AKHIYEZER, A. I.

Akhiyezer, A. I. and Pargamanik, L. E. - "Free oscillations of the electron plasma in a magnetic pole", Uchen. zapiski Khar'k. gos. un-ta im. Gor'kogo, Vol. XXVII, Trudy Fiz. otdniya Fiz.-matem. fak., Vol. I, 1948, p. 75-104.

SO: U-3042, 11 March 53, (Letopis 'Zhurnal 'nykh Statey, No. 8, 1949).

U.A.
931

Refraction of neutrons. A. I. Akhiezer and I. Ya. Pomeranchuk (Phys.-Tech. Inst., Acad. Sci. Ukr. S.S.R., Kiev). *Zhur. Eksptl. Teoret. Fiz.* **18**, 475-8(1948).—In the case of a magnetized (paramagnetic or ferromagnetic) medium, an addn. term must be added to the potential energy in the Schrödinger equation. Expressions are obtained for the wave vectors of the neutron within the crystal showing that the refraction coeff., and also the angle of total reflection, depends on the orientation of the spin of the neutron relative to the vector of magnetic induction. This fact can be utilized to obtain a completely polarized neutron beam. N. Thon

1ST AND 2ND ORDERS 3RD AND 4TH ORDERS

PROCESSES AND PROPERTIES INDEX

N 8

1639. Contribution to the Theory of Resonance Scattering of Particles, by A. Akhiezer and I. Pomeranchuk. Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki 18, p. 603-608, July 1948. (In Russian)

It is known that the phenomenon of resonance scattering taking place at collisions between neutrons (or other particles) and atomic nuclei can be described by a resonance formula analogous to that describing the resonance interactions between light and matter. The formulas which have been given by various authors, are however, generally very complicated and not easily adaptable to a survey of the possible classes of the phenomenon. The present writers suggest a method for obtaining formulas of the cross sections of scattering based on wave-mechanical considerations of a very general character. Their formulas show that only two general classes of scattering of slow particles by nuclei are possible: (1) those in which the amplitude is the resultant of the amplitudes of the resonance and the potential scatterings, and (2) those of the type of scattering occurring from collision between slow neutrons and protons. The proposed method enables the natural introduction of the finite radius of action of nuclear forces, without special assumptions. Elastic and inelastic scatterings, cases of nuclear disintegration, and nuclear spin considerations are surveyed in succession.

989. On the non-electromagnetic interactions between electrons and neutrons. A. Akhiezer and I. Pomeranchuk. Zhur. Ekspt. i Teoret. Fiz. 19, 558-9(1949) June (in Russian) (Letter to the editor).

The asymmetry of the scattering of neutrons in xenon was attributed by Fermi and Marshall (Phys. Rev. 72, 1139(1947)) to a non-electromagnetic interaction between neutrons and electrons. However, the observed asymmetry may also be caused by the interference of waves scattered by the gas atoms. This interference is due to a correlation in the mutual arrangement of the atoms, which is determined by the fact that the distance between the centers of two atoms cannot to less than two atomic radii. Being proportional to the gas density, the interference effect is small at pressures of the order of magnitude of 1 atm, employed by Fermi and Marshall; however, the effect described by these authors is also very small. It is shown in the present note that the interference effect must be of the order of magnitude of the effect observed.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

PROCESSES AND PROPERTIES INDEX

2457 Diffraction Scattering of Fast Neutrons and Charged Particles. A. I. Akhiezer and I. Ya. Pomeranchuk. Uspekhi Fiz. Nauk 39, 155-200(1949)(in Russian).

The theory of diffraction phenomena, regarded as one of the aspects of the scattering of particles by nuclei, is given, the latter being phenomenologically treated as opaque bodies. The opacity is represented by the phenomenon of formation of excited compound nuclei, and the dependence of the opacity both on the energy of the incident particles (neutrons or charged light nuclides) and on the mass of the absorbing nuclei, is determined by statistical methods, independently of any theory of nuclear forces. After that, an optical diffraction theory of the scattering of fast neutrons is outlined, followed by a quantum-mechanical one, both leading to the same cross-section formula for the diffraction scattering of neutral particles. These considerations are generalized so as to include the diffraction of charged nuclides, viz. fast protons, deuterons, and α particles.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

A 55
Q

SA

537.533.9

377. The interaction of a beam of charged particles with electron plasma. A. I. Akhiezer and Ya. B. Fainberg. Dokl. Akad. Nauk, SSSR, 69 (No. 4) 555-6 (1949).

Phys-Tech. Inst. - Ukr. SSR acad. Sci.

METALLURGICAL LITERATURE CLASSIFICATION

W.E.,

Aerials and Transmission Lines

621.392.26* : 538.561 2335

Theory of the Excitation of Oscillations in a Waveguide by means of a Linear Aerial. A. I. Akhiezer & G. Ya. Lyubarski (*Zh. tekh. Fiz.*, Sept. 1950, Vol. 20, No. 9, pp. 1049–1064.) One of the main problems in the theory of aerials is the determination of the current distribution in an aerial to which given electromotive forces are applied. It has been shown by Leontovich & Levin (2618 of 1945) that in the case of an aerial in unlimited space the problem is reduced to the solution of a linear integrodifferential equation. A study is here presented of the current distribution in a linear aerial mounted along the axis of a cylindrical waveguide. In this case it is necessary to solve an equation of the same type as for an aerial in unlimited space. No effective methods of solving this equation for an aerial of arbitrary dimensions are known. The discussion is therefore limited to the case of a sufficiently long and thin aerial and, using a method proposed by Leontovich & Levin (2618 of 1945), an approximate solution of the equation is found by expanding the current in a series of powers of the inverse logarithm of the ratio of the length to the radius of the aerial.

The following two cases are considered separately: (*a*) when the wavelength differs considerably from the critical wavelength of the waveguide; (*b*) when this difference is not great. The current distribution in a tuned aerial differs very much from that in an aerial in unlimited space. Simple formulae for determining the amplitudes of the waves excited in the waveguide are also derived.

CA 51

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

Akhiezer, A. I., and Fainberg, Ya. B. On high frequency oscillations of an electron plasma. Akad. Nauk SSSR

[illegible] Reviews

AKHIYEZER, A. I.

USSR/Physics - Nonlinear Plasma Oscillations

11 Sep 51

"Nonlinear Theory of Oscillations of Electron Plasma," A. I. Akhiyezer, G. Ya. Lyubarskiy

"Dok Ak Nauk SSSR" Vol LXXX, No 2, pp 193-195

Solves the simplest uniform nonlinear problem: Considers the longitudinal oscillations in unbounded plasma at abs zero, with the state of the plasma characterized by the ordinarily used distribution function of electron density n(r,t). Acknowledges the interest and valued discussion of Acad L. D. Landau. Submitted by L. D. Landau 18 Jul 51.

221T86

PA 236T101

AKHIYEZER, A. I.

USSR/Physics - Plasma Oscillations Nov 52

"Oscillation of Plasma in Crossed Electrical and Magnetic Fields," A. I. Akhiyezer and R. V. Polovin

"Zhur Tekh Fiz" Vol 22, No 11, pp 1794-1802

Authors consider the interaction of a compensated beam of electrons with slow waves in crossed-over electrical and magnetic fields. Clarify the conditions that govern the instability of the beam. Cite related works of V. M. Lopukhin and S. D. Gvozdover.

236T101

/11914 AERE Lib/Trans 749

PENETRATION OF CHARGED PARTICLES THROUGH AN [illegible]

[illegible]

Vol. 23, 61 [illegible]

[illegible]

[illegible] when the particle velocities exceed the thermal velocity of the electrons in the plasma. (D.E.B.)

AKHIYEZER A.

USSR/Physics - Paramagnetism 21 Dec 52

"Paramagnetic Dispersion," A. Akhiyezer and I. Pomeranchuk

"DAN SSSR" Vol 87, No 6, pp 917, 918

Introduce definition of "magnons" (certain deviations from distribution of magnetic electron moments which are propagated in a crystal in form of a wave) and assume that they obey Fermi-Dirac statistics. Attemp to explain why susceptibility of paramagnetic dielectrics becomes independent of temp at low temps. (cf. B. Cabrera, Rep Inst Phys Solvay, 6, 183, 1932). Presented by Acad L. A. Landau 11 Oct 52.

240T94

Translated from a publication of the State Technico-Theoretical [illegible]

AKHIYEZER, A.

Radiative Corrections to the Scattering of an Electron by an Electron, A. Akhiyezer and R. Polovin. DAN SSSR Vol.90, no. 1, pp.55-57, 1953

Interaction of electron with zero oscillation of electromagnetic field and polarization of electron-positive vacuum lead to additional electron scattering in a specified external electromagnetic field. This should be considered in electron electron scattering. Corrections are computed and represented graphically. Presented by Acad. L.D.Landau, 10 Mar 53.

AKHIEZER, A.I.

Russian. English translation, [illegible]
[illegible] NSF [illegible]

USSR/Physics-Endovibrators FD-1234

Card 1/1 Pub. 153-18/22

Author : Akhieser, A. I. and Lyubarskiy, G. Ya.

Title : Theory of coupled endovibrators

Periodical : Zhur. tekh. fiz., 24, 1697-1706, Sep 1954

Abstract : Proper frequencies of two endovibrators coupled through narrow and and long slits in metallic separators are computed. The necessary field equations are derived and integrated. Indebted to Prof. K. D. Sinelnikov, P. M. Zeydlits, O. Zavgorodnyy. Six references including 2 foreign.

Institution :

Submitted : April 3, 1954

AKHIZER, A. I.

USSR/Physics - Quantum electrodynamics

Card 1/1 : Pub. 118 - 7/9

Authors : Abrikosov, A. A.; Pomeranchuk, I. Ya.; and Shmushkevich, I. M.

Title : "Quantum Electrodynamics" by A. I. Akhizer and B. B. Berestetskiy. Gosizdat, 1953, 428 p.

Periodical : Usp. fiz. nauk 53/3, 442-444, July 1954

Abstract : A monographical work by two Soviet scientists is reviewed. The monograph deals with quantum electrodynamics and is considered to be a unique and very valuable work on theoretical physics.

Institution : ...

Submitted : ...

USSR/Physics - Endovibrators FD-3134

Card 1/1 Pub. 153 - 9/19

Author : Akhiyezer, A. I.; Lyubarskiy, G. Ya.

Title : Theory of connected endovibrators. II

Periodical : Zhur. tekh. fiz., 25, No 9 (September), 1955, 1597-1603

Abstract : The authors consider the propagation of waves in a series of indentical endovibrators connected with one another by narrow and long slots for which the parameter a = 1/(ln[L/d]) is considerably less than unity, where L is the length and d is the width of the slot. In the series it is possible then to have the propagation of both endovibratorial and also slot waves whose length is determined by the length of the slot. The pass band in both cases is proportional to the above parameter alpha, excluding the case of resonance between endovibrator and slot waves, when the band remains proportional to the square root of alpha. The displacement of frequency in the absence of resonance both for endovibrator waves and also for slot waves is proportional to parameter alpha and this frequency shift is a linear function of the cosine of psi, the shift in phases between the oscillations in two adjacent endovibrators. In the case of resonance the displacement in frequency is proportional to the square root of the linear function of cosine of psi multiplied by parameter alpha. The authors thank K. D. Sinel'nikov, Ya. B. Faynberg, and P. M. Zeydlits, and O. Zavgorodnyy. One reference: ibid., 24, 1697, 1954.

Submitted : April 1, 1955

I

USSR / Radiophysics

Abs Jour : Ref Zhur - Fizika, No 4, 1957, No 9918

Abstract : in that case when the undisturbed beam velocity exceeds a certain critical value. The smaller the coupling between the resonators, the smaller this velocity. Thus, in a chain of resonators it is possible to propagate a space-charge wave and electromagnetic waves with increasing amplitudes. It is shown that as regards the character of the propagating waves, the resonator chain with a beam is analogous to a waveguide filled with dielectric, through which a beam of particle passes.

