VAYNSHTEYN L. A. FA 172T86

USSR/Physics - Wave Guides 11 Oct 50

"Diffraction of Waves at Open End of a Circular Wave Guide Whose Diameter is Considerably Greater Than Wave Length," L. A. Vaynshteyn

"Dok Ak Nauk SSSR" Vol LXXIV, No 5, pp 909-913

Formulas for radiation characteristics had been obtained previously by Vaynshteyn in studies of radiation of various types of electromagnetic waves from open end of cir wave guide. Considers now physical meaning of these formulas for radiation field under condition that diam of pipe is greater than wave length. Submitted by Acad M. A. Leontovich 5 Aug 50.

172T86

VAYNSHTEYN, L. A.

USSR/Electronics - Wave Guides Mar 51

"General Theory of Nonsymmetrical Waves in a Round Wave Guide With Open End," L. A. Vaynshteyn

"Zhur Tekh Fiziki" Vol XXI, No 3, pp 328-345

Obtains exact soln of subject problem. Soln is complicated, because electromagnetic fld has 2 Hertz functions due to diffraction of wave on tube's end. Gives formulas for coeff of reflection of incoming wave and for coeff of transformation of elec waves into magnetic and vice versa. Derives approx formulas for radiation fld.

180T46

LC

180T47

USSR/Electronics - Wave Guides

Mar 51

"Numerical Results From the Theory of Nonsymmetrical Waves in a Round Wave Guide With Open End (Waves E_1 and H_1)," L. A. Vaynshteyn

"Zhur Tekh Fiziki" Vol XXI, No 3, pp 346-357

Constructs graphs of abs magnitudes and phases of: coeff of reflection from open end, and coeff of transformation of one kind of wave into another. Gives graphs of radiation characteristics of waves E_{11} and H_{11} and compares results with Huygens' principles. Studies excitation of various waves in guide by plane-wave incident on open end.

LC

180T47

VAYNSHTEYN, L. A.

VAYNSHTEYN, L. A. - "Diffraction of Electromagnetic and Sound Waves at the Open End of a Wave Guide." Sub 31 Mar 52, Physics Inst imeni P. N. Lebedev, Acad Sci USSR. (Dissertation for the Degree of Doctor in Physicomathematical Sciences).

SO: Vechernaya Moskva January-December 1952

USSR/Physics - Photocurrent Aug 52

"Appearance of an Alternating Component in the Photocurrent of Photocells During Strong Illumination," L. A. Vaynshteyn, L. P. Malyavkin, Phys Inst imeni P. N. Lebedev, Acad Sci USSR

"Zhur Tekh Fiz" Vol 22, No 8, pp 1315-1317

The appearance of an alternating component of audiofrequency was observed in the photocurrent of vacuum or gas-filled photocells during illumination of the order of 10^4 luxes. Sometimes high-frequency oscillations were superimposed on the

226T97

oscillations of audiofrequency. Indebted to V. V. Druzhinin and S. L. Mandelshtam. Received 16 May 52.

226T97

VAYNSHTEYN, L. A.

VAYNSHTEYN, L. A.

PA 240T95

USSR/Physics - Optical Transitions 21 Dec 52

"Approximate Method of Computing the Probabilities of Optical Transitions," L. A. Vaynshteyn and B. M. Yavorskiy, All-Union Inst of Correspondence Courses of Textile and Light Industry

"DAN SSSR" Vol 87, No 6, pp 919-922

Analyzes functions by J. Slater (cf. Phys Rev. 36, (1930); P. Gombas Acta Physica (Budapest) 1, 3, 1952; V. Fok et al. Sow. Phys. 6, (1936); etc.) and attempts to simplify computations for specific cases. Presented by Acad G. S. Landsberg 21 Oct 52.

