 - 654 (USSR)

ABSTRACT: The formation of hydrogen μ-mesic molecules is of
             interest for the theory of μ-mesic catalysis of nuclear
             reactions for two reasons: Firstly, because the yield
             of nuclear reactions depends essentially on the
             probability of the formation of mesic molecules, and
             secondly, because the formation of mesic molecules
             $(pp)\ddagger$ introduces the process. $(pp)\mu^+$-formation is also
             of importance for investigations of the elementary $(pn\mu\nu)$-
             interactions and problems connected with the theory of
             weak interaction. In the present paper a mechanism for the
             formation of hydrogen mesic molecules is theoretically
             described. This mechanism is based on the assumption of a
             dipole transition from the S-wave in the repulsion state
             to the rotational level K= 1 with transfer of the

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The Formation of Hydrogen Mesic Molecules

energy to a conversion electron. An ansatz for W (Formula 2) after some intermediate steps (c.f. also figures 1,2, potential curves E(R), effective potentials for the Σ_g-state for K=0 and K=1 in consideration of the correction because of nuclear motion, Morse (Morse)-function (Ref 7), E and R in monoatomic units) leads to the result: $W \approx 1,5 . 10^6 sec^{-1}$ for the probability of formation of a mesic molecule $(pp)^+_\mu$ in liquid hydrogen. The mechanism described in the present paper applies to the catalysis of p+d nuclear reactions as well as for the $\mu^-+p \to n+\nu$ process in liquid hydrogen. The influence exercised by reciprocal orientations of the proton- and meson spins upon the probability of the $\mu+p \to n+\nu$ process will be dealt with by the authors in a later paper. There are 2 figures and 9 references, 4 of which are Soviet.

ASSOCIATION: Institut fizicheskikh problem Akademii nauk SSSR (Institute for Physical Problems of the Academy of Sciences, USSR)

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SOV/56-35-3-57/61

21(7)
AUTHORS: Zel'doyich, Ya. B., Gershteyn, S. S.

TITLE: The Universal Fermi Interaction and the Capture of a μ-Meson by a Proton (Universal'noye Fermi-vzaimodeystviye i zakhvat μ-mezona protonom)

ABSTRACT: Gell-Mann and Feynman (Ref 1) and also E. C. G. Suderman and R. E. Marshak (Ref 2) independently suggested principles which lead to a certain variant of the form of interaction between 4 fermions. According to whether A, B, C, D are "particles" or "antiparticles", these principles offer two different possibilities: either an interaction $(V - A)$ (which is invariant with respect to the process of the pair-wise joining of the particles)
$$H_1 = 8^{1/2}G(\bar{\Psi}_A \gamma_\mu^a \Psi_B)(\bar{\Psi}_C \gamma_\mu^a \Psi_D)$$ or a $(V + A)$-interaction
$$H_2 = 8^{1/2}G(\bar{\Psi}_A \gamma_\mu^a \Psi_B)(\bar{\Psi}_C \gamma_\mu^a \Psi_D).$$ In the case of H_1

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The Universal Fermi Interaction and the Capture of a μ-Meson by a Proton

Ψ_A, Ψ_B, Ψ_C, Ψ_D are the wave functions of the "particles" and it holds that $a = (1 + \gamma_5)/2$. In the case of H_2, Ψ_A and Ψ_B are the wave functions of the antiparticles and it holds that $\bar{a} = (1 - \gamma_5)/2$. In the case of a different manner of joining the particles in pairs, H_2 has the $(S - P)$ shape:

$H_2 = 2 \cdot 8^{1/2} G (\Psi_A a \Psi_D)(\bar{\Psi}_C \bar{a} \Psi_B)$. The present paper in all formulae investigates only one and the same process $A + C = B + D$, and it is agreed that such particles are described as "particles" as have a left longitudinal polarization at $v/c = 1$. The antiparticles then have the opposite sign of polarization. The difference between the interactions H_1 and H_2 is particularly marked in the case of transition to the last-mentioned formula. The ideas discussed here furnish the following result: In the variant $V + A$ the $(S - P)$ probabilities of capture in the states $F = 0$ and $F = 1$ (where F denotes the total spin of the proton and the myon) are exactly equal to each other. However, in the variant $V - A$

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.The Universal Fermi Interaction and the Capture of a μ-Meson by a Proton

the probability of capture from $F = 1$ is equal to zero, whereas for the capture from $F = 0$ it amounts to four times the value averaged over the spins. In the case of the capture of a myon by a proton, this capture is effected from a state with the hyperfine structure $F = 0$. In this state the spins of the myon and of the proton are antiparallel to each other. Measurement of the absolute yield of the reaction

