Davydov, A. S. On the theory of a particle with a spin 3/2. Akad. Nauk SSSR. Zhurnal Eksper. Teoret. Fiz. 17, 427–436 (1947). (Russian. English summary)

A spin-vector form of writing down equations for a particle with a spin 3/2 in the case when external fields are present is discussed in the paper. The case is considered of a particle having a zero stationary mass. The relation between the equations obtained and those proposed by Rarita and Schwinger is discussed. *Author's summary.*

Source: Mathematical Reviews, 1948, Vol 9, No. 3

DAVYDOV, A. S.

PA 19/49T86

USSR/Physics
Spectra, Absorption

Sep/Oct 48

"Theory of the Absorption Spectra of Some Polyatomic Molecules," A. S. Davydov, Phys Inst, Acad Sci Ukrainian SSR, 1 3/4 pp

"Iz Ak Nauk SSSR, Ser Fiz" Vol XII, No 5
p. 644-5

Existing methods of calculating energy states of polyatomic molecules are unsatisfactory. Three methods are usually used: (1) valence bonds, (2) molecular orbits, and (3) antisymmetrical molecular orbits. Davydov describes new method based on antisymmetrical wave-

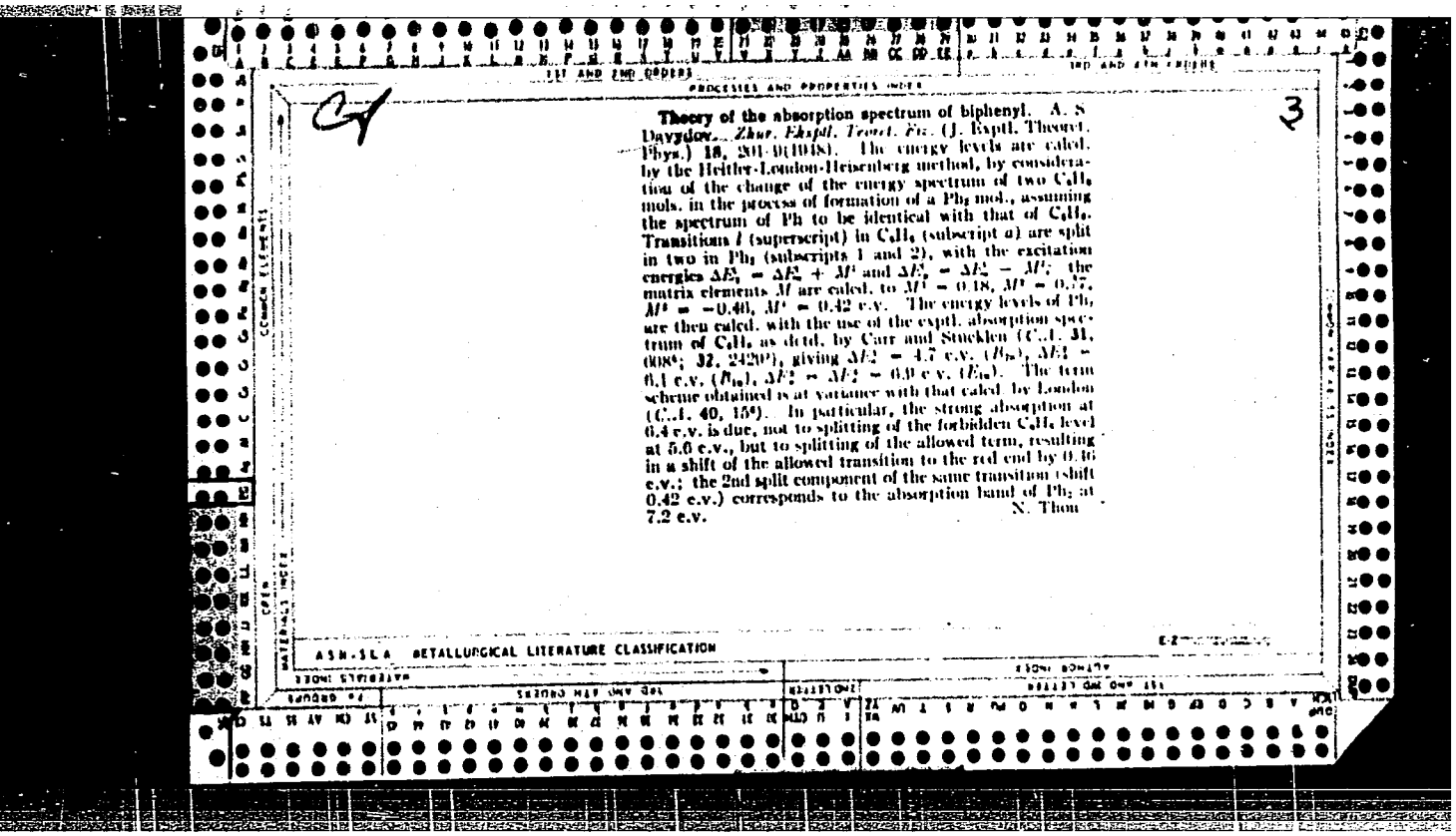
[redacted] 19/49T86

USSR/Physics (Contd)

Sep/Oct 48

functions. Gives synopsis of his paper and discussion which ensued.

[redacted] 19/49T86

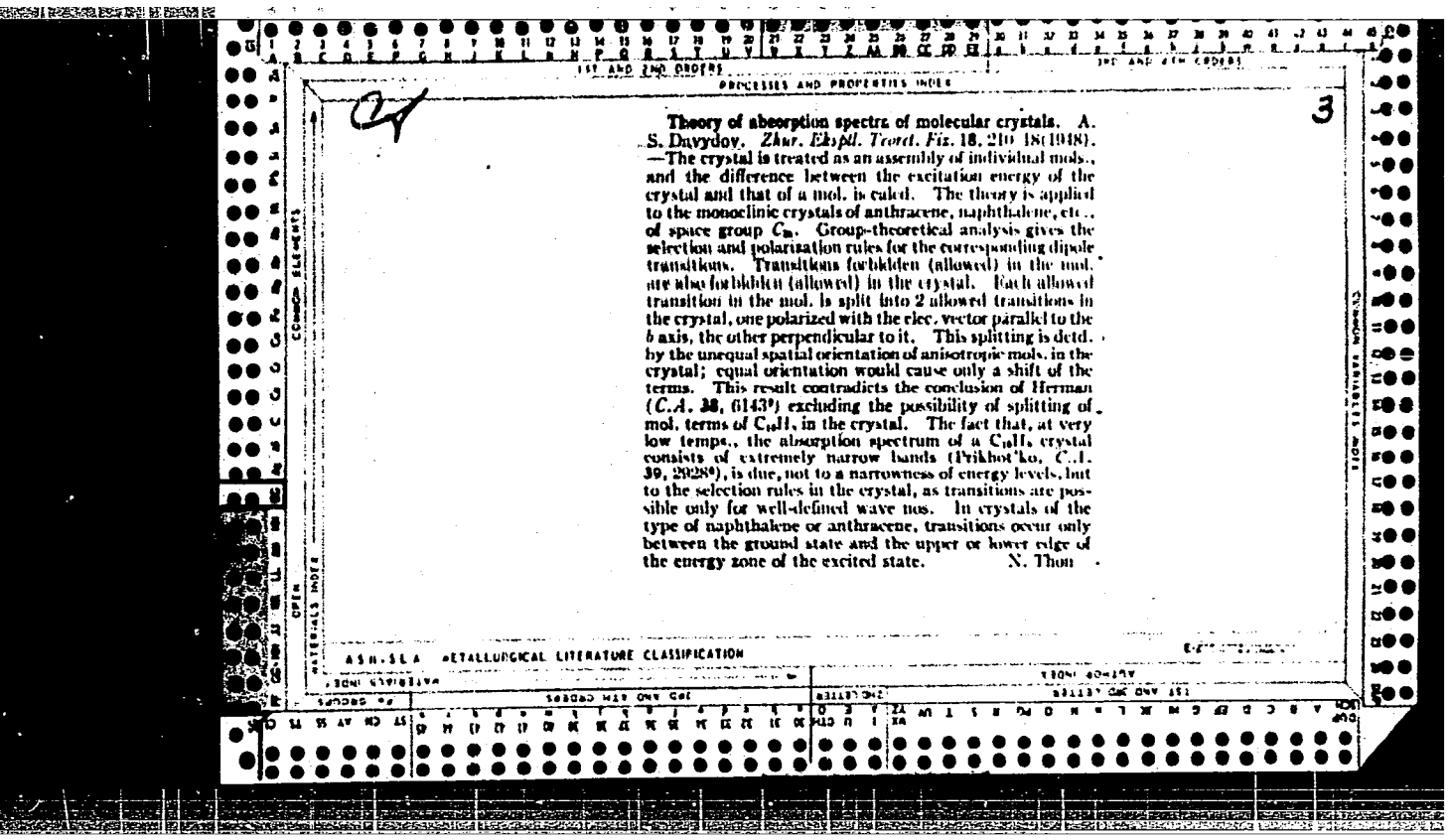


PROCESSES AND PROPERTIES INDEX

Theory of the absorption spectrum of biphenyl. A. S Davydov. *Zhur. Eksptl. Teoret. Fiz.* (J. Exptl. Theoret. Phys.) **18**, 201-9(1948). The energy levels are calcd. by the Heitler-London-Heisenberg method, by consideration of the change of the energy spectrum of two C_6H_6 mols. in the process of formation of a Ph_2 mol., assuming the spectrum of Ph to be identical with that of C_6H_6. Transition l (superscript) in C_6H_6 (subscript a) are split in two in Ph_2 (subscripts 1 and 2), with the excitation energies $\Delta E_1^l = \Delta E_a^l + M^l$ and $\Delta E_2^l = \Delta E_a^l - M^l$; the matrix elements M are calcd. to $M^1 = 0.18$, $M^2 = 0.17$, $M^3 = -0.40$, $M^4 = 0.42$ e.v. The energy levels of Ph_2 are then calcd. with the use of the expt. absorption spectrum of C_6H_6, as detd. by Carr and Stuckler (C.A. 31, 6088; 32, 2420[9]), giving $\Delta E_a^1 = 4.7$ e.v. (B_{1u}), $\Delta E_a^2 = 6.1$ e.v. (B_{1u}), $\Delta E_a^3 = \Delta E_a^4 = 6.9$ e.v. (E_{1u}). The term scheme obtained is at variance with that calcd. by London (C.A. 40, 159[6]). In particular, the strong absorption at 6.4 e.v. is due, not to splitting of the forbidden C_6H_6 level at 5.6 e.v., but to splitting of the allowed term, resulting in a shift of the allowed transition to the red end by 0.16 e.v.; the 2nd split component of the same transition (shift 0.42 e.v.) corresponds to the absorption band of Ph_2 at 7.2 e.v.

N. Thon

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION



PROCESSES AND PROPERTIES INDEX

3

Theory of absorption spectra of molecular crystals. A. S. Davydov. *Zhur. Eksptl. Teoret. Fiz.* 18, 210–18(1948). —The crystal is treated as an assembly of individual mols., and the difference between the excitation energy of the crystal and that of a mol. is calcd. The theory is applied to the monoclinic crystals of anthracene, naphthalene, etc., of space group C_{2h}. Group-theoretical analysis gives the selection and polarization rules for the corresponding dipole transitions. Transitions forbidden (allowed) in the mol. are also forbidden (allowed) in the crystal. Each allowed transition in the mol. is split into 2 allowed transitions in the crystal, one polarized with the elec. vector parallel to the *b* axis, the other perpendicular to it. This splitting is detd. by the unequal spatial orientation of anisotropic mols. in the crystal; equal orientation would cause only a shift of the terms. This result contradicts the conclusion of Herman (*C.A.* **38**, 6143⁹) excluding the possibility of splitting of mol. terms of C_6H_6 in the crystal. The fact that, at very low temps., the absorption spectrum of a C_6H_6 crystal consists of extremely narrow bands (Prikhot'ko, *C.A.* **39**, 2928⁸), is due, not to a narrowness of energy levels, but to the selection rules in the crystal, as transitions are possible only for well-defined wave nos. In crystals of the type of naphthalene or anthracene, transitions occur only between the ground state and the upper or lower edge of the energy zone of the excited state. N. Thon

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

CA

Theory of the absorption spectra of solutions of metals in ammonia. A. S. Davydov. (Phys. Inst., Acad. Sci. Ukr. S.S.R., Kiev). *Zhur. Eksptl. Teoret. Fiz.* 18, 913–16 (1948).—On the basis of the accepted dissocn. of the atoms of the metals dissolved in liquid NH_3 into a pos. ion and a free electron, the electrons are described in terms of Pekar's polaron theory, whereby the mass of the electron, maintained in a localized state as a result of the polarization of the medium by the elec. field of the electron, is replaced by an effective mass μ, and the medium is described by its macroscopic refractive index n and dielec. const. ϵ. The energy of the ground state $1s$ of the polaron, in units of (μ/m) 27.09 e.v., is $E_{1s} = -0.101\ c^2$, where $c = (1/n^2) - (1/\epsilon)$, and the energy change of the transition $2p \rightarrow 1s$ is $\Delta E = 0.071c^2 = (\mu/m)\ 0.888$ e.v.; from the expt. $\Delta E = 0.7$ e.v., it follows that $\mu/m = 1.33$. Excitation of the polaron to the $2p$ state produces a change of the polaron well and this, in turn, produces a change of the state of the electron, until a new self-consistent state is established. This is shown to correspond to 2 energy levels, -0.568 and -0.444 e.v.; whether the polaron is excited to one or the other level depends on the polarization of the absorbed light. From that excited state the electron can pass to the non-selfconsistent state E'_{1s} with emission of 0.107 e.v., and thence to E_{1s}. The energy of the optical dissocn. of the polaron is thus $= -1.617$ e.v. In a liquid, and in contrast to a solid crystal, polarization is essentially inelastic, and the optical dissocn. energy of the polaron is not different from its thermal dissocn. energy. N. Thon

DAVYDOV, A. S.