A connection is established between the increasing waves of the field and the space charge density and the Cherenkov radiation of each individual particle.

Card : 2/2

AKHIYEZER, A.I.

Akhiezer A. I. [illegible]

On the radiation of [illegible]

[illegible] resonators

[illegible]

connected with the moving [illegible]

AKHIYEZER, A.I.; SITENKO, A.G.

Charge-field interactions in cavity resonators. Uch.zap. KHGU 64 no.6:5-7 '55. (MLRA 10:7)
(Electrons) (Electric fields)

Akhiyezer, A.I.

C-5

Category : USSR/Nuclear Physics - Nuclear Reactions

Abs Jour : Ref Zhur - Fizika, No 3, 1957, No 6057

Author : [redacted], Sotenko, A.G.

Title : Concerning the Theory of the Deuteron Splitting Reaction.

Orig Pub : Uch. zap. Khar'kovsk. u-nt, 1955, 64, 9-12

Abstract : If the change in the momentum of a deuteron is sufficiently large, as a result of diffraction scattering of rapid deuterons by a nucleus, deuteron splitting is possible. The cross section of the diffraction splitting is approximately πRR_d, i.e., of the same order as the cross section of the deuteron break-up, observed by Serber (Serber, R., Physical Review, 1947, 72, 1008). Using the known expression for the amplitude of the nuclear reaction

$$\nu = -2(M/4\pi\hbar^2)\int \Psi_p(r_p)\,\Psi_n(r_n)\,\Psi_d(r_n r_p) \times$$

$$\times V(r_n - r_p)\,dr_n\,dr_p \ldots (e^{-\alpha p/\beta})\psi(r)\ldots =$$

and replacing Ψ_p, Ψ_n, and Ψ_d = ... by the wave function describing the $r_n - r_p$, $r = (r_n + r_p)/2$, by the wave function describing the diffraction of protons, neutrons, and deuterons, respectively

Card : 1/2

AKHIYEZER, A. I.

H-7

Category : USSR/Electronics - Gas Discharge and Gas-Discharge Instruments

Abs Jour : Ref Zhur - Fizika, No 1, 1957, No 1709

Author : Akhiyezer, A.I., Lyubarskiy, G.Ya.

Title : On the Stability of the Distribution Function of Electron Plasma.

Orig Pub : Uch. zap. Khar'kovsk. un-ta, 1955, 64, 13-16

Abstract : An investigation was made of the stability of the stationary state in electron plasma in response to small disturbances. It was established that any monotonically decreasing energy-distribution function is stable with respect to small disturbances of the field and of the density. It is also shown that an electron beam of low density is unstable in the plasma for all electron velocities in the beam and for any dependence of the plasma electron distribution functions on the energy.

Card : 1/1

AKHIYEZER, A. I.

USSR/Nuclear Physics - Nuclear Reactions, C-5

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 34054

Author: Akhiezer, A. I., Sitenko, A. G.

Institution: Khar'kov University, Khar'kov, USSR

Title: On the Theory of the Nuclear Photoeffect

Original Periodical: Uch. zap. Khar'kovsk. un-ta, 1955, 64, 67-72

Abstract: It is shown that in addition to the process of evaporation of the nucleon from the nucleus and of the photoeffect by an individual nucleon, the photonucleons can also be produced by the following mechanism: the additional nucleon interacts with the surface oscillations of the nucleus, which interact in turn with the electromagnetic wave (interaction of the quadrupole moment of the nucleus with the electromagnetic field of the wave). Using perturbation theory, the authors obtain an approximate expression for the cross section of the quadrupole photonuclear effect. The ratio of the cross section of the quadrupole transition to the cross section of the dipole transition is $\frac{\sigma^q}{\sigma^d} \approx \frac{1}{5}\left(\frac{Z}{A-Z}\right)^2 \left(\frac{w}{w+w_2}\right)^2 \left(\frac{w}{w_2}\right)^2 \left(\frac{\hbar w}{Mc^2}\right)^2 A^{2/3}$, where $\hbar w$ is the

USSR/Nuclear Physics - Nuclear Reactions, C-5

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 34054

Author: Akhiezer, A. I., Sitenko, A. G.

Institution: Khar'kov University, Khar'kov, USSR

Title: On the Theory of the Nuclear Photoeffect

Original Periodical: Uch. zap. Khar'kovsk. un-ta, 1955, 64, 67-72

Abstract: energy of the incident photon and $\hbar w_2$ is the difference between the nearest levels of the residual nucleus. If A ~ 100 and $\hbar w_2 \sim$ 2-3 Mev, then at $\hbar w$ = 17.5 Mev this ratio will be on the order of 0.1-0.05.

AKHIYEZER, A.I.; LYUBARSKIY, G.Ya.; FAYNBERG, Ya.B.

[redacted] Nonlinear theory of oscillations in plasma. Uch.zap. KHGU 64 no.6:73-80 '55. (MLRA 10:7)

(Electric discharges through gases)

AKHIYEZEN, A.

USSR/Physics

Card 1/1 Pub. 22 - 17/54

Authors : Akhiyezen, A., and Polovin, R.

Title : About the relativistic oscillations of plasma

Periodical : Dok. AN SSSR 102/5, 919-920, June 11, 1955

Abstract : Questions connected with the relativistic oscillations of plasma are analysed. The analysis is accomplished in view of the Maxwell electromagnetic equations for the electric (E) and magnetic (H) fields. Only the longitudinal oscillations of the plasma are considered. One USSR reference (1951).

Institution : ....

Presented by : Academician L. D. Landau, February 26, 1955

AKHIYEZER, A.

1964

ON SOME EFFECTS RESULTING FROM THE INTERACTION OF THE ELECTROMAGNETIC FIELD WITH THE VACUUM OF SCALAR CHARGED PARTICLES. A. Akhiezer, V. Aleksin, and D. Volkov. Doklady Akad. Nauk S.S.S.R. 104, 830-3(1955) Oct. 21. (In Russian)

The interaction of the electromagnetic field with electron-positron vacuum leads to changes in Coulomb's law and to a series of non-linear effects (scattering of light by light, nuclear coherent scattering of γ rays, etc.). Studies of this effect in the electrodynamics of a particle with zero-spin are made. (R.V.J.)

AKHIYEZER, A. I. (Khar'kov)

"Theory of Relaxation and Kinetic Processes in Ferrodielectrics at Low Temperatures," paper presented at the International Conference on Physics of Magnetic Phenomena, Sverdlovsk, USSR, 23-31 May 1956.

AKHIYEZER, A. I. and SITENKO, A. G.

"On the Diffractional Disintegration and Scattering of Fast Neutrons by Nuclei"
and
"Note on Nuclear Photo Effect" papers presented at the International Conference on Nuclear Reactions, Amsterdam, 2-7 July 1956.

D551274

Distr: 4E4b

or extension of the usual theory ...

This error, which appears ...

Teoret. Fiz. 30 (1956), 915–928) seems to be fundamental

soluble for H, while in the form given the right hand side

9437. ON PLASMA OSCILLATIONS IN AN EXTERNAL FIELD 1/A I Akhiezer and A G Sitenko.

... authors find ...

... T ... the temperature ...

... masses respectively ...

H

USSR /Electronics

Abs Jour : Ref Zhur - Fizika, No 4, 1957, No 9816

Abstract : plasma. For a plasma without external magnetic field, it is shown that the sollutions obtained are equivalent to the motion of an unrelativistic particle of unit mass in a field with a potential energy determined in this article. On the basis of the general equations, the authors consider in greater detail the following plasma motions: small oscillations of plasma (in the first and second approximation), longitudinal oscillations without limitation of the oscillation amplitudes, where the dependence of the period of such oscillations on the amplitude of the velocity is found; transverse oscillations, which have purely circular polarization, and particular cases of coupled longitudinal-transverse oscillations with types of polarizations that are unique to them. The frequencies of all the types of oscillations considered are determined.

Card : 2/2

2653

BY NUCLEI. A. I. Akhiezer and A. G. Sitenko (Gor'kii Kharkov State Univ.) Doklady Akad. Nauk S.S.S.R. 107,

(In Russian)

scattering

AKHYEZER, A. I., FAYNBERG, Ya. B., LYUBARSKIY, G. Ya.

"Cerenkov Radiation and the Stability of Beams in the Wave Guides of Slow Waves used in Linear Accelerators," paper presented at CERN Symposium, 1956, appearing in Nuclear Instruments, No. 1, pp. 21-30, 1957

56-4-20/52

AUTHOR AKHIYEZER, A.I., SITENKO, A.G.

TITLE On the Diffraction Scattering of Fast Deuterons By Nuclei
(O diffraktsionnom rasseyanii bystrykh deytonov yadrami. Russian)

PERIODICAL Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol 32, Nr 4, pp 794 - 805 (U.S.S.R.)

ABSTRACT The paper under review determines the cross sections of the elastic scattering and of the diffraction spallation of fast deuterons by absolutely black nuclei. It also determines the energy distribution of the spallation products. It is possible to determine the diffraction scattering of punctiform by absorbing nuclei with the aid of the optical method using the Huygens principle. In order to generalize this method for deuterons, the authors of the paper under review first of all investigate the problem of the diffraction scattering of punctiform particles by absorbing nuclei. This method of investigation permits to make the generalization for the case of the diffraction scattering of composed particles with weak coupling, e.g. of deuterons by absolutely black nuclei. In this context it is necessary to take into account the motion of the centers of mass of the deuterons as well as the relative motions of the neutron and of the proton in the deuteron.
The paper under review proceeds to derive expressions for the differential and for the integral cross section of the elastic scattering and of the diffraction spallation, and also an expression for the inte-

Card 1/2

56-4-25/52

AUTHOR AKHIYEZER, A.I., KAGANOV, M.I., LYUBARSKIY, G.Ya.

TITLE On the Absorption of Ultrasonics in Metals
(O pogloshchenii ul'trazvuka v metallakh. Russian)

PERIODICAL Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol 32, Nr 4, pp 837 - 841 (U.S.S.R.)

ABSTRACT When investigating the absorption of sound vibrations in solid bodies, we have to distinguish between two cases. - (a) the frequency of the sound vibrations ω is considerably higher than the reciprocal value of the relaxation time τ; (b) $\omega \ll 1/\tau$. In this first case ($\omega\tau \gg 1$) it is possible to treat the absorption of sound as an absorption of sound quanta with the energy $\hbar\omega$ and with the impulse $\hbar \vec{k}$ ($\vec{k}$ denotes the wave vector of the sound wave). This absorption takes place as result of the collisions of the sound quanta with the quasi-particles characterising the energy spectrum of the solid body, i.e. in the usual dielectric media with the phonons, and in the metals with electrons and phonons. In the second case ($\omega\tau \ll 1$) the sound vibrations may be viewed as a certain external field in which the gas of the quasi-particles is situated and which modulates the energy of these particles.

The paper under review investigates the absorption of sound in the metals at low temperatures. In this case the rôle played by the phonons is unimportant as their number tends towards zero in proportion to T^3 if the temperature is reduced. The absorption of sound is caused by the

Card 1/2

56-4-25/52

On the Absorption of Ultrasonics in Metals

interaction of the sound wave with the conduction electrons. It is possible that also the experimentally observable difference of coefficients of absorption of ultrasound in metals in their normal and in their superconductive state is connected with this phenomenon. First of all the paper under review discusses the case $\omega\tau \ll 1$. In this context, the changes of the distribution function of the electrons with respect to time and space are essential. The sound field alters the energy of the electrons, and thus also the chemical potential μ and the temperature T are altered. In the metals, heat conductance has at low temperatures no considerable influence on the dissipation of the energy. This dissipation is mainly caused by a "friction" of the electron gas. It is possible to neglect the appearing magnetic field and to consider the electrical field as longitudinal. With the aid of the equation which is obtained by linear approximation it then is possible to determine the dissipation of the energy.

