56-6-35/56

AUTHOR: DZYALOSHINSKIY, I.Ye.

TITLE: A Thermodynamic Theory of "Weak" Ferromagnetism in Antiferromagnetic Substances. (Termodinamicheskaya teoriya "slabogo" ferro-

DZYALOSHINSKIY, I. YE.

56-3-45/59

AUTHOR: Dzyaloshinskiy, I.Ye.

TITLE: On the Problem of the Piezomagnetism (K voprosu o p'yezomagnetizme) (Letter to the Editor)

PERIODICAL: Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol. 33, Nr 3 (9), pp. 807 - 808 (USSR)

ABSTRACT: The present paper describes some substances really existing in nature which, according to the deliberations of the magnetic symmetry, must be piezomagnetic. Thus, for instance, the antiferromagnetic crystals α-Fe_2O_3 and $FeCO_3$ have one and the same symmetry class which consists of the elements $2C_3$, $3U_2$, I, $2S_6$, $3\sigma_d$. This refers to those of the two antiferromagnetic phases of α-Fe_2O_3, which exist at $T < 250^0K$. Such a symmetry permits the existence of two linear combinations with respect to the components of the stress tensor σ_{ik} and the magnetic field $\vec{H}$ in the expression for the thermodynamic potential:

$$\Phi = -\lambda_1 \{(\sigma_{xx} - \sigma_{yy})H_x - 2\sigma_{xy}H_y\} - \lambda_2(\sigma_{xz}H_y - \sigma_{yz}H_x).$$

From this there immediately result the expressions for the magnetic moment with a lacking exterior field :

$$m_x = \lambda_1(\sigma_{xx} - \sigma_{yy}) - \lambda_2\sigma_{yz},\ m_y = -2\lambda_1\sigma_{xy} + \lambda_2\sigma_{xz}.$$

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56-3-45/59

On the Problem of the Piezomagnetism

Another example are the antiferromagnetica MnF_2, CoF_2 and FeF_2. Their class of magnetical symmetry consists of C_2, $2C_4^2R$, $2U_2$, $2U_2'R$, I, σ_h, $2S_4R$, $2\sigma_v$, $2\sigma_v'R$. This group of symmetry, in the expression for Φ leaves the term $\Phi = -\lambda(\sigma_{xz}H_y + \sigma_{yz}H_x)$ invariant. Herefrom the expressions $m_x = \lambda\sigma_{yz}$, $m_y = \lambda\sigma_{xz}$ are obtained for the magnetic moments. There are 4 references, 3 of which are Slavic.

ASSOCIATION: Institute for Physical Problems, AN USSR Institut fizicheskikh problem Akademii nauk SSSR)

SUBMITTED: June 20, 1957

AVAILABLE: Library of Congress

Card 2/2

DZYALOSHINSKIY, I. Ye.

56-6-20/47

AUTHOR: Dzyaloshinskiy, I. Ye.

TITLE: On the Magnetic Structure of the Fluorides of Transition Metals (O magnitnom stroyenii ftoridov perekhodnykh metallov)

PERIODICAL: Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, 1957, Vol. 33 Nr 6, pp. 1454 - 1456 (USSR)

ABSTRACT: By means of the theory of phase transitions of second order developed by Landau the problem of the weak ferromagnetism of anti-ferromagnetic materials can be explained. By this method the magnetic structure of the crystals MnF_2, CoF_2, FeF_2 and NiF_2 is now investigated.
As it can be proved that phase transitions exist in which one group symmetry is at the same time a sub-group of the other symmetry group, it is clear that the fluorides mentioned are slightly ferromagnetic. There are 2 figures, and 4 references, 1 of which is Slavic.

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56-6-20/47

On the Magnetic Structure of the Fluorides of Transition Metals

ASSOCIATION: Institute for Physical Problems AN USSR
(Institut fizicheskikh problem Akademii nauk SSSR)

SUBMITTED: June 20, 1957

AVAILABLE: Library of Congress

Card 2/2

DZYALOSHINSKIY, I. Ye.

56-7-59/66

AUTHOR DZYALOSHINSKIY, I.Ye., LIFSHITS, Ye.M.

TITLE A Phase Transitio.. of Second ..ind in Sodium Saltpeter. (Fazovyy perekhod vtorogo roda v natriyevoy selitre - Russian)

PERIODICAL Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol 33, Nr 7, pp 299-301 (USSR)

ABSTRACT The present paper investigates this phase transition in connection with the measurements carried out by M-O.Kornfeld and A.A.Chudinov, Zhurn.Eksp.i Teoret.Fiz., 1957, Vol 33, Nr 7, pp 33. These authors investigated the temperature dependence of the elastic constants of sodium saltpeter mear the point of transition. Below this point two molecules are located in the elementary cell of the $NaNO_3$-crystal, the two NO_3 groups having two different crystallographical orientations. Above the point of transition all differences between the NO_3 groups vanish, because each of them may, with the same degree of probability, assume one of the two possible orientations. The volume of the elementary cell is here reduced by one half. Thus, the transition is connected with the order of the NO_3 groups. The here discussed phase transition is described by a parameter η, which, in the case of all transformations (to which belong also the translations) of the symmetry group (of the phase D^5_{3d} corresponding to the high temperature) are transformed like the function sin $\pi(x+y+z)$. Herefrom it follows that in connection with the development of the thermodynamic potential the term which is proportional to η^3 is lacking, so that this transition is actually realizable as a transition of the second kind. For the determination of the modification of the elastic coef-

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A Phase Transition of Second Kind in Sodium Saltpeter. 56-7-59/66

ficients at the point of transition and expression for the thermodynamical potential which applies in the vicinity of this point is written down. Phase transition takes place at the point where the coefficient near η^2 vanishes, i.e. at the temperature $T'_c = T_c - (a/A)(\sigma_{xx}+\sigma_{yy}) - b\sigma_{zz}/A$.

Here σ_{ik} denotes the tensor of the elastic tensions, T_c - the transition temperature in the case of lacking tensions. The authors then explicitly give the expression for the phase that corresponds to the low temperature. Herefrom the jump of the electrical coefficient at the point of transition and the jump of the coefficient of thermal expansion can immediately be obtained.
(No illustrations).

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

SUBMITTED 16.4.1957

AVAILABLE Library of Congress.

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DZYALOSHINSKIY, I.,

"A Thermodynamic Theory of 'Weak' Ferromagnetism of Antiferromagnetics," Journal of the Physics and Chemistry of Solids, Vol 4, No. 4, 1958.

Institute of Physical Problems, AS USSR.

24(3), 24(5) SOV/56-35-3-32/61

AUTHORS: Abrikosov, A. A., Dzyaloshinskiy, I. Ye.

TITLE: Spin Waves in a Ferromagnetic Metal (Spinovyye volny v ferromagnitnom metalle)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol 35, Nr 3, pp 771-775 (USSR)

ABSTRACT: The first investigations of spin waves were carried out by Bloch (Blokh) (Ref 2) on the basis of Heisenberg's (Geyzenberg) model for ferromagnetics. The phenomenological theory was developed by Landau and Lifshits (Refs 3,4). In these theories the ferromagnetic substance is treated as a spin system which is firmly connected with the crystal lattice. However, this in no case applies to a metal in which the electrons are able to move freely. It is therefore of interest to find out in what form the motion of electrons can be represented in accordance with phenomenological theory. It is this problem that forms the object of the present paper; according to Landau (Ref 1) it is based upon the theory of the Fermi liquid. The electron spectrum of metals is described by means of quasiparticles which satisfy Fermi statistics. The energy

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of these quasiparticles depends on spinor orientation, and for the energy operator $\varepsilon(\vec{p},\sigma)$ it holds that $\delta E = \frac{1}{2} Sp_{\sigma} \int \varepsilon(\vec{p},\sigma)\delta n(\vec{p},\sigma)d\tau$, $d\tau = 2dp_x dp_y dp_z/(2\pi\hbar)^3$, where $\vec{p}$ denotes the quasimomentum, $\vec{\sigma}$ - the spin operator, E - the energy of the unit of volume, n - the distribution function. For slight variations of n the following holds for the electron energy: $\delta\varepsilon(\vec{p},\vec{\sigma}) = \frac{1}{2} Sp_{\sigma'} \int f(\vec{p},\vec{\sigma};\vec{p}',\vec{\sigma}')\delta n(\vec{p}',\vec{\sigma}')d\tau'$, where $f(\vec{p},\vec{\sigma};\vec{p}',\vec{\sigma}') = \delta\varepsilon(\vec{p},\vec{\sigma})/\delta n(\vec{p}',\vec{\sigma}')$ and $f(\vec{p},\vec{\sigma};\vec{p}',\vec{\sigma}') = \psi(\vec{p},\vec{p}') + \psi(\vec{p},\vec{p}')(\vec{\sigma}+\vec{\sigma}') + \psi_{ik}(\vec{p},\vec{p}')\sigma_i\sigma_k'$.
In ferromagnetic metals, in which only exchange-interaction occurs between the electrons, the energy operator depends only on the direction of spin with respect to the total magnetic moment: $\varepsilon(\vec{p},\vec{\sigma}) = \alpha(\vec{p}) - \beta(\vec{p}).\vec{m}\vec{\sigma}$ ($\vec{m}$ = unit-pseudovector in the direction of the magnetic moment of the crystal). For the equilibrium distribution function it holds that $n_o = \frac{1}{2}(n^+ + n^-) + \frac{1}{2}(n^+ - n^-)\vec{m}\vec{\sigma}$; $n^{\pm} = n_F(\alpha \mp \beta)$ (n_F = Fermi function). Further deliberations are based upon these equations. Expressions are

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obtained for $\delta\varepsilon$, δn_0, and $\beta(p)$. Also non-ferromagnetic metals are discussed, in the case of which the terms with m do not occur and a law of dispersion of the form $\varepsilon \sim k$ applies (for ferromagnetic substances the law of dispersion $\varepsilon \sim k^2$ applies). Further, the connection between ω and k is investigated. Finally, the authors thank L. D. Landau, Academician, for his valuable advice and discussions of the results obtained. There are 6 references, 5 of which are Soviet.

ASSOCIATION: Institut fizicheskikh problem Akademii nauk SSSR (Institute for Physical Problems, AS USSR)

SUBMITTED: April 22, 1958

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R000411920018-5"

Dzyaloshinskiy, I. Ye.