$\mu^- + P \to N + \nu$ in hydrogen at the capture from $F = 0$ makes it possible to determine the relative sign of V and A in the elementary law of interaction $(\mu \nu PN)$. Expressions are written down for the Hamiltonian of the interaction of real nucleons with $(\mu \nu)$ and also for the absolute yield of the reaction $\mu^- + P \to N + \nu$ from the state $F = 0$. As the pro-duction of meso-molecule-ions $(pp)^+_\mu$ in liquid hydrogen compli-cates the representation of the capture of myons by protons, experiments must be carried out at such densities of hydrogen as are from 20 to 30 times lower than the density of liquid hydrogen at 20°K. There are 11 references, 4 of which are Soviet.

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Leningrad Phys-Tech Inst. AS USSR

SOV/56-35-6-13/44

24(0)
AUTHORS: Zel'dovich, Ya. B.,   Rayzer, Yu. P.

TITLE: Physical Phenomena During the Expansion of Solid Bodies in a
             Vacuum, Which Were Compressed by Strong Shock Waves
             (Fizicheskiye yavleniya pri rasshirenii v vakuum tverdykh
             tel, szhatykh sil'nymi udarnymi volnami)

ABSTRACT: A number of Soviet authors such as Al'tshuler, Krupnikov,
             Brazhnik, Ledenev, Zhuchikhin, Kormer, Sinitsyn, Kuryapin,
             as well as the authors of the present paper have already worked
             on this problem; very strong shock waves (amplitudes of the
             order of 10 million atmospheres, temperatures on the wave
             front of from 10 to 100000 degrees) and transparent solid bodies
             were investigated (Refs 1-3). In the present paper the authors
             carry out a theoretical investigation of optical and other
             physical properties shown by a nontransparent primarily solid
             body when expanding after being compressed by a strong shock
             wave. The hydrodynamics of the expansion process is at first
             discussed in short. The bright luminescence occurring on the
             front is then investigated. Absorption and emission of visible

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Physical Phenomena During the Expansion of Solid Bodies in a Vacuum, Which
Were Compressed by Strong Shock Waves

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light in monoatomic gases (as e.g. metal vapor) occurs as a
result of the photoeffect in highly excited atomic levels as
well as in consequence of the inverse processes, i.e. of
photorecombination. According to Boltzmann (Bol'tsman) it
holds for the absorption process that

$\varkappa_\nu \sim \varrho\exp\left[-(I-h\nu)/kT\right]$, where I is the ionization potential.

For temperature, the approximated solution $T_{eff} = (I - h\nu)/k$
$\ln(tT_{eff}^\beta \cdot const)$ is given. (β is a constant of the order of
some units). A numerical estimation for T_{eff} at $I \sim 5 \div 8$ ev
results in 3000 - 7000° ($t \sim 10^{-10}$ sec). In the following, the
condensation of the substance as well as the recombination
of electrons and ions is dealt with. The authors do not mention
further calculations or numerical results, but the problems
are merely discussed. In conclusion, they express their
gratitude to L. V. Al'tshuler and S. B. Kormer for discussions.
A footnote draws the attention to the fact that in previous

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Physical Phenomena During the Expansion of Solid Bodies in a Vacuum, Which
Were Compressed by Strong Shock Waves

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works (Refs 4-6) the authors had carried out a theoretical
investigation of the luminescence of gases, especially of air,
in a shock wave. There are 9 references, 8 of which are
Soviet.

SUBMITTED: July 11, 1958

Card 3/3

20-118-4-13/61

AUTHORS: Zel'dovich, Ya. B., Corresponding Member AS USSR, Barenblatt, G. I.