ASSOCIATION Physical-Technical Institute, Academy of Sciences of the Ukrainian SSSR

PRESENTED BY

SUBMITTED 3 April 1956

AVAILABLE Library of Congress

Card 2/2

AKHIYEZER, A.I.

56-3-29/59

AUTHORS: Akhiyezer, A.I., Prokhoda, I.G., Sitenko, A.G.

TITLE: On the Scattering of Electromagnetic Waves in a Plasma (O rasseyanii elektronagnitnykh voln v plazme)

PERIODICAL: Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol. 33, Nr 3, pp. 753-757 (USSR)

ABSTRACT: For the propagation of electromagnetic waves in the plasma a combined scattering of the wqves by the density oscillations of the plasma is possible. The combined scattering is due to the fact that in the plasma a weakly damped electromagnetic oscillation may occur which is coupled with the variation of density of the plasma. The frequency of these oscillations is given by

$$\Omega = \sqrt{4\pi n_0 e^2/m}.$$

These oscillations lead to a periodical variation of the dielectric constant of the plasma. The intensity of the combined scattering of the electromagnetic field waves in the plasma is theoretically derived with and without the exterior homogeneous magnetic field. There are 4 Slavic references.

ASSOCIATION: Khar'kov State University (Khar'kovskiy gosudarstvennyy universitet)

AVAILABLE: Library of Congress
SUBMITTED: March 18, 1957

Card 1/1

AKHIYEZER, A.I.

56-3-31/59

AUTHORS: Akhiyezer, A.I., Rozentsveyg, L.N., Shmushkevich, I.M.

TITLE: On the Scattering of Electrons by Protons (O rasseyanii elektronov protonami)

PERIODICAL: Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol. 33, Nr 3, pp. 765-772 (USSR)

ABSTRACT: It is demonstrated theoretically that also in the case of most general conditions prevailing the scattering of electrons by protons can be represented by two real functions $a(q^2)$ and $b(q^2)$ of the invariant $q^2 = (p_1 - p_2)^2$. p_1 and p_2 is the fourdimensional electron momentum before and after the collision. Since the terms a and b do not depend on q^2 an unlimited number of experiments independent of each other exist from which in the case of fixed q^2 a and b can be computed. If the comparison of the results for the determination of a and b leads to contradictions in the case of high electron energies it is an important indication that the theory developed is not applicable for high energies. There are 5 figures.

SUBMITTED: March 21, 1957.

Card 1/1

AKHIYEZER, A.I.

56-4-31/54

AUTHORS: Akhiyezer, A.I., Sitenko, A.G.,

TITLE: On the Theory of Evaporation Reactions at High Energies (K teorii raaktsii sryva pri vysokikh energiyakh)

PERIODICAL: Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol. 33, Nr 4, pp. 1040 - 1042 (USSR) (Letter to the Editor)

ABSTRACT: The effective cross section of an evaporation is theoretically dervied, when the generally made assumption $R \gg R_d$ is not valid. (R = the radius of the nucleus to be split, R_d = the radius of the deuteron). The reaction is treated in which a neutron becomes free and a proton is absorbed. The total effective cross section for the evaporation reaction is determined to

$$\sigma_n = \pi R^2 \left\{ 1 - 2 \int_0^\infty \frac{p}{\xi} \operatorname{arc\,tg} \frac{\xi}{p} \cdot \frac{J_1^2(\xi)}{\xi} d\xi \right\},$$

whereas the following was found for the absorption of a deuteron:

$$\sigma_a = 2 \pi R^2 \int_0^\infty \frac{p}{\xi} \operatorname{arc\,tg} \frac{\xi}{p} \cdot \frac{J_1^2(\xi)}{\xi} d\xi.$$

~~Card 1~~/2

Khar'kov State Univ, Physico-Tech Inst AS UkrSSR

...Y NUCLEI. A. I. ... [illegible] June 15 ...

... (U.S.S.R.) ... Phys. Rev. 106, 1334-40(1957) ... and the differen...

... [illegible] ...

... [illegible] ... the ...

... [illegible] disintegration products is ...

energy spectrum of the disintegration products ... the radii of the nu...

For R = R ... (where R and R ... are the radii of the ... [illegible]

AKHIYEZER, A. I. and FEYNBERG, Ya. B.

"Theoretical Research on High-Frequency Properties of Plasma and Magnetohydro-Dynamic Shock Waves."

paper to be presented at the 2nd UN Intl. Conf. on the peaceful uses of Atomic Energy, Geneva, 1 - 13 Sept 58.

AKHIYEZER, A.I.

S/058/60/000/006/004/040
A005/A001

26.2312

Translation from: Referativnyy zhurnal, Fizika, 1960, No. 6, p. 30, # 13142

AUTHORS: Sinel'nikov, K.K., Zeydlits, P.M., Nekrashevich, A.M., Bolotin, L.I., Shutakever, Ya.S., Akshanov, B.S., Kovpak, N.Ye., Leontovich, K.A., Akhiyezer, A.I., Lifshits, I.M., Faynberg, Ya.B., Rosentsveyg, L.N., Lyubarskiy, G.Ya., Kaganov, M.I., Pargamanik, L.E.

TITLE: A 20.5-Mev Linear Proton Accelerator

PERIODICAL: Tr. Sessii AN UkrSSR, po mirn. ispol'zovaniyu atomn. energii, Kiyev, AN UkrSSR, 1958, pp. 5-15

TEXT: The physical substantiation of the parameter choice is presented and the design of a linear proton accelerator with a drift tube at 20.5 Mev energy is described; the accelerator was constructed in the Fiziko-tekhnicheskiy institut AN UkrSSR (Institute of Physical Engineering of the AS UkrSSR). The main computational data of the accelerator are the following: the operational wave length is $\lambda = 215$ cm; the injection energy is 1.7 Mev; the length of the accelerator is 1,446.8 cm; the synchronous phase is 20°; the length of the first half-tube is 4.875 cm; that of the last one is 16.725 cm; the length of the first gap is

Card 1/2

3.380 cm; that of the last one is 11.150 cm; the length of the first drift tube is 0.145 cm; that of the last one is 32.955 cm. Altoghether, the number of drift tubes is 50, that of the half tubes is 2; the acceleration system begins and ends with the latter. At the entrance of every drift tube, focusing grids are fixed consisting of parallel tungsten wires of 0.07 mm thickness; their total geometric transmittance amounts to 30%. The drift tubes are installed within the resonator by means of a suspension system; the resonator is made as a 1,446.8-cm long regular 16-face prism. The resonator is fed from 20 h.f. generators. The Q-factor of the resonator in the loaded state is equal to $6.5 \cdot 10^4$ in consequence of which the h.f. power needed for accelerating particles to the rated energy amounts to 1.2 Mw. An electrostatic generator operating by pulses with the pulse duration of 500 μ sec at about 1 ma current intensity and 1.7 mv voltage serves as proton injector. The principal circuit and the design of the individual accelerator units are presented.

ASSOCIATION: Fiz.-tekhn. in-t AN UkrSSR (Physico-Engineering Institute of the Ukrainian Academy of Sciences)

A.P. Fateyev

Translator's note: This is the full translation of the original Russian abstract.

Card 2/2

AKHIYEZER, A.I.

84096

S/058/60/000/006/003/040
A005/A001

26.2340

Translation from: Referativnyy zhurnal, Fizika, 1960, No. 6, p. 29, # 13140

AUTHORS: Sinel'nikov, K.D., Zeydlits, P.M., Grishayev, I.A., Kitayevskiy, L.Kh., Akhiyezer, A.I., Faynberg, Ya.B., Selivanov, N.P., Khizhnyak, N.A.

TITLE: An Electron Accelerator With 3.5 Mev Output Energy

PERIODICAL: Tr. Sessii AN UkrSSR po mirn. ispol'zovaniyu atomn. energii, Kiyev, AN UkrSSR, 1958, pp. 16-23

TEXT: The authors describe a linear electron accelerator with a travelling wave of 3.5 Mev energy. A waveguide loaded with disks is used as accelerating system. The necessary law of wave phase velocity variation is brought about by variation of the diameter of the apertures in the disks. The 280-cm long waveguide is divided into three sections. In the first section, the phase velocity is varied from 0.5 to 0.97 c; in the second and third section it is equal to 0.98 and 0.99 c respectively. The electron equilibrium phase increases during the acceleration process; its initial value is equal to 45° and is chosen according to the optimum capture condition. The computational value of the h.f. power at the

Card 1/2

accelerator input is 900 kw; the accelerator field intensity amounts hereat to 16.5 kv/cm. The accelerator output power (about 600 kw) is absorved in a steel load with water cooling; approximately 300 kw are dissipated in the waveguide walls. An additional axisymmetrical magnetic field with an intensity up to 400 Oe is developed by solenoids for focusing the electrons along the waveguide axis. An electron gun with three electrodes serves as electron source; it operates pulsing synchronously with the magnetron generator and provides for a beam of 5-6 mm diameter at the accelerator input. The output parameters of the accelerator measured are: the current is about 20-30 ma in the pulse of 2 μsec duration, the average current is about 20-30 μa; the beam diameter is 3-4 mm with the divergence angle of 7.10^{-4} - 3.10^{-3} radian; the energy beam half-width is about 8%.

ASSOCIATION: Fiz.-tekhn. in-t AN UkrSSR (Physico-Engineering Institute of the Ukrainian Academy of Sciences)

A.Z. Fateyev

Translator's note: This is the full translation of the original Russian abstract.

Card 2/2

Akhiyezer, A.I.

82128
S/058/60/000/02/13/023

21.1700

Translation from: Referativnyy zhurnal, Fizika, 1960, No. 2, p. 73, # 3070

AUTHORS: Akhiyezer, A. I., Akhiyezer, N. I., Lyubarskiy, G. Ya.

TITLE: The Effective Boundary Condition on the Interface of a Multiplying and Moderating Medium

PERIODICAL: Tr. Sessii AN UkrSSR po mirn. ispol'zovaniyu atomn. energii. Kiyev, AN UkrSSR, 1958, pp. 107-115

TEXT: The distribution of thermal neutrons in a multiplying medium is described by the diffusion equation: $\Delta N_+ + N_+/\lambda^2 = 0$, where $\lambda = L_+/\sqrt{K-1}$, L_+ is the diffusion length, K is the coefficient of multiplication. In a certain region near the boundary of the multiplying medium with a reflector, Equation (1) is not applicable and yields an incorrect expression for N_+. If dimensions of the multiplying medium surpass the thickness of this layer considerably and if the distribution of the neutrons near the boundary is without interest, Equation (1) can be used for solving boundary problems by introducing the effective boundary condition which compensates the incorrectness of the shape of the curve N_+ (x, y, z) near the boundary. In the general case of a boundary of arbitrary shape this condition can be expressed in the form

Card 1/4

82138
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The Effective Boundary Condition on the Interface of a Multiplying and Moderating Medium

$\partial N_+/\partial \nu = -(b_\infty/a_\infty)\, xN_+/L_+$, where ν is the direction of the inner normal to the boundary surface, a_∞ and b_∞ are coefficients which are chosen in such a way that the asymptotic bahavior of N_+ should coincide with that obtained from the solution of the kinetic equation. An infinitely extended medium is considered which is divided by the plane x = 0 into two parts: the left semi-infinite space filled with the moderator, and the right one filled with the multiplying medium. The moderating properties of both media are considered to be equal and K = 1. The density n of the superthermal neutrons formed as a result of the moderation of fast neutrons is expressed by the authors in conformity with the age theory. H is assumed that neutrons with an initial energy (age $\tau = 0$) are distributed according to the law $n(x,0) = \varepsilon N_+(x)$ at $x > 0$, $n(x,0) = 0$ at $X < 0$ (ε is a certain coefficient). Then the densities of thermal neutrons in the left and right semi-infinite spaces N_- and N_+ satisfy a system of integro-differential equations of the second order: $d^2N_\pm/dx^2 = \beta_\pm^2 N_\pm - (\varepsilon\gamma/2\sqrt{\pi\tau_0})\, I$, $I = \int_0^\infty N_+(x')\exp[-(x-x')^2/4\tau_0]\, dx'$. Applying a method close to Wiener-Hopf's method the authors succeeded in finding the ratio a_∞/b_∞ in the form of quadratures; for small τ/L_+ ratios a simple analytical expression was found. In the appendix the mathematical apparatus used is applied to a more general integro-differential equation.