24(5)

SOV/56-36-3-39/71

AUTHORS: Abrikosov, A. A., Gor'kov, L. P., Dzyaloshinskiy, I. Ye.

TITLE: On the Application of the Methods of the Quantum Field Theory to Problems of Quantum Statistics at Finite Temperatures (O primenenii metodov kvantovoy teorii polya k zadacham kvantovoy statistiki pri konechnykh temperaturakh)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 3, pp 900-908 (USSR)

ABSTRACT: The present paper intends to formulate a variation of the thermodynamic perturbation theory which permits the full application of quantum-field theoretical methods to quantum statistics at finite temperatures. This method is in principle based on an extension of the method developed by Matsubara (Ref 4). In the Green's functions transition to "imaginary times" is made by $t \rightarrow -i\tau\hbar$, and from operators of second quantization in Schroedinger (Shredinger) representation $\tilde{\psi}, \tilde{\psi}^{+}$ transition is made to operators in "interaction representation" $\psi(\vec{r},\tau)$, $\psi^{+}(\vec{r},\tau)$; these new Green's functions are expanded according to the imaginary time variable in Fourier series.

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This procedure differs from the usual one by the fact that integration with respect to frequencies is replaced by summation over discrete values of the imaginary "frequency" $i\omega_n$; otherwise this method is fully equivalent to the usual diagram-technique in the momentum space at $T = 0$. In the following, the analytical properties of the Fourier (Fur'ye) components of the Green's functions are investigated and it is shown that, due to the possibility of analytical continuation, it suffices for the treatment of various kinetic and non-steady problems to know the corresponding equilibrium Green's functions. The authors finally thank Academician L. D. Landau and L. P. Pitayevskiy for discussing the results obtained by this paper. There are 4 figures and 9 references, 5 of which are Soviet.

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

SUBMITTED: December 4, 1958

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24(3)

AUTHORS: Dzyaloshinskiy, I. Ye., Pitayevskiy, L. P. SOV/56-36-6-25/66

TITLE: Van der Waals Forces in an Inhomogeneous Dielectric (Van-der-Vaal'sovy sily v neodnorodnom dielektrike)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 6, pp 1797-1805 (USSR)

ABSTRACT: In the present paper the forces are calculated which result from the interaction of particles in an inhomogeneous dielectric with the fluctuations of a long-wave electromagnetic field (in which the dielectric is located). These forces may be described as Van der Waal forces, because they are of a similar nature. The contribution made by long-wave fluctuations to the free energy is small compared to the total free energy of the body, but it represents a new effect, namely that of the non-additivity of the free energy of the body. The calculation of the (non-additive) correction to the free energy of an inhomogeneous dielectric carried out by the authors cannot be performed in the usual manner by determination of the field energy in the medium because of the dissipation occurring in the absorbing medium e.g. in the case of variable fields. The authors used the diagram technique developed by

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Van der Waals Forces in an Inhomogeneous Dielectric SOV/56-36-6-25/66

Matsubara (Ref 4), which was used also in the papers by Abrikosov, Gor'kov, Dzyaloshinskiy, and Fradkin (Ref 5). The authors first investigate the properties of the Green functions of an electromagnetic field in an inhomogeneous absorbing medium. In the second part of this paper the correction to the free energy of the system is derived by summation of the Matsubara graphs (Fig 2), and the corresponding part of the stress tensor (stress tensor of Van der Waal forces) is calculated. In an appendix the authors derive formulas for the Green functions in a homogeneous absorbing medium with complex dielectric constant. In conclusion, they thank Academician L. D. Landau and Ye. M. Lifshits for their interest and discussions. There are 2 figures and 8 references, 7 of which are Soviet.

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

SUBMITTED: December 17, 1958

Card 2/2

10 (4)

AUTHORS: Dzyaloshinskiy, I. Ye., Lifshits, Ye. M., SOV/56-37-1-36/64
Pitayevskiy, L. P.

TITLE: Van der Waals' Forces in Liquid Films (Van-der-Vaal'sovy sily v zhidkikh plenkakh)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 37, Nr 1(7), pp 229 - 241 (USSR)

ABSTRACT: The authors find general formulas for the determination of the thermodynamic quantities (chemical potential) of a liquid film, and they find the limiting laws for the dependence of the chemical potential on the thickness of the film. The difficulties in the generalization of the formulas derived for the vacuum in the case in which the interspace between the bodies is filled with any medium, are now eliminated because of the general formulas (Ref 2) already derived for that part of the thermodynamic quantities of any absorbing medium which is conditioned by the electromagnetic fluctuation field with the wave lengths $\lambda \gg a$ (a denoting the interatomic distances). This field corresponds to those forces which have the same nature as the van der Waals' forces between the single molecules at large distances. At first, the stress tensor in a stratified absorbent medium is

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calculated, and in the next part the forces of molecular interaction between solids are determined. In the case of a metallic "intermediate layer" between the bodies, the force of molecular attraction passes from the law l^{-3} at "small" distances to the law l^{-5} at "large" distances. The authors then investigate a liquid film on the surface of a solid body. This film is assumed to be applied to a wall vertically arranged in the field of gravity. $F(l) + \rho gz = \text{const}$ is the condition for the constancy of the chemical potential along the system, for $F(l)$ is the part of its chemical potential μ depending on the film thickness. Thus, $\mu = \mu_0 + F(l)$, μ_0 denoting the chemical potential of the "massive liquid". Further, $\mu(l) + \rho gz = 0$, the function $\mu(l)$ determining all thermodynamic properties of the film. The authors then investigate some typical cases which may be present according to the character of the function $\mu(l)$: (a) If $\mu(l)$ is a monotonely falling, everywhere positive function, the liquid does not moisten the solid surface, and no field is formed. (b) If $\mu(l)$ is a monotonely increasing, everywhere negative function, this usually corresponds to a liquid which completely moistens a solid surface. On a vertical wall, a film with a thickness tending to zero at $z \rightarrow \infty$ is particularly formed. This decrease in thickness takes place at first according to the law $l \sim z^{-1/4}$, then according to $z^{-1/3}$. Subsequently, the contribution to the chemical potential caused by forces of nonelectromagnetic origin is estimated. Finally, some films of liquid helium are specially investigated. The authors thank the Academician L. D. Landau for the discussion of the problems investigated here, and Professor B. V. Deryagin for the supply of his papers. There are 3 figures and 21 references, 10 of which are Soviet.

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

SUBMITTED: February 12, 1959 (initially), and March 27, 1959 (after revision)

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R000411920018-5"

24 (3)

AUTHOR: Dzyaloshinskiy, I. Ye. SOV/56-37-3-56/62

TITLE: On the Problem of the Magneto-electric Effect in Antiferromagnetic Substances

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 37, Nr 3(9), pp 881 - 882 (USSR)

ABSTRACT: Landau and Lifshits (Ref 1) have shown that in certain antiferromagnetic crystals, if a magnetic (electric) field is applied, an electric (magnetic) moment, which is proportional to this field, occurs. This so-called magneto-electric effect is closely connected with the magnetic symmetry of the substance. Actually, the thermodynamic potential of such a body ought to contain a term Φ, for which $\Phi \sim EH$ holds. For paramagnetic crystals this is, however, unnecessary because their thermodynamic potential is invariant with respect to space transformation and a reversal of the time axis. In bodies having a magnetic structure, the transformation properties, however, depend on magnetic symmetry. In the present "Letter to the Editor" the crystal Cr_2O_3, the magnetic structure of which is exactly

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known, is investigated in this respect. The class of the mag-

netic symmetry of Cr_2O_3 consists of the following elements: $2C_3$, $3U_2$, IR, $2S_6R$, $3\sigma_dR$, where C_3 is the vertical axis of the symmetry of third order, U_2 - the horizontal axis of the symmetry of second order, I - the inversion, S_6 - the mirror symmetry axis of 6th order, and σ_d - plane symmetry. Two terms which are linear in $\vec{E}$ and $\vec{H}$, are invariant with respect to transformation of this class: E_zH_z and $E_xH_y+E_yH_y$. The thermodynamic potential of Cr_2O_3 is thus

$$\Phi = -\frac{1}{8\pi}\left[\varepsilon_{\parallel} E_z^2 + \varepsilon_{\perp}(E_x^2 + E_y^2)\right] - \frac{1}{8\pi}\left[\mu_{\parallel} H_z^2 + \mu_{\perp}(H_x^2 + H_y^2)\right] - \frac{1}{4\pi}\alpha_{\parallel} E_zH_z - \frac{1}{4\pi}\alpha_{\perp}(E_xH_x + E_yH_y).$$

$\varepsilon_{\parallel}$, $\varepsilon_{\perp}$ are the longitudinal and transversal dielectric constants, $\mu_{\parallel}$, $\mu_{\perp}$ - the magnetic permeabilities, $\alpha_{\parallel}$, $\alpha_{\perp}$ - the constants describing the magneto-electric effect. The relations existing between the inductions and the field strengths are:

$$D_z = \varepsilon_{\parallel} E_z + \alpha_{\parallel} H_z, \quad D_x = \varepsilon_{\perp} E_x + \alpha_{\perp} H_x, \quad D_y = \varepsilon_{\perp} E_y + \alpha_{\perp} H_y,$$

$$B_z = \mu_{\parallel} H_z + \alpha_{\parallel} E_z, \quad B_x = \mu_{\perp} H_x + \alpha_{\perp} E_x, \quad B_y = \mu_{\perp} H_y + \alpha_{\perp} E_y.$$

There are 3 references, 2 of which are Soviet.

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

SUBMITTED: June 17, 1959

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R000411920018-5"

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30937
S/570/60/000/017/007/012
E032/E114

AUTHORS: Gor'kov, L.P., Dzyaloshinskiy, I.Ye., and Pitayevskiy, L.P.