USSR/Physics Jun 48

Light - Absorption
Chemistry - Polyphenyls

"Dependence of the Frequency of the Absorption of Light of p-Polyphenylenes on the Number of Phenyl Groups," A. S. Davydov, Inst of Phys, Acad Sci Ukrainian SSR, 4 pp

"Zhur Eksper i Teoret Fiz" Vol XVIII, No 6

Theory is developed for dependence of frequency and intensity of absorption of light on length of chain of p-polyphenyls. Good agreement is obtained with experimental data.

6/49T97

USSR/Physics Nov 48
Wave Functions
Mathematics, Applied

"Calculating the Nonorthogonal Quality of Wave Functions by the Molecular-Orbit Method," A. S. Davydov, Chair of Theoretical Phys, Kiev State U, 3 3/4 pp

"Zhur Fiz Khim" Vol XXII, No 11

Develops a simple formula with which, given results determined by the molecular-orbit method without computation of the overlapping integrals of the wave functions, values can be obtained with calculation of these integrals. Submitted 24 Feb 48.

56/49T103

Davydov, A. S.
25363

Otvet A. S. Davydova Na Pisbmo L. A. Blyumenfelbda //<<Po Povodu Statbi A. S. Davydova <<Vychislenie Nizshikh Elektronnykh Urovney Molekuly Naftalina>> <<Zhrnale Eksperim. I Teoret Fiziki>> 1948, Vyp. 77
Zhrnal Eksperim. I Teoret. Fiziki, 1948, Vyp. 7, s 671-72

SO: LETOPIS NO. 30, 1948

DAVYDOV, A.S. DOC PHYSICOMATH SCI

Dissertation: "Theory of Light Absorption by Molecular Crystals."

26 Sep 49

Physics Inst imeni P.N. Lobedev, Acad Sci USSR

SO Vecheryaya Moskva
Sum 71

DAVYDOV, A. S.

Feb 49

USSR/Physics
Absorption, Molecular
Crystallography

"The Molecular Theory of Pleochroism," A. S. Davydov, Inst of Phys, Ukrainian SSR, 7 pp

"Zhur Eksper i Teoret Fiz" Vol XIX, No 2

Attempts to construct molecular theory of pleochroism of molecular crystals. Assumes energy states of individual molecules are known. Investigates alteration of energy spectrum when molecules combine into a crystal of any symmetry. Shows it is possible that new "crystalline" absorption bands may appear, which vanish when crystal is melted. Shows, using crystals

[redacted] 32/49T84

Feb 49

USSR/Physics (Contd)

containing two and four molecules in a single crystalline nucleus as an example, that the frequency of absorbed light will depend on the directions of propagation and polarization. Submitted 5 Jul 48.

[redacted] 32/49T84

DAVYDOV, A. S.

USSR/Physics
Oscillations
Molecular Structures

Feb 49

"The Effect of Molecular Interaction in a Lattice on Intramolecular Oscillations," A. S. Davydov, Inst of Phys, Acad Sci Ukrainian SSR, 1½ pp

"Zhur Eksper i Teoret Fiz" Vol XIX, No 2

Derives equation for oscillation frequency with the assumption that molecules are rigidly connected. Explains conditions for which this assumption is valid.

32/49T78

Davydov, A.S.

Davydov, A. S. The theory of dispersion of molecular crystals in the infrared region. Akad. Nauk SSSR. Zurnal Eksper. Teoret. Fiz. 19, 930–936 (1949). (Russian) MR 10

The problem of dispersion of crystals is studied by using a one-dimensional model. Intramolecular vibrations and lattice vibrations are considered. The interaction between these two kinds of vibration leads to the appearance of a secondary maximum in the absorption curve, which loses the symmetrical form found for gases. The approximations should be good for infrared rays and very low temperatures, but the results may also have some relevance for other regions of the spectrum and higher temperatures.

W. H. Furry (Cambridge, Mass.).

Inst. Physics AS Ukr SSR

Source: Mathematical Reviews, Vol 12 No. 8

CA 47 no 21:10994 '53

DAVYDOV, A. S.

BA 165T108

USSR/Physics - Dispersion Aug 50

"Theory of the Dispersion of Molecular Crystals, II," A. S. Davydov, Inst of Phys, Acad Sci Ukrainian SSR

"Zhur Eksper i Teoret Fiz" Vol XX, No 8, pp 760-766

On example of one-dimensional crystal, Davydov investigates influence of interaction of intramolecular oscillations with rotational qualities of molecules upon curve of dispersion and absorption for frequencies corresponding to intramolecular oscillations. Submitted 27 Feb 50.

[redacted]

165T108

CR

3

Theory of luminescence of molecular crystals. A. S. Davydov. *Izvest. Akad. Nauk S.S.S.R., Ser. Fiz.* 15, 655-7(1951); cf. *C.A.* 44, 4325e.—In mol. crystals 2 types of excitation are possible: (1) leading to exciton waves throughout the crystal; (2) leading to localized states. In the second case the absorption band does not show the influence of the structure of the crystal, and its polarization is given by the orientation of the mol.; i.e. the absorption is the same as in soln. The luminescence is absent or weak. In the first case there are several strongly polarized bands which can be derived from calcns. of the unit cell. Such excitation leads to strong luminescence when excitons spread to spots with lattice defects or spots capable of emitting or absorbing phonons. S. Pakswer

S. A.

Sect. A

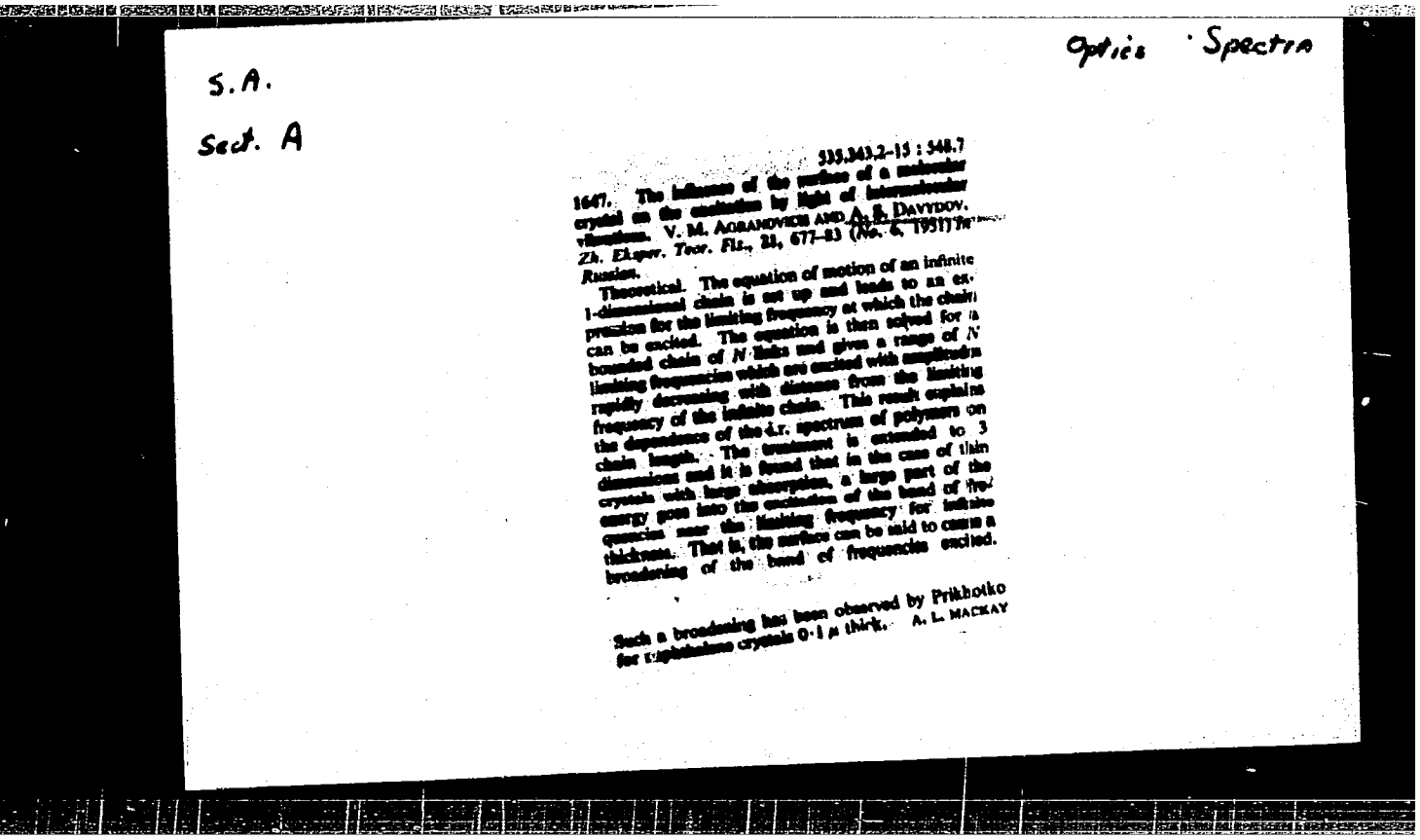
Optics · Spectra

535.343.2 : 539.132

3489. The theory of the absorption of light by crystalline benzene. A. S. DAVYDOV. *Zh. Eksper. Teor. Fiz.*, 21, 673–6 (No. 6, 1951) In Russian.

It is shown that by examining the absorption spectrum of polarized light it is possible to establish the symmetry of the electronic transitions in the molecule of benzene.

A. L. MACKAY



S.A.

Sect. A

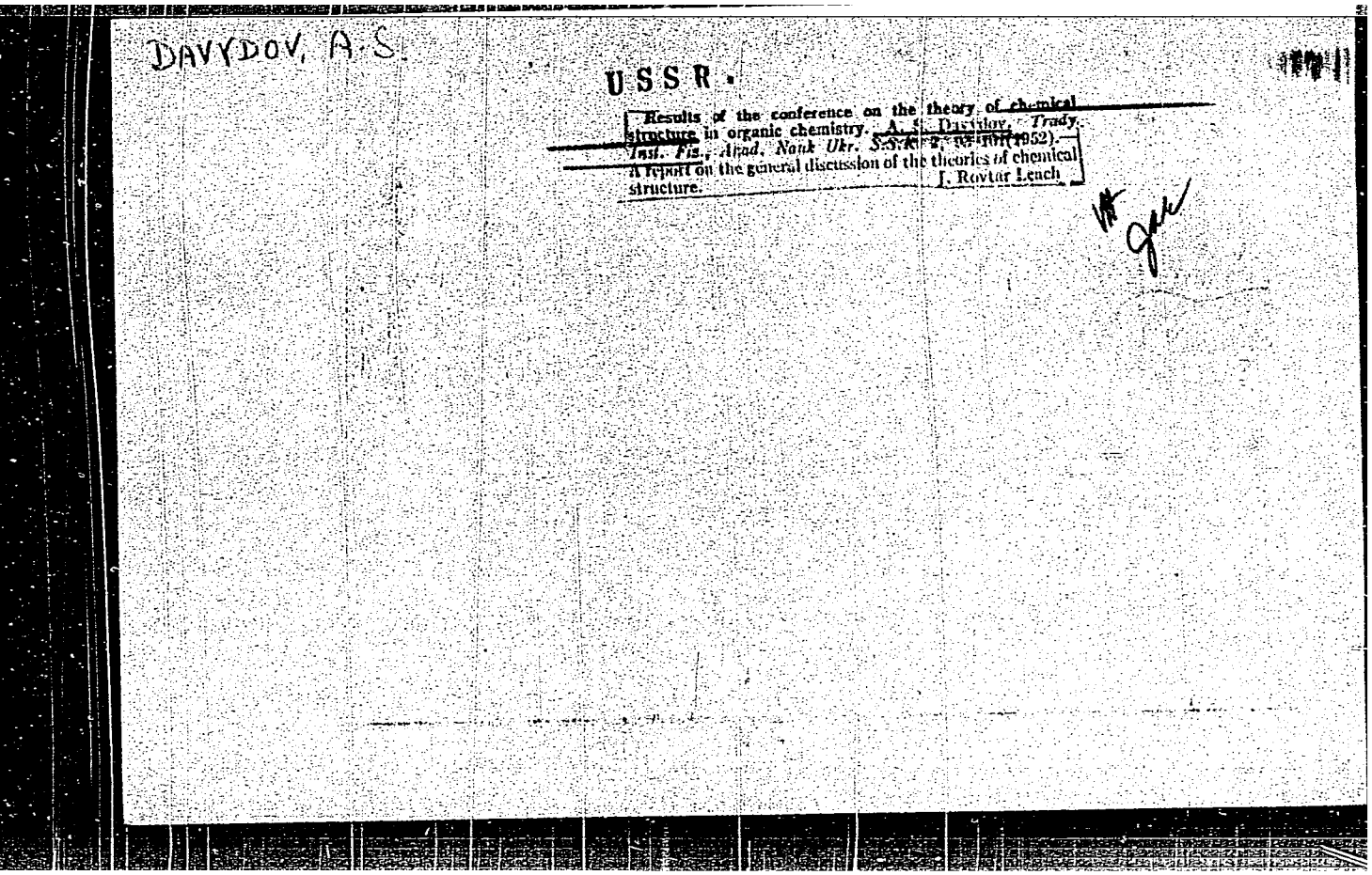
Optics · Spectra

535.343.2-15 : 548.7

1647. The influence of the surface of a molecular crystal on the excitation by light of intramolecular vibrations. V. M. AGRANOVICH AND A. S. DAVYDOV. *Zh. Eksper. Teor. Fiz.*, 31, 677–83 (No. 4, 1951) In Russian.