Card 2/2

A. Ya. Temkin

AKHIYEZER, O.I.; SITENKO, O.G. [Sytenko, O.H.]

Diffraction nuclear processes at high energies. Ukr.fiz.zhur. no.1:16-34 Ja-F '58. (MIRA 11:4)

1.Fiziko-tekhnichniy institut AN URSR.
(Collisions (Nuclear physics)

AKHIYEZER, A.I. [Akhiiezer, O.I.]; LYUBARSKIY, G.Ya.[Liubars'kyi, H.IA.];
POLOVIN, R.V.

Simple waves in magnetohydrodynamics [with summary in English].
Ukr.fiz.zhur. 3 no.4:433-438 Jl-Ag '58. (MIRA 11:12)

1. Fiziko-tekhnicheskiy institut AN USSR i Khar'kovskiy gosudarstvennyy institut.
(Magnetohydrodynamics)

AKHIYEZER, A.I.; POMERANCHUK, I.Ya.

Diffraction phenomena during collisions of fast particles with nuclei.
Usp. fiz. nauk 6 no.4:593-630 Ag '58. (MIRA 11:10)
(Collisions (Nuclear physics))

SOV/126-6-5-28/43

AUTHORS: Akhiyezer, A. I., Bar'yakhtar, V. G. and Kazanov, M.I.

TITLE: On the Problem of the Ferromagnetic Resonance Line Width (K voprosu o shirine linii ferromagnitnogo rezonansa)

PERIODICAL: Fizika Metallov i Metallovedeniye, 1958, Vol 6, Nr 5, pp 932-934 (USSR)

ABSTRACT: Kittel and Herring (Ref 5) and Ament and Rado (Ref 6) showed that the exchange interaction may broaden the ferromagnetic resonance lines if the magnetic moment is not uniform. Such a non-uniformity does in fact occur in ferromagnetic metals due to the skin effect. The present paper estimates the magnitude of broadening (γ_e) of the ferromagnetic resonance lines due to the exchange interaction. The value of γ_e is given as a function of the parameters of the ferromagnetic and of the frequency ω in Eq (5). The symbols used in Eq (5) have the following meanings:

θ_c is the Curie temperature in ergs,

a is the lattice constant,

c is the velocity of light

Card1/2

On the Problem of the Ferromagnetic Resonance Line Width

σ is the electrical conductivity
γ_r is the broadening due to relaxational processes,
g is the gyromagnetic ratio,
M_0 is the magnetic moment at saturation and
B_0 is the magnetic flux density at saturation.

The total broadening γ is given by $\gamma = \gamma_e + \gamma_r$.

The results obtained are generalised to the case of the anomalous skin effect at low temperatures. The expressions for γ_e^a (which is the value of γ_e in the case of the anomalous skin effect) and γ_r are then given by Eq (6), where ℓ is the mean free path of electrons. Comparison of Eqs (6) and (5) shows that γ_e^a is much smaller than γ_e. Dependence of $\gamma = \gamma_e + \gamma_r$ on temperature is given in Fig.1. The total broadening γ is seen to have a minimum, but this can be observed only in very pure samples.

Card2/2 Physics-Tech Inst AS UkrSSR

SOV/56-34-5-31/61

AUTHORS: Akhiyezer, A. I., Shishkin, L. A.

TITLE: On the Theory of Thermal Conductivity and Absorption of Sound in Ferromagnetic Dielectrics (K teorii teploprovodnosti i pogloshcheniya zvuka v ferromagnitnykh dielektrikakh)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol. 34, Nr 5, pp. 1267 - 1271 (USSR)

ABSTRACT: In this paper the determination of the temperature dependence of the heat conductivity and of the absorption coefficient of sound in ferromagnetic dielectrics is investigated. In ferromagnetic dielectrics the elementary excitations are not only represented by phonons but also by spin waves. Therefore the investigation of the influence of the spin waves on heat conductivity and absorption of sound in these materials is of interest. The authors show that at low temperatures the heat conductivity of an unlimited ferromagnetic dielectric without admixtures is determined essentially by the interaction of the spin waves with each other and with the phonons. The dissipation function of the ferromagnetic dielectric will, if an external sonic field

Card 1/3

at low temperatures is present, also be determined by the interaction of the spin waves among each other; it will be independent of the temperature. (In the case of common dielectrics it is inversely proportional to the temperature). The following elementary interaction processes in the system of the spin waves and phonons which are considered are the most important ones: Transformation of two phonons into one phonon, transformation of two spin waves into one spin wave, the scattering of a spin wave by a phonon, and the transformation of two spin waves into one phonon. Expressions for the probability of these processes are written down. Subsequently the authors write down and explain the kinetic equations for the distribution functions of the spin waves and phonons with regard to these interaction processes. These equations are specialized for low temperatures. Expressions for the heat currents, caused by the phonons and spin waves, are given. In the last section the absorption of sound in a ferromagnetic dielectric is investigated. On this occasion the deviations of the distribution functions of the phonons and spin waves from their equilibrium values must be found and the increase

On the Theory of Thermal Conductivity and Absorption of Sound in Ferromagnetic Dielectrics SOV/56-34-5-31/61

of the entropy of the crystal, which is connected with these deviations, must be determined. The influence of the sound field on the phonons and spin waves is reduced to a change in the energy of the phonon and of the spin wave. At $T \ll \Theta^2/\Theta_c$ the absorption of the sound is caused mainly by the spin waves. The authors express their gratitude to M.I.Kaganov for valuable discussions. There are 4 references, 3 of which are Soviet.

ASSOCIATION: Khar'kovskiy gosudarstvennyy universitet (Khar'kov State University)

SUBMITTED: December 12, 1957

Card 3/3

SOV/56-35-1-16/59

AUTHORS: Akhiyezer, A. I., Sitenko, A. G.

TITLE: On the Theory of the Excitation of Hydromagnetic Waves (K teorii vozbuzhdeniya gidromagnitnykh voln)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol. 35, Nr 1, pp. 116 - 12o (USSR)

ABSTRACT: In conductive liquids located in an external magnetic field hydromagnetic and magneto-acoustic waves are able to propagate (Ref 1). Lundquist (Lundkvist) (Ref 2) investigated the behavior of hydromagnetic waves in a liquid (Hg) during the mechanical excitation of waves by means of a revolving disk. It is, finally, possible to excite hydromagnetic waves by means of external variable currents. In the present paper the latter possibility is theoretically investigated, and the intensity of excitation is compared with that attained by mechanical means. First, a perfectly conductive compressible liquid is assumed to exist, which is located in an external magnetic field and is subjected to the action of external currents. The initial equations for the following deliberations are the hydrodynamic basic equations as well as Maxwell's (Maksvell) equations.

Card 1/2

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$\vec{v}(\vec{r},t)$ is here set up as Fourier (Fur'ye) integral, and also for the current density $\vec{j}_0(\vec{k},\omega)$ the Fourier components are written down; the wave equation in the perfect liquid and, further, an expression for the intensity are derived. Furthermore, an expression is also derived for the intensity of excitation as well as for the velocity of the propagation of the hydromagnetic waves in consideration of a damping, by basing on the assumption that the liquid possesses only finite conductivity and is viscous. There are 2 references, 1 of which is Soviet.

ASSOCIATION: Fiziko-tekhnicheskiy institut Akademii nauk Ukrainskoy SSR (Physico-Technical Institute, AS Ukrainskaya SSR)

SUBMITTED: January 29, 1958

AUTHORS: Akhiyezer, A. I., Bar'yakhtar, V. G., Peletminskiy, S. V. SOV/56-35-1-31/59

TITLE: Coupled Magnetoelastic Waves in Ferromagnetics and Ferroacoustic Resonance (Svyazannyye magnitouprugiye volny v ferromagnetikakh i ferroakusticheskiy rezonans)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol. 35, Nr 1, pp. 228-239 (USSR)

ABSTRACT: A deviation of the magnetic moment of ferromagnetics or Seignette electrics from the equilibrium value (at a given temperature) propagates in form of waves, the dispersion characteristics of which do not differ from those of spin waves (Ref 1). In elastically deformable ferromagnetics an interaction between magnetic and elastic waves occurs as a result of magnetostriction and the ponderomotoric forces (caused by spontaneous magnetization). In the present paper the authors develop a phenomenological theory of these phenomena and determine the velocities of sound in ferromagnetics in dependence on magnetization and the applied magnetic field strength, the absorption coefficient in dependence on elec-

Card 1/2

tric conductivity and the relaxation of the magnetic moment, and finally they discuss the possibility of exciting magnetic waves with the aid of ultrasonics (as a result of resonance). The paper is divided into individual sections which deal with the following problems in the following order: Free energy of ferromagnetics; introduction of Maxwell's equations; the dispersion properties of magnetic waves; the absorption of magnetic waves as a result of limited conductivity and of relaxation processes; the case $\lambda \ll gM_0$; coupled and magneto-acoustic waves in ferromagnetics; coupled magneto-acoustic waves with $\lambda = 0$; coupled magneto-acoustic waves for the limiting case of high conductivity $\sigma \gg \omega c^2/c_t^2$; determination of the phase velocity of sound vibrations at $\vartheta = 0$; determination of the absorption coefficients of magneto-acoustic vibrations; disturbance of magnetic waves by external sound-fields. In conclusion, the authors thank L.D. Landau, Academician, and M.I. Kaganov for their advice and discussions.

There are 8 references, 6 of which are Soviet.

24(3), 10(4) SOV/56-35-3-25/61

AUTHORS: Akhiyezer, A. I., Lyubarskiy, G. Ya., Polovin, R. V.