TITLE: Calculations of fluctuations in quantities described by transport equations

SOURCE: Akademiya nauk SSSR. Institut zemnogo magnetizma, ionosfery i rasprostraneniya radiovoln. Trudy, no.17(27). Moscow, 1960. Rasprostraneniye radiovoln i ionosfera. 203-207

TEXT: The authors discuss fluctuations in quantities which can be described by transport equations, e.g. the equations of Boltzmann, Fokker-Planck and Landau, in the case of a Coulomb interaction between the particles. The knowledge of these fluctuations is essential to the theory of scattering of electromagnetic waves in rarefied gases and electron plasma. The method employed is analogous to that used by L.D. Landau and Ye.M. Lifshits (Ref.2: Electrodynamics of uniform media, M., Gostekhizdat, 1957, Ref.3: ZhETF, v.32, 618, 1957). It consists in the introduction into the transport equation of additional random

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terms whose correlations are then determined on the basis of the general theory of fluctuations. For example, the Boltzmann equation is modified to read

$$\frac{\partial \nu}{\partial t} + (\underline{v} \nabla)\nu = J + y \quad (1)$$

where the collision integral J is given by

$$J = \iint w(p_1, p_1'; p, p') \{n_o(p_1)\nu(p_1') + n_o(p_1')\nu(p_1) - - n_o(p')\nu(p) - n_o(p)\nu(p')\} d^3p_1 d^3p_1' d^3p' \quad (2)$$

and y is the "random" collision integral. The problem consists in the evaluation of the average of $y(p,r,t)y(p',r',t')$. It is shown that this average is in fact given by:

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$$\overline{y(p,r,t)y(p',r',t')} = 2\delta(r - r')\delta(t - t') \times$$
$$\times \Big\{ - n_o(p') \iint w(p',p_1;\ p_1,p_1')\ n_o\ (p_1)\ d^3p_1 d^3p_1' -$$
$$- n_o(p) \iint w(p',p_1;\ p_1,p_1')\ n_o\ (p_2')\ d^3p_1 d^3p_1' +$$
$$+ \delta(p - p')n_o(p) \iiint w(p_1',p_1'';\ p,\ p_1)n_o(p_1)\ d^3p_1' d^3p_1'' d^3p_1 +$$
$$+ n_o(p)n_o(p') \iint w(p_1,p_1';\ p,\ p')\ d^3p_1 d^3p_1' \Big\} \qquad (9)$$

4

which is equivalent to the results obtained by B.B. Kadomtsev (Ref.5: ZhETF, v.32, 943, 1957). It can be shown that the introduction of the "random" collision integral into Eq.(1) does not upset the conservation of the number of particles, energy and momentum. Another transport equation considered is the following:

$$\frac{\partial \nu}{\partial t} + (\underline{v}\nabla)\nu = -\operatorname{div} \mathfrak{j} \qquad (10)$$

where j is the current density in the momentum space. Here it is convenient to introduce a "random" current y so that

$$\frac{\partial \nu}{\partial t} + (\underline{v} \nabla)\nu = - \operatorname{div} (j + y)$$

Expressions analogous to Eq.(9) are then derived. An account of the general theory of fluctuations on which these calculations are based is given in "Statistical Physics" by L.D. Landau and Ye.M. Lifshits (Ref.4: izd. 3 M., Gostekhizdat, 1951). The method can be used for fluctuations in the equations for fermi and bose gases. A.A. Abrikosov and I.M. Khalatnikov,(Ref.7: ZhETF, v.34, 198, 1958) have used it to study light scattering in liquid He^3, Acknowledgments are expressed to L.D. Landau and Ye.M. Lifshits for discussions. S.M. Rytov and B.B. Kadomtsev are mentioned in connection with their contributions to the theory of fluctuations. There are 7 Soviet-bloc references.

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24.6100

AUTHORS: Dzyaloshinskiy, I. Ye., Lifshits, Ye. M., and Pitayevskiy, L. P.

TITLE: General theory of the Van der Waals forces

PERIODICAL: Uspekhi fizicheskikh nauk, v. 73, no. 3, 1961, 381-422

TEXT: A brief report is first given of the methods of the quantum field theory, and the general theory of the Van der Waals forces is then explained on this basis. Such a theory has been developed for the first time by Ye. M. Lifshits. The application of the methods of the quantum field theory to the problems of statistical physics at finite temperature is based on a paper by Matsubara. According to it, the free energy can be calculated by the rules of Feynman's graph technique. Matsubara's technique can be appreciably improved by taking account of some general properties of the Green functions (A. A. Abrikosov, L. P. Gor'kov, I. Ye. Dzyaloshinskiy, ZhETF 33, 799 (1959), Ye. S. Fradkin, ZhETF 36, 1286 (1959). The following series presented schematically must be summed

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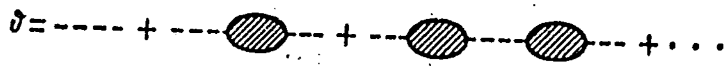
to calculate the total Green function of the photon:



In the case of a spatially inhomogeneous system it has the form

$$\mathfrak{D}_{\alpha\beta}(r_1, r_2; \xi_n) = \mathfrak{D}^0_{\alpha\beta}(r_1, r_2; \xi_n) + \int \mathfrak{D}_{\alpha\gamma}(r_1, r_3; \xi_n)\Pi_{\gamma\delta}(r_3, r_4; \xi_n) \times$$
$$\times \mathfrak{D}^0_{\delta\beta}(r_4, r_2; \xi_n)\, dr_3\, dr_4 + \int \mathfrak{D}^0_{\alpha\gamma}(r_1, r_3; \xi_n)\Pi_{\gamma\delta}(r_3, r_4; \xi_n)\mathfrak{D}^0_{\delta\mu}(r_4, r_5; \xi_n) \times$$
$$\times \Pi_{\mu\nu}(r_5, r_6; \xi_n)\mathfrak{D}^0_{\nu\beta}(r_6, r_2; \xi_n)\, dr_3\, dr_4\, dr_5\, dr_6 + \dots \quad (2,8)$$

Eq. 2.8

$\Pi_{ik}(\vec{r}_1, \vec{r}_2; \xi_n)$ signifies the so-called polarization operator of the system. (2.8) or, in another form,

$$\mathfrak{D}_{\alpha\beta}(\mathbf{r}_1, \mathbf{r}_2; \xi_n) = \mathfrak{D}^0_{\alpha\beta}(\mathbf{r}_1, \mathbf{r}_2; \xi_n) + \int d\mathbf{r}_3 d\mathbf{r}_4 \mathfrak{D}^0_{\alpha\gamma}(\mathbf{r}_1, \mathbf{r}_3; \xi_n) \Pi_{\gamma\delta}(\mathbf{r}_3, \mathbf{r}_4; \xi_n) \times$$
$$\times \Big\{ \mathfrak{D}^0_{\delta\beta}(\mathbf{r}_4, \mathbf{r}_2; \xi_n) + \int d\mathbf{r}_5 d\mathbf{r}_6 \mathfrak{D}^0_{\delta\mu}(\mathbf{r}_4, \mathbf{r}_5; \xi_n) \Pi_{\mu\nu}(\mathbf{r}_5, \mathbf{r}_6; \xi_n) \mathfrak{D}_{\nu\beta}(\mathbf{r}_6, \mathbf{r}_2; \xi_n) + \quad (2,8a)$$
$$+ \int d\mathbf{r}_5 d\mathbf{r}_6 d\mathbf{r}_7 d\mathbf{r}_8 \mathfrak{D}^0_{\delta\mu}(\mathbf{r}_4, \mathbf{r}_5; \xi_n) \Pi_{\mu\nu}(\mathbf{r}_5, \mathbf{r}_6; \xi_n) \mathfrak{D}^0_{\nu\lambda}(\mathbf{r}_6, \mathbf{r}_7; \xi_n) \times$$
$$\times \Pi_{\lambda\varrho}(\mathbf{r}_7, \mathbf{r}_8; \xi_n) \mathfrak{D}^0_{\varrho\beta}(\mathbf{r}_8, \mathbf{r}_2; \xi_n) + \dots \Big\},$$

is an integral equation with respect to $\mathfrak{D}$ having the form

$$\mathfrak{D}_{\alpha\beta}(\mathbf{r}_1, \mathbf{r}_2; \xi_n) = \mathfrak{D}^0_{\alpha\beta}(\mathbf{r}_1, \mathbf{r}_2; \xi_n) + \int \mathfrak{D}^0_{\alpha\gamma}(\mathbf{r}_1, \mathbf{r}_3; \xi_n) \Pi_{\gamma\delta}(\mathbf{r}_3, \mathbf{r}_4; \xi_n) \mathfrak{D}_{\delta\beta}(\mathbf{r}_4, \mathbf{r}_2; \xi_n) d\mathbf{r}_3 d\mathbf{r}_4. \quad (2,9)$$

X

In the general case there is no expression in a closed form for the polarization operator. In the present case of longwave photons, the polarization operator can be expressed by the dielectric constant of the body. To calculate the additional term to the energy of a condensed body, due to the longwave fluctuations of the electromagnetic field, a part describing the energy of interaction of the particle with the electromagnetic field:

$$H = H_o + H_{int} = H_o - \int A_\alpha(\vec{r})\vec{j}_\alpha(r)d^3\vec{r},$$

is separated from the total Hamiltonian of the system. The series of the perturbation theory is represented by diagrams of the type of Fig. 7 or Fig. 8 for the free energy or the Green function of the longwave photons, respectively. In the $k_o a \ll 1$ approximation, only diagrams of the form of Fig. 7a offer a correction to the free energy. The corresponding expression for the free energy reads, Eq. (3.1)

$$F = F_0 - \frac{1}{2} T \sum_{n=-\infty}^{\infty} \left\{ \int \Pi_{\alpha\beta}(r_1, r_2; \xi_n) \mathfrak{D}^0_{\beta\alpha}(r_2, r_1; \xi_n) dr_1 dr_2 + \right.$$
$$+ \frac{1}{2} \int \Pi_{\alpha\beta}(r_1, r_2; \xi_n) \mathfrak{D}^0_{\beta\gamma}(r_2, r_3; \xi_n) \Pi_{\gamma\delta}(r_3, r_4; \xi_n) \times$$
$$\times \mathfrak{D}^0_{\delta\alpha}(r_4, r_1; \xi_n) dr_1 dr_2 dr_3 dr_4 + \ldots + \frac{1}{m} \int \Pi_{\alpha\beta}(r_1, r_2; \xi_n) \mathfrak{D}^0_{\beta\gamma}(r_2, r_3; \xi_n) \ldots$$
$$\left. \ldots \Pi_{\mu\nu}(r_{2m-1}, r_{2m}; \xi_n) \mathfrak{D}^0_{\nu\alpha}(r_{2m}, r_1; \xi_n) dr_1 \ldots dr_{2m} + \ldots \right\}, \quad (3,1)$$

If the polarization operator $\Pi_{ik}(\vec{r}_1, \vec{r}_2; \xi_n) = \Pi_{ki}(\vec{r}_2, \vec{r}_1; -\xi_n)$ can be expressed by the dielectric constant of the body, it will be then possible in principle to express the corresponding correction to the free energy by formula (3.1).