Theoretical. The equation of motion of an infinite 1-dimensional chain is set up and leads to an expression for the limiting frequency at which the chain can be excited. The equation is then solved for a bounded chain of N links and gives a range of N limiting frequencies which are excited with amplitudes rapidly decreasing with distance from the limiting frequency of the infinite chain. This result explains the dependence of the i.r. spectrum of polymers on chain length. The treatment is extended to 3 dimensions and it is found that in the case of thin crystals with large absorption, a large part of the energy goes into the excitation of the band of frequencies near the limiting frequency for infinite thickness. That is, the surface can be said to cause a broadening of the band of frequencies excited.

Such a broadening has been observed by Prikhotko for naphthalene crystals 0·1 μ thick. A. L. MACKAY



DAVYDOV, A.S.

USSR

Results of the conference on the theory of chemical structure in organic chemistry. A. S. Davydov. *Trudy. Inst. Fiz., Akad. Nauk Ukr. S.S.R.* 2, 65-101(1952). A report on the general discussion of the theories of chemical structure.
J. Rovtar Leach

DAVYDOV, A. S.

The Committee on Stalin Prizes (of the Council of Ministers USSR) in the fields of science and inventions announces that the following scientific works, popular scientific books, and textbooks have been submitted for competition for Stalin Prizes for the years 1952 and 1953. (Sovetskaya Kultura, Moscow, No. 22-40, 20 Feb - 3 Apr 1954)

Name	Title of Work	Nominated by
Davydov, A. S. Prikhot'ko, A. F. Obreimov, I. V.	Research in the field of the spectrosocopy of molecular crystals	Academy of Sciences, Ukrainian SSR

SO: W-30604, 7 July 1954

DAVYDOV, A. S.

USSR/Physics - Dispersion of light FD-490

Card 1/1 : Pub. 146-7/18

Author : Davydov, A. S.

Title : Theory of absorption, dispersion and scattering of light by solutions

Periodical : Zhur. eksp. i teor. fiz., 24, 197-209, Feb 1953

Abstract : Obtain general formulas determining the shape of the curves of absorption, dispersion and scattering of light and their dependence in temperature and the other parameters characterizing the oscillations of the atoms of the solvent and their interaction with the dissolved molecules in various energy states. 3 references, including 1 foreign.

Institute : Physics Institute, Acad. Sci Ukrainian SSR

Submitted : September 16, 1952

DAVYDOV, A. S.

USSR

539.13 : 535.37

10377. Theory of emissionless transitions in molecules in solutions. A. S. DAVYDOV. *Zh. eksper. teor. Fiz.*, 24, No. 4, 397–410 (1953) *In Russian.*

Probabilities are calculated for emissionless transitions of the excitation energy of a molecule into the vibration energy of the atoms of (solid or liquid) solvents, and *vice versa*. It is shown that these probabilities depend on (1) the temperature, (2) the displacement of equilibrium positions of the solvent atoms when the energy state of the molecule undergoes a change, and (3) the way in which wave-functions which determine the state of the molecule in the solution react to the change of co-ordinates of the solvent atoms. The part played by emissionless transitions in the phenomena of luminescence and photoconductivity is stressed. F. LACHIAN

DAVYDOV, A. S.

USSR/Physics - Luminescence

Card 1/1 Pub. 43 - 43/62

Authors : Borisov, M. D., and Davydov, A. S.

Title : Luminescence of molecular crystals containing foreign molecules

Periodical : Izv. AN SSSR. Ser. fiz. 18/6, 714-715, Nov-Dec 1954

Abstract : The absolute energetic yield of luminescence by a naphthalin crystal containing various anthracene concentrations was investigated by the known sphere method. The anthracene concentration in the naphthalin crystal was determined by the anthracene absorption spectra. Photos of the luminescence spectra for naphthalin crystals with anthracene as an admixture made it possible to determine whether the anthracene penetrated the naphthalin lattice in the form of individual molecules or in the form of crystalline formations. One USSR reference (1948-1951). Graph.

Institution : Acad. of Sc., Ukr. SSR, Phys. Inst.

Submitted : .....

DAVYDOV, A.S.

Theory of light absorption and dispersion in solutions. Pt.2.
Nauk zap.Kyiv.un. 14 no.8:5-13 '55. (MLRA 9:10)

(Solutions--Optical properties)

DAVDOV, A. S.

USSR/Optics - Physical Optics, K-5

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 35749

Author: Agranovid, V. M., Davydov, A. S.

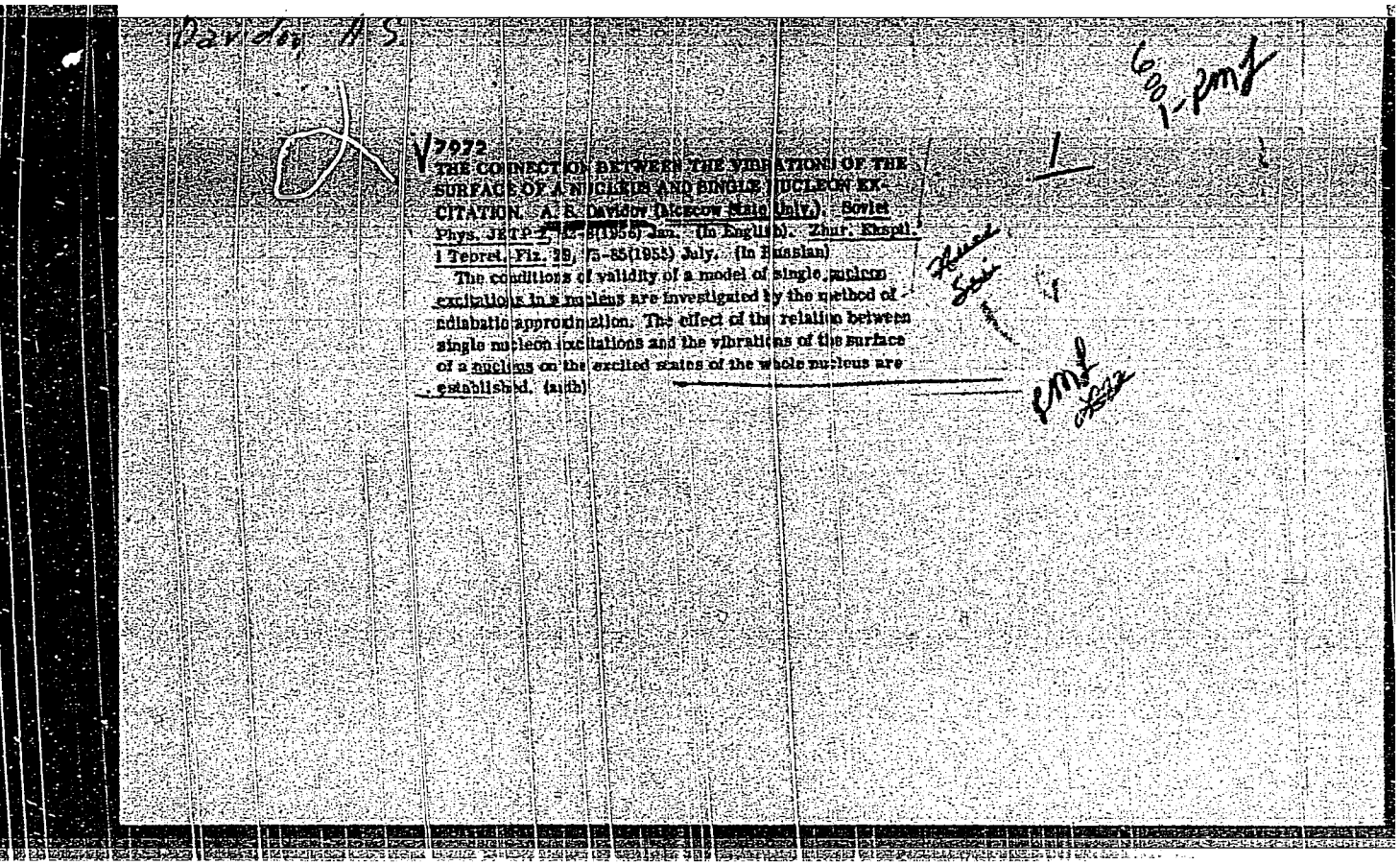
Institution: None

Title: Absorption and Luminescence Spectra of Polyatomic Molecules

Original Periodical: Nauk. zap. Kiivs'k. un-t., 1955, 14, No 8, 15-20

Abstract: Starting with the idea that the polyatomic molecule can be considered to some approximation as a complex system, obeying statistical laws, a determination was made of the shape of the absorption bands and of the fluorescence bands of bomplicated molecules, characterized by not too strong an interaction between the electronic and oscillatory states (Neporent, B. S., Eksperim. i teor. fiziki, 1951, 21, 172). It is shown that the Levshin mirror-symmetry law should hold for such molecules.

Card 1/1



V7972
THE CONNECTION BETWEEN THE VIBRATIONS OF THE SURFACE OF A NUCLEUS AND SINGLE NUCLEON EXCITATION. A. S. Davidov (Moscow State Univ.). Soviet Phys. JETP 2, 87-93(1956) Jan. (In English). Zhur. Eksptl. i Teoret. Fiz. 29, 75-85(1955) July. (In Russian)

The conditions of validity of a model of single nucleon excitation in a nucleus are investigated by the method of adiabatic approximation. The effect of the relation between single nucleon excitations and the vibrations of the surface of a nucleus on the excited states of the whole nucleus are established. (auth)

Davydov, A.S.

2

The spectral distribution of the intensity of emission and absorption of light by molecular crystals under formation of localized excitations. A. S. Davydov and A. F. Lubchenko. *Ukrain. Fiz. Zhur.* 1, 11–27 (Russian summary 27–8) (1956). —The spectral distribution and the av. radiation lifetime of the localized excitation were calcd. on the basis of the Weisskopf-Wigner formula (cf. *C.A.* 24, 5502; 25, 1168); the nonemitting transitions were not calcd. At higher temps. the absorption and emission bands have the shape of a Gauss distribution curve. At lower temps. the asymmetry of the bands becomes pronounced, the band goes through a max. vertical to the frequency axis, and the absorption curve reaches the red end of the spectrum faster than the violet end; the luminescence curve shows a reverse trend.
Werner Jacobson

1. Inst. fizyki akademii nauk URSR
(Crystals -- optical properties)

DAVYDOV, A.S.

"USSR/Physical Chemistry - Crystals B-5

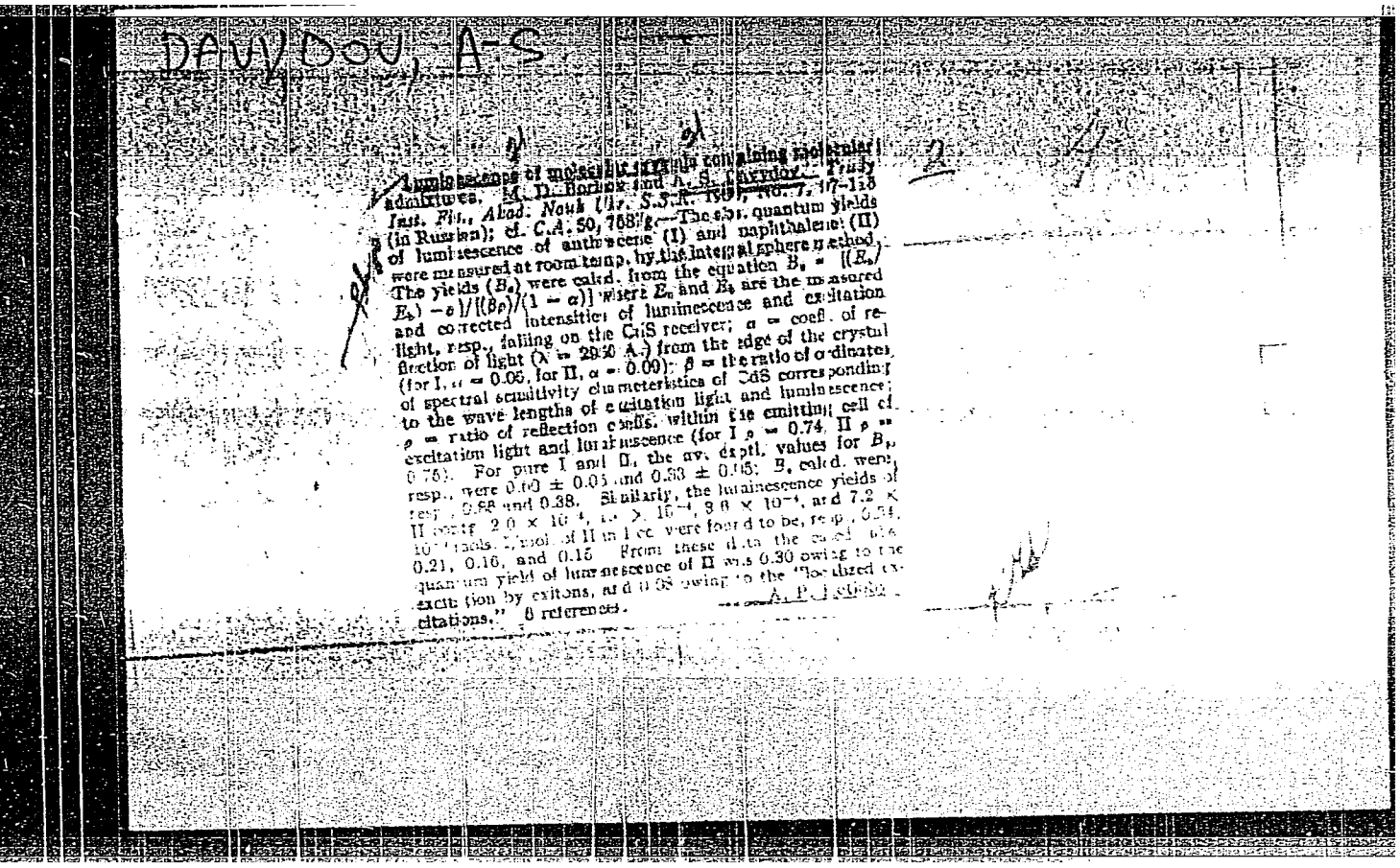
Abs Jour : Referat Zhur - Khimiya, No 2, 1957, 3593

Author : Davydov A.S., Lubchenko A.F.
Title : Configuration of the Dispersion Curves of Molecular Crystals Corresponding to Localized Excitations

Orig Pub : Ukr. fiz. zh., 1956, 1, No 2, 111-119

Abstract : On the basis of previously obtained results (RZhKhim, 1956, 67745, 67746) were calculated the configurations of dispersion curves (DC) of molecular crystals in the region of localized excitations, at different temperatures. At high temperatures DC have a configuration analogous to that of DC of the free molecule on taking into account the Doeppler effect. On decrease of temperature DC becomes asymmetrical in relation to straight line extending through maximum of absorption band, perpendicularly to the frequency axis. At low temperatures, when the absorption spectrum separates into a system of lines,

Card 1/2 - 34 -



DAVYDOV, A.S.