TITLE: On the Stability of Shock Waves in Magnetohydrodynamics (Ob ustoychivosti udarnykh voln v magnitnoy gidrodinamike)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol 35, Nr 3, pp 731-737 (USSR)

ABSTRACT: The present paper aims at investigating the stability of plane magnetohydrodynamic shock waves against minor disturbances in dependence on the distance to the explosion front and on time. It is shown that magnetohydrodynamic shock waves become instable and may be split up into several shock waves if the number of magnetohydrodynamic, magnetosound-, and entropy waves leaving the explosion front is different from six. The method of investigation is then described. By basing on the system of equations (1) $\sum_{k=1}^{n}\left\{X_{ik}(u)\frac{\partial u_k}{\partial x} + T_{ik}(u)\frac{\partial u_k}{\partial t}\right\} = 0$; $i = 1,2,\dots n$, where u_k is the total of hydrodynamic quantities (velocity v, magnetic field H, density ϱ, entropy s); $X_{ik}(u)$ and $T_{ik}(u)$ are

Card 1/3

SOV/56-35-3-25/61

On the Stability of Shock Waves in Magnetohydrodynamics

functions of $u_1, u_2, \ldots u_n$; x is the distance to the explosion front, and t denotes the time. (1) is, in the following, linearized for u_{1k} and u_{2k}, and the system of equations (2) thus obtained is solved. Investigation of stability of shock waves is based on Syrovatskiy's (Ref 2) assumption that in magnetohydrodynamics there are seven types of onedimensional plane waves: 1) magnetohydrodynamic waves with the phase velocities $v_x - V_x$, $v_x + V_x$, where $V_x = H_x/\sqrt{4\pi\varrho}$; 2) magnetic sound waves with the phase velocities $v_x - u_-$, $v_x + u_-$, $v_x - u_+$ and $v_x + u_+$, where $u_\pm^2 = \frac{1}{2}\left[V^2 + c^2 \pm \sqrt{(V^2 + c^2)^2 - 4c^2V_x^2}\right]$, $\vec{V} = \vec{H}/\sqrt{4\pi\varrho}$ (c = velocity of sound); 3) entropy waves the phase velocity of which coincides with the velocity of the liquid v_x. It holds that (8): $u_- \leq V_x \leq u_+$. In the following it is shown what waves show convergence and divergence respectively at what phase velocities. Stability is obtained only in the following 3 cases:

Card 2/3

SOV/56-35-3-25/61

On the Stability of Shock Waves in Magnetohydrodynamics

$$\begin{array}{lll} A) & u_{-1} < v_{1x} < V_{1x}, & v_{2x} < u_{2-} \\ B) & V_{1x} < v_{1x} < u_{1+}, & u_{2-} < v_{2x} < V_{2x} \\ C) & u_{1+} < v_{1x} & V_{2x} < v_{2x} < u_{2+} \end{array} \qquad (9)$$

(cf. Fig 1).

The authors further investigate such cases in which the magnetic field develops parallel to the wave front and in which it is vertical to it; the respective conditions for stability are given (equations 10-13). In conclusion the case of an Al'fven rotary shock wave is investigated and the conditions of stability according to scheme (9) are discussed for various cases. The authors thank L. D. Landau, A. S. Kompaneyets, and G. I. Barenblatt for discussions and advice. There are 6 figures and 2 references, — which are Soviet.

ASSOCIATION: Fiziko-tekhnicheskiy institut Akademii nauk Ukrainskoy SSR (Physico-Technical Institute of the Academy of Sciences, Ukrainskaya SSR)

Card 3/3

AUTHORS: Akhiyezer, A. I., Pomeranchuk, I. Ya. SOV/53-65-4-3/13

TITLE: Diffraction Phenomena in Collisions of Fast Particles With Nuclei (Difraktsionnyye yavleniya pri stolknoveniyakh bystrykh chastits s yadrami)

PERIODICAL: Uspekhi fizicheskikh nauk, 1958, Vol. 65, Nr 4, pp. 593 - 630 (USSR)

ABSTRACT: Absorption accompanied by nucleon-nuclei scattering causes an additional disturbance of the incident nucleon wave and independently of a production of compound nuclei leads to an additional elastic scattering of nucleons. Strong absorption of particles occurs when the wavelength λ of the particles is short compared with the radius of the nuclei. In such cases for the incident particles the nucleus is a black or semitransparent body and the elastic scattering of these particles can, according to their absorption by the nuclei, be compared with the diffraction of light in black or semi-transparent bodies. Diffraction scattering of fast particles by absorbing nuclei shows up in the purest form in the case of fast neutrons, but in a modificated form it also is possible with protons. In this case a diffraction emission

Card 1/4 3

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of photons takes place. Even more interesting are diffraction phenomena of charged pions scattered at nuclei or single nucleons. Pions of high energy come into intensive interaction with nucleons; pion and nucleon unite to form a short-lived system. The decay products of such systems are mesons and some pairs of nucleons. Diffraction production of mesons and nucleon pairs can also be a consequence of a collision of fast mesons or nucleons with nuclei. In the present paper such phenomena are investigated by wave mechanics. The wave functions of the particles (far away from the nucleus) are written down as superpositions of the incident plane waves with the waves diffracted by nuclei (black or semi-transparent). The analogy with the optical phenomenon makes possible the application of the Huyghens (Gyuygens) principle. The authors try to construct a semi-phenomenological theory of the diffraction phenomena for high energies; this theory bases upon the application of a generalized Huyghens principle. The paper contains the following sections: 1) Introduction, 2)The elastic diffraction scattering, 3) Computation of the nuclear semitransparency, 4) The influence of the Coulomb

Diffraction Phenomena in Collisions of Fast Particles With Nuclei SOV/53-65-4-3/13

(Kulon) nuclear field, 5) The Huyghens principle, 6) Diffraction emission of photons by pions (perturbation theory), 7) Emission of photons in dependence on the absorption of pions by nuclei or nucleons, 8) Diffraction production of pion pairs, 9) Diffraction emission of photons by particles with the spin = 1/2, formation of nucleon pairs, 10) Stopping emission of photons by particles with the spin = 1/2, 11) Diffraction phenomena in the scattering of fast neutrons at nuclei, 12) The elastic scattering cross section of the diffraction disintegration of deuterons. The stripping cross section at high energies. There are 5 figures and 28 references, 20 of which are Soviet.

Card 3/4

AKHIYEZER, A.I.

SOV/3762

PHASE I BOOK EXPLOITATION

Konferentsiya po magnitnoy gidrodinamike. Riga, 1958.

Voprosy magnitnoy gidrodinamiki i dinamiki plazmy; trudy Konferentsii. (Problems in Magnetohydrodynamics and Plasma Dynamics; Transactions of a Conference) Riga, Izd-vo AN Latviyskoy SSR, 1959. 343 p. Errata slip inserted. 1,000 copies printed.

Sponsoring Agency: Akademiya nauk Latviyskoy SSR. Institut fiziki.

Editorial Board: D.A. Frank-Kamenetskiy, Doctor of Physics and Mathematics, Professor; A.I. Vol'dek, Doctor of Technical Sciences, Professor; I.M. Kirko, Doctor of Physics and Mathematics; V.Ya. Veldre, Candidate of Physics and Mathematics; V.G. Vitol, Candidate of Physics and Mathematics; Yu.M. Krumin'; and V.Ya. Kravchenko.

Ed.: A. Teytel'baum; Tech. Ed.: A. Klyavinya

PURPOSE: This book is intended for physicists working in the field of magneto-hydrodynamics and plasma dynamics.

COVERAGE: This volume contains the transactions of a conference held in Riga, June 1958, on problems in applied and theoretical magnetohydrodynamics. The objects of the conference were the investigation of the basic trends in theoretical and applied magnetohydrodynamics, establishing contact between the people doing research in different branches of magnetohydrodynamics, and promoting the participation of theoretical physicists in problems in applied magnetohydrodynamics. More than 160 persons from different parts of the Soviet Union took part in the conference, and 55 papers were read. Similar conferences are to be held regularly in the future; the next such conference is scheduled to be held in Riga in June 1960. In this present collection of the transactions of the conference, most of the papers and comments on papers are presented by the authors themselves in an abridged form. The book is divided into two parts: the first part deals with problems in theoretical magnetohydrodynamics and plasma dynamics, and consists of 35 articles on such aspects of the problem as the application of magnetohydrodynamics in astrophysics (D.A. Frank-Kamenetskiy), magneto-hydrodynamics and the investigation of cosmic-ray variations (L.I. Dorman), acceleration of plasma in a magnetic field (G.V. Gordeyev and A.I. Gubanov), stability of shock waves and magnetohydrodynamics (A.I. Akhiyezer). The second part, consisting of 33 articles, deals with problems of experimental magneto-hydrodynamics, including the application of physical simulation for investigation of electromagnetic processes in liquid metals (I.M. Kirko) and the development of electromagnetic pumps (P.G. Kirillov), at the Institute of Physics of the Academy of Sciences, Latvian SSR. Several articles are devoted to induction pumps, electromagnetic crucibles, electromagnetic stirrers for molten metals, and their application in the metallurgical industry including schematic diagrams of their power-supply systems. References are given at the end of most of the articles.

AKhEYEZER, A.I.

Voprosy Magnitnoy Gidrodinamiki i Dinamiki Plazmy. Trudy Konferentsii Po Magnitnoy Gidrodinamike, Riga, 2-10 Iyulya 1958 g. (Problems of Magnetohydrodynamics and Plasma Dynamics. Works of the Conference On Magnetohydrodynamics, Riga, 2-10 July 1958), Riga, 1959, 339 pp

The majority of the texts of the 55 conference reports and discussions of reports are presented in the source in abridged form. Previously published reports are included there as brief abstracts only. The material published there for the first time (abridged and unabridged) are as follows:

"The Role of Magnetohydrodynamics and Plasma Dynamics in Certain Problems of Astrophysics," by D. A. Frank-Kamenetskiy, Moscow, pp 7-11

"Magnetohydrodynamics and the Study of Variations of Cosmic Rays," by L. I. Dorman, Moscow, pp 13-44

"Cosmic Ray Spectra and Their Role in Cosmic Gas Dynamics," by S. I. Syrovatskiy, Moscow, pp 45-48

"The Influence of a Magnetic Field on the Stability of Flow of a Conducting Fluid," by Ye. P. Velikhov, Moscow, pp 49-58

"Some Problems of the Motion of a Rarefied Plasma in a Magnetic Field," by Ya. P. Terletskiy, Moscow, pp 59-62

"On Nonlinear Steady-State Motions of a Rarefied Plasma in a Magnetic Field," by R. Z. Sagdeyev, Moscow, pp 63-65.

"On One Criterion of Applicability of the Equations of Magnetohydrodynamics to a Plasma," by S. I. Braginskiy, Moscow, pp 67-71 (Discussion of the report by R. V. Polovin, Khar'kov, pp 71-72)

"On the Possibility of Accelerating Charged Particles by Means of Shock Waves in a Magnetized Plasma," by L. I. Dorman and G. I. Freyman, Moscow and Gor'kiy, pp 77-81

"On the Acceleration of Charged Particles During Powerful Impulse Discharges and During the Collision of Magnetized Clouds," by L. I. Dorman, Moscow, pp 83-88

"The Influence of a Longitudinal Magnetic Field on the Temperature of the Electrons in a Plasma," by M. V. Konyukov, Tula, pp 89-92

"Investigation of Certain Characteristics of a Plasma of Xenon and Argon Behind a Powerful Shock Wave," by S. R. Kholev, Moscow, pp 93-105

"Observation of Electrodynamic Contraction of an Arc With the Aid of an Electron-Optical Converter," by V. L. Granovskiy, K. P. Rymina, V. I. Savoskin, and G. G. Timofeyeva, Moscow, pp 107-115

"On the Interaction of Weak Perturbations With Discontinuities and the Stability of Shock Waves in Magnetohydrodynamics," by V. M. Kontorovich, Khar'kov, pp 117-125

"On the Stability of Shock Waves in Magnetohydrodynamics," by S. I. Syrovatskiy, Moscow, pp 127-131

"On the Scattering of Hydromagnetic Waves on Turbulent Fluctuations," by A. G. Sitenko and Yu. A. Kirochkin, Khar'kov, pp 143-146

"On the Damping of Magnetohydrodynamic Waves in a Plasma," by R. Z. Sagdeyev, Moscow, pp 147-149

"Simple Waves in Magnetohydrodynamics," by A. I. Akhyezer, G. Ya. Lyubarskiy, and R. V. Polovin, Khar'kov, pp 151-157

"Two-Dimensional Problems of Magnetohydrodynamics," by G. S. Golitsyn, Moscow, pp 161-165

"On Wave-Induced Flows in Magnetohydrodynamics," by A. I. Ivanovskiy, Moscow, pp 167-171

"Oscillations of an Infinite Gas Cylinder With Its Own Gravitation in a Magnetic Field," by I. M. Yavorskaya, Moscow, pp 175-183

"On Magnetic Boundary Layers and Electric Current Discharges in Moving Media," by V. N. Zhigulev, Moscow, pp 185-190

28369
S/124/61/000/008/008/042
A001/A101

10.2000
26.1410

AUTHORS: Akhiyezer, A.I., Lyubarskiy, G.Ya., Polovin, R.V.