$$\mathbf{f} = -\operatorname{grad} p_0 - \frac{T}{4\pi}\sum_{n=0}^{\infty}{}' \xi_n^2 \mathfrak{D}_{ll}(\mathbf{r}, \mathbf{r}; \xi_n) \operatorname{grad} \varepsilon + \frac{T}{4\pi}\sum_{n=0}^{\infty}{}' \xi_n^2 \operatorname{grad} \left\{ \mathfrak{D}_{ll}(\mathbf{r}, \mathbf{r}; \xi_n) \varrho \frac{\partial \varepsilon}{\partial \varrho} \right\}. \quad (3,17)$$

permits the ready calculation of the correction to the chemical potential of the body. The pressure is calculated next. The force can be represented by $f_i = -\partial \sigma_{ik}/\partial x_k$ with the potential tensor

$$\sigma_{ik} = -p_0 \delta_{ik} - \frac{T}{2\pi}\sum_{n=0}^{\infty}{}' \left\{ -\frac{1}{2}\delta_{ik}\left[\varepsilon(\mathbf{r}, i\xi_n) - \varrho \frac{\partial \varepsilon(\mathbf{r}, i\xi_n)}{\partial \varrho}\right] \mathfrak{D}_{ll}^{E}(\mathbf{r}, \mathbf{r}; \xi_n) + \varepsilon(\mathbf{r}, i\xi_n) \mathfrak{D}_{ik}^{E}(\mathbf{r}, \mathbf{r}; \xi_n) - \frac{1}{2}\delta_{ik}\mathfrak{D}_{ll}^{H}(\mathbf{r}, \mathbf{r}; \xi_n) + \mathfrak{D}_{ik}^{H}(\mathbf{r}, \mathbf{r}; \xi_n) \right\}. \quad (3,24)$$

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The equations (3.24) and

$$\zeta(\varrho, T) = \zeta_0(\varrho, T) + \frac{T}{4\pi} \sum_{n=0}^{\infty}{}' \frac{\partial \varepsilon(\mathbf{r}, i\xi_n)}{\partial \varrho} \mathfrak{D}_{ii}^{E}(\mathbf{r}, \mathbf{r}; \xi_n). \qquad (3,25)$$

(found by I. Ye. Dzyaloshinskiy and L. I. Pitayavskiy, ZhETF 36, 1797 (1959)) solve in principle the problem of calculating the Van der Waals part of the thermodynamic quantities of a body. The fourth part of the present paper deals with the molecular forces of interaction between solid bodies. In this connection, the general theory developed above is applied to the calculation of the Van der Waals forces between closely approached bodies. The force between the unit area of the two bodies (media 1 and 2) which are separated by a gap of width l filled with medium 3, is described by Eq. (4.13).

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$$F(l) = \frac{kT}{\pi c^3} \sum_{n=0}^{\infty}{}' \varepsilon_3^{3/2} \xi_n^3 \int_1^{\infty} p^2 \left\{ \left[\frac{(s_1+p)(s_2+p)}{(s_1-p)(s_2-p)} \exp\left(\frac{2p\xi_n}{c} l \sqrt{\varepsilon_3}\right) - 1 \right]^{-1} + \right.$$

$$\left. + \left[\frac{(s_1+p\varepsilon_1/\varepsilon_3)(s_2+p\varepsilon_2/\varepsilon_3)}{(s_1-p\varepsilon_1/\varepsilon_3)(s_2-p\varepsilon_2/\varepsilon_3)} \exp\left(\frac{2p\xi_n}{c} l \sqrt{\varepsilon_3}\right) - 1 \right]^{-1} \right\} dp, \qquad (4,13)$$

где where

$$s_1 = \sqrt{(\varepsilon_1/\varepsilon_3) - 1 + p^2}, \quad s_2 = \sqrt{(\varepsilon_2/\varepsilon_3) - 1 + p^2}, \quad \xi_n = 2\pi n kT/\hbar;$$

Here ε_1, ε_2, ε_3 denote functions of the imaginary frequency $\omega = i\xi$ ($\varepsilon = \varepsilon(i\xi_n)$), k being the Boltzmann constant. Summation is done over the integers n, and the term with n = 0 is to be taken with half the weight. The general formula and limit cases are then discussed. Eq. (4.13) can be simplified because the effect of temperature upon the interaction force between the bodies is generally quite negligible. The thus resulting formula (4.14)

$$F = \frac{\hbar}{2\pi^2 c^3} \int_0^\infty \int_1^\infty p^2 \xi^3 \varepsilon_3^{3/2} \left\{ \left[\frac{(s_1+p)(s_2+p)}{(s_1-p)(s_2-p)} \exp\left(\frac{2p\xi}{c} l\sqrt{\varepsilon_3}\right) - 1 \right]^{-1} + \right.$$
$$\left. + \left[\frac{(s_1+p\,\varepsilon_1/\varepsilon_3)(s_2+p\,\varepsilon_2/\varepsilon_3)}{(s_1-p\,\varepsilon_1/\varepsilon_3)(s_2-p\,\varepsilon_2/\varepsilon_3)} \exp\left(\frac{2p\xi}{c} l\sqrt{\varepsilon_3}\right) - 1 \right]^{-1} \right\} dp\, d\xi. \qquad (4,14)$$

is suited for distances $l \ll c\hbar/kT$. Also (4.14), however, can be appreciably simplified in two important limit cases:

$$F = \frac{\hbar}{16\pi^2 l^3} \int_0^\infty \int_0^\infty x^2 \left[\frac{(\varepsilon_1+\varepsilon_3)(\varepsilon_2+\varepsilon_3)}{(\varepsilon_1-\varepsilon_3)(\varepsilon_2-\varepsilon_3)} e^x - 1 \right]^{-1} dx\, d\xi \qquad (4,15)$$

or

$$F = \frac{\hbar\bar{\omega}}{8\pi^2 l^3}, \quad \bar{\omega} = \int_0^\infty \frac{[\varepsilon_1(i\xi)-\varepsilon_3(i\xi)][\varepsilon_2(i\xi)-\varepsilon_3(i\xi)]}{[\varepsilon_1(i\xi)+\varepsilon_3(i\xi)][\varepsilon_2(i\xi)+\varepsilon_3(i\xi)]} d\xi. \qquad (4,18)$$

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respectively, holds for "small" distances (i.e., small with respect to the lengths λ_0 of the waves that are typical of the absorption spectra of the given bodies). $|\omega|$ is a frequency that is typical of the absorption spectra of all three media. For "large" distances $l \gg \lambda_0$,

$$F = \frac{\hbar c}{32\pi^2 l^4 \sqrt{\varepsilon_{30}}} \int_0^\infty \int_1^\infty \frac{x^3}{p^2} \left\{ \left[\frac{(s_{10}+p)(s_{20}+p)}{(s_{10}-p)(s_{20}-p)} e^x - 1 \right]^{-1} + \right.$$

$$\left. + \left[\frac{(s_{10}+p\,\varepsilon_{10}/\varepsilon_{30})(s_{20}+p\,\varepsilon_{20}/\varepsilon_{30})}{(s_{10}-p\,\varepsilon_{10}/\varepsilon_{30})(s_{20}-p\,\varepsilon_{20}/\varepsilon_{30})} e^x - 1 \right]^{-1} \right\} dp\,dx, \qquad (4,19)$$

$$s_{10} = \sqrt{(\varepsilon_{10}/\varepsilon_{30}) - 1 + p^2}, \quad s_{20} = \sqrt{(\varepsilon_{20}/\varepsilon_{30}) - 1 + p^2},$$

holds after the substitution $x = 2pl\xi/c$, where ε_{10}, ε_{20}, ε_{30} denote the electrostatic values of the dielectric constant. From (4.19),

$$F = \frac{\hbar c}{16\pi^2 l^4 \sqrt{\varepsilon_{30}}} \int_0^\infty \int_1^\infty \frac{x^3\,dp\,dx}{p^2 (e^x - 1)} = \frac{\pi^2}{240} \frac{\hbar c}{\sqrt{\varepsilon_{30}}\, l^4}. \qquad (4,21)$$

follows for metals, and

$$F = \frac{\pi^3}{240}\frac{\hbar c}{l^4}\frac{1}{\sqrt{\varepsilon_{20}}}\left(\frac{\varepsilon_{10}-\varepsilon_{20}}{\varepsilon_{10}+\varepsilon_{20}}\right)^2 \varphi_{ДД}\left(\frac{\varepsilon_{10}}{\varepsilon_{20}}\right), \qquad (4,22)$$

for equal bodies. If the gap between the two bodies is filled with a liquid metal, the interaction force decreases as l^{-3} at "small" distances, and as l^{-5} at "large" distances. B. V. Deryagin, I. I. Abrikosova made the first reliable measurements of molecular attractive forces between solid bodies. For two metals separated by a vacuum

$$F = \frac{kT}{8\pi l^3}\left[1 + 2\left(\frac{4\pi kTl}{\hbar c}\right)^2 \exp\left(-\frac{4\pi kTl}{\hbar c}\right)\right] \qquad (4.30)$$

At "large" distances

$$F = \frac{\hbar c}{l^4}\frac{23}{640\pi^2}(\varepsilon_{10}-1)(\varepsilon_{20}-1) \qquad (4.35)$$

holds for the attractive force between two split up bodies. This corresponds to the interaction of two atoms with the energy

$$U = -\frac{23\hbar c}{4\pi R^7}\alpha_1\alpha_2 \quad (4.36)$$

The interaction energy between two atoms in a liquid is

$$U(R) = -\frac{3\hbar}{16\pi^3 R^6}\int_0^\infty \left(\frac{\partial\varepsilon_1(i\xi)}{\partial N_1}\right)_{N_1=0}\left(\frac{\partial\varepsilon_2(i\xi)}{\partial N_2}\right)_{N_2=0}\frac{d\xi}{\varepsilon^2(i\xi)}. \quad (4.40)$$

at "small" distances and

$$U(R) = -\frac{23\hbar c}{64\pi^3\varepsilon_0^{3/2}R^7}\left(\frac{\partial\varepsilon_{10}}{\partial N_1}\right)_{N_1=0}\left(\frac{\partial\varepsilon_{20}}{\partial N_2}\right)_{N_2=0}. \quad (4.41)$$

at "large" distances.