TITLE: Asymptotic Properties of Automodel Solutions of Equations for the Unsteady Motion of Gas Through Porous Media (Ob asimptoticheskikh svoystvakh avtomodel'nykh resheniy uravneniy nestatsionarnoy fil'tratsii gaza)

ABSTRACT: At first, a short reference is made to previous papers dealing with the same subject. The authors here investigate the asymptotic behaviour of the solutions of Cauchy's problem for the equations by L. S. Leybenzon for the unsteady filtration of a gas: $\frac{\partial u}{\partial t} = a^2 \frac{\partial^2 u^{n+1}}{\partial x^2}$ or $\frac{\partial w^{1/(n+1)}}{\partial t} = a^2 \frac{\partial^2 w}{\partial x^2}$;

$w = u^{n+1}$. Here n denotes the density of the gas, a^2 a constant depending upon the properties of the medium and of the gas, x a coordinate $(-\infty < x < \infty)$, t time, n the exponent of the polytropic line. These solutions correspond to the

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Asymptotic Properties of Self-Preserving Solutions of   20-118-4-13/61
Equations for the Unsteady Motion of Gas Through Porous Media

limited initial distributions $u(x,0) = U(x)$, which tend
toward zero outside a certain finite interval of the x-axis.
For the purpose of illustrating this the linear case $(n = 0)$
is investigated. The solution of Cauchy's problem is given
for this case and is specialized for great t. In this case,
the solution can be represented in the form of a sum of
automodel   terms, in which the absolute values of the
powers of time increase by 1/2 on each step. The coefficients
are expressed by the successive moments of the initial
distribution. The general solution tends toward the
automodel   solution $u_o(x,t) = (E/2a\sqrt{\pi t})e^{-x^2/4a^2t}$

Then the authors turn to the nonlinear case $(n = 0)$. The
solution of the problem investigated here satisfies certain
relations given here. The self-preserving solution
corresponding to these conditions is written down explicitly
and is discussed, and an asymptotic representation is written
down in particular. In the solution of the nolinear problem
there exists a boundary of the perturbed domain, which
characterizes the peculiarities of the solution. In a quite
analoguous way the asymptotic character of the automodel

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SOV/2o-122-1-12/44

15(8), 24(8)
AUTHORS: Zel'dovich, Ya. B., Academician, Kormer, S. B., Sinitsyn,
M. V., Kuryapin, A. I.

TITLE: The Temperature and the Specific Heat of Plexiglass Compressed
by a Shock-Wave (Temperatura i teployemkost' pleksiglasa
szhatogo udarnoy volnoy)

ABSTRACT: Compression by a shock wave is a means of obtaining high
pressures and high temperatures which cannot be obtained by
other methods. The investigation of transparent bodies per-
mits an immediate determination of temperature by measuring
the brightness of the body compressed by the shock wave.
After an intense compression (by which a temperature of some
thousands of degrees is attained) an initially transparent
substance becomes opaque and radiates intensely. This phenom-
enon is caused by a displacement of the electron levels and
by an excitation of the electrons. The radiation of the
front of the shock waves was observed through a layer of

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The Temperature and the Specific Heat of Plexiglass Compressed by a Shock-Wave

the not yet compressed transparent substance and it was recorded by photochronographs in 2 parts of the spectrum: $\lambda = 4020$ Å (blue) and red ($\lambda = 6000$ Å). The authors determined the temperature in polymethyl metacrylate $(C_5H_8O_2)_n$ (plexiglass) of an initial density of 1,18 g/cm^3. The velocity of the shock wave was 16,5 km/sec. In the compressed state, the density was equal to 3,15 g/cm^3, pressure was 2.10^{12} $dyne/cm$. By 3 experiments the following quantities were determined: the brightness temperature deduced from the intensity of the radiation in the red part of the spectrum ($8300 \pm 500°K$) and the color temperature, deduced from the ratio of the intensities in the red and in the blue parts of the spectrum ($11\,000 \pm 1\,000°K$). For the energy of the compressed plexiglass, the value $E = P(V_0 - V)/2 = 0,53.10^{12}$ erg/g was found. Thermal pressure is equal to $\sim 1,3.10^{12}$ $dyne/cm^2$ and the thermal energy of the atoms amounts to $\sim0,31.10^{12}$ erg/g. The elastic pressure was determined as being the difference between the total and the thermal pressures, i.e. $0,7.10^{12}$ $dyne/cm^2$. An expression is then given for the elastic energy. The compression causes a thorough destruction

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The Temperature and the Specific Heat of Plexiglass Compressed by a Shock-Wave

of the molecules, but the energy is not sufficient to cause a total interruption of all the chemical bonds. The conception of single molecules cannot be applied to densities of ~ 3 g/cm^2. The optical investigations of the transparent bodies are continued. The authors thank L. V. Al'tshuler, I. Sh. Model', and Yu. P. Rayzer for their constant interest in this paper. There are 4 references, all of which are Soviet.

SUBMITTED: June 4, 1958

Card 3/3

66266

SOV/181-1-11-1/27

24(6) 24,6100

AUTHOR: Zel'dovich, Ya. B.