TITLE: On the theory of plain and shock magnetohydrodynamical waves

PERIODICAL: Referativnyy zhurnal.Mekhanika, no. 8, 1961, 3-4, abstract 8B17 ("Tr. 2-y Mezhdunar. konferentsii po mirn. ispol'zovaniyu atomn. energii, 1958, T.1. Yadern. fiz.", Moscow, Atomizdat,. 1959, 213-220)

TEXT: The authors point at the existence of plane non-stationary plain magnetohydrodynamical waves, each of which propagates in an immovable gas with one of the velocities of small disturbance propagation. It is shown that phase velocity within the wave increases with increasing density, if the following relation is fulfilled:

$$\left(\frac{\partial^2}{\partial p^2}\frac{1}{\rho}\right)_s > 0$$

where p is pressure, ρ is density, S is entropy. The interaction of magnetohydrodynamical shock waves with plane waves of small disturbances is considered. It is concluded that the necessary condition for the stability of a wave is as

Card 1/2

28369
S/124/61/000/008/008/042
A001/A101

On the theory of plain and shock ...

follows: velocities of gas behind the wave and before it should be such that the number of small disturbances of various types diverging from the wave to both sides should be equal to six. By analyzing the shock adiabatic curve, it is established in magnetic hydrodynamics that in media in which relations

$$\left(\frac{\partial^2}{\partial p^2}\frac{1}{\rho}\right)_s > 0, \left(\frac{\partial p}{\partial T}\right)_\rho > 0$$

are fulfilled, shock waves accompanied by entropy growth are compression waves. It is concluded from the equation which relates the magnitude behind the shock wave to that before it, that magnetic field in the wave varies depending on the relation between densities and velocities.

A. Kulikovskiy

[Abstracter's note: Complete translation]

Card 2/2

24(5); 21(7),(8) PHASE I BOOK EXPLOITATION SOV/2950

Akhiyezer, Aleksandr Il'ich, and Vladimir Borisovich Berestetskiy

Kvantovaya elektrodinamika (Quantum Electrodynamics) 2d ed., rev. Moscow, Fizmatgiz, 1959. 656 p. Errata slip inserted. 10,000 copies printed.

Ed.: Ye. Ye. Zhabotinskiy; Tech. Ed.: N. A. Tumarkina.

PURPOSE: This book is intended for students in advanced physics courses, Aspirants, and scientific researchers in this field.

COVERAGE: This is the second edition of a book which first appeared in 1953. Most of the chapters have been rewritten and much new material has been included. The book examines in detail the basic theories of quantum electrodynamics; i. e., the general theory of wave fields, the theory of Green's functions, and the theory of a scattering (S-) matrix. Radiation, internal conversion of gamma rays, the behavior of electrons in an external field, the Compton

Card ~~1/~~26

effect, brehmsstrahlung, the creation and annihilation of electron-position pairs, the equivalent photon method, radiative corrections to atomic level and scattering, scattering of light by light and polarized particle processes are reviewed. The present intense interest in these subjects is attributed by the authors to the discovery of the nonconservation of parity. The various sections contain numerous computations, illustrated applications of general methods, and final results in the form of formulas and curves which may be used both in theoretical and experimental applications. As to the principal problems of quantum electrodynamics, the theory of renormalizations underwent the greatest revision. While the authors do not profess complete mathematical strictness, they attempt to set forth the concept of renormalizations from one simple physical point of view, avoiding prescribed methods for removing divergences and utilizing the general properties of quantum mechanics systems to the full. In relation to this, some changes have been made in the organization of the book: the investigation of the S matrix in light of the theory of radiative corrections is treated in a separate chapter

(Chapter VII); the study of dynamic processes in the first, not zero, approximation, not related to the removal of divergences and renormalizations, is given in Chapters V and VI; and higher approximations, in Chapter VIII. The number of electrodynamic phenomena covered has been increased, and in particular the theory of polarized particle processes, the method of "sighting" ("target", "aimed" or "definite-purpose") parameters, and other concepts have been introduced. The book aims on one hand to give a clear physical picture of principles and results of quantum electrodynamics and, on the other, to give, the reader an opportunity to master the method and technique of appropriate computation. The authors thank V. Aleksin, V. Bar'yakhtar, V. Boldyshev, D. Volkov, S. Peletminskiy, R. Polovin, and P. Fomin for assistance in preparing the manuscript. References are included as footnotes.

TABLE OF CONTENTS:

30848
S/044/61/000/008/020/039
C111/C333

3,2600(1502)

AUTHORS: Akhiyezer, A. I., Lyubarskiy, G. Ya., Polovin, R. B.

TITLE: Simple waves in magnetic hydrodynamics

PERIODICAL: Referativnyy zhurnal, Matematika, no. 8, 1961, 56, abstract 8B244.("Vopr. magnitn. gidrodinamiki i dinamiki plazmy" Riga, AN Latv SSR, 1959, 151-157)

TEXT: The authors describe a method for finding out simple plane waves with a finite amplitude of oscillation in magnetic hydrodynamics. The basic system of equations of magnetic hydrodynamics is schematically represented in the unidimensional case in the form

$$\sum_{k=1}^{n} X_{ik}(u) \frac{\partial u_k}{\partial x} + T_{ik}(u) \frac{\partial u_k}{\partial t} = 0; \; i = 1,2,\ldots, n, \qquad (1)$$

where u_k is the totality of the hydrodynamic parameters, X_{ik} and T_{ik} -- certain functions of u_k. The authors interprete all the functions u_k as functions of one of them: $u_k = u_k(u_1(x,t))$, substitute this into

Card 1/2

30848
S/044/61/000/008/020/039
C111/C333

Simple waves in magnetic . . .

(1) and obtain a system of ordinary differential equations for the determination of u_k:

$$\frac{du_k}{du_1} = U_k(u_1, u_2, \ldots, u_n) \quad .$$

The form of the functions U_k is determined from the known solutions of the linearized system of equations (1). Simple plane waves with arbitrary amplitude of oscillation are investigated. In the domain adjecent to the constant flow the authors prove the uniqueness of the plane wave solution of (1).

[Abstracter's note: Complete translation.]

4

Card 2/2

AKHIYEZER, A.I.

24(0) SOV/30-59-2-42/60

AUTHOR: Khalatnikov, I. M., Doctor of Physical and Mathematical Sciences

TITLE: Investigations of Low-temperature Physics (Issledovaniya po fizike nizkikh temperatur)

PERIODICAL: Vestnik Akademii nauk SSSR, 1959, Nr 2, pp 98-100 (USSR)

ABSTRACT:
The 5th All-Union Conference on this problem took place in
Tbilisi from October 27 to November 1, 1958. It was attended by
physicists from Moscow, Khar'kov, Leningrad, Tbilisi,
Sverdlovsk, and Kiyev. 4 fields of low-temperature physics were
discussed: superliquidity of liquid helium II, supraconductivity,
antiferromagnetism, magneto-resistive effect. The following
reports and communications were heard: A. A. Abrikosov, L. P.
Gor'kov reported on the investigation of the properties of
supraconductive alloys. A. A. Abrikosov, L. P. Gor'kov, I. M.
Khalatnikov spoke of properties of supraconductors in the high-
frequency magnetic field. D. V. Shirkov and Chen' Chun'-yan'
and Chzhou Si-shin', two young Chinese scientists working at
Moscow University, described investigations for determination
of the influence exercised by the Coulomb (Kulon) interaction
of charges on supraconductivity. V. V. Tolmachev explained the

Card 1/4

nature of the so-called collective excitations of the Bose
type in supraconductors. D. N. Zubarev, Yu. A. Tserkovnikov
spoke of the thermodynamics of supraconductors and B. T.
Geylikman, V. Z. Kresin of the thermal conduction of supra-
conductors. Yu. V. Sharvin, V. F. Gantmakher reported on ex-
perimental work with supraconductors. N. V. Zavaritskiy spoke
of the measurement of the anisotropy of thermal conductivity in
the supraconductive state. In a series of reports problems of
the superliquidity of helium were discussed, which was discover-
ed in 1938 by P. L. Kapitsa and the theory of which was set up
in 1941 by L. D. Landau. E. L. Andronikashvili and his col-
laborators investigated the properties of rotating helium.
V. P. Peshkov spoke of the effect of the formation of the
boundary between superliquid and non superliquid helium. Guan
Vey-yan', collaborator of the Institut fizicheskikh problem
(Institute of Physical Problems) investigated the properties of
the so-called jump in temperature of Kapitsa. I. M. Lifshits,
V. D. Peschanskiy investigated galvanomagnetic phenomena in
strong magnetic fields for metals with open Fermi surfaces.
N. Ye. Alekseyevskiy, Yu. P. Gaydukov experimentally investi-
gated the resistance anisotropy of gold monocrystals in the
magnetic field. L. S. Kan, B. G. Lazarev combine the presence of
a temperature minimum with the structural state of the metal.

Card 2/4

M. Ya. Azbel' reported on the quantum theory of metallic con-
ductivity in the alternating electromagnetic and constant mag-
netic field. A. S. Borovik-Romanov reported on the weak ferro-
magnetism in antiferromagnetic samples of $MnCO_3$. N. M. Kreynes,
Ye. A. Turov investigated the magnetic anisotropy of the anti-
ferromagnetic monocrystals $CuSO_4$ and $CoSO_4$. A. A. Alikhanov
reported on neutronographic investigations of antiferromagnetics.
Ye. I. Kondorskiy and collaborators reported on the suscepti-
bility of nickel and nickel-copper alloys at low temperatures.
M. I. Kaganov, V. M. Tsukernik reported on kinetic phenomena in
ferromagnetics at low temperatures. A. I. Akhiyezer, V. G.
Bar'yakhtar, and S. P. Peletminskiy spoke of computations of the
relaxation of the magnetic moment in ferromagnetic dielectrics
at low temperatures. T. I. Sanadze spoke of observation re-
sults of paramagnetic resonance of terbium in the $TbNO_3 \cdot 6H_2O$
nitrate. G. R. Khutsishvili gave a theoretical analysis of the
orientation of the nuclear spin in the Overhauser (Overkhauzer)

Card 3/4

effect in nonmetals. B. N. Samoylov, N. M. Reynov and collabora-
tors reported on obtaining orientated nuclei. N. F. Bulatova,
V. S. Kogan and B. G. Lazarev showed that hydrogen isotopes in
solid state have different structures. I. A. Gindin, B. G.
Lazarev, Kh. D. Starodubov and V. I. Khotkevich detected poly-
morphism in a number of metals at low temperatures. E. L.
Andronikashvili, V. P. Peshkov and M. P. Malkov reported on the
stage of development of foreign scientific research work in the
field of low-temperature physics. At the end of the Conference
P. L. Kapitsa spoke of his successful development of investi-
gations in the field of low-temperature physics. The partici-
pants of the Conference visited the Institut fiziki Akademii
nauk Gruzinskoy SSR (Physics Institute of the Academy of Sciences
of the Gruzinskaya SSR) and the Physics Faculty of Tbilisi
University as well as the building of the new research atomic
reactor near Tbilisi.

24(3) SOV/56-36-1-29/62

AUTHORS: Akhiyezer, A. I., Bar'yakhtar, V. G., Peletminskiy, S. V.