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$$U(R) = -\frac{27\hbar V^2}{16\pi^3 R^6}\int_0^\infty \left[\frac{\varepsilon'(i\xi)-\varepsilon(i\xi)}{\varepsilon'(i\xi)+2\varepsilon(i\xi)}\right]^2 d\xi, \quad R \ll \lambda_0, \qquad (4,42)$$

and

$$U(R) = -\frac{207V^2}{64\pi^3 R^7}\frac{\hbar c}{\sqrt{\varepsilon(0)}}\left[\frac{\varepsilon_0'-\varepsilon_0}{\varepsilon_0'+2\varepsilon_0}\right]^2, \quad R \gg \lambda_0, \qquad (4,43)$$

hold for the interaction force of emulsion particles at "small" and "large" distances, respectively. The theory described in the present paper is also suited for calculating the thermodynamic quantities of a thin liquid film on the surface of a solid. Simply, $\varepsilon_2 = 1$ is to be put in the earlier found formulas (e.g., general formula (4.13)) for determining μ. The function $\mu(T,l)$ determines all thermodynamic quantities of the film. A report is finally given of the negligibly small contribution of forces of non-electromagnetic origin (V. L. Ginzburg is mentioned), and liquid helium films are discussed. $\mu \sim l^{-3}$ is to be

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expected for the actual thicknesses of the helium film, and $1 - z^{-1/3}$ for the film profile. There are 13 figures and 30 references: 15 Soviet-bloc and 15 non-Soviet-bloc. The two most recent references to English-language publications read as follows: L. G. Grimes, L. G. Jackson, Philos. Mag. 4, 1346 (1959). I. A. Kitchener, A. P. Prosser, Proc. Roy. Soc. A 242, 403 (1959).

Card 14/14

ABRIKOSOV, Aleksey Alekseyevich; GOR'KOV, Lev Petrovich; DZYALOSHINSKIY, Igor' Yekhiyel'yevich; GUROV, K.P., red.; PLAKSHE, L.Yu., tekhn. red.

["Quantum field theory methods in statistical physics] Metody kvantovoi teorii polia v statisticheskoi fizike. Moskva, Fizmatgiz, 1962. 443 p. (MIRA 15:7)

(Quantum field theory)

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S/056/62/042/004/034/037
B125/B102

AUTHOR: Dzyaloshinskiy, I. Ye.

TITLE: Graph technique for calculating kinetic coefficients in statistical physics at finite temperatures

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 42, no. 4, 1962, 1126-1134

TEXT: The graph technique described is a generalization of J. M. Luttinger's technique (Phys. Rev., 121, 942, 1961). It operates directly with the quantities dependent on the real frequency ω, and delivers the direct analytic continuation of the graphs of T. Matsubara's technique (Progr. Theor. Phys., 14, 351, 1955) from the imaginary axis to the upper (or lower) half-plane of the complex variable ω. The present technique is much simpler and easier than that of O. V. Konstantinov and V. I. Perel' (ZhETF, 39, 197, 1960). The Lehmann representation $\int_{-\infty}^{\infty} \varrho(\vec{p},\eta)/(\eta - \omega)d\eta$ (1) of the retarded or advanced Green functions

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$G^R(\vec{p},\omega)$ or $G^A(\vec{p},\omega)$, respectively, and the relations $\mathcal{G}(\omega_n > 0) = G^R(i\omega_n)$, $\mathcal{G}(\omega_n < 0) = G^A(i\omega_n)$ (3) for the temperature Green function give

$$\mathfrak{G}(p,\tau) = \begin{cases} \int_{-\infty}^{\infty} (1 - n(\eta)) e^{-\eta\tau} \rho(p,\eta)\, d\eta, & \tau > 0 \\ -\int_{-\infty}^{\infty} n(\eta) e^{-\eta\tau} \rho(p,\eta)\, d\eta, & \tau < 0 \end{cases} \qquad (5)$$

for Fermi particles and

$$\mathfrak{G}(p,\tau) = \begin{cases} \int_{-\infty}^{\infty} (1 + n(\eta)) e^{-\eta\tau} \rho(p,\eta)\, d\eta, & \tau > 0, \\ \int_{-\infty}^{\infty} n(\eta) e^{-\eta\tau} \rho(p,\eta)\, d\eta, & \tau < 0 \end{cases} \qquad (6)$$

$$n(\eta) = [e^{\eta/T} - 1]^{-1},$$

for Bose particles after conducting the inverse Fourier transformation in

(1). $n(\eta) = \left[e^{\eta/T} + 1\right]^{-1}$. The simplest graph (Fig. 1) for the two-particle interaction is continued without Fourier transformation with respect to the time τ in the inner lines. The diagrams corresponding to the expressions

$$\delta\Sigma_a^R(p,\omega) \sim -\int d\eta_1 d\eta_2 d\eta_3 \rho(p_1,\eta_1)\rho(p_2,\eta_2)\rho(p_1+p_2-p,\eta_3) \times \times \frac{(1-n(\eta_1))(1-n(\eta_2))n(\eta_3)}{\eta_1+\eta_2-\eta_3-\omega}, \qquad (9a),$$

$$\delta\Sigma_\delta^R(p,\omega) \sim \int d\eta_1 d\eta_2 d\eta_3 \rho(p_1,\eta_1)\rho(p_2,\eta_2)\rho(p_1+p_2-p,\eta_3) \times \times \frac{n(\eta_1)n(\eta_2)(1-n(\eta_3))}{-\eta_1-\eta_2+\eta_3+\omega}. \qquad (9б)$$

which have been determined by the mass operator for $G^R(\omega) = G_0^R(\omega) = G_0^R(\omega) + G_0^R(\omega)G^R(\omega)$ are a simple modification of the ordinary Feynman graphs. The graph rules derived in the present paper also hold for complicated Feynman graphs. The analytic continuation with respect to all discrete "frequencies" ω_n of the many-particle Green function is generally hopeless. All important kinetic quantities can, however, be calculated by continuing the many-particle function with respect to one frequency. For instance, the electrical conductivity, the dielectric constant, and the viscosity are expressed by the retarded two-particle function

$$K^R(r_1, r_2; r_3, r_4; t_1 - t_2) = \mathrm{Sp}\left\{\exp\left(\frac{\Omega - \hat{H} + \mu\hat{N}}{T}\right)[\psi^+(r_1, t_1)\psi(r_2, t_1) \times \times \psi^+(r_3, t_2)\psi(r_1, t_2) - \psi^+(r_3, t_2)\psi(r_4, t_2)\psi^+(r_1, t_1)\psi(r_2, t_1)]\right\} t_1 > t_2; \quad (10).$$
$$K^R(r_1, r_2; r_3, r_4; t_1 - t_2) = 0, \quad t_1 < t_2,$$

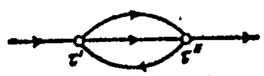
The graphs for three-particle Green functions and the similarly built temperature Green functions are continued analogously with respect to one of the discrete frequencies. L. D. Landau is thanked for a discussion. There are 9 figures. The English-language references read as follows: T. Matsubara. Progr. Theor. Phys., 14, 351, 1955; J. M. Luttinger. Phys. Rev., 121, 942, 1961.

S/056/62/042/004/034/037
B125/B102

Graph technique for calculating ...

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

SUBMITTED: November 25, 1961

Fig. 1 

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DZYALOSHINSKIY, I. YE.

Dissertation defended for the degree of Doctor of Physicomathematical Sciences at the Institute of Physical Problems imeni S. I. Vabilov in 1962:

"Application of Methods of the Quantum Field Theory to Statistical Physics."

Vest. Akad. Nauk SSSR, No. 4, Moscow, 1963, pages 119-145

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R000411920018-5"

DZIALOSZYNSKI, I.E.; LIFSZYC, E.M.; PITAJEWSKI, L.P.; WOJCIECHOWSKI, Kazimierz [translator]

Van der Waals general theory of forces. Postepy fizyki 14 no.1:3-50 '63.

L 10202-63 EWP(k)/EWT(l)/EWP(q)/EWT(m)/BDS--AFFTC/ASD--Pf-4--
JD
ACCESSION NR: AP3000064 S/0056/63/044/005/1650/1660

AUTHOR: Gor'kov, L. P.; Dzyaloshinskiy, I. Ye.

TITLE: Possibility of zero-sound type of oscillations in metals

SOURCE: Zhurnal eksper. i teoret. fiziki, v. 44, no. 5, 1963, 1650-1660

TOPIC TAGS: Fermi liquids, zero sound, metals

ABSTRACT: Zero-sound electron oscillations in an anisotropic metal are studied on the basis of the theory of the Fermi liquid. Both spin and non-spin oscillations are possible. The latter apparently exist in any type of metal and possess a linear dispersion law throughout the frequency range. Spinless waves can exist if some restrictions are imposed on the magnitude of the Fermi-liquid interaction. For symmetric directions in the crystal, these restrictions can be appreciably relaxed. The non-spin oscillations have two linear regions of the dispersion law, one at radio frequencies and the other in the infrared. The possibility of observing zero sound in metals is discussed. It is pointed out that zero-sound oscillations might manifest themselves also in many other

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ACCESSION NR: AP3000064

effects, such as line widths in electron diffraction, characteristic losses of charged particles passing through metals placed in magnetic fields, and others. Orig. art. has: 32 formulas.

ASSOCIATION: Institut fizicheskikh problem Akademii nauk SSSR (Institute of Physics Problems, Academy of Sciences SSSR)

SUBMITTED: 20Dec62 DATE ACQ: 12Jun63 ENCL: 00

SUB CODE: PH NR REF SOV: 007 OTHER: 001

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Card 2/2

ACCESSION NR: AP4031157 S/0056/64/046/004/1352/1359

AUTHOR: Dzyaloshinskiy, I. Ye.; Man'ko, V. I.

TITLE: Nonlinear effects in antiferromagnets. "Latent" antiferromagnetism.