Luminescence of molecular crystals containing molecular admixtures. M. D. Galanin and A. S. Davydov. Trudy Inst. Fiz., Akad. Nauk Ukr. S.S.R. 1958, No. 7, 117-128 (in Russian); cf. C.A. 50, 7683g.—The abs. quantum yields of luminescence of anthracene (I) and naphthalene (II) were measured at room temp. by the integral sphere method. The yields (B_0) were calcd. from the equation $B_0 = [(E_0/E_b) - a]/[(\beta\rho)/(1 - \alpha)]$ where E_0 and E_b are the measured and corrected intensities of luminescence and excitation light, resp., falling on the CdS receiver; α = coeff. of reflection of light ($\lambda = 2950$ A.) from the edge of the crystal (for I, $\alpha = 0.06$, for II, $\alpha = 0.09$); β = the ratio of ordinates of spectral sensitivity characteristics of CdS corresponding to the wave lengths of excitation light and luminescence; ρ = ratio of reflection coeffs. within the emitting cell of excitation light and luminescence (for I $\rho = 0.74$, II $\rho = 0.75$). For pure I and II, the av. exptl. values for B_0 resp., were 0.40 ± 0.05 and 0.53 ± 0.05; B_0 calcd. were 0.38 and 0.38. Similarly, the luminescence yields of I contg. 2.0×10^{-4}, $> 10^{-4}$, 3.0×10^{-4}, and 7.2×10^{-4} mols. C$_{10}$H$_8$/mol. of II in 1 cc were found to be, resp., 0.34, 0.21, 0.16, and 0.15. From these data the calcd. quantum yield of luminescence of II was 0.30 owing to the "localized excitation by exitons, and 0.68 owing to the "free" excitations." 8 references.

A. P. Jenkins

USSR / Optics Davydov, A.S. K

Abs Jour: Referat Zhur-Fizika, 1957, No 4, 10364

Author : Davydov, A.S.
Inst : Not Given
Title : Theory of Absorption and Dispersion of Light by So,utions. II.

Orig Pub: Nauk zap. Kiivsk. un-t, 1956, 14, No 8, 5-13

Abstract: Unlike the preceding work by the author (Referat Zhur-Fizika, 1955, 1521), it is assumed that at the instant of excitation of the impurity molecule the change in the forces of interaction with the solvent leads to both a shift in the equilibrium positions for the vibrations of the solvent atoms, as well as to a change in the frequencies of vibrations themselves. General formulas are obtained for the coefficient of absorption and for the index of refraction. It is shown that if there is no change in the equilibrium positions of the solvent atoms upon excitation of the impurity molecule, the dispersion and index of absorption curves of the impurity molecules,

Card : 1/2

DAVYDOV, A. S.

USSR/Nuclear Physics - Nuclear Reactions. C-5

Abs Jour : Ref Zhur - Fizika, No 4, 1957, 8788

Author : Davydov, A.S., Filippov, G.F.
Inst : Moscow State University.
Title : Concerning the Problem of Scattering Lengths of Slow Neutrons on Deuterons.

Orig Pub : Zh. eksperim. i teor, fiziki, 1956, 31, No 2, 340-341.

Abstract : Scattering of slow neutrons on deuterons is fully determined by two scattering lengths $a_{3/2}$ and $a_{1/2}$ corresponding respectively to two possible spin states of the system. According to the experimental data two variants of the values of the scattering length are possible. A qualitative estimate made by the authors, based on the Pauli principle, favors one of the variants, namely $a_{3/2} = 6.2 \times 10^{-3}$ cm, and $a_{1/2} = 0.8 \times 10^{-3}$ cm.

Card 1/1

DAVYDOV, A. S., and FILIPPOV, G. F.

"Collective Excitation of Even-Even Atomic Nuclei

paper included in the program of the All-Union Conf. on Nuclear Reactions in Medium and low Energy Physics, Moscow, 19-27 Nov. 1957.

Moscow State University.

DAVYDOV, A.S.

AGRANOVICH, V. M., DAVYDOV, A. S. (Acad. Sci. USSR)

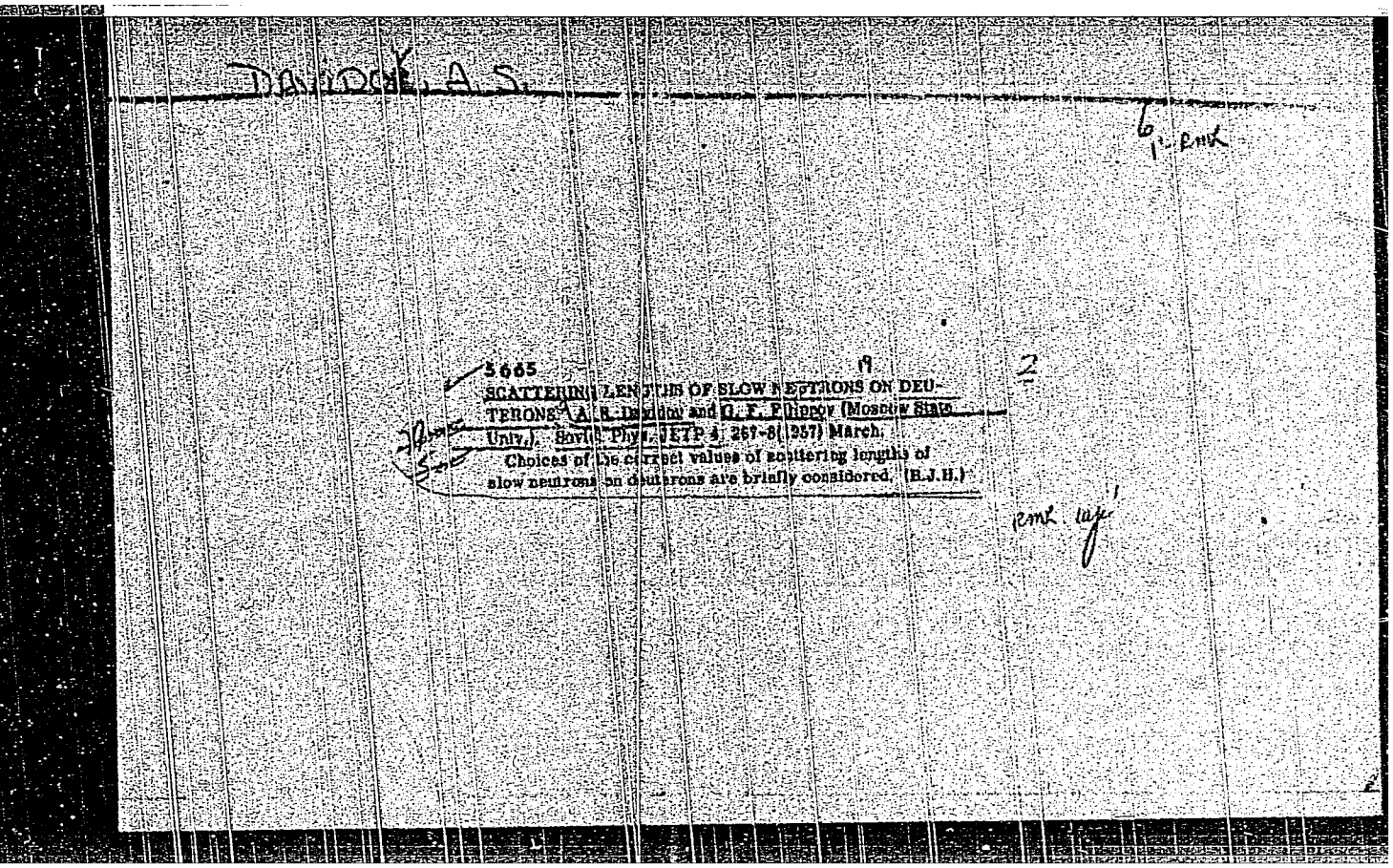
"Optical Model of Nucleons-Nuclei Interaction in the Resonance Region of the Compound Nucleus,"

paper submitted at the All-Union Conf. on Nuclear Reactions in Medium and Low Energy Physics, Moscow, 19-27 Nov 1957.

Distr: 4E3n/4E4o

Light absorption in molecular crystals at weak interaction between excitons and phonons. A. S. Davydov and E. I. Rashba. *Ukrain. Fiz. Zhur.* 2, 226–40 (1957).—The fundamental absorption spectra of mol. crystals were investigated mathematically for the case of such weak interaction that the electronic transition is accompanied by the generation or absorption of one phonon. The calcns. were first made for linear chains, then extended to 2- and 3-dimensional crystals with arbitrary structure where the law of interaction between mols. still would hold true. The absorption intensity distribution was detd. for the background, if exciton interaction occurs with the optical and the acoustical crystal vibrations. The background contours depend essentially on the nos. of dimensions of the crystal structure. If the width of the exciton band $\Delta\varepsilon$ is of the same order or greater than the av. phonon energy $\hbar\nu$, then the displacement of the background max. with respect to the line of non-phonon transitions depends essentially on the structure of the exciton band and such max. never coincide with the boundary frequencies of the lattice vibrations; interaction with one vibration branch can lead to the simultaneous appearance of several background max. If $\Delta\varepsilon \ll \hbar\nu$ the sepn. of the satellites in one-dimensional chains can in certain cases coincide with the boundary frequencies. On the other hand, max. displacements in 3-dimensional crystals always correspond to certain intermediate values of vibration frequencies. Therefore, the shifting of the background max. in the spectra of the mol. crystals cannot be compared with the vibrations found from Raman dispersion (the "gross" frequencies). This conclusion is confirmed by the expt.

Werner Jacobsen



DAVIDOV, A. S.

3665 19

SCATTERING LENGTHS OF SLOW NEUTRONS ON DEUTERONS. A. S. Davidov and G. F. Filippov (Moscow State Univ.). Sovt. Phys. JETP 3, 257-8 (1957) March.

Choices of the correct values of scattering lengths of slow neutrons on deuterons are briefly considered. (B.J.H.)

56-4-24/52

AUTHOR DAVYDOV, A.S., FILIPPOV, G.F.

TITLE Moment of Inertia of a System of Particles in Interaction (Moment inertsii sistemy vzaimodeystvuyushchikh chastits. Russian)

PERIODICAL Zhurnal Eksperim. i. Teroret. Fiziki, 1957, Vol 32, № 4, pp 826 - 836 (U.S.S.R.)

ABSTRACT The paper under review investigates the problem of the cutoff of the collective motions in a system consisting of N particles in interaction with each other.

A system consisting of three particles of equal masses. - In this chapter, the authors investigate three particles without spin and of equal masses m, these particles being in interaction with each other by central forces of any arbitrary kind. By introducing new coordinates, the authors of the paper under review go over to the center-of-mass system. The paper under review follows the computations step by step. For the following magnitudes explicit expressions are given. - potential energy of the system, operator of the total angular momentum of the entire system, Hamilton's operator of the entire system. The operators of the square of the total angular momentum and of its projectum commute with the total Hamiltonian. For this reason, the magnitude corresponding to these operators are integrals of the motion. The system of equations as obtained in the paper under review is then a good approximation, if (a) the three-particles system is symmetrical about an axis

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56-4-47/52

AUTHOR DAVYDOV, A.S., MEL'NICHENKO, D.M.

TITLE On the Second Approximation in the Problem of the Scattering of Slow Neutrons By Coupled Protons
(O vtorom priblizhenii v zadache rasseyaniya medlennykh neytronov svyazannymi protonami. Russian)

PERIODICAL Zhurnal Eksperim. i. Teoret. Fiziki, 1957, Vol 32, Nr 4, pp 943 - 943 (U.S.S.R.)