TITLE: On the Theory of Relaxation Processes in Ferroelectrics at Low Temperatures (K teorii relaksatsionnykh protsessov v ferrodielektrikakh pri nizkikh temperaturakh)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 1, pp 216-223 (USSR)

ABSTRACT: The authors developed a theory of the relaxation of the magnetic moment of a ferrorelectric and showed that, because of the exchange interaction between the spin waves, above all the Bose distribution of the spin waves with the given nonequilibrium values of the square and the projection of the magnetic moment on to the axis of the slightest magnetization occurs. The Hamiltonian of interaction among spin waves and between spin waves and phonons can be represented in the form $\mathcal{H}_{int} = \mathcal{H}_e + \mathcal{H}_w + \mathcal{H}_a + \mathcal{H}_p$. Here $\mathcal{H}_e$ and $\mathcal{H}_w$ denote the Hamiltonians of exchange interaction and magnetic interaction respectively, $\mathcal{H}_a$ - the energy of anisotropy, and $\mathcal{H}_p$ - that Hamiltonian which describes the interaction between spin waves and phonons. When

Card 1/3

determining $\mathcal{H}_e$ it is necessary to proceed from the expression for the exchange energy of the ferromagnetic:

$$\mathcal{H}_e = \frac{\alpha}{2}\int \frac{\partial M_l}{\partial x_i}\frac{\partial M_l}{\partial x_i}\,dV,$$

where M is the magnetic moment of the volume unit and α is the exchange integral. In the following, the expressions for $\mathcal{H}_w$, $\mathcal{H}_a$, and $\mathcal{H}_p$ are written down. The authors then give the formulas for the variation of the number of spin waves with the momentum $\vec{k}$ in the unit of time, which are caused by the above-mentioned interactions. By using expressions for the collision operators, it is possible to determine the mean probabilities of the various processes of interaction between spin waves and phonons. Above all, the average probabilities for spin wave - spin wave scattering (due to exchange interaction), of the splitting up of a spin wave into two, and of the fusion of two spin waves into one, are written down. The probabilities of the other processes are lower than those of the two last-mentioned. An equation, On the Theory of Relaxation Processes in Ferroelectrics at Low Temperatures

SOV/56-36-1-29/62

which is given, determines the quantity of heat transferred from the spin system to the lattice, and a further equation is the law for the conservation of energy. Also relaxation times are calculated. The authors finally thank Academician L. D. Landau and M. I. Kaganov for their valuable suggestions. There are 5 references, 4 of which are Soviet.

ASSOCIATION: Fiziko-tekhnicheskiy institut Akademii nauk Ukrainskoy SSR (Physico-Technical Institute of the Academy of Sciences, Ukrainskaya SSR)

SUBMITTED: July 5, 1958

Card 3/3

24(3), 24(5) SOV/56-36-3-32/71

AUTHORS: Akhiyezer, A. I., Pomeranchuk, I. Ya.

TITLE: On the Interaction Between Conductivity Electrons in Ferromagnetics (O vzaimodeystvii mezhdu elektronami provodimosti v ferromagnetikakh)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 3, pp 859-862 (USSR)

ABSTRACT: Whereas in ordinary metals mutual attraction between electrons is a consequence of virtual phonon exchange and the matrix element describing interaction energy tends towards an infinite limiting value if the phonon momentum tends towards zero, ferromagnetics show an additional attraction between electrons, and this attraction forms the object of a theoretical investigation in this paper. Additional attraction is a consequence of a virtual emission and absorption of spin waves. As spin wave energy is proportional to the square of their momentum, and as the matrix elements of the emission and absorption of spin waves contain no additional factor that is proportional to the square root of spin wave energy, the matrix element describing the electron interaction energy which depends on the exchange spin waves, is inversely proportional

Card 1/2

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SOV/56-36-3-32/71

On the Interaction Between Conductivity Electrons in Ferromagnetics

to the square of the spin wave momentum. In the present paper the character of this effective interaction between electrons in dependence on spin wave exchange is investigated, where the energy operator of interaction between s- and d-electrons is written down in the form $V(\vec{r}) = C\vec{s}\vec{M}(\vec{r})$, where s denotes the spin of the s-electrons and $\vec{M}(\vec{r})$ - the magnetic moment caused by the d-electrons. C is given as $C = \Delta a^3/\mu_o$, where μ_o denotes the Bohr magneton, a - the lattice constant, and Δ - an energy ($\Delta \sim \sqrt{\Theta A}$) depending on the Curie (Kyuri) temperature. For an energy of the conductivity electrons of the form $\varepsilon(\vec{p},\sigma) = \varepsilon^o(\vec{p})+2\sigma\Delta$ (p = electron momentum, $\sigma = \pm 1/2$, the projection of the spin on to the z-axis, and $\varepsilon^o(\vec{p}) = p^2/2m$) an explicit formula is derived for the matrix element U_{if} which describes the interaction energy. For its maximum $(U_{if})_{max} = - a^3U/\Omega$, is obtained with $U = \mu^2/\Theta$, and for the total momentum of an electron pair it holds that $P_o = \sqrt{p_-^2 - p_+^2} = p_o\sqrt{2\Delta/\mu}$. There are 1 figure and 7 references, 3 of which are Soviet.

Card 2/2

Physics-Tech Inst. AS UkrSSR

A. I. AKHIYEZER

21(0) SOV/53-67-4-7/7

AUTHOR: Chentsov, R.

TITLE: The Fifth All-Union Conference on the Physics of Low Temperatures (5-ye Vsesoyuznoye soveshchaniye po fizike nizkikh temperatur)

PERIODICAL: Uspekhi fizicheskikh nauk, 1959, Vol 67, Nr 4, pp 743-750 (USSR)

ABSTRACT: This Conference took place from October 27 to November 1 at Tbilisi; it was organized by the Otdeleniye fiziko-matematicheskikh nauk Akademii nauk SSSR (Department of Physico-mathematical Sciences of the Academy of Sciences, USSR), the Akademiya nauk Gruzinskoy SSR (Academy of Sciences, Gruzinskaya SSR), and the Tbilisskiy gosudarstvennyy universitet im. Stalina (Tbilisi State University imeni Stalin). The Conference was attended by about 300 specialists from Tbilisi, Moscow, Khar'kov, Kiyev, Leningrad, Sverdlovsk, and other cities as well as by a number of young Chinese scientists at present working in the USSR. About 50 lectures were delivered which were divided according to research fields.

IV. Magnetism. A. S. Borovik-Romanov (IFP) delivered a report on investigations he carried out of the anisotropy of the weak ferromagnetism in monocrystal samples of the antiferromagnetic $MnCO_3$ (the effect of anisotropy was predicted by the thermodynamical theory developed by Dzyaloshinskiy). In the course of the discussion E. A. Alikhanov (IFP) spoke about neutronographical investigations he carried out of the magnetic structure of $MnCO_3$ and $FeCO_3$ at low temperatures. P. L. Kapitsa stressed the importance of the method based upon Dzyaloshinskiy's theory. N. E. Kreynes (VNIIFTRI), whose lecture was read by A. S. Borovik-Romanov, reported on measurements carried out by him (in the IFP) of the magnetic anisotropy of the antiferromagnetic $CuSO_4$- and $CoSO_4$-monocrystals.

Card 7/11

Ye. A. Turov (IFM AN SSSR, Sverdlovsk) spoke about his theoretical investigations of the magnetizability, the susceptibility, the specific heat, and the resonance frequencies of antiferromagnetics and weak ferromagnetics. A. I. Sudovtsov and Ye. Ye. Semenenko (KhFTI) spoke about measurements of the electric resistance of iron in magnetic fields in a wide temperature range with simultaneous plotting of the magnetization curve. N. V. Vol'kenshteyn, G. V. Fedorov, E. V. Galoshina and M. I. Surchinskaya (IFM AN SSSR) spoke about measurements of magnetization and the Hall effect of polycrystalline samples, nickel and Ni_3Mn at low temperatures. Ye. I. Kondorskiy, V. Rode, U. Gofman and Chang, Shou-ch'un (MGU) gave a report on susceptibility measurements on nickel and its alloys with copper at low temperatures; T. I. Sanadze (TGU) spoke about the spectrum of the paramagnetic resonance of Tb^{3+} in terbium nitrate at temperatures of liquid hydrogen. M. I. Kaganov and V. M. Tsukernik (KhFTI) dealt with the kinetic phenomena in ferromagnetics at low temperatures and with calculation of relaxation time; A. I. Akhiyezer, V. Bar'yakhtar and S. Peletminskiy (KhFTI) carried out a theoretical investigation of the relaxation of the magnetic moment in ferrodielectrics; Vlasov (IFM AN SSSR) showed that a linearly polarized elastic (ultrasonic) wave of a frequency of 10^7 cycles when passing through a ferromagnetic substance in the direction of the magnetic field, is subjected to a turn of the polarization plane of the order of 10^{-3} - 10^{-4} radian/cm oersted. M. I. Kaganov pointed out that in this connection yet another phenomenon may be observed, namely the resonance absorption of ultrasonics if the wavelength is equal to the radius of the Larmor orbit of the electron. V. Various Questions. One of the most interesting lect-

Card 8/11

AKHIYEZER, A.I.

[Introductory remarks to theoretical reports on magnetohydrodynamics] Vstupitel'nye zamechaniia k teoreticheskim dokladam po magnitnoi gidrodinamike. Khar'kov, Fizikotekhn. in-t AN USSR, 1960. 7 p. (MIRA 17:1)

(Magnetohydrodynamics) (Plasma (Ionized gases))

AKHIYEZER, A.I.; LYUBARSKIY, G.Ya.; POLOVIN, R.V.

[Evolutional discontinuities in magnetohydrodynamics] Evoliutsionnye razryvy v magnitnoi gidrodinamike. Khar'kov, Fiziko-tekhn. in-t AN USSR, 1960. 8-24 p. MIRA 17:3)

84592

S/181/60/002/010/014/051
B019/B056

9.4300 (1143, 1144, 1138)

AUTHORS: Akhiyezer, A. I. and Bar'yakhtar, V. G.

TITLE: Theory of the Heat Conductivity of Ferrodielectrics at Low Temperatures

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 10, pp. 2446-2449

TEXT: As shown in an earlier paper (Ref. 1), the spin waves make a considerable contribution to the heat flow in ferrodielectrics at low temperatures. There, only one kind of interaction of spin waves was, however, taken into account, namely the merging of two spin waves into one, and the division of one spin wave into two. Simultaneously with this interaction, the "volume" scattering of spin waves by spin waves plays an essential part. In the present paper this kind of interaction is investigated and at the same time inaccuracies in previous papers are eliminated (Refs. 1,2). In this case, the authors proceed from the kinetic equations (1) for the determination of the change in the number of spin waves and phonons in the case of a small temperature gradient,

Card 1/3

84592

Theory of the Heat Conductivity of Ferrodielectrics at Low Temperatures

S/181/60/002/010/014/051
B019/B056

and obtain the solutions

$$n_{\vec{K}} = n^{o}_{\vec{K}} + n^{o}_{\vec{K}}(n^{o}_{\vec{K}} + 1)\ \varphi_{\vec{K}}/T$$
$$N_{\vec{K}j} = N^{o}_{\vec{K}j} + N^{o}_{\vec{K}j}(N^{o}_{\vec{K}j} + 1)\,\Phi_{\vec{K}}/T \qquad (2)$$

$n^{o}_{\vec{K}}$ and $N^{o}_{\vec{K}j}$ are equilibrium Bose functions. For the collision operators

$\mathcal{L}_{o}(\varphi) + \xi\mathcal{L}_{u}(\varphi) = n^{o}(n^{o} + 1)\frac{\varepsilon}{T}(\vec{v},\nabla T)$ (3) is obtained. Here ξ is a small parameter, which gives the probability of transfer processes. Proceeding from (3), the operators for the collision of spin waves among themselves, for the collision of phonons among themselves, and the collision of spin waves with phonons are investigated. From an investigation of the limiting cases, expressions are obtained for the heat conduction coefficient, from which it may be seen that for $\Theta_{D} \gg \Theta_{C}$ and $T \ll \Theta^{2}_{D}/\Theta_{C}$, the main part in heat conduction is played by the spin waves, because $c_{s} \gg c_{1}$. If, however, $\Theta_{D} \gg T \gg \Theta^{2}_{D}/\Theta_{C}$, then the heat is

Card 2/3

84592

Theory of the Heat Conductivity of Ferrodielectrics at Low Temperatures

S/181/60/002/010/014/051
B019/B056

transferred by phonons. $c_l \gg c_s$. Here Θ_D is the Debye temperature, Θ_C - the Curie temperature. c_s and c_l are the specific heats of the spin waves and the lattice respectively. There are 3 Soviet references.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR Khar'kov (Institute of Physics and Technology of the AS UkrSSR, Khar'kov)

SUBMITTED: April 4, 1960

Card 3/3

S/053/60/071/004/001/004
B004/B056

AUTHORS: Akhiyezer, A. I., Bar'yakhtar, V. G., Kaganov, M. I.