SOURCE: Zh. eksper. i teor. fiz., v. 46, no. 4, 1964, 1352-1359

TOPIC TAGS: antiferromagnetism, magnetic moment, uranium peroxide, iron carbonate, ferric oxide

ABSTRACT: In the general expansion of the magnetic moment

the quadratic terms (coefficient b), which vanish in the case of paramagnetic substances but not in the case of antiferromagnetic substances, are shown to be either of exchange or of relativistic origin. In the case of exchange origin their order is b ~ χ/H_e (χ— ordinary susceptibility, H_e -- exchange field, ~ 5 x 10^5 -- 10^6 Oe) and can necessitate appreciable corrections (on the order of 10%). In the case of relativistic origin b ~ $\alpha\chi/H_e$ (α is the ratio of the relativistic energy to the exchange energy), and the correction is on the order of 1% and cannot be detected. It is shown specifically that in the antiferromagnet the coefficient b is due

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ACCESSION NR: AP4031157

to exchange forces, whereas in FeCO and in the low-temperature modification of α-Fe_2O_3 the coefficient b is of relativistic origin. It is also shown that ferromagnets can exist which have a unique "latent" antiferromagnetism, in which the average magnetic moment of the ions differ both in magnitude and in direction, although, unlike in ferrites all the magnetic ions are identical and are located in crystallographically equivalent positions. This "latent" antiferromagnetism changes the temperature dependence of the spontaneous moment near the ferromagnet transition point. The "latent" antiferromagnetism of a cubic face-centered crystal having the symmetry corresponding to close packing (space group O_h^5) is considered as an example. The formulas obtained for the nonlinear effects in antiferromagnets are useful at low temperatures and not only near the temperature of the antiferromagnetic transition. Orig. art. has: 2 figures and 13 formulas.

ASSOCIATION: Institut fizicheskikh problem Akademii nauk SSSR (Institute of Physics Problems Academy of Sciences SSSR)

SUBMITTED: 02Oct63 DATE ACQ: 07May64 ENCL: 00

SUB CODE: SS NR REF SOV: 002 OTHER: 002

Card 2/2

ACCESSION NR: AP4031167 S/0056/64/046/004/1420/1437

AUTHOR: Dzyaloshinskiy, I. Ye.

TITLE: Theory of helicoidal structures in antiferromagnets. 1. Nonmetals

SOURCE: Zh. eksper. i teor. fiz., v. 46, no. 4, 1964, 1420-1437

TOPIC TAGS: antiferromagnetism, helicoidal structure, phase transition theory, spin lattice force, exchange interaction anisotropy, molecular theory, spin spin force

ABSTRACT: The author advances the opinion that the current molecular field theory of helicoidal structures has several deficiencies and presents a theory of magnetic superstructures based on Landau's theory of phase transitions (L. Landau and Ye. Lifshits, Statisticheskaya fizika, Gostekhizdat, 1951). The large period of the superstructure is attributed in this theory either to relativistic spin-lattice or spin-spin forces, or else to a sharp anisotropy of the exchange interaction. The general theory of the superstructure in the vicinity of the phase-transition point is first developed and then applied to the case of nonmetallic antiferromagnets. The theory is then generalized to the case of arbitrary temperature and is compared with other theories. The theory of superstructures in metals

ACCESSION NR: AP4031167

differs in a number of particulars and will be treated in a later publication. Orig. art. has: 20 formulas and 3 figures.

ASSOCIATION: Institut fizicheskikh problem Akademii nauk SSSR (Institute of Physics Problems Academy of Sciences SSSR)

SUBMITTED: 30Oct63 DATE ACQ: 07May64 ENCL: 00

SUB CODE: EM, GP NR REF SOV: 003 OTHER: 008

Card 2/2

ACCESSION NR: AP4037585 S/0056/64/046/005/1722/1725

AUTHOR: Dzyaloshinskiy, I. Ye.

TITLE: A general relation in the theory of ferromagnetic Fermi fluids

SOURCE: Zh. eksper. i teor. fiz., v. 46, no. 5, 1964, 1722-1725

TOPIC TAGS: Fermi fluid, ferromagnetism, spin orbit coupling, exchange force, particle interaction, angular momentum, spin

ABSTRACT: It is shown that the total spin of the system of Fermi particles possessing a spectrum of the Fermi type (a Fermi fluid) is equal to the sum of the spins of its excitations, provided only exchange forces are operative in the system. This general relation, which is analogous to the condition of equality of the number of particles to the number of excitations, was proved by J. M. Luttinger and J. C. Ward (Phys. Rev. v. 118, 1417, 1960) for a physically un-

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ACCESSION NR: AP4037585

realistic case of paired interactions between the particles. It is emphasized that the assumption used in the present proof about the exchange does not limit in any essential respect the generality of the proposition, for only in the absence of non-exchange interactions does a separation of the total momentum of the system into spin and orbital parts have any meaning. Orig. art. has: 2 figures and 9 formulas.

ASSOCIATION: Institut fizicheskikh problem Akademii nauk SSSR (Institute of Physics Problems, Academy of Sciences SSSR)

SUBMITTED: 02Oct63 DATE ACQ: 09Jun64 ENCL: 00

SUB CODE: NP NR REF SOV: 004 OTHER: 001

ACCESSION NR: AP4042406 S/0056/64/047/001/0336/0348

AUTHOR: Dzyaloshinskiy, I. Ye.

TITLE: Theory of helicoidal structures in antiferromagnets. II. Metals

SOURCE: Zh. eksper. i teor. fiz., v. 47, no. 1, 1964, 336-348

TOPIC TAGS: rare earth element, antiferromagnetism, magnetic structure, crystal lattice, neutron diffraction pattern

ABSTRACT: This is a second paper on this subject (the first was published in ZhETF v. 46, 1420, 1964), but deals with antiferromagnetic metals rather than semiconductors. Unlike in the latter case, the thermodynamic potential and the coefficients of the quadratic terms involved in the Landau theory are not analytic functions in the wave vector of the magnetic structure ($f = 2\pi/L$, where L -- period of the magnetic structure), since the interaction be-

ACCESSION NR: AP4042406

tween the spins of the magnetic ions and the electrons gives rise to singularities in the variation of the potential and of the coefficients with the wave vector. In this case the periods of the structures are determined by the interaction between the conduction electrons and the spins of the magnetic ions and the positions of the singular points are determined not by the symmetry properties of the lattice, but by the properties of the electronic Fermi surfaces -- the extremal diameters of the Fermi surface. In fact, the periods of the structures differ little from quantities that are reciprocal to these extremal diameters. The magnetic structures are investigated both at low temperatures and at temperatures close to the transition point. The results show that a greater variety of magnetic structures is possible in metals than in insulators. In particular, structures are possible in which the vector f occupies an arbitrary asymmetrical position. The latter has been confirmed by many neutron-diffraction investigations of rare-earth metals. It is pointed out in the conclusion that final calculations

ACCESSION NR: AP4042406

will have to await the acquisition of more reliable experimental data on the shape of the Fermi surfaces in rare-earth metals. Orig. art. has: 10 figures and 23 formulas.

ASSOCIATION: Institut fizicheskikh problem Akademii nauk SSSR (Institute of Physics Problems, Academy of Sciences SSSR)

SUBMITTED: 10Feb64 ENCL: 00

SUB CODE: EM, SS NR REF SOV: 005 OTHER: 006

Pt-10 IJP(c)/RAEM(a)/ASD(a)-5/AFWL/AS(mp)-2/SSD/

Ye.

dal structures

experimental

492-1002

antiferromagnetism, helicoidal magnetic spin resonance, atomic lattice magnetic lattice

This is a continuation of two earlier papers 1964 and

than those

L 11063-65

ACCESSION NR: AP4046419

"-localized" part of the density is always small compared [illegible] part. The analysis [illegible]

[illegible] fizicheskikh [illegible]

BYCHKOV, Yu.A.; GOR'KOV, L.P.; DZYALOSHINSKIY, I.Ye.

One-dimensional superconductivity. Pis'. v red. Zhur. eksper. i teoret.fiz. 2 no.3:146-152 Ag '65.

(MIRA 18:12)

1. Institut fizicheskikh problem AN SSSR i Institut teoreticheskoy fiziki AN SSSR. Submitted June 15, 1965.

L 22249-66 EWT(1) IJP(c) GG

ACC NR: AP6010996 SOURCE CODE: UR/0056/66/050/003/0738/0758

AUTHOR: Bychkov, Yu. A.; Gor'kov, L. P.; Dzyaloshinskiy, I. Ye.

51

B

ORG: Institute of Theoretical Physics, Academy of Sciences, SSSR (Institut teoreticheskoy fiziki Akademii nauk SSSR)

21

TITLE: The possibility of effects similar to superconductivity in a one-dimensional system

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 50, no. 3, 1966, 738-758

TOPIC TAGS: superconductivity, superconductor, Fermi particle, BCS theory, electron pair

ABSTRACT: It is shown that the Fermi state of a one-dimensional system is unstable relative to an arbitrarily weak attraction between the particles. In distinction to the three-dimensional case, it is the particle quartets near the Fermi surface which exhibit specific properties similar to those of the electron pairs in the BCS theory. Instability changes the ground state in such a way that a spectrum gap appears and the structure period doubles. However, the new ground state is capable of passing a current without energy dissipation. Interaction with the lattice leads to the appearance of an effective interaction between the electrons. If the effective interaction be-

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R000411920018-5"

L 22249-66

ACC NR: AP6010996

between the electrons. If the effective interaction is repulsive (but weak), the system remains in the metallic state of all temperatures. The problem of fluctuations is discussed. [CS]

SUB CODE: 20/ SUBM DATE: 06Oct65/ ORIG REF: 006/ OTH REF: 005/

Card 2/2 nst

L 19629-65 EWT(m)/EWP(t)/EWP(b)

structure of the compound

no 4, 1964,

europium gallide, aluminum boride, crystal structure, crystal lattice

The intention of the authors was primarily

they were

art. has: 2 tables.

Card 1/2

L 8894-65 EWT(m)/EWP(q)/EWP(b) ESD(gs)

rare earth metal, gallium, ... um

To ascertain the possible ... compounds

... systems, alloys in the ...

... were melted ...

L 8891-65

ACCESSION NR: AP4044173

5(2) SOV/78-4-7-18/44

AUTHORS: Mironov, K. Ye., Dzyatkevich, B. S.