ABSTRACT First of all the paper under review refers to some relevant previously published papers. Then it proceeds to investagate the convergence of the second approximation in the problem of the scattering of a slow ($E \sim 0$) neutron by a proton situated in the formation of a molecule of the mass M. First of all, the paper under review puts down a formula for the scattering matrix T_{ba} for neutrons of the energy zero, - the accuracy of this formula includes the second approximation. In the theory devised by Schwinger-Lippmann, the second approximation diverges at the consideration of the scattering of a neutron by a harmonically bound proton. The author of the paper points out a bringing about of convergence which, in his opinion, is not justified from a mathematical point of view. But the above-mentioned second approximation converges always then, when the wave functions of the real molecules (instead of the wave functions of idealized systems) are used. In a real molecule the high excited states correspond to the decaying system. The corresponding expression is written in its explicit form in the paper under review. Even if the energy

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DAVYDOV, A.S.

56-4-50/52

AUTHOR: DAVYDOV,A.S., FILIPPOV,G.F.

TITLE: The Quadrupole Moments and the Zero Oscillations on the Surface of the Axially-symmetric Nuclei. (Kvadrupol'nyye momenty i nulevyye kolebaniya poverkhnosti aksial'no-simmetricheskikh yader, Russian).

PERIODICAL: Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol 32, Nr 4, pp 945 - 947 (U.S.S.R.)

ABSTRACT: For the purpose of simplification the authors here investigate even-even atomic nuclei. In the generalized model of the nucleus the nucleons located outside the nucleus are described by means of the one-particle approximation, and the nucleons within the completely filled-up shells (nucleus trunk) are noticeable only by their collective properties. As collective coordinates the authors here selected the three EULER angles as well as the variables β and γ, which characterize the deviation of the nucleus from the spherical shape. In adiabatic approximation investigation of the motion of the outer nucleons in the field of a nucleus trunk with fixed shape can be carried out. The energy of the interaction of the outer nucleons with the nucleus trunk (which are averaged over the state of motion $\langle H_w \rangle = A\beta\cos\gamma$ of the nucleons) will depend upon the coordinates β and γ, and will play the part of an additional

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DAVYDOV, A.S.

56-6-20/56

AUTHOR AGRANOVICH, V.M., DAVYDOV, A.S.

TITLE Optical Model of Interaction between Nucleons and Nuclei in the Resonance Region of the Compound Nucleus. (Opticheskaya model' vzaimodeystviya nuklonov s yadrami v oblasti rezonansov sostavnogo yadra.- Russian)

PERIODICAL Zhurnal Eksperim. i Teoret. Fiziki 1957, Vol 32, Nr 6, pp 1429-1436 (U.S.S.R.)

ABSTRACT The energy dependence of the real part and the imaginary part of the effective potential is investigated here by taking account of all components of the compound nucleus. For the purpose of not complicating the problem by taking account of COULOMB'S interaction, the authors here investigate only the interaction between one neutron and one nucleon.

The dependence of the real part of the optical potential upon energy: At first the formula for the real part of this potential is given. Next, the authors determine the energy dependence of the relative motion of the mean value of the real part of the optical potential. The authors are interested here in the domain of energies which correspond to the resonances of the cross sections of the nuclear reactions. At energies of the relative motion $\mathcal{E} > 30$ MeV

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[redacted]

Optical Model of Interaction between Nucleons and Nuclei in the Resonance Region of the Compound Nucleus.

56-6-20/56

ASSOCIATION: not given.
PRESENTED BY: -
SUBMITTED: 17.8. 1956
AVAILABLE: Library of Congress.

CARD 3/3

56-2-42/47

The Rotation Bands of Even-Even Axially-Symmetric Nuclei.

the relations $\xi^2(\xi - 1) = J(J+1)/3\delta^4$

$\varepsilon_\nu(J)/\hbar\omega_0 = (\nu + (1/2))\sqrt{1 + J(J+1)/\delta^4\xi^4} + J(J+1)/6\delta^2\xi^2 + (1/2)\delta^2(\xi - 1)^2$. The present statement gives the results of the solution of this system of equations for the case $\delta > 1$. A diagram illustrates the dependence of $\varepsilon_\nu(J)/\hbar\omega_0$ upon the parameter δ. At $\delta > 2{,}5$ the collective spectrum of the collective excitations of the even-even nuclei decomposes into a system of rotation-vibration bands. A table compares the theoretical values of the excitation energy of the first and second rotation band of the excited states of some nuclei with the experimental values. The same table contains the values of the parameters $\hbar\omega_0$ and δ which were used in the course of these computations. A second table contains the ratios of the energies of the first and second rotation state.

CARD 2/3

56-3-25/59

AUTHORS: Davydov, A.S., Filippov, G.F.

TITLE: Collective Excitation of Even-Even Atomic Nuclei. (Kollektivnyye vozbuzhdeniya chetno-chetnykh atomnykh yader)

PERIODICAL: Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol. 33, Nr 3, pp. 723-729 (USSR)

ABSTRACT: The collective excitation of the levels of axial-symmetrical even-even nuclei is theoretically treated by means of the increased Bohr nuclear model. It is shown that the collective excitation of such nuclei is characterized by 2 types: a) excitation which is accompanied by only a small variation of the nuclear quadrupole moment and b) excitation which is connected with an important variation of the nuclear quadrupole moment. The excitation mentioned at b) occurs especially in the case of nuclei which do not deviate to a great extent from the spherical form. In the case of nuclei deviating to a great extent from the spherical form the form mentioned at b) does not play any role in the case of transitions with small energies variations. For the first 4 - 5 excited states of the nuclei Sn^{116}, Ba^{134}, Pt^{192}, Ge^{72}, Se^{76}, Xe^{128}, Cd^{114}, Pd^{106} the energies of the excited states as well as the inherent spin values are compared to the experimentally found values and in general a good

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21(7) PHASE I BOOK EXPLOITATION SOV/1588

Davydov, Aleksandr Sergeyevich

Teoriya atomnogo yadra (Theory of the Atomic Nucleus) Moscow, Fizmatgiz, 1958. 611 p. 12,000 copies printed.

Ed.: Ye.Ye. Zhabotinskiy; Tech. Ed.: Murashova, N. Ya.

PURPOSE: This book is intended to serve as a text for independent study by individuals with a sufficient knowledge of theoretical physics, but the USSR Ministry of Higher Education also permits its use as a textbook for students in State universities.

COVERAGE: This book presents a revised and enlarged edition of lectures delivered by the author at the Physics Department of Moscow State University im. Lomonosov. The text analyzes problems in nuclear theory relating to phenomena occurring at energy levels up to 100 Mev. But, special attention is given to the nuclear shell model, the generalized nuclear model, and problems

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DAVYDOV, A. S. and FILIPOV, G. F.

"L'Etat Rotationnel Des Noyaux Pair-Pairs."

Report presented at the Intl. Congress for Nuclear Interactions (Low Energy) and Nuclear Structure, Paris, 7-12 July 1958.

DAVYDOV, A.S. and FILIPPOV, G. F.
Moscow State University.

"Rotational States in Even Atomic Nuclei." Nuclear Physics, v. 8,3(1958) (North-Holland Publishing Co., Amsterdam) pp. 237-249.

Abstract: A theory of the energy states and the electromagnetic transitions between them is developed for neuclei which do not posses axial symmetry. It is shown that violation of axial symmetry does not significantly change the rotational states of axial nuclei and leads to the appearance of new energy states. The reduced probabilities for E2 and M1 transitions between various rotational states are computed.

HUNGARY/Nuclear Physics - Structure and Properties of Nuclei C-

Abs Jour : Ref Zhur Fizika, No 3, 1960, 5329

Author : Davydov, A.S., Filippov, S.F.

Inst : Moscow State University.

Title : Collective Excited States of Even-Even Atomic Nuclei

Orig Pub : Acta phys. Acad. scient. hung., 1958, 9, No 1-2, 169-176

Abstract : The energy of collective excited states is calculated under the assumption that the nuclei have an axial symmetry. Conditions are obtained under which the collective excitations can be separated into rotational and vibrationa. See also Referat Zhur Fizika, 1958, No 6, 12634 .

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irreducible representations of the rotation group. The second part of this paper reports on the collective excitations of the odd non-spherical nuclei. A table compares the theoretical values of the energy necessary for the excitation of the first and second vibration-rotation bands of the excited states of the odd nuclei (which were obtained in this paper) with the corresponding experimental data. Comparing the spectrum of the collective excitations of the odd nuclei with the spectrum of the collective excitations of the even-even nuclei some conclusions concerning the parameters used in the calculations are obtained. There are 1 figure, 1 table, and 8 references, 3 of which are Soviet.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: January 24, 1958

21 (0)

AUTHORS: Davydov, A. S., Filippov, G. F. SOV/56-35-2-18/60

TITLE: Rotation States of Nonaxial Nuclei (Vrashchatel'nyye sostoyaniya neaksial'nykh yader)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol 35, Nr 2, pp 440-447 (USSR)

ABSTRACT: In previous papers by the same authors (Refs 1 - 4) the energy levels of nonspherical nuclei were investigated on the basis of a generalized model of a nucleus according to Bohr and Mottelson (Bor, Mottel'son) (Refs 5 and 6) for collective excitation without disturbing axial symmetry. In the present paper a theory of energy states and of the transitions among them is worked out for nuclei without axial symmetry. It is shown that, though in the case of a disturbance of axial symmetry the rotation spectra in even-even nuclei change only relatively slightly (compared to those of axially symmetric nuclei), new rotation states (with J = 2, 3, 4....) occur. In the case of slight deviations from axial symmetry these levels are considerably higher and are undisturbed; in the case of major deviations from axial symmetry it is found that part of these additional levels is considerably

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reduced. Thus, the ratio of two excited levels (1. level - spin = 2) from ∞ to 2. In the second part of this paper the authors investigate the probability of electromagnetic transitions between the rotation levels of non-axially symmetric nuclei. A comparison between theory and experiment shows that the so-called γ-vibrational energy levels of even-even nuclei must be looked upon as rotation levels. The same appears to be true for several nuclei with a spin sequence of 0, 2, 2, 3. There are 1 figure, 3 tables, and 24 references, 6 of which are Soviet.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: March 17, 1958

SOV/56-35-3-21/61

21(0), 24(5)

AUTHORS: Davydov, A. S., Filippov, G. F.

TITLE: Magnetic Transitions Between Collective Excited States of Even-Even Nuclei (Magnitnyye perekhody mezhdu kollektivnymi vozbuzhdennymi sostoyaniyami chetno-chetnykh yader)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol 35, Nr 3, pp 703-706 (USSR)

ABSTRACT: The present paper is partly based on a previous work (Ref 1) in which the authors calculated the probability for electric quadrupole transitions between rotational states of non-axial even-even nuclei; it was found that a number of energetic states of non-axial nuclei can be well explained by assuming that they refer to rotational states. In the present paper the authors calculate the probability of magnetic dipole transitions between rotational states with the spins 2^+, 2^+. Such levels are observed in the case of the nuclei Se^{76}, Te^{122}, Os^{188}, Os^{186}, Pt^{192} etc. As already shown by reference 1, it is possible, by knowing the ratio between the second 2^+-level and

the first, to determine the parameter μ and the ratio of the reduced probabilities for transitions. In the present paper the reduced probability of an M1 transition between 2^+, 2^+ states as well as the ratio between this transition and an E2 transition between the same states is calculated. The values obtained agree well with experimental results (Ref 3). For the intensity ratios of magnetic dipole- and electric quadrupole transitions the general formula $T(MJ)/T(E,J+1) \sim \left[25(2J+1)/A^{2/3}(\hbar\omega)_{MeV}\right]^2$ (according to reference 5) applies. For $A \sim 30$ and $\hbar\omega \sim 100$ keV the ratio is $\sim 10^4$, for heavy nuclei at $\hbar\omega \sim 1$ MeV it is ~ 10. For the ratio investigated by the authors the formula $T(M1)/T(E2) = (0{,}03k^2)^{-1} \cdot \frac{B(M1;\ 22 - 21)}{B(E2;\ 22 - 21)}$ was derived, where $k = (E_{22} - E_{21})/\hbar c$. For the ratio of reduced transition probabilities (magnetic dipole $\longrightarrow$ electric quadrupole) it holds that $\frac{B(M1;\ 22 - 21)}{B(E2;\ 22 - 21)} = \frac{80}{7}\left(\frac{\mu_0 g R}{eZR_0^2}\right)^2$; it is, therefore, independent of μ and β. (R_0 = nuclear radius)

Magnetic Transitions Between Collective Excited States of Even-Even Nuclei

The numerical results for $\mu_c = 5{,}05.10^{-24}$ erg/G, $g_R = 0{,}4$, and $R_0 = 1{,}2\ A^{1/3}.10^{-13}$ cm are:

Nucleus	$E_{22}-E_{21}$ [keV]	T(M1)/T(E2)	Percentage of E2 transition (experimental - Ref 3)
Se^{76}	643	$9{,}8.10^{-2}$	98 ± 1
Te^{122}	693	$1{,}9.10^{-2}$	92 ± 4
Os^{186}	627	$6{,}5.10^{-3}$	99 ± 1
Os^{188}	480	$1{,}04.10^{-2}$	99,6

There are 1 table and 4 references, 1 of which is Soviet.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: April 3, 1958

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SOV/56-35-6-27/44

24(5)

AUTHORS: Davydov, A. S., Lubchenko. A. F.