TITLE: Spin Waves in Ferromagnetics and Antiferromagnetics I

PERIODICAL: Uspekhi fizicheskikh nauk, 1960, Vol. 71, No. 4, pp. 533 - 579

TEXT: The present paper deals with the essential properties of the energy spectrum of a ferromagnetic near magnetic saturation. The following properties depend on this spectrum at low temperatures: The interrelation between the magnetization of the ferromagnetic and temperature as well as with the external magnetic field; the thermal properties of the ferromagnetic, the relaxation of the magnetic moment, and the behavior of the ferromagnetic in electromagnetic alternating fields and in sound fields. In crystals, the deviation of the magnetic moment of an atom from the predominant direction does not remain localized on the atom, but it propagates as a wave, which is called spin wave. In the present paper, the ferromagnetic theory is dealt with as follows from the viewpoint of the spin waves: I. Energy spectra, thermal and magnetic

APPROVED FOR RELEASE: 06/05/2000 CIA-RDP86-00513R000100610005-8"

Spin Waves in Ferromagnetics and Antiferromagnetics I

S/053/60/071/004/001/004
B004/B056

properties of ferromagnetics and antiferromagnetics. 1) Spin waves in ferromagnetics. Definition of the microscopic theory of spin waves. 2) The phenomenological theory of spin waves. (The spin wave is defined as an oscillation of the magnetic moment of the ferromagnetic). 3) Derivation of the quantum theory of spin waves by proceeding from the phenomenological Hamiltanian of the ferromagnetic. 4) The high-frequency properties of ferromagnetics and ferromagnetic resonance. Here, the natural oscillations of the magnetic moment are investigated in finite samples, whose dimensions are considerably smaller than the damping length. This condition does not apply to massive ferromagnetic metals because of the skin effect, and therefore 5) deals with surface impedance. 6) Coupled magnetic and elastic waves and ferroacoustic resonance. In 7) the energy spectrum of antiferromagnetics is investigated by means of the phenomenological method. 8) Thermal and magnetic properties of ferromagnetics. From the spin-wave spectrum the magnetic moment of the ferromagnetic may be determined as a function of temperature and of the magnetic field, as well as the contribution made by the spin waves to the thermodynamic parameters of the ferromagnetic. In a similar manner, 9) deals with the thermal and magnetic properties of antiferro-

Card 2/3

Spin Waves in Ferromagnetics and Antiferromagnetics I

S/053/60/071/004/001/004
B004/B056

magnetics. In the next issue of this periodical, the last part of this work will be published: II. Interaction among spin waves and between spin waves and lattice vibrations. Relaxation processes and kinetic processes. The authors mention papers by Ya. I. Frenkel' and Ya. G. Dorfman (Ref. 5), Ye. Lifshits (Ref. 8), L. Landau and Ye. Lifshits (Ref. 11), a paper by the authors in collaboration with S. Peletminskiy (Ref. 12), V. Gurevich (Ref. 30), A. Borovik-Romanov (Refs. 39,40), I. Dzyaloshinskiy (Ref. 41), Ye. Turov (Ref. 42), and N. N. Bogolyubov and S. V. Tyablikov (Ref. 15). There are 6 figures and 55 references: 36 Soviet, 13 US, 3 British, 2 Dutch, 3 French, and 3 German.

Card 3/3

83985

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

9.4300 (1035,1138,1143)

AUTHORS: Akhiyezer, A. I., Bar'yakhtar, V. G., Kaganov, M. I.

TITLE: Spin Waves in Ferromagnetics and Antiferromagnetics. II

PERIODICAL: Uspekhi fizicheskikh nauk, 1960, Vol. 72, No. 1, pp. 3-32

TEXT: This is the second part of an article published in "Uspekhi fizicheskikh nauk", 1960, Vol. 71, 533, and is devoted to the interaction of spin waves with one another and with lattice vibrations and, furthermore, to the relaxation- and kinetic processes. § 10 deals with the fusion and splitting of spin waves and their scattering on spin waves. The authors restrict themselves to considering electrets and, therefore, take into account, aside from the interaction of spin waves with one another, also their interaction with phonons (Ref. 1). The Hamiltonians of the interaction of spin waves are set up, the use of which is restricted to the temperature range below the Curie temperature. The probabilities of fusion and splitting, as well as the scattering of spin waves, are calculated. § 11 deals with the interaction of spin waves with lattice vibrations. The interaction of spin waves with one

Card 1/3

83985

Spin Waves in Ferromagnetics and Antiferromagnetics. II

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

another was found to be stronger than their interaction with the lattice. This allows the conclusion that the equilibrium in the spin wave system is more quickly brought about than the one between spin waves and lattice. For this reason, the temperatures of spin waves and lattice may differ. The temperature balance is discussed in § 12 together with the relaxation of the magnetic moment in electrets. The course of relaxation of the magnetic moment in electrets can be explained on the basis of the probabilities the authors established for the interaction processes. In § 13, the authors deal with the dispersion of magnetic permeability of a ferromagnetic dielectric. The complicated character of relaxation established in the preceding chapter influences the dependence of the electret susceptibility on frequency (Refs. 1,7). The case of a longitudinal magnetic alternating field polarized along the equilibrium magnetic moment is examined, i.e., the longitudinal component of magnetic permeability is calculated. When frequencies are sufficiently high it is more expedient not to speak of a calculation of susceptibility, but rather of an absorption coefficient of the photon. This coefficient is determined as the difference of the probabilities of all of the absorption and emission processes of the photon. A formula for determining the

Card 2/3

83985

Spin Waves in Ferromagnetics and Antiferromagnetics. II

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

dependence of the photon absorption coefficient on frequency is given (13,20); it can be applied to all limiting cases. The last chapter of the present article (§ 14) deals with the thermal conductivity of electrets. It can be calculated from the spin wave interaction Hamiltonian and the spin wave phonon Hamiltonian, as well as the phonon - phonon interaction Hamiltonian. There are 10 Soviet references.

Card 3/3

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AUTHORS: Akhiyezer, A. I., Lyubarskiy, G. Ya., Polovin, R. V.

TITLE: Stability conditions of the electron distribution function in the plasma

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 40, no. 3, 1961, 963-969

TEXT: The authors deal with the problem of the stability of the electron distribution function toward plasma oscillations. The behavior of these functions at $t \rightarrow \infty$ (t-time) is determined by special points of their Laplace transforms φ_p and f_p with respect to time ($p = i\omega$, ω - complex oscillation frequency). In the free plasma φ_p and f_p are connected by $f_p(u) = (p+iku)^{-1}\{g(u)+ikem^{-1}\varphi_p f_o'(u)\}$ (1) where u is the projection of the electron velocity on the wave vector $\vec{k}$, $f_o(u)$ the initial function of the distribution of u, and g the initial value of f(u,t). The necessary and sufficient condition for the stability of the distribution function $F_o(v)$

Card 1/6

is given by the vanishing of the roots of

$$G(s) \equiv \int_{-\infty}^{\infty} \frac{f_0'(u)du}{u-s} = \frac{k^2}{\omega_0^2}, \quad s = \frac{ip}{k} \tag{3}$$

(ω_0 plasma frequency) in the upper semiplane s at an arbitrary value k(k > 0). The criterion for the stability of the distribution function $f_0(u)$ has the form

$$\int_{-\infty}^{\infty} \frac{f_0''(u)\,du}{u-u_l} < 0, \quad f_0'(u_l) = 0, \quad f_0''(u_l) > 0. \tag{6}$$

from which it follows that a distribution function having only one maximum is stable. This stability condition was observed by P. L. Auer (Ref.7: Phys.Rev.Lett.,1,411,1958). If the distribution function has two maxima, the function will not be stable. A further condition is that any spherically symmetrical distribution function $F_0(|v|)$ which is nowhere vanishing is stable. Since

$$f_0(u) = \int F_0(v)\,dv_\perp = 2\pi \int_0^{\infty} F_0\left(\sqrt{u^2 + v_\perp^2}\right) v_\perp dv_\perp, \quad (A)$$

holds, where $v_\perp$ is the velocity component of the electron which is

Card 2/7

perpendicular to $\vec{k}$, $f_0'(u) = -2\pi u F_0(|u|)$ is obtained. Hence (3) takes on the form

$$2\pi \int_{-\infty}^{\infty} \frac{uF_0(|u|)}{s-u}\, du = \frac{k^2}{\omega_0^2}, \qquad (7)$$

from which

$$2\pi \int_{-\infty}^{\infty} \frac{uF_0(|u|)}{s-u}\, du - 2\pi^2 i s F_0(|s|) = \frac{k^2}{\omega_0^2}. \qquad (8)$$

follows. The stability condition leads to the fulfillment of the inequality: $-\int_{-\infty}^{\infty} F_0(|u|)du < 0$. If $g(\xi)$ is the Fourier component of the function $f_0'(u) = \int_{-\infty}^{\infty} g(\xi)e^{i\xi u}\cdot d\xi$ it can be represented in form

$$g(\xi) = -\int_0^{\xi} \psi(\xi-\xi')\,\psi(\xi')\,d\xi', \qquad (10)$$

$$\psi(\xi) = \int_{-\infty}^{\infty} e^{-i\xi\lambda}\, d\sigma(\lambda)$$

22147

if the distribution function is stable. Here $\sigma(\lambda)$ is an arbitrary continuous non-decreasing limited function. A certain stable distribution function corresponds to each of these functions. Representation (10) was obtained by A. I. Achizer, G. Ya. Lyubarskiy (Ref.3: Tr.fiz.otd.fiz.-mat. f-ta KhGU,6,13). With a sufficient length of the plasma wave and a sufficiently strong magnetic field $\vec{H}$ the dispersion equation has the following form:

$$1-\frac{\omega_0^2\cos^2\theta}{\chi}\int_{-\infty}^{\infty}\frac{f_0'(u)du}{\chi u-\omega}+\frac{\omega_0^2\sin^2\theta}{2\omega_H}\int_{-\infty}^{\infty}\left(\frac{1}{\chi u-\omega+\omega_H}-\frac{1}{\chi u-\omega-\omega_H}\right)f_0(u)\,du=0, \quad (12)$$

where $\chi = |k\cos\theta|$ and θ are the angles between $\vec{k}$ and $\vec{H}$ and $\omega_H = eH/mc$ the electronic gyrofrequency. In the following,

$$G_H(s)\equiv\int_{-\infty}^{\infty}\left(\frac{\cos^2\theta}{u-s}+\frac{\sin^2\theta}{2s_H}\ln\frac{u-s+s_H}{u-s-s_H}\right)f_0'(u)\,du=\frac{\chi^2}{\omega_0^2}, \quad (13)$$

$$s_H=|\omega_H|/\chi.$$