240T95

VAYNSHTEYN, L.A.; SHORIN, N.A., redaktor; URAZOVA, A.N., tekhnicheskiy redaktor

[Diffraction of electromagnetic and sound waves at the open end of a wave guide] Diffraktsiia elektromagnitnykh i zvukovykh voln na otkrytom kontse volnovoda. Moskva, Izd-vo "Sovetskoe radio," 1953. 203 p. [Microfilm] (MLRA 7:10)
(Electric waves) (Sound waves)

~~VAYNSHTEYN, L. A.~~

VAYNSHTEYN, L.A.

913 AEC-tr-2320
PHOTOELECTRIC INVESTIGATION OF THE SPECTRUM FROM THE CHANNEL OF A SPARK DISCHARGE. L. A. Vaĭnshteĭn, A. M. Leontovich, L. P. Malyavkin, and S. L. Mandel'shtam. Translated from Zhur. Ekspt'. i Teoret. Fiz. 24, 326-38(1953). 14p. Available from Associated Technical Services (Trans. 00G0R), East Orange, N. J.

A description is given of the method and apparatus for photoelectric registration of the intensity of spectral lines in a single pulse of a spark discharge, using an oscilloscope. An investigation is made of the change taking place during the process of development of a spark discharge in air, of the intensities of the spectral lines of nitrogen of various degrees of ionization, and of the line H_α. A number of interrelations which characterize the excitation of the spectrum in the discharge channel have been established. (auth)

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VAYNSHTEYN, L. A. and YAVORSKIY, B. M.

"Photoionization of Complex Atoms," Dokl. AN SSSR, 89, No.5, pp 813-16, 1953. All-Union Correspondence Inst. of Textile and Light Industry.

Calcn of the probability of transition of an optical electron into a continuous spectrum, a method for the calcn of the probabilities of transitions between discrete levels of an atom having already been proposed by the authors (DAN 87, 919, 1952). State that the photoionization processes and also the reverse processes of recombination with radiation are essential in many problems of astrophysics and gas-discharge physics. Presented by Acad. G.S.Landsberg 19 Feb 53.

259T85

VAYNSHTEYN, L. A. 260T97

USSR/Physics - Spectral Lines 11 Jun 53

"Widening of Spectral Lines in Consequence of the Quadrupole Stark Effect," I. I. Sobel'man and L. A. Vaynshteyn, All-Union Correspondence-School Inst of Textile and Light Industry

DAN SSSR, Vol 90, No 5, pp 757-760

Gives an expression for U''_{nn}, a second-order potential-energy term occurring in the familiar formula for the displacement of the nth energy level of an atom due to the presence of an electrical field, namely, in the case of a

260T97

non-hydrogenlike atom with one or two valence electrons. Carry out a numerical evaluation for Na, Ca, and Ca^+. Presented by Acad G. S. Landsberg 17 Apr 53.

USSR/ Physics

Card 1/1 Pub. 43 - 12/97

Authors : Vaynshteyn, L. A., and Yavorskiy, B. M.

Title : Approximate method for the calculation of probabilities of optical transitions

Periodical : Izv. AN SSSR. Ser. fiz. 18/2, page 251, Mar-Apr 1954

Abstract : The contents of this report were published in Doklady Akademii Nauk SSSR (Reports of the Academy of Sciences USSR), vol. 87, page 919, 1952.

Institution : ....

Submitted : ....

L. A.

USSR.

An approximate calculation of ... and effective ... of photoionization ... Vainshtein and ... Zhur. ... Fiz. 27, 713-18 (1954). The effective cross section ... is given by ... of the 1st ... orbit) and the oscillator strength ... of approx. radial functions ... for Li (2S-2P and ...) ... and ..., K (...), Cd (...), and the results are compared with expt. ... B, C, N, O, Mg, Ca, and Na ... ; the discrepancy is of the order ...

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①

VAYNSHTEYN, L. A.

USSR/Radiophysics - Superhigh Frequencies, I-11

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 35427

Author: Vaynshteyn, L. A.