TITLE: On the Effect of Glacial Acetic Acid on Some Carbonates of the Alkali- and Alkaline-earth Metals (O deystvii ledyanoy uksusnoy kisloty na nekotoryye karbonaty shchelochnykh i shchelochnozemel'nykh metallov)

PERIODICAL: Zhurnal neorganicheskoy khimii, 1959, Vol 4, Nr 7, pp 1582-1586 (USSR)

ABSTRACT: The decomposition of the carbonates of Li, Na, K, Ca, Sr, and Ba was carried out in a somewhat modified apparatus described by Seyb and Kleinberg (Ref 10) (Fig 1). During the reaction the separated CO_2 and the coefficient

$\frac{v(CO_2)_{exper}}{v(CO_2)_{theor}}$ were determined. The data are given in table 1 and figure 2. In no experiment was a complete separation of the carbon dioxide attained. The maximum values of separation for alkali carbonates (90-95%) are attained at a ratio between glacial acetic acid and carbonate that is just necessary to decompose the carbonate and to dissolve the acetate. With an in-

Card 1/3

On the Effect of Glacial Acetic Acid on Some Carbonates of the Alkali- and Alkaline-earth Metals

creased addition of glacial acetic acid v_{exp}/v_{theor} decreases. This is explained by the formation of bicarbonates which are soluble in glacial acetic acid as an intermediate product of acetolysis. Corresponding to the increasing stability of the bicarbonates in the order $LiHCO_3$ - $NaHCO_3$ - $KHCO_3$, the coefficient of the separation of CO_2 decreases. The alkaline-earth carbonates at the same conditions yield only 30% of the theoretical quantity of carbon dioxide. As the alkaline-earth bicarbonates are less stable than the alkali bicarbonates, the formation of acetobicarbonates soluble in glacial acetic acid is assumed to be $Me\begin{matrix} \diagup OCOCH_3 \\ \diagdown OCO(OH) \end{matrix}$. There are 3 figures, 1 table, and 16 references, 4 of which are Soviet.

ASSOCIATION: Institut obshchey i neorganicheskoy khimii im. N. S. Kurnakova Akademii nauk SSSR, Laboratoriya perekisnykh soyedineniy (Institute for General and Inorganic Chemistry imeni N. S. Kurnakov of the Academy of Sciences of the USSR, Laboratory for Peroxide

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R000411920018-5"

ACC NR: AP7000012 SOURCE CODE: UR/0076/66/040/011/2907/2909

AUTHOR: Vol'nov, I. I.; Dzyatkevich, B. S.

ORG: Laboratory of Peroxy Compounds, Institute of General and Inorganic Chemistry im. N. S. Kurnakov, Academy of Sciences, SSSR (Laboratoriya perekisnykh soyedineniy, Institut obshchey i neorganicheskoy khimii Akademii nauk SSSR)

TITLE: Hydrogen peroxide solutions and metallic gallium and indium

SOURCE: Zhurnal fizicheskoy khimii, v. 40, no. 11, 1966, 2907-2909

TOPIC TAGS: hydrogen peroxide, gallium indium

ABSTRACT: The influence of metallic gallium and indium on the decomposition of hydrogen peroxide solutions (33-96 mass %) was studied at 20°C at a constant ratio of the area of the metallic mirror of Ga or In (deposited on the inner surface of reactor vessels) to the volume of H_2O_2 solution. The decomposition rate was determined gasometrically and permanganatometrically, and found to be virtually the same on the indium mirror, gallium mirror, and glass No. 23. Ga_2O_3 (in various modifications) was formed on the gallium morror. The decomposition of the 93.5% H_2O_2 solution on gallium is characterized by the presence of an induction period; the numerical value of the decomposition rate is 8×10^{-5} ml O_2/min, g, i. e., one order of magnitude less than the value for the 33.5% concentration, 7×10^{-4} ml O_2/min, g. The decomposition of the 95.8% H_2O_2 solution is also characterized by the presence of an induction

Card 1/2 UDC: 541.128

ACC NR: AP7000012

period, and the decomposition rate is equal to 3.5×10^{-5} ml O_2/min, g, which is one order of magnitude less than the value for the 33.8% solution, 2×10^{-4} ml O_2/min, g. Orig. art. has: 8 figures.

SUB CODE: 07/ SUBM DATE: 12Feb66/ ORIG REF: 001/ OTH REF: 001

Card 2/2

MIRONOV, K.Ye.; DZYATKEVICH, B.S.; ROGOZHNIKOVA, T.I.

A reaction of hydrogen peroxide formation in the medium of liquid ammonia. Izv. Sib. otd. AN SSSR no.11:130-132 '61. (MIRA 15:1)

1. Institut neorganicheskiy khimii Sibirskogo otdeleniya AN SSSR, Novosibirsk i Institut i neorganicheskoy khimii imeni N.S. Kurnakova, Moskva.

(Hydrogen peroxide)

DOBRYNINA, T.A.; DZYATKEVICH, B.S.

Peroxyhydrates and hydrates of rubidium and cesium carbonates. Report No. 1: Solubility isotherms of the ternary systems $Rb_2CO_3 - H_2O_2 - H_2O$ and $Cs_2CO_3 - H_2O_2 - H_2O$ at 0°C. Izv. AN SSSR.Ser.khim. no. 5:790-794 My '64. (MIRA 17:6)

1. Institut obshchey i neorganicheskoy khimii im. N.S. Kurnakova AN SSSR.

DZYATKEVICH, B.S.; DOBRYNINA, T.A.

Peroxyhydrates and hydrates of rubidium and cesium carbonates. Report No.2: Physicochemical study of the ternary system $Rb_2CO_3 - H_2O_2 - H_2O$. Izv.AN SSSR. Ser.khim. no.1:37-42 '66. (MIRA 19:1)

1. Institut obshchey i neorganicheskoy khimii im. N.S.Kurnakova AN SSSR.

KHIL'CHEVSKIY, V.V. [Khil'chevs'kyi, V.V.]; SHASHLOV, V.I.; PISARENKO, G.S. [Pysarenko, H.S.], otv.red.; DZYATKOVSKAYA, N.P. [Dziatkivs'ka, N.P.] red.-leksikograf; REMENNIK, T.K., red.izd-va; YEFIMOVA, M.I. [IEfimova, M.I.], tekhn.red.

[Russian-Ukrainian dictionary on mechanical engineering and general manufacture of machinery] Russko-ukrainskii slovar' po mashinovedeniiu i obshchemu mashinostroeniiu. 16000 terminov. Sost.V.V.Khil'chevskii i V.I.Shashkov. Kiev, 1959. 232 p. (MIRA 13:4)

1. Akademiya nauk USSR. 2. Chlen-korrespondent AN USSR (for Pisarenko).
(Technology--Dictionaries--Russian)
(Russian language--Dictionaries--Ukrainian)

DZYGADLO, Zbigniew (Warsaw)

Linearized supersonic [redacted] past vibrating surface of a body of revolution. Proc vibr probl 2 no.3:265-284 '61.

51

L 16723-63 EWP(r)/EWT(m)/BDS AFFTC S/124/63/000/004/009/064

AUTHOR: Dzygadlo, Z.

TITLE: Linearized supersonic flow past a vibrating surface of a body of revolution. (In Engl.; abs. in Polish and Russian)

PERIODICAL: Referativnyy zhurnal, Mekhanika, no. 4, 1963, 23, abstract 4B145 (Proc. Vibrat. Probl. Polish Acad. Sci., 2, no. 3, 1961, 265-284)

TEXT: The author considers the harmonic oscillations of a body of rotation in a supersonic flow. For determining the potential of the perturbation velocity, a Laplace transform of the wave equation of the appropriate boundary problem is used. In a general case, the problem reduces to an integral Volterra equation of the second kind. By the method of asymptotic expansion in a series in the small parameter, for an oscillating cylinder the author establishes a dependence of the pressure distribution on the normal component of the perturbation rate, valid for fairly high M-numbers. The error of an approximate solution is estimated. It is shown that at M greater than 1.5, it suffices to keep 3 to 5 terms of the series in the expansion. There is developed a second linear approximation of the flow potential around thin pointed bodies; this approximation is used for finding the pressure distribution in an oscillating cone. A. M. Volodko.

[Abstracter's note: Complete translation.]

Card 1/1

DZYGADLO, Z.

Problem of aeroelasticity of a cylindrical panel and a plate strip taking into consideration the transversal coupling. Proceed vibr probl 5 no.2:95-115 '64.

1. Department of Vibrations, Institute of Basic Technical Problems, Polish Academy of Sciences, Warsaw.

L 3301-66 EWT(d)/EWT(l)/EWP(m)/EWP(w)/EWA(d)/EWP(v)/EWP(k)/FCS(k)/EWA(h)/EWA(l)/
ACC NR: AP5016900 ETC(m) WW/EM SOURCE CODE: PO/0097/65/006/001/0033/0048

45
B

AUTHOR: Dzygadlo, Z. (Warsaw)

ORG: Institute of Basic Technical Problems, Polish Academy of Sciences

TITLE: Linearized supersonic flow in an axially symmetric duct with vibrating wall

SOURCE: Proceedings of vibration problems, v. 6, no. 1, 1965, 33-48

TOPIC TAGS: shell structure dynamics, cylindric shell structure, shell vibration, supersonic flow, external flow, internal flow

ABSTRACT: This article discusses the problem of a linearized supersonic flow in an axially symmetric duct with a vibrating wall. The general form of the potential of internal flow is determined, and the problem is then reduced to a recurrence set of Volterra equations of the second type. An analysis of the equations thus obtained is carried out, and an equation is also obtained for determining the pressure acting on the wall in function of the normal displacement component of the wall. This relation is obtained in the form of an asymtotic expansion valid for high Mach numbers of undisturbed flow. Thus it follows that a number of known solutions of the flutter problem of a cylindrical shell in outer flow, for which the piston approximation is used, are also valid for the analogous inner problems. Orig. art. has: 3 figures, 7 formulas.

SUB CODE: ME, AS / SUBM DATE: 15Oct64 / ORIG REF: 004 / OTH REF: 003
Card 1/1 DP

L 36169-66 EWP(m)/EWT(1)/EWP(w) IJP(c) EM/WW

ACC NR: AP6017887 (N) SOURCE CODE: PO/0097/65/006/004/0353/0365

AUTHOR: Dzygadlo, Z. (Warsaw)

ORG: none

TITLE: Parametric autoexcited vibration of a hinge-supported plate in a supersonic gas flow [Paper presented at the Scientific Conferece of the Department of Mechanics of Continuous Media, IBTP, Polish Academy of Sciences, at Zakopane, September 1964]

SOURCE: Proceedings of vibration problems, v. 6, no. 4, 1965, 353-365

TOPIC TAGS: parametric resonance, gas flow, supersonic flow, autoexcitation, vibration

ABSTRACT: The author analyzes a boundary-value problem presented by parametric autoexcited vibration of a hinged plate of finite length in a supersonic flow. Assuming that the plane is affected by alternate periodic forces, the gas flow will change the final location of the parametric resonance regions, i. e., the regions of unstable vibrations. When the Mach number of an undisturbed gas flow moves towards M_{cr} of the plate, the main region of unstable vibrations increases considerably,

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L 36169-66

ACC NR: AP6017887

and moves toward the lower frequencies. The autoexcited vibrations and the parametric excitement of vibrations act simultaneously in this case. When $M > M_{cr}$, autoexcitation damps the parametric vibrations. Orig. art. has: 4 figures and 33 formulas. [GC]

SUB CODE: 20, 09/ SUBM DATE: 20Jun65/ ORIG REF: 002/ OTH REF: 006/ SOV REF: 001/

Card 2/2 MLP

L 47416-66 EWP(m)/EWP(w) IJP(c) WW/EM

ACC NR: AP6028312 SOURCE CODE: PO/0097/66/007/002/0121/0134

AUTHOR: Dzygadlo, Z.