TITLE: Electromagnetic Waves in Crystals in the Region of Exciton Absorption (Elektromagnitnyye volny v kristalle v oblasti eksitonnogo pogloshcheniya)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol 35, Nr 6, pp 1499-1507 (USSR)

ABSTRACT: Pekar (Ref 1), Ginzburg (Ref 2) and Agranovich and Rukhadze (Ref 3) investigated the propagation of light waves in the case of spatial dispersion. They showed that in frequency ranges near the exciton absorption band, waves with the same frequency, propagation direction, and polarization may have different refraction indices. Only the transparency domain was investigated in this connection. A reduction of the amplitudes of electromagnetic oscillations during their passage through matter is a consequence of 1) scattering of the wave and b) of energy transfer from the wave to particle motion (genuine absorption). In the present paper only genuine absorption at crystal temperatures near absolute zero is investigated, namely for a frequency range that coincides with the exciton absorption band. Because of the connection between genuine ab-

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sorption and the innermolecular excitations and oscillations of the molecule, the absorption band broadens also at temperatures near 0°K. Davydov (Ref 4) showed that an excitation in molecule crystals by light waves occurs in two different ways: a) as a localized excitation and b) as an exciton excitation. The absorption bands according to a) have nearly a Gaussian distribution and are independent of crystal structure, those according to b) depend essentially on crystal structure. Thus, investigation of the band structure of exciton absorption offers a possibility of investigating crystal structure, of the dependence of the energy of the exciton state on the wave vector of the exciton, and of exciton interaction with lattice oscillations. Davydov (Ref 5) as well as Davydov and Rashba (Ref 6) developed a theory of the structure of light absorption bands by basing on the example of a onedimensional crystal and on a more general case, without, however, considering the dependence on refraction- and absorption coefficients. In the present paper the authors develop a theory that furnishes refraction index and absorption coefficient in absorption bands corresponding to exciton excitations. They operate with the model of the pure molecule crystal, in which molecules are able

Electromagnetic Waves in Crystals in the Region of Exciton Absorption

to perform only translation- and rotation oscillations of a certain (average) value. It is shown that knowledge of the structure of the absorption band may be instrumental in determining the sign of the effective exciton mass. Furthermore, the conditions are given which lead to a zero refraction index at the short wave side of the excitation band. Electromagnetic waves of these frequencies are totally reflected, they penetrate only very little into the crystal surface. This total reflection is found to vanish with rising temperature. There are 3 figures and 8 Soviet references.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: June 26, 1958

DAVYDOV, A.S.

21 (7), 21 (8)

AUTHOR: Rudakov, V. P. SOV/89-7-1-18/25

TITLE: IX All-Union Conference on Nuclear Spectroscopy
(IX Vsesoyuznoye soveshchaniye po yadernoy spektroskopii)

PERIODICAL: Atomnaya energiya, 1959, Vol 7, Nr 1, pp 76-78 (USSR)

ABSTRACT: The IX All-Union Conference was held from January 26 to February 2, 1959 at Khar'kov. More than 300 participants heard 100 lectures, the most important of which dealt with the following fields: Nuclear Theory, General problems of β-decay. A. S. Davydov (MGU): Theoretical classification of low-energy excited nuclear states. L. K. Peker: Deformed nuclei. B. L. Birbrair, L. K. Peker, L. A. Sliv (LFTI): Quadrupole oscillations of deformed nuclei. Ye. V. Inopin, V. Yu. Gonchar, S. P. Tsytko (KhFTI): Calculation of the ft-values with matrix elements for β-transitions by means of the generalized nuclear model. S. T. Belyayev (IAE): Consideration of pair-correlation in nuclei. A. B. Migdal (IAE): The application of the superconductivity model to nuclei for the purpose of calculating their moments of inertia. P. E. Nemirovskiy (IAE): Problems of the neutron stability of nuclei. Yu. A. Smorodinskiy (IAE): The present stage in the theory of β-decay. V. V. Vladimirskiy,

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V. K. Grigor'yev, V. A. Yergakov, Yu. V. Trebukhovskiy (ITEF): Measurement of the angular correlation between electron and neutrino in the decay of the neutron. V. M. Lobashev, V. A. Nazarenko, L. I. Rusinov (LFTI): Measurement of the correlation between the transversal electron polarization and circular polarization of γ-quanta occurring in the decay of Sc^{46} and Co^{60}. Decay Schemes. γ-radiation of Nuclei. Yu. P. Anufriyev, A. K. Val'ter, Yu. V. Gonchar, Ye. G. Kopaneyts, A. N. L'vov, P. M. Tutakin, S. P. Tsytko, P. V. Sorokin, A. S. Deyneko, I. Ya. Malakhov, A. Ya. Taranov (Fiziko-tekhnicheskiy Khar'kovskiy institut (Physico-technical Institute, Khar'kov)): The $Si^{28,29,30}(p,\gamma)$, $Ne^{20}(p,\gamma)$, $S^{32-34}(p,\gamma)$, $Ar^{40}(p,\gamma)$ and $N^{14}(p,\gamma)$ reactions. D. G. Alkhazov, A. P. Grinberg, G. M. Gusinskiy, M. Kh. Lemberg, V. V. Rozhdestvenskiy, K. N. Yerokhina of the Leningradskiy fiziko-tekhnicheskiy institut (Leningrad Physico-technical Institute): Investigation of the Coulomb excitation of the lower levels of some nuclei during their bombardment by multiply charged ions (C, N, O, and Ne). A. V. Kalyamin, A. N. Murin, V. N. Pokrovskiy, V. A. Yakovlev (RIAN): New isotopes

Tu^{161}, Ho^{153}, Ho^{155} and Ho^{157}. B. S. Dzhelepov, V. A. Sergiyenko (LGU): Decay schemes of some neutron-deficient isotopes, set up on the basis of measurements of the coincidence of the internal conversion electrons. Spectroscopy Engineering. B. S. Dzhelepov, R. B. Ivanov, V. G. Nedovesov, V. G. Chumin (RIAN): α-spectrometer with double focusing. S. A. Baranov, V. V. Beruchko, A. G. Zelenkov, A. F. Malov, G. Ya. Shchepkin (IAE): Improved α-spectrometer. I. F. Barchuk, G. V. Belykh, V. I. Golyshkin, V. A. Kovtun (IFAN UkrSSR): Magnetic spectrograph for heavy charged particles. The representatives of the Ministerstvo radiotekhnicheskoy promyshlennosti (Ministry of the Radio-engineering Industry) gave a report about new multipliers. The Conference was closed by B. S. Dzhelepov, who stressed the fact that nuclear tables and reference works ought to be published much more quickly in order to be of real use to the experimenter.

24(5)
AUTHOR: Davydov, A. S. SOV/48-23-7-3/31

TITLE: Collective Excited States of Atomic Nuclei (Kollektivnyye vozbuzhdennyye sostoyaniya atomnykh yader)

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1959, Vol 23, Nr 7, pp 792-811 (USSR)

ABSTRACT: The introduction of the present paper points out that the excited state of many nuclei can be approximated by a division into a single-nucleon excitation and a collective excitation. This division is only usable for even-even nuclei since there the energy of the single-nucleon excitation in the order of magnitude of 1.5-2 Mev is many times larger than that of the collective excitation. The collective excitation is characterized by the high probability of quadrupole transitions caused by the collective motion of a large number of nucleons. The former assumption that all nuclei possessed a spherical symmetry proved to be wrong, and it became clear that many nuclei are non-spherical. The collective motion of non-spherical nuclei is divided into an internal excitation causing an oscillation of the surface, and a rotary motion of the nuclei which does not change the internal state of the nucleus.

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The existence of a rotary excitation of low energy is characteristic of a non-spherical nucleus; three ranges in the periodic system of elements are indicated by formula (1,1), in which the nuclei have a rotational spectrum. Table 1 indicates the first excited levels of some even-even nuclei, and the values of the nonsphericity parameters β. The approximation of these nuclei by an ellipsoid is dealt with, the equation (1,4) for the rotational spectrum of axisymmetric even-even nuclei is given, and the interval rule (1,5) is put forward for the energy levels of these nuclei. Examples of these levels are shown in figure 1, and at the end of the introduction, the papers of a number of non-Russian and of the following Russian authors are indicated as references for the subsequent chapters: G. F. Filippov, V. S. Rostovskiy, D. A. Zaikin, B. T. Geylikman. The second part of the present paper investigates the rotational levels of non-axial nuclei. In this connection, a diagram (Fig 2) shows the dependence of the energy of the rotational levels of even-even nuclei on the parameter of non-axiality γ. The spin quantum numbers are investigated for the determination of the rotational state, and formula (2,1) is indicated in this connection, which

considers the non-axiality of the nuclei. The small deviations of the experimental values from the theoretical ones in figure 2 are calculated by formula (2,2) considering the coupling of the rotational energy with the internal excitation. Further, the energy levels of various non-axial nuclei are investigated, and the level scheme (Fig 3) is shown. The third part investigates electromagnetic transitions between rotational states of non-axial nuclei. At first, the wave functions of these nuclei are obtained, then the probability of electromagnetic transitions is investigated; table 2 comprises the reduced probabilities of electric quadrupole transitions. This table shows that there are three types of this kind of transitions, and they are dealt with in detail. Table 3 comprises the ratios of the reduced probabilities of quadrupole transitions of different nuclei, and compares the experimental with the theoretical values. Besides, this chapter investigates the ratios of the reduced probabilities of the transitions to levels with spin 2, and in particular the ratios of the reduced probabilities of quadrupole transitions of wolfram. The fourth chapter deals with rules for the intensity of β-transitions to different rotational states of the even-even

daughter nuclei. At first, the corresponding theory is developed, then the ratios of the reduced probabilities in the disintegration of Re^{186} are calculated; the excitation of the rotational levels of the nuclei of Os^{190} in the β-decay of Re^{190} and in the K-capture decay of Ir^{190} is investigated, table 6 showing the ratios of the reduced probabilities. Chapter 5 deals with equilibrium forms of even-even nuclei, and two diagrams (Fig 4) show the energy of the basic state of the even-even nuclei as a function of γ. In the summary, it is ascertained that the theory of the rotational excited states is in an initial stage of development, that the limits of the applicability of the adiabatic approximation have not been investigated in this direction, and that for the solution of these problems the intensity of the γ-transitions must be investigated theoretically and experimentally. There are 4 figures, 6 tables, and 38 references, 15 of which are Soviet.

21(8)

AUTHORS: Davydov, A. S., Zaikin, D. A. SOV/56-36-1-31/62

TITLE: On the γ-Oscillations of the Surfaces of an Atomic Nucleus (O γ- kolebaniyakh poverkhnosti atomnogo yadra)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 1, pp 233-237 (USSR)

ABSTRACT: The authors investigate the stability of a nucleus with respect to the variation of the value γ corresponding to equilibrium for the minimum of potential energy. On the simple model of the anisotropic harmonic oscillator field for the individual nucleons, the following is shown: The energy of the first excited state, which corresponds to the γ-oscillations, is nearly of the same order of magnitude as the energy of the single-nucleon excitation. The reduced probability of the reduced quadrupole transitions to levels corresponding to the γ-oscillations is some hundred times lower than the corresponding probability of transition to the first rotation level of an axially-symmetric nucleus. According to the authors' opinion, these results confirm the high stability of the shape of the nucleus with respect to γ-oscillations. The first part of this paper deals with the potential energy of the surface oscillations

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of the nucleus. The nucleons with the mass m are assumed to move in a potential of the type $V = (m\omega^2/2) \sum_{k=1}^{3} (x_k/R_k)^2$. Here it holds that $R_k = R \exp(\xi_k)$; $\xi_k = \sqrt{5/4\pi}\,\beta\cos(\gamma - (2\pi/3)k)$, where β and γ determine the shape of the nucleus. Besides, it holds that $R_1R_2R_3 = R^3$, so that $\sum \xi_k = 0$ holds. The energy of each nucleon depends on 3 quantum numbers n_k. For each filled shell it holds that $\sum_{sk} n_{sk} \xi_k = 0$, and the total energy of the nucleons which fill several shells (magic nucleus), can be written down as $E_M = \hbar\omega(\varepsilon_0 + (1/2)D\beta^2)$, $\varepsilon_0 = \sum_s (n_s + (3/2))$, where $D > 0$ denotes the elasticity of the nucleus with respect to β-oscillations. The minimum energy of the nuclei with filled shells corresponds to the spherical shape of the nucleus. In

the second chapter the γ-oscillations of the surface of an atomic nucleus are calculated. The Schrödinger (Shredinger)-equation for the determination of the energy of these oscillations is explicitly written down. The solutions of this equation are to be found in form of periodic even functions (with the period $2\pi/3$) of γ. The authors confine themselves to dealing with the first four terms in the corresponding expansion in series. Expressions are written down for the difference between the ground state and the first excited γ-oscillation level. The authors investigate especially the filling of a shell with $N = 5$. The third and last chapter of the present paper deals with the excitation probability of the γ-oscillations. An expression is written down for the transition probability of the nucleus from the ground state to the first excited γ-oscillation state under the action of an electromagnetic field. The reduced probability of the first γ-oscillation state is some hundred times smaller than the corresponding excitation probability of the first rotational state of the nucleus. There are 6 references, 3 of which are Soviet.

On the γ-Oscillations of the Surfaces of an Atomic Nucleus

SOV/56-36-1-31/62

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

SUBMITTED: July 10, 1958

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21(1), 24(5)

AUTHORS: Davydov, A. S., Filippov, G. F. SOV/56-36-5-30/76

TITLE: On the Problem of the Shape of Even-even Nuclei
(K voprosu o forme chetno-chetnykh yader)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 5, pp 1497-1502 (USSR)

ABSTRACT: In the present very detailed paper a nonspherical nuclear model is investigated. First, the problem of non-sphericity is discussed by way of an introduction and discussed on the basis of the numerous works already published and dealing with this field and phenomena connected with it. Among other things it is shown that the majority of the properties of the first excited states of even-even nuclei may be well explained by the assumption that the nucleus has the shape of a triaxial ellipsoid when in equilibrium (Bohr). The authors investigated the possibility of a deviation of the equilibrium shape of a nucleus from axial symmetry by means of a new method which is based on a generalization of Bohr's method (Ref 2). A model is investigated in which the nucleus consists of a core of several nucleons and 2 equivalent external nucleons in a shell

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On the Problem of the Shape of Even-even Nuclei SOV/56-36-5-30/76

with a certain j-value. According to Bohr the ellipsoidal shape of the nucleus may be characterized by the two parameters β and γ ; the authors derive formulas representing nuclear energy as functions of β and γ . The two figures show nuclear energy as a function of γ and I with J = 2 and J = 4 at various I-values. It is shown that in the ground state of the nucleus a nonaxial shape of the nucleus with $j > 3/2$ corresponds to the energy minimum. Several experimental data are given which are in keeping with the authors' theory. There are 2 figures and 10 references, 3 of which are Soviet.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: November 20, 1958

Card 2/2

24(5)

AUTHOR: Davydov, A. S.