TITLE: Energy Levels in a Distorted   Coulomb Field

PERIODICAL: Fizika tverdogo tela, 1959, Vol 1, Nr 11, pp 1637-1641 (USSR)

ABSTRACT: It is shown theoretically that at the Coulomb potential a
             spectrum is present everywhere which differs but slightly from
             the Bohr spectrum of the hydrogen atom. This does not apply
             to a small range in the vicinity of the origin of the coor-
             dinates. An appreciable distortion   of the spectrum is apparent
             only in the case in which the distortion   potential for low-
             energy particles has a   resonance. Without applying the per-
             turbation theory, the authors illustrate that the variations
             in energy of the Coulomb level of particle density in the
             origin of coordinates is proportional in the undistorted
             solution. The problem arose during the discussion which fol-
             lowed the lecture by L. Keldysh in the Seminar of L. Landau.
             Ye. Rabinovich also participated in the discussion. There are
             3 figures and 1 Soviet reference.

Card 1/2   Inst. Exptl. + Theoretical Physics, AS USSR

SOV/56-36-2-61/63

.21(7), 21(8)
AUTHOR: Zel'dovich, Ya. B.

TITLE: On the Annihilation of $\mu^+\mu^-$ and on the Decay of Neutral Mesons
                (Ob annigilyatsii $\mu^+\mu^-$ i raspade neytral'nykh mezonov)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959,
                Vol 36, Nr 2, pp 646-647 (USSR)

ABSTRACT: It is probable (in analogy to the annihilation of e^+e^-) that
                the $\mu^+\mu^-$ "atom" in the para state will give 2 quanta, and
                in the ortho-state - 3 quanta. Berestetskiy and Pomeranchuk
                (Ref 2) assumed the possible existence of a direct conversion
                of the pair e^+e^- into $\mu^+\mu^-$ by way of 1 virtual quantum. By
                investigating the inverse process the conclusion may be drawn
                that (besides of the annihilation of $\mu^+\mu^-$ with emission of
                quanta) also the conversion of $\mu^+\mu^-$ into a e^+e^- pair is pos-
                sible. This process develops in the same order with respect
                to $e^2/\hbar c$ as the two-quantum annihilation. In this order of
                magnitude, the conversion of $\mu^+\mu^-$ into e^+e^- does not occur
                in the para-state. In the ortho-state, this conversion develops
                with a probability which is 3 times lower than the probability
                of the two-quantum annihilation of the para-state. The
                probability of the conversion of the ortho-$\mu^+\mu^-$ into e^+e^-, is

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On the Annihilation of $\mu^+\mu^-$ and on the Decay of Neutral Mesons

therefore 400 times higher than the probability of the three-quantum annihilation of ortho-$\mu^+\mu^-$. The pseudoscalar neutral meson π^0 is similar to the para-state of $\mu^+\mu^-$ or e^+e^- and the decay of π^0 into 2 quanta agrees with this analogy. The ortho-state of $\mu^+\mu^-$ would be similar to a neutral odd meson of spin 1. Such a meson would not decay into 3 quanta, but direct-ly into a e^+e^- pair with a lifetime of the same order of magni-tude as the π^0-meson. Careful investigations of e^+e^--pairs in high-energy collisions of cosmic particles with nuclei exclude the existence of a nuclear-active neutral meson of spin 1. The author thanks I. Ya. Pomeranchuk for his help. There are 7 references, 2 of which are Soviet.

ASSOCIATION: Institut teoreticheskoy i eksperimental'noy fiziki Akademii navk SSSR (Institute of Theoretical and Experimental Physics of the Academy of Sciences, USSR)

SUBMITTED: December 10, 1958

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SOV/56-36-3-19/71

10(6)
AUTHOR: Zel'dovich, Ya. B.