ORG: Department of Vibrations, IBTP, Polish Academy of Sciences

TITLE: Forced vibration of a plate on hinged supports in supersonic flow

SOURCE: Proceedings of vibration problems, v. 7, no. 2, 1966, 121-134

TOPIC TAGS: forced vibration, perturbation, supersonic flow, self excitation

ABSTRACT: The paper concerns forced vibrations of a hinge-supported plate in a supersonic flow under pressure produced by the motion of the plate in gas, as well as under additional harmonic pressure produced by external perturbation, independent of the motion of the plate. It was found that the self-excitation of the system affects the shape and amplitude of forced vibrations considerably, as well as resonance frequencies. For $M < M_{cr}$, amplitude vibrations in the vicinity of resonance frequencies corresponding to the first two eigenfunctions increase to a high degree with the increase of M. For $M = M_{cr}$, in spite of damping in the system, a strong resonance with an unlimited vibration amplitude (on the basis of the linear theory) occurs. For

L 47416-66

ACC NR: AP6028312

$M > M_{cr}$, the amplitude of forced vibrations decreases with the increase of M. Therefore, self-excitation contributes to external pressure only in the case of $M \leq M_{cr}$, while for $M > M_{cr}$ it acts as a damping factor. [DW]

SUB CODE: 20/ SUBM DATE: 22Dec65/ ORIG REF: 002/ OTH REF: 003

vlr

Card 2/2

ACC NR: AP7003453 SOURCE CODE: PO/0097/66/007/004/0287/0309

AUTHOR: Dzygadlo, Z. (Warsaw)

ORG: none

TITLE: Parametric self-excited vibration of a plate of finite length in plane supersonic flow

SOURCE: Proceedings of vibration problems, v. 7, no. 4, 1966, 287-309

TOPIC TAGS: flow analysis, supersonic flow, vibration effect, digital computer, linearized potential flow theory, plane supersonic flow, surface structure, Mach number, undisturbed flow, instability boundary region, self excited vibration, plate vibration/Ural 2 digital computer

ABSTRACT: This paper continues the author's previous studies of fundamental phenomena connected with the action of loads which depend explicitely on time on finite surface struectures in supersonic flow. It contains an analysis of parametric self-excited vibrations of a plate of finite length in plane supersonic flow. Complete and simplified theories of linearized potential flow are used, assuming that condi-

Card 1/2

ACC NR: AP7003453

tions of either hinged support or rigid or elastic clamping are satisfied at the plate's edges. Frequency equations derived from the analysis make it possible to obtain boundaries of instability regions of the system as a function of the Mach number of undisturbed flow. The convergence of the solution is investigated. The computations were performed using the Ural 2 digital computer. The results are used to establish the existence of a number of new effects related to the effects of parametric excitation on finite plates in supersonic flow. Orig. art. has: 10 figures, 4 tables, and 56 formulas. [Based on author's abstract] [DR]

SUB CODE: 20/SUBM DATE: 02Jul66/ORIG REF: 002/SOV REF: 003/
OTH REF: 004/

Card 2/2

DZYGALO, A.I., inzh.

Transitory interference during the shaping of a modulated pulse train using a shock-excitation stage. Sbor. trud. LIIZHT no.224: 108-113 '64. (MIRA 18:9)

L 10446-66 EWT(d)/EWT(1)/EWA(h)

ACC NR: AR5027563 SOURCE CODE: UR/0274/65/000/008/A057/A057

SOURCE: Ref. zh. Radiotekhnika i elektrosvyaz', Abs. 8A414

AUTHOR: Dzygalo, A. I.

TITLE: Cross interference in shaping modulated pulse sequence by a shock-excitation circuit

CITED SOURCE: Sb. tr. Leningr. in-t inzh. zh.-d. transp., vyp. 224, 1964, 108-113

TOPIC TAGS: pulse modulation, signal interference

TRANSLATION: A group pulse-modulation (PM) unit contains a circuit excited by a voltage step and is intended for shaping truncated pulses for converting time PM into phase PM. Only the first (negative) half-wave is used; the second half-wave is suppressed by means of a semiconductor diode. The resistance of the suppressor circuit containing an open diode is finite; hence, an aperiodic positive peak will always be present and its "tail" may persist longer than the intra-pulse spacing; this "tail" may displace the time position of the next pulse, or in other words a spurious modulation of one channel by another may occur. It is proven that the interference level depends on the relation between the spacing and the shaped-pulse duration and is independent of the modulation time interval.

SUB CODE: 09 UDC: 621.374.2

Card 1/1

DZYGALO, V.I.

Magnetoelastic stress pickup. Izm. tekh. no.1:33-34 Ja '65.
(MIRA 18:4)

USSR / Human and Animal Morphology (Normal and Pathological). Nervous System. S-2

DZYGAYEVA, S.B.

Abs Jour: Ref Zhur-Biol., No 10, 1958, 45486

Author : Dzygaeva, S. B.
Inst : Not given
Title : The Anterior Suture of the Brain.

Orig Pub: Zh. nevropatol. i psichiatrii, 1957, 57, No 6, 724-730

Abstract: A miscoscopic disclosure of the anterior suture (AS) of the brain is accomplished by means of a refined anatomical preparation after a special treatment of the brain. The human brain was investigated in the fetus, children and adults, as well as the brains of a rabbit, a cat and a dog. The author found that AS in man consists of an underdeveloped anterior phylogenetically-early

Card 1/2

15

USSR / Human and Animal Morphology (Normal and Pathological). Nervous System. S-2

Abs Jour: Ref Zhur-Biol., No 10, 1958, 45486

Abstract: stage and a strongly developed posterior phylogenetically-late stage. In AS, fibers are developed, which lead to the wedge and to the tongue convolutions of the occipital section. -- A. B. Kuz'mina-Prigradova

Card 2/2

DZYGALO, A.I., inzh.

Possibility of replacing railroad wire communication systems with multichannel radio-relay systems and choice of multiplexing apparatus. Sbor. LIIZHT no.169:123-129 '60. (MIRA 13:11)
(Railroads--Communication systems)
(Radio relay systems)

DZYGALO, A.I., inzh. (g.Leningrad)

Communication systems for electric railroads operated on commercial frequency. Zhel.dor.transp. 43 no.3:48-49 Mr '61. (MIRA 14:3)
(Electric railroads--Communication systems)

40553

S/142/62/005/003/008/009
E192/E382

6.7110

AUTHOR: Dzygalo, A.I.

TITLE: Analysis of the operation of a pulse-selector as a pulse-noise source in time-division multiplex radio-relaying communications systems

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Radiotekhnika, v. 5, no. 3, 1962, 402 - 404

TEXT: When the signal of a channel in a time-division multiplex system is demodulated after passing through a pulse selector, the signal contains not only the required component U_m but small pulse components $U_ш$, produced by the pulses of the neighbouring channel. This is primarily due to the non-ideal characteristics of the selector and its selectivity can be defined as:

$$b = U_m/U_ш \quad (1)$$

The selector can be represented in the form shown in Fig. 2, where the key П simulates the change of the transfer function

Card 1/3

X

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by a certain time function $G(t) = f(t - t_N)$, where $f(t)$ is a function describing the operation of the selector and t_N is the instant of selector operation for the N-th pulse. If the input signal of the selector is in the form of a train of pulses F(t):

$$F(t) = \sum_{K=0}^{K=p} f_1(t - t_k) ,$$

the selector has a maximum transfer function G_1 for the pulse for which $t_k = t_N$. The transfer function for all the remaining pulses is given by:

$$G_2 = \frac{Z_2}{Z_1 + Z_2} .$$

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The selectivity for the case of time-modulated signals with modulation-conversion is shown to be given by:

$$b = \frac{1}{\Omega\tau} \frac{G_1}{G_2} \qquad (3)$$

It is seen that the selectivity depends on the duration τ of the pulses and the frequency of the modulating waveform. There are 2 figures.

ASSOCIATION: Kafedra Leningradskogo instituta inzhenerov zhel. dor. transporta im. akad. V.N. Obraztsova (Department of the Leningrad Institute of Railway-transport Engineers imeni Academician V.N. Obraztsov)

SUBMITTED: February 20, 1960 (initially)
November 14, 1961 (after revision)

Fig. 2

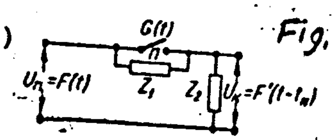

Fig. 2:

BEREZIN, Yu.L., inzh.; DZYGALO, V.I., inzh.

Automatic measurement of the quantity of solid substance in the pulp. Mekh. i avtom. proizv. 18 no.9:14 S '64.

(MIRA 17:11)

/EWT(m)/EWP(t)/EWP(t)/EWP(b) Pab IJP(c) JD/JG

DZYGADLO, Zbigniew (Warsaw)

Self-excited vibrations of a pointed conical shell in supersonic flow. Proceed vibr probl 4 no. 3:265-280 '63.

DZYGADLO, Z.; SOKOLOWSKI, M.; ZAHORSKI, S. (Warszawa); ZYCZKOWSKI, M. (Krakow)

A scientific conference held in Krynica on the mechanics of continuous media: a review of papers. Mechan teor stosow 1 no. 1:99-107 '63.

DZYGAYEV, V. [Dzuhaiev, V.], kand.arkhitektury

Plastic doors and window blocks. Prosk. i bud. 1 no.1:57-59 O '59.
(MIRA 13:12)
(Doors) (Windows) (Plastics)