SOV/56-36-5-41/76

TITLE: Rotational States of Non-axial Odd Nuclei (Vrashchatel'nyye sostoyaniya neaksial'nykh nechetnykh yader)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 5, pp 1555-1559 (USSR)

ABSTRACT: In an earlier paper (Ref 1) the author, in collaboration with G. F. Filippov, already showed that many properties of the first excited states of even-even nuclei, as e.g. the spin sequence of excited states, their energies, and electromagnetic transition probabilities, may be explained well by the assumption that the equilibrium shape of the nucleus may in first approximation be considered to be a triaxial ellipsoid, which, according to Bohr, may be characterized by the parameters β and γ (γ shows deviation from axial symmetry). Certain connections exist between these parameters. B. T. Geylikman (Ref 3), D. A. Zaikin (Ref 4), as well as the author and Filippov (Ref 5) already investigated the possibility of a disturbance of the axial symmetry of the equilibrium shape. In the present investigation the author analyzes the rotational states of odd nuclei on the assumption

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that the shape of the nucleus is characterized by fixed equilibrium values of the parameters β and γ, and that the odd nucleon is in a state with a fixed value of the total momentum $j = 1/2$. In the first part of this paper equations are derived for the energy of the rotational levels of an odd nucleus with fixed β and γ, and for the case in which the external nucleon is in the state $j = 1/2$. The equations obtained were numerically evaluated by G. I. Marchuk and A. I. Vaskin, the energy values are given in tables 1 and 2 for the spins 5/2, 7/2, and 9/2 for various γ-values between 0 and $\pi/6$. The energy ε of the rotational states may be represented as a function of γ, $0 \leq \gamma \leq \pi/3$, i.e. $\varepsilon(I,\gamma) = \varepsilon(I,\pi/3 - \gamma)$. In the second part of the paper theoretical results are shortly compared given with the values obtained experimentally for the W^{183}-nucleus (Dzhelepov, Peker) (Ref 8). The left part of figure 2 shows the energy levels of this nucleus determined experimentally, the right part shows those calculated with $\gamma = 27^{\circ}$. Agreement appears to be satisfactory. The author thanks G. I. Marchuk and A. I. Vaskin for the numerical computation of energy values. There are 1 figure, 2 tables, and 8 references, 5 of which are Soviet.

Rotational States of Non-axial Odd Nuclei

SOV/56-36-5-41/76

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

SUBMITTED: December 7, 1958

Card 3/3

24(5)

AUTHORS: Davydov, A. S., Rostovskiy, V. S. SOV/56-36-6-24/66

TITLE: Transition Probabilities Between the Levels of the Rotation Bands of Nonaxial Nuclei (Veroyatnosti perekhodov mezhdu urovnyami vrashchatel'noy polosy neaksial'nykh yader)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 36, Nr 6, pp 1788-1796 (USSR)

ABSTRACT: It is the aim of the present paper to calculate the energies and wave functions of the rotational states ($J \geq 4$) of non-axial nuclei and to derive the reduced probabilities for E2 transitions between these states. Davydov and Filippov (Refs 1-3) have already investigated the rotational states of even-even nuclei on the assumption that the equilibrium form of the nucleus may be represented by a triaxial ellipsoid. They found analytical expressions for the energies of the levels with the spins 2, 3, 5, and calculated the transition probabilities between these levels. The results obtained by these investigations are discussed. In the present paper the author gives the results of numerical computations of the level energies (spins 4, 6, and 8) for various values of the parameter γ, which characterizes the deviation of the

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nucleus from the axially-symmetric shape. Calculation of the wave functions of these excited states and of the transition probabilities between them (quadrupole transitions in the rotational band) are very detailed and are discussed in the following. Table 2 shows the coefficients of the wave functions for spins 4 and 6 in the case of γ-values between 0 and 30°. Table 3 shows the probabilities for the electric quadrupole transitions between some rotational states of even-even nuclei again for 9 γ-values between 0 and 30°. It is found that these transitions may be subdivided into 3 types: 1) Such, the probabilities of which (in $e^2Q_0^2/16\pi$ units) are of the order of magnitude 1 - cascade transitions of the type $3 \rightarrow 22$, $42 \rightarrow 3$, $42 \rightarrow 22$. 2) Transitions between levels of the ground rotational band and "anomalous" rotational levels of another spin, e.g. $3 \rightarrow 21$, $41 \rightarrow 22$, $42 \rightarrow 21$, $61 \rightarrow 42$. 3) Transitions between levels of the same spin, e.g. $22 \rightarrow 21$, $42 \rightarrow 41$. In part 3 of the paper the conditions at which the rotational states of the nuclei can be described are investigated by means of approximation wave functions. The here derived approximation formulas for the determination of the

Transition Probabilities Between the Levels of the Rotation Bands of Nonaxial Nuclei

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E2 transition probabilities between rotational states of the nucleus deviate only little from those for axially symmetric nuclei. Comparisons with experimental results show that, if the nuclear shape deviates from the axially symmetric shape, the interval rule 1 : 3.3 : 7 : 12 observed in the rotational band of axial nuclei is infringed. Thus, for $\gamma = 30^{\circ}$ the ratio 1 : 2.67 : 5 : 8 holds. Tables 4 and 5 contain further reduced probabilities, viz for various transitions in Os^{190} and E_{22}/E_{21} for a number of other nuclei (comparison between calculated and measured values). There are 1 figure, 5 tables, and 15 references, 4 of which are Soviet.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: December 16, 1958

Card 3/3

21(8)
AUTHOR: Davydov, A. S.

SOV/56-37-1-22/64

TITLE: The Rules of Intensities of the β-Transitions for Different Rotational States of the Even-even Daughter Nucleus (Pravila intensivnostey dlya β-perekhodov na razlichnyye vrashchatel'nyye sostoyaniya dochernego chetno-chetnogo yadra)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 37, Nr 1(7), pp 137-142 (USSR)

ABSTRACT: As the relative energies of all rotational levels and their wave functions can be definitely determined for any nucleus if the ratio of energies of two levels (which have the spins 2) is known, the relative probabilities of the β-decays can be estimated from a given state of the parent nucleus into various rotational states of the nonaxial nucleus. Such relative probabilities of the β-decays are calculated in the present paper. The author finds out at first the ratio of the squares of the modules of the matrix elements which determine the β-decay into various rotational levels. An even-even nucleus results from the β-decay of an odd-odd parent nucleus with integral spin. The β-decay is characterized by

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the moment L which is carried off by an electron and an anti-neutrino. The operator $\mathcal{M}_{L\mu}$ can be assigned to such a β-decay, μ denoting the projection of the moment L onto a certain marked direction. For investigating the excitation of the rotational states of the daughter nucleus in the β-decay, it is convenient to express the moment $\mathcal{M}_{L\mu}$ by the multipole operators $\mathcal{M}'_{L\nu}$ which are defined in the coordinate system connected with the nucleus. Such a transition is represented by the transformation $\mathcal{M}_{L\mu} = \sum_{\nu} \mathcal{M}'_{L\nu} D^{L}_{\nu\mu}(\Theta_i)$. Subsequently, expressions are written down for the final states of the even-even daughter nucleus (in adiabatic approximation), for the wave function of the initial state of the parent nucleus, for the reduced probability corresponding to a β-transition with the moment L, and for the ratio of the reduced probabilities. In the next part, these theoretical results are compared with the experiment. A formula for the ratio of the values τf_n for 2 β-transitions

The Rules of Intensities of the β-Transitions for Different Rotational States of the Even-even Daughter Nucleus SOV/56-37-1-22/64

with an initial state of the parent nucleus to various rotational states of the daughter nucleus is written down. τ denotes the half life, and f_n the integral, taken over the energy, of the distribution function of the electrons for a given type of decay. The results found are then applied to the decay of Re^{186}, Np^{238} and to the β-decay of Eu^{154}. Finally, the excitation of the rotational levels of the Os^{190}-nucleus in the β-decay of Re^{190} and in the K-capture decay of Ir^{190} are investigated. There are 3 figures, 2 tables, and 10 references, 6 of which are Soviet.

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

SUBMITTED: January 13, 1959

Card 3/3

DAVYDOV, A.S.

"Collective Excited States of Nuclei"

report submitted for the 2nd USSR Conference on Nuclear Reactions at Low and Intermediate Energies, Moscow, 21-28 July 1960.

S/048/60/024/007/003/011
B019/B060

AUTHOR: Davydov, A. S.

TITLE: The Rotational Energy of Even - Even and Odd Atomic Nuclei 19

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1960, Vol. 24, No. 7, pp. 820-832

TEXT: This is the reproduction of a lecture delivered at the 10th All-Union Conference on Nuclear Spectroscopy held in Moscow from January 19 to 27, 1960. In introduction, the author discusses the theory of nonaxial nuclei which has been developed by A. S. Davydov and G. F. Filippov (Ref. 2) as well as A. S. Davydov and V. S. Rostovskiy (Ref. 3), and which is based on three simplifying assumptions. Firstly, the internal state is not altered by the nuclear rotation; secondly, the three principal moments of inertia of the nucleus are dependent on a parameter which determines the deviation of the nuclear from the axially symmetric shape; thirdly, the probability of electromagnetic transitions between the rotational states is calculated on the premise of the electric charge being homogeneously distributed in the nuclear volume. With assumptions the theory of rotational

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states of nonaxial even-even nuclei becomes very simple and can be easily compared with experimental results. In the first part of this article, a comparison is made between the results derived from the theory of rotational states of nonaxial nuclei and those obtained from experiments. Here the author refers to papers by American and Canadian physicists and thoroughly discusses the comparison between theoretical and experimental results made by Ye. P. Grigor'yev and M. P. Avotina (Ref. 7). This paper also supplied the dependence, illustrated in Fig. 2, of the rotational levels on the parameter of nonaxiality for 15 atomic nuclei. The deviations of the theoretical values from the experimental ones are greatest in the case of Mg^{24}, Gd^{154}, and Hg^{198} nuclei. The second part of this article deals with the further development of the theory of rotational states of nonaxial even-even nuclei. Formula (3) which has been formulated by the British physicist Donald for the moments of inertia is then discussed, and a paper by Davydov, N. S. Rabotnov, and A. A. Chaban (Ref. 8) is mentioned. Mention is made of the current assumption that the moments of inertia in nuclei have values lying between those that are obtained with the hydrodynamic nuclear model and the model of a rotating solid body. The third

part offers a theory of the rotational states of odd nuclei, which starts from the Hamilton operator (5) proposed by Bohr and Mottelson, and the extension of the theory to nonaxial odd nuclei, made by Davidson (New York) is discussed. The author then refers to one of his own papers (Ref. 11), in which he studied the effect of coupling between nuclear rotation and the motion of outer nucleons. D. F. Zaretskiy and A. V. Shut'ko (Ref. 12) attempted to introduce an additional interaction of nucleon spin with nuclear rotation. The author obtains formula (9) for the energy levels, which reveals that the interaction of outer nucleons with rotation gives rise to a shift and to a splitting of the rotational levels of the core of the nucleus. It is found that in nonaxial odd nuclei the core of the nucleus has the shape of a triaxial ellipsoid. In the fourth part, the author discusses the theoretical calculation of the equilibrium shapes of nuclei, and makes further reference to several papers. Some configurations calculated by Filippov are cited, which correspond to nonaxial nuclear forms and from which the conclusion is drawn that a correlation in the motion of the outer nucleons gives rise to nonaxial nuclear forms

The Rotational Energy of Even - Even and Odd Atomic Nuclei

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in some cases. B. T. Geylikman (Ref. 16) and D. I. Zaikin (Ref. 17) are mentioned. There are 6 figures, 1 table, and 17 references: 13 Soviet, 2 Canadian, 1 US, and 1 Danish.

ASSOCIATION: Moskovskiy gos. universitet im. M. V. Lomonosova
(Moscow State University imeni M. V. Lomonosov)

Card 4/4

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S/056/60/038/004/034/048
B006/B056

24.6520

AUTHORS: Davydov, A. S., Rabotnov, N. S., Chaban, A. A.