TITLE: The Converging Cylindrical Detonation Wave (Skhodyashchayasya tsilindricheskaya detonatsionnaya volna)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 3, pp 782-792 (USSR)

ABSTRACT: The first investigation of a converging detonation wave was carried out by L. D. Landau and K. P. Stanyukovich (1944, Ref 1). In the course of this investigation the author derived an asymptotic law for the description of pressure increase in nearly spherical waves in the direction toward the axis. In the present paper the author, by means of approximation methods (asymptotically), investigated the primary process of a converging detonation wave. In the first instant of wave excitation on the external surface of a sphere or of a cylinder a normal detonation wave occurs, which does not differ from a plane detonation wave. The second paragraph of the paper, which follows the introduction, is concerned with the theoretical investigation of the properties of this normal detonation wave, proceeding from the description by means of the Hugoniot (Gyugonio) adiabatic curve and the Jouguets (Zhuge)

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The Converging Cylindrical Detonation Wave

point: $D_0 = u_0 + c_0 (dD/dp)_{H,0} = 0$; where D denotes the propagation rate of the detonation wave, u - the velocity of the motion of matter, and c - the velocity of sound. For the Jouguets point on the Hugoniot adiabatic curve it also holds that $(dS/dp)_{H,0} = 0$ and $(du/dp)_{H,0} = 1/\varrho c$. From the hydrodynamical point of view it may be assumed that $D \geqslant u+c$, and from the chemical point of view that $D \leqslant u+c$; on the basis of the latter assumption work has already been carried out by a number of authors (Refs 6 - 10), and it is also used as a basis by the present paper. In paragraph 3 of the paper, which deals with the converging cylindrical wave, the author explains the basic equations and describes the method of approximation for the solution of the equation of motion (characteristics method). The following paragraph deals with a calculation, carried out on the basis of a numerical example of the equation of state

$$p = A\varrho^3, \quad c = \sqrt{dp/d\varrho} = \varrho\sqrt{3A}, \quad \alpha = u + c, \quad \beta = u - c;$$

and of the characteristic condition

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The Converging Cylindrical Detonation Wave   SOV/56-36-3-19/71

$$\left.\frac{d\beta}{dt}\right|_{dr/dt=\beta} = \left.\beta\,\frac{d\beta}{dr}\right|_{dt/dr=1/\beta} = \frac{\alpha^2-\beta^2}{4r}$$

(cf. table 3, figure 3). For small radii and a considerable amplification of the wave, the theory was found to lead to satisfactory results. The last paragraph finally deals with an extrapolation of the solution. The author in conclusion thanks S. B. Aretskin, Ye. I. Zababakhin, Ya. M. Kazhdan, A.S. Kompaneyets, K. A. Semendyayev and K. P. Stanyukovich for discussions and for their assistance in carrying out calculations. There are 3 figures, 3 tables, and 13 references, 9 of which are Soviet.

SUBMITTED: September 13, 1958

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SOV/56-36-3-70/71

21(7), 24(5)

AUTHOR: Zel'dovich, Ya. B.

TITLE: The Non-conservation of Parity of the First Order With Respect to the Constant of Weak Interaction in Electron Scattering and Other Effects (Nesokhraneniye chetnosti pervogo poryadka po konstante slabogo vzaimodeystviya v rasseyanii elektronov i drugikh effektakh)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 3, pp 964 - 966 (USSR)

ABSTRACT: The author first investigates beta decay and suggests that besides the weak interaction $g(\overline{P}ON)(\overline{e}^-O\nu)$ + e.s. the existence of an interaction (2) $g(\overline{P}OP)(\overline{e}^-Oe^-)$ be assumed. Here $g \approx 10^{-49}$, and $O = \gamma_\mu(1+i\gamma_5)$ characterize processes in which parity is not conserved. In the scattering of electrons on protons interaction (2) will interfere with the Coulomb scattering, and disturbance of parity occurs in the first order of g. This effect might serve the purpose of experimentally checking the form of interaction suggested by the author and determining the sign of g. The author shows that the effect of

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Respect to the Constant of Weak Interaction in Electron Scattering and
Other Effects

parity disturbance might be of the order of magnitude
0.1 - 0.01%. Also in the case of the scattering of fast
longitudinally polarized electrons on unpolarized target
nuclei under large angles it is possible that for electrons
with $\vec{\sigma p} > 0$ (right) and $\vec{\sigma p} < 0$ (left) a deviation of the
cross sections by 0.1 - 0.01% may occur, a specific effect
for an interaction disturbing parity. Experimental possi-
bilities are discussed in short. The interaction (2) also
leads to a mixture of the electron levels of different parity
in the free atom. In the following, the author investigates
the effect of (2) in a hydrogen atom and shows that (2)
may lead to a rotation of the polarization plane of visible
light in any matter containing no optically active molecules.
An estimate of this effect results to $|n_{right} - n_{left}| \sim 10^{-20}$.

The author finally endeavors to find out to what extent
the existence of an interaction of the form (2) is probable
and plausible. The author thanks G. M. Gandel'man,

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The Non-conservation of Parity of the First Order With   SOV/56-3 6-3-7 /71
Respect to the Constant of Weak Interaction in Electron Scattering and
Other Effects

A. S. Kompaneyets, L. D. Landau, L. B. Okun', I. Ya. Pomeran-
chuk and Ya. A. Smorodinskiy for their valuable remarks and
discussions. There are 6 references, 1 of which is Soviet.

SUBMITTED: December 25, 1958

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SOV/56-36-5-11/76

21(7)
AUTHOR: Zel'dovich, Ya. B.

TITLE: The $K_2^0 \to K_1^0$ Transformation on Electrons
            (Prevrashcheniye $K_2^0 \to K_1^0$ na elektronakh)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959,
            Vol 36, Nr 5, pp 1381-1386 (USSR)

ABSTRACT: The present theoretical paper investigates the
            EO-transformation of a K_2^0-meson into a K_1^0-meson in the
            case of interaction with electrons, i. e. the reaction
            $K_2 + e = K_1 + e$. The EO-moment and K-e interaction are
            first discussed in short. The following chapter deals with
            an estimation of the cross section of this process. If
            the cross section does not depend on the energy (mass)
            difference of K_2 and K_1 nor on the kinetic energy of the
            K-mesons (in nonrelativistic approximation), the $K_2 - K_1$
            transformation cross section in collisions with nucleons
            amounts to several millibarn; the nuclear $K_2 - K_1$ production

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The $K_2^o \rightarrow K_1^o$ Transformation on Electrons

cross section on an electron is estimated as amounting to 5.10^{-27} cm^2; in the laboratory system the K-interaction with nucleons or electrons has a totally different angular distribution. For K-energies of the order of 100 Mev the differential nuclear cross section of an electron is $d\sigma_{nucl}/d\Omega|_{\theta=0} \sim 2.10^{-28}$ cm^2/steradian. For the scattering of K-mesons on electrons $d\sigma_{el}/d\Omega|_{\theta=0} = (m_K/m_e)^2 \sigma_{el}/4\pi = 1.5.10^{-30}$ is given. In the last part of this paper, K_1 production in a non-scattered beam is finally investigated, and the correction to Good's theory (cf. Ref 7) contributed by E0 interaction is estimated. The contribution made by E0 interaction of K_2 with electrons to the refraction index of matter attains 10 % in the above estimate, which may result in a correction of ± 25 % to Good's ratio of K_1-production at small angles and in a non-scattered beam.

The author thanks L. D.Landau and L. B. Okun' for discussions. There are 7 references; 1 of which is Soviet.

Card 2/2

21 (1), (24,8)

SOV/56-36-6-62/66

AUTHOR: Zel'dovich, Ya. B.

TITLE: Storage of Cold Neutrons (Khraneniye kholodnykh neytronov)

ABSTRACT: Slow neutrons are subjected to total internal reflection in the
               case of grazing incidence on the surface of most substances. If
               velocities are sufficiently low, they cannot, even at normal
               pressure, penetrate into the material. For carbon (density
               $\sim 2g/cm^3$) the critical neutron velocity is nearly 5 m/sec, for
               beryllium it is about 7 m/sec. These facts give rise to a dis-
               cussion of the possibilities of storing cold neutrons in clos-
               ed containers. Thus, a graphite container, which is closed on
               all sides, and which contains neutrons with $v < v_{crit}$, is in-
               vestigated; neutrons in such a container can decrease only be-
               cause of their limited life time (half life $\sim$12 min); they are
               able to penetrate into the walls only up to depths having the
               order of magnitude of their wavelength ($\sim 10^{-6}$cm). There follows
               a discussion of the capture cross sections for neutrons in car-

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Storage of Cold Neutrons

bon ($5.5 \cdot 10^{-27} cm^2$ at v = $2.2 \cdot 10^5$ cm/sec); for neutrons in a container absorption time is 10^5 sec = 24 h. The author then discusses the difficulties and possibilities of collecting such neutrons. The most promising method appears to be using a reactor with a flux of 10^{12} neutrons/cm^2 sec (10^{11} n/cm^2 sec at $3^\circ K$), average velocity $2 \cdot 10^4$ cm/sec - $5 \cdot 10^6$ thermal neutrons/cm^3; among them are about 50 slow neutrons/cm^3, i.e. v < 500 cm/sec which corresponds to $5 \cdot 10^7$ slow neutrons/m^3. Heating of the neutrons in the container up to velocities of $> v_{crit}$ can be realized by means of a mechanical displacement of the graphite surface with a velocity of some meters per second. Finally, it is pointed out that the imaginary part of the pseudopotential (according to the theory of the refraction index), which describes absorption, is small compared to the real part describing scattering; its ratio is $\sqrt{\pi\sigma_s}/\lambda_1$; λ_1 is that neutron wave length at which $\sigma_s = \sigma_a$. Therefore absorption does not influ-

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Storage of Cold Neutrons

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ence the exponential law of the damping of the neutron wave
function in a medium with total internal reflection. There are
2 Soviet references.