TITLE: Rotational Energy and Moments of Inertia of Nonaxial Nuclei 19

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1960, Vol. 38, No. 4, pp. 1311 - 1315

TEXT: A. S. Davydov, G. F. Filippov, and Y. S. Rostovskiy developed a theory of the rotational states of nonaxial nuclei (Refs. 1,2). They showed that the ratios of the energies of all rotational levels to the energy of the first excited spin-2 level can be uniquely determined if the corresponding ratios for the second excited spin-2 level are known from the experiment. It was further found that the relative probabilities of electric quadrupole transitions between rotational levels may also be determined from these ratios. These results were obtained on the assumptions that a) the inner state of the nucleus does not change during its rotation (adiabatic approximation), and b) the main moments of inertia of the nucleus can be expressed by the parameters A and γ:

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$I_i = A\sin^2(\gamma - 2\pi i/3)$, $i = 1,2,3$. This formula corresponds to the hydrodynamic nuclear model. The authors therefore described this approximation as hydrodynamic. The authors now investigate the question as to the manner in which these results change if the simplifying assumptions are abandoned. The rotational states of nonaxial nuclei with arbitrary (three) main moments of inertia are investigated in adiabatic approximation. It is shown that in general the rotational energy ratio may be expressed by two parameters: by ξ, the energy ratio of two spin-2 levels, and by η, a parameter depending on the character of the collective motions causing nuclear rotation; $\xi = E_2(2)/E_1(2) > 1$, $\eta = a_1a_2a_3/E_1^3(2)$. In the following, the energies of all rotational states are expressed by the dimensionless ε: $\varepsilon = E/E_1(2)$. Thus, the following relations hold for the spin-2 and spin-3 states as, e.g., $\varepsilon(3) = 1 + \xi$, $\varepsilon_1(5) = 4 + \xi$, $\varepsilon_2(5) = 1 + 4\xi$. The energies of other rotational levels cannot be given as functions of ξ alone, but they are functions of ξ and η. For the spin-4 and spin-6 states, the corresponding formulas are given. With

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formula (5) the following inequalities are given for ξ and η: $\xi^2(3-\xi) \leq 54\eta \leq 3\xi - 1$, $(1 < \xi \leq 3)$ and $0 \leq 54\eta \leq 3\xi - 1$, $(\xi \geq 3)$; these inequalities result from the demand that the roots of the equation $x^3 - \frac{1}{2}(1+\xi)x^2 + \frac{1}{3}\xi x - \eta = 0$ be positive and real. Fig. 1 shows the possible values of the ratios $\varepsilon_1(4)$ and $\varepsilon_2(4)$ for different values of the parameters ξ and η, which are defined by (5); Fig. 2 shows the same for $\varepsilon_1(6)$. The experimental points are plotted in each case for a number of heavy nuclei. The numerical experimental data taken from Refs. 4-8 are given in a table. There are 2 figures, 1 table, and 9 references: 5 Soviet, 3 Dutch, and 1 US.

ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: November 19, 1959

Card 3/3

21212
S/188/61/000/001/007/009
B104/B203

24.4500 (1395, 1538)

AUTHOR: Davydov, A. S.

TITLE: Collective excitations corresponding to quadrupole oscillations of a nuclear surface

PERIODICAL: Vestnik Moskovskogo universiteta. Seriya 3, fizika, astronomiya, no. 1, 1961, 56-66

TEXT: In an introduction, the author describes quadrupole oscillations of the surface of spherical nuclei by means of five variables $b_\mu (\mu = 0, \pm 1, \pm 2)$, as well as the interaction of oscillations of the nuclear surface with nucleons. He mainly relies on Bohr (Ref. 1: Bohr A., Dan. Mat.-Fys. Medd., 26, 14, 1952), Wilets (Ref. 2: Wilets I., Fean M., Phys. Rev., 102, 788, 1956), and Jankovic (Ref. 3: Jankovic Z., Nuovo Cimento, 14, 1174, 1959). The present paper studies the generalized system

$$\left[T_1 + \frac{1}{4}\sum_{l=1}^{3} A_l \hat{J}_l^2 + D(\gamma - \gamma_0)^2 - \Lambda\right]\Phi(0, \gamma) = 0, \qquad (7)$$

$$\left[-\frac{\hbar^2}{2B}\frac{d^2}{d\beta^2} + \frac{C}{2}(\beta - \beta_0)^2 + \frac{\hbar^2(\Lambda+2)}{2B\beta_0^2} - E\right]\beta^2 F(\beta) = 0, \qquad (8)$$

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Collective excitations corresponding...

$$D = \frac{BC_\tau}{\hbar^2}\beta_0^4, \quad C_\tau = \omega_\tau^2 B, \tag{9}$$

satisfying the wave function of steady states. The first part deals with collective excitations in spherical nuclei. It is shown that for spherical nuclei the system (7) - (9) can be accurately solved, producing a well-known spectrum with equidistant energy levels. The second part deals with collective excitations of non-spherical, non-axial nuclei. When studying small oscillations about the position of equilibrium of non-spherical nuclei, (8) may be given in the form

$$\left\{\frac{\hbar^2}{2B}\frac{d^2}{d\beta^2} - W_\Lambda(\beta) + E\right\} f(\beta) = 0, \quad f(0) = 0, \tag{19}$$

where

$$W_\Lambda(\beta) = \frac{C}{2}(\beta - \beta_0)^2 + \frac{\hbar^2(\Lambda+2)}{2B\beta^2} \approx W_\Lambda(\beta_\Lambda) + \frac{C_\Lambda}{2}(\beta - \beta_\Lambda)^2, \tag{20}$$

$$\beta_\Lambda = \beta_0 + \frac{\hbar^2(\Lambda+2)}{BC\beta_\Lambda^3}, \tag{21}$$

$$C_\Lambda = C\left[1 + \frac{3\hbar^2(\Lambda+2)}{BC\beta_\Lambda^4}\right]. \tag{22}$$

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Collective excitations corresponding...

For the energy of collective excitations of nuclei, the relation

$$E_{\Lambda\nu} = \hbar\omega\left\{\left(\nu+\frac{1}{2}\right)\sqrt{1+3(\Lambda+2)\left(\frac{\mu}{p}\right)^4}+\frac{\Lambda+2}{2}\left(\frac{\mu}{p}\right)^2+\frac{(p-1)^2}{2\mu^2}\right\}, \quad (25)$$

is indicated, where ν is the root of the transcendental equation $H_\nu(-p/\mu_1) = 0$.

$$\omega = \sqrt{C/B};\ p = \beta_\Lambda/\beta_0 \geq 1;\ \mu^2 = \frac{\hbar\omega}{C\beta_0^2}.$$

In the general case, collective excitations have a complex character, and it is shown that the separation of β-oscillations is only possible if the "parameter of non-adiabaticity" $\mu < 1/3$, i.e., if the amplitude of the zero oscillation is small as compared with β_0. Further, it is shown that in adiabatic approximation ($\mu = 0$) the energy of collective excitations is equal to the total energy of β- and γ-oscillations and the energy of rotation. Thus, the experimentally observed, excited states 0^+ of a non-axial, symmetrical nucleus may be excitations of two types (β and γ) which may be greatly different in their properties. The third part deals with collective excitations of non-spherical, axisymmetrical nuclei. On the basis of Eq. (7), the author first studies the energy of nuclear

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Collective excitations corresponding...

excitation for collective spin-zero excitations, and obtains the following relation:

$$\Delta E_{n\lambda}(0) = n\hbar\omega + \hbar\omega_\gamma\{2\lambda - 8\mu^4\lambda[(\lambda+1)\sqrt{D}+1] + 3\mu^2 n(2\lambda+1) + 3\mu^2\lambda\} + 3n\mu^2\frac{\hbar^2}{B\beta_0^2}. \quad (A)$$

Further it is shown that the axial symmetry of the nucleus is disturbed on transition to spin-three states. For the energy of excited spin-three states the following expression is obtained:

$$\Delta E_{n2m}(3) = n\hbar\omega + 2\hbar\omega_\gamma(\lambda + 1/2) + 3\hbar^2/2B\beta_0^2.$$

The first excited state of this type is called "rotational excitation", and it is shown that the energy of this state does not tend toward infinity with $\gamma_0 \longrightarrow 0$. Once more on the basis of Eq. (7), the author studies the spin-two states. For (7), the two differential equations

$$\left[T_\gamma + \frac{3}{4}(A_1 + A_2) + D\gamma^2 - \Lambda\right]G_0(\gamma) + \frac{\sqrt{3}}{4}(A_1 - A_2)G_2(\gamma) = 0,$$

$$\frac{\sqrt{3}}{4}(A_1 - A_2)G_0(\gamma) + \left[T_\gamma + \frac{A_1 + A_2}{4} + A_3 + D\gamma^2 - \Lambda\right]G_2(\gamma) = 0, \quad (41)$$

are obtained. It is shown that also with small γ-oscillations of

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Collective excitations corresponding...

axisymmetrical nuclei the quantum number k is not described by an integral of motion. The solutions found for $A_1 = A_2 = 4/3$ are approximations in which the quantum number k is described by an integral of motion. Finally, the relation:

$$E_{n\lambda}(I) = n\hbar\omega + \hbar\omega_\gamma(2\lambda + K/2) + \hbar^2\{I(I+1) - 3K^2/4\}/6B\beta_0^2$$

is obtained for states with a spin $I \geq 4$ for the energy of excitation of an axisymmetrical nucleus. Here, the first term refers to β-oscillations, the second one to γ-oscillations, and the third one to the energy of rotation. There are 7 references: 4 Soviet-bloc and 3 non-Soviet-bloc.

ASSOCIATION: Kafedra elektrodinamiki i kvantovoy teorii (Department of Electrodynamics and Quantum Theory)

SUBMITTED: October 26, 1960

Card 5/5

DAVYDOV, A.S.; ROSTOVSKIY, V.S.; CHABAN, A.A.

Form of atomic nuclei and excited states of zero spin levels.
Vest. Mosk. un. Ser. 3: Fiz., astron. 16 no.3:66-74 My-Je '61.
(MIRA 14:7)

1. Kafedra elektrodinamiki i kvantovoy teorii Moskovskogo gosudarstvennogo universiteta.
(Nuclei, Atomic)

DAVYDOV, A.S.

New results achieved in the theory of nonaxial nuclei. Izv. AN SSSR. Ser. fiz. 25 no.7:782-791 Jl '61. (MIRA 14:7)

1. Moskovskiy gosudarstvennyy universitet im. M.V. Lomonosova.
(Nuclei, Atomic)

DAVYDOV, A.S.; SARDARYAN, R.A.

Rotational states of odd nuclei with small nonaxiality. Zhur. eksp. i teor. fiz. 40 no.5:1429-1433 My '61. (MIRA 14:7)

1. Moskovskiy gosudarstvennyy universitet.
(Nuclear spin)

FRANK, I.M., otv. red.; DAVYDOV, A.S., red.; LAZAREVA, L.Ye., red. NEMIROVSKIY, P.E., red.; CHUYEV, V.I., red.; POLYAKOVA, T.V., tekhn. red.

[Transactions of the Second All-Union Conference on Nuclear Reactions at Low and Medium Energies] Trudy Vtoroy Vsesoyuznoy konferentsii po iadernym reaktsiiam pri malykh i srednikh energiiakh, Moscow. 1960. Moskva, Izd-vo Akad. nauk SSSR, 1962. 658 p. (MIRA 16:2)

1. Vsesoyuznaya konferentsiya po yadernym reaktsiyam pri malykh i srednikh energiyakh, 2d, Moscow, 1960.
(Nuclear physics—Congresses)

S/188/62/000/004/008/010
B108/B102

AUTHORS: Davydov, A. S., Sardaryan, R. A.

TITLE: The excited states of odd atomic nuclei with slight nonaxiality

PERIODICAL: Moscow. Universitet. Vestnik. Seriya III. Fizika, astronomiya, no. 4, 1962, 72 - 82

TEXT: The excited states of odd nuclei with ground state spin 5/2 and 7/2 are studied on a simple model. The system is assumed to consist of a shell having the shape of an ellipsoid of revolution and of one outer nucleon. The nuclear surface may perform slight beta and gamma vibrations. Formulas derived for this model make it possible to calculate the sequence of the spins and the energy ratio of the excited states with the aid of energy parameters. Adiabatic approximation with respect to the beta vibrations of the nuclear surface enable the formulas to be expressed in terms of one parameter for the ground-state single-particle rotational band and two parameters for the first abnormal band. From a comparison with experimental data on heavy nuclei it is inferred that several excited

DAVYDOV, A. S.

SREDNIAWA, Bronislaw

Poland

no title given

no affiliation given

Crakow, Postepy Fizyki, Vol XIII, No 6, 1962, p 681.

Book Review of Atomic Nuclear Theory by A. S. DAVYDOV DAWYDOW, translated from the Russian by R. Michalska and B. Tuczyiew.

DAVYDOV, A.S.; SARDARYAN, R.A.

Excited states of odd atomic nuclei with slight nonaxiality. Vest. Mosk.un.Ser.3:Fiz.,astron. 17 no.4:72-82 Jl-Ag '62. (MIRA 15:9)

1. Kafedra elektrodinamiki i kvantovoy teorii Moskovskogo universiteta.

(Quantum theory)

DAVYDOV, A.S.

Dispersion relations for the refractive index and absorption coefficient in media with exciton absorption. Zhur. eksp. i teor. fiz. 43 no.5:1832-1840 N '62. (MIRA 15:12)

1. Moskovskiy gosudarstvennyy universitet.
(Electromagnetic waves)
(Dispersion)
(Dielectric constant)

DAVYDOV, A.S. [Davydov, O.S.]

Rotational single-particle excitations of nonspherical odd atomic nuclei. Ukr. fiz. zhur. 8 no.7:717-727 Jl '63. (MIRA 16:8)

1. Institut fiziki AN UkrSSR, Kiyev.
(Nuclear models)

DAVYDOV, A.S.

Energy levels of nonspherical odd atomic nuclei. Izv. AN SSSR. Ser. fiz. 27 no.7:851-861 '63. (MIRA 16:8)

1. Moskovskiy gosudarstvennyy universitet im. M.V.Lomonosova.
(Nuclei, Atomic) (Gamma--Ray spectrometry)

DAVYDOV, A.S.

Excitons in thin crystals. Zhur. eksp. i teor. fiz. 45 no.3:723-729 S '63. (MIRA 16:10)

1. Moskovskiy gosudarstvennyy universitet.
(Excitons) (Crystals—Optical properties)

DAVYDOV, A. S.

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