SUBMITTED: April 3, 1959

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21(1),24(5)

SOV/56-37-2-44/56

AUTHOR: Zel'dovich, Ya. B.

TITLE: The Number of Elementary Baryons and the Hypothesis of the
              Universal Repulsion of Baryons

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959,
              Vol 37, Nr 2(8), pp 569-570 (USSR)

ABSTRACT: The author first discusses the following hypothetical experi-
              ment: neutrons are compressed to a density so as to give a
              Fermi limit energy exceeding several Mc^2. This is thermo-
              dynamically favorable to the partial conversion of neutrons
              into other baryons - protons and hyperons. In this case the
              number of independent Fermi distributions to be investigated
              is equal to the number of elementary particles. This offers
              an approach to the problem concerning the number of elemen-
              tary particles, because only truly elementary particles have
              a separate Fermi distribution. In the asymptotic expression
              for the energy of the relativistic Fermi gas $\mathcal{E} = AN^{4/3}$ holds,
              where N denotes the total density of all baryons, the coeffi-
              cient A being specified by
              $$A = \left[3(3\pi^2)^{1/3}/4\right]\nu^{-1/3}\hbar c = a\nu^{-1/3}.$$

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The Number of Elementary Baryons and the Hypothesis
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Here ν denotes the number of types of elementary particles and a the coefficient for $\nu = 1$. This offers, in principle, a possibility of determining ν. If it is insisted that each particle be denoted differently (subscript 1 and 2), actually consisting of the same fermion with different surrounding boson clouds, the increase of the energy of the system consisting of N_1 particles of the first and N_2 particles of the second type will, as compared to the Fermi energy of each individual group, appear as an apparent repulsion of these particles: $\varepsilon = a(N_1 + N_2)^{4/3} - aN_1^{4/3} + aN_2^{4/3} + V$, where V denotes the energy of apparent interaction. There arises the problem as to whether the repulsion of the nucleons observed experimentally ("hard core") at small distances is just this "apparent" interaction which is due to the fact that all baryons carry in their "interior" a common fermion - the carrier of the conserved fermion charge. Such a repulsion can be traced by an elementary example. The author investigates the collision of a proton p with a mesic atom H con-

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sisting of $p + \pi^-$. p and H are considered two different
particles, each with the spin 1/2. The wave function ψ of
the system may, after a separation of the motion of the center
of mass and the spin function , be written as follows:

$\psi (\vec{R}, \vec{\rho}) = \Phi (\vec{R}) \chi (\vec{R}, \vec{\rho})$, where $\vec{R} = \vec{r}_1 - \vec{r}_2$,

$\vec{\rho} = \vec{r}_\pi - (\vec{r}_1 + \vec{r}_2)/2$ holds. An approximate expression for χ is
written down. In reality, the action of the operator

$(-\hbar^2/2\mu)\Delta_R$ upon $\chi (\vec{R}, \vec{\rho})$ must be taken into account,
μ denoting the reduced mass of both protons. If R is small
this term contributes $E_1 = \langle \chi^* | -(\hbar^2/2\mu)\Delta_R|\chi \rangle = (\hbar^2/2\mu)2R^{-2}$.
The Schroedinger equation for Φ considering E_1 only, secures
that Φ is zero for R = 0 if Φ is a spherical symmetrical
function. When investigating the scattering of p on H the
contribution E_1 can be regarded as a strong repulsion at low
distances, after the ^3S component has been separated. E_1 is

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independent of the properties (mass and charge) of the meson.
A repulsion occurs also in the state ^1S, in the case of two
similar particles (for example two H-atoms) accompanied by
meson clouds with 1_π, but this repulsion is compensated by
the attraction in the ^3P state. When similar particles inter-
act, the short range interaction averaged properly over states
with different momenta is zero. The authors express their
gratitude to A. D. Sakharov for the discussion on the state
of matter in superdense stars, which induced the author to
this study. There is 1 reference.

SUBMITTED: May 11, 1959

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16.8100,21.5000,24.6720,24.6800,24.6810

77005
SOV/56-37-6-45/55

AUTHOR: Zel'dovich, Ya. B.

TITLE: Letter to the Editor. Mass of μ-Meson and of Electron

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki,
            1959, Vol 37, Nr 6, pp 1817-1819 (USSR)

ABSTRACT: The μ-meson, electron, and neutrino are related to
            other particles only through electromagnetic and weak
            interaction. Therefore, it was assumed that the
            masses of m_μ and m_e can be expressed by means of
            the electromagnetic interaction constant $e = 4.8 \times$
            10^{-10} $g^{\frac{1}{2}} \times cm^{3/2} \times sec^{-1}$, $e^2/\hbar c = \alpha = 1/137$, and
            through the universal constant of weak interaction
            $g = 1.41 \times 10^{-49}$ $g \times cm^5 \times sec^{-2}$, $gc/\hbar^3 = 10^{-5}/M_N^2$
            (where M_N is nucleon mass). Numerically the masses
            are

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$$m_{\mu} = 0{,}57 \sqrt{c^6 / gc^4}, \qquad m_e = 0{,}38 \sqrt{c^{10} / gc^8 \hbar^2}. \tag{1}$$

The structure of the formula can be explained by the
concept that the weak interactions proceed in the
second order through an intermediately charged bosons,
X, having spin 1 (cf., J. Schwinger, Ann. Physik, 2,
407, 1957), so that

$$\mu \quad 2g_X^2 \hbar^2 / M_X c^2, \tag{2}$$

(where, G_X is interaction constant, having dimensions
of e, of the Fermi current with X). It was assumed
that the masses of μ-meson and electron are due to
the interaction with X and the quanta with identical
dimensionless constant $G_X = e = \sqrt{1/137}$, i.e.:

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$$m_\mu = 0.40 \frac{1}{137} M_X = 0.40 \frac{e_X^2}{hc} M_X.$$

(3)

$$m_e = 0.27 \left(\frac{1}{137}\right)^2 M_X = 0.27 \left(\frac{e_X^2}{hc}\right)^2 M_X.$$

The interaction X with μ, e, and ν nullifies the
parity, and therefore this fact should be considered
in the theory of the masses, which depend on the
interaction. There are 10 references, 1 Soviet, 2
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ASSOCIATION: Inst. Theoret. and Experiment. Phys. Acad. Sciences
USSR (Institut teoreticheskoy i eskperimental'noy
fiziko Akademii nauk SSSR)

SUBMITTED: September 24, 1959   Card 3/3

5 (4), 2 (5)

AUTHORS: Rivin, M. A. (Deceased), Zel'dovich,   SOV/20-125-6-33/61
Ya. B., Academician, Tsukerman, V. A., Sof'ina, V. V.,
Beregovskiy, A. S.

TITLE: Investigation of the Density Distribution in the Detonation
Front of Gas Mixtures by the X-Ray-examination Method
(Issledovaniye raspredeleniya plotnosti vo fronte detonatsii
gazovykh smesey rentgenograficheskim metodom)

PERIODICAL: Doklady Akademii nauk SSSR, 1959, Vol 125, Nr 6,
pp 1292-1293 (USSR)

ABSTRACT: The investigation mentioned in the title was begun in 1945,
but had to be interrupted because of the illness and death of
M. A. Rivin. It was resumed in 1957. The method employed in
the present investigation uses a needle-shaped pulse tube
(Ref 10) with zirconium anode as a source, and krypton, which
is added to the detonating gas, as an absorbing medium. The
characteristic radiation of zirconium (λ_{k_α} = 0.788 Å) incides
upon the absorption band of krypton. This combination made
it possible to detect density variations in relatively thin
layers of gas mixtures. The main result is that a thin layer

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of gas, with a density that is from three to four times that of the original density, was found to exist in the front of the detonating wave. Figure 1 shows the density distribution in pure krypton and in the detonating wave of a mixture of detonating gas and krypton. The authors thank N. N. Orlova for her collaboration, Ye. I. Leont'yeva for taking part in the experiments of 1945, and R. M. Zaydel' for his assistance in carrying out calculations. There are 1 figure and 10 references, 4 of which are Soviet.

ASSOCIATION: Institut khimicheskoy fiziki Akademii nauk SSSR (Institute for Chemical Physics of the Academy of Sciences, USSR)

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