Institution: None

Title: Electron Wave in Decelerating Systems. I. General Theory

Original Periodical: Zh. tekhn. fiziki, 1956, 26, No 1, 126-140

Abstract: A linear theory is developed for electron waves in "smooth" or approximately "smooth" decelerating systems. On the basis of the rigorous theory of excitation of waveguides by specified currents (Referat Zhur - Fizika, 1955, 5366), and integral equation is obtained for the distribution function $\psi(x,y)$ of the electron current in the transverse cross section. The analysis is carried out under the assumption that the flow has one velocity, that the signals are small, and that the relationship between z and t is in the form of the function exp (-jwt + jhz). The wave numbers h, being the eigenvalues of this equation, represent stationary

Card 1/2

USSR/Radiophysics - Superhigh Frequencies, I-11

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 35427

Abstract: functionals of the distribution $\psi(x,y)$, and can therefore be determined by using a variational method. An equation is given for h, its solutions are given, and the regions of the values of the parameters corresponding to complex roots of h are determined.

Card 2/2

VAYNSHTEYN, L. A

USSR/Radiophysics - Superhigh Frequencies, I-11

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 35428

Author: Vaynshteyn, L. A.

Institution: None

Title: Electron Wave in Decelerating Systems. II. Specific Problems

Original Periodical: Zh. tekhn. fiziki, 1956, 26, No 1, 141-148

Abstract: On the basis of the general theory developed in the first part of the article (see abstract 35427) an investigation was made of the electron waves in the following decelerating systems: dielectric-filled waveguide; "serrated" waveguide; spiral waveguide. For a spiral waveguide the author considers separately the cases of solid cylindrical and hollow cylindrical electron beams. A comparative analysis is made of the various approaches to this problem described in the literature.

Card 1/1

VAYNSHTEYN, L.A.

COMB-LIKE STRUCTURE. L.A.Vainshtein.

VAYNSHTEYN, L. A.

VAYNSHTEYN, L. A., Cand Phys-Math Sci -- (diss) "~~Evaluation~~ Computation of wave functions and forces of ~~the~~ oscillators of complex atoms." Mos, 1957. 7 pp (Acad Sci USSR, Phys Inst im P. N. Lebedev), 125 copies (KL, 2-58, 110)

APPROVED FOR RELEASE: 08/31/2001 CIA-RDP86-00513R001859120008-7"

VAYNSHTEYN, Lev Al'bertovich; ALEKSANDROVA, A.A., redaktor; KORUZEV, N.N., tekhnicheskiy redaktor

[Electromagnetic waves] Elektromagnitnye volny. Moskva, Izd-vo "Sovetskoe radio," 1957. 580 p. (MIRA 10:9)
(Electric waves)

VAYNSHTEYN, L.A.

109-6-2/17

AUTHOR: VAYNSHTEYN, L.A.

TITLE: The Electron Waves in Slow-Wave Circuit Structures. On Non-Linear Equations for Travelling-Wave Tubes. (Elektronnyye volny v zamedlyayushchikh sistemakh. O nelineynykh uravneniyakh IBV, Russian)

PERIODICAL: Radiotekhnika i Elektronika, 1957, Vol 2, Nr 6, pp 686-695 (U.S.S.R.)

ABSTRACT: All results obtained by the author by his works (Zhurnal Tekhn.Fiz. 1956, Vol 26, pp 126 and 141) for a nonlinear operation are generalized and the basic equations of the nonlinear theory for travelling waves tubes are derived. It is shown that the much used method of successive approximations is of no effect in this case. The forces acting upon the electron bundle in the case of nonlinear operation are investigated and the corresponding formulae are set up. Next, nonlinear equations are derived in a dimensionless form. In conclusion several questions connected with the nonlinear theory of travelling wave tubes are dealt with. (With 1 Illustration and 1 Slavic Reference).

ASSOCIATION: Not given

PRESENTED BY:

SUBMITTED: 23.7.1956

AVAILABLE: Library of Congress

Card 1/1

VAYNSHTEYN, L.A

109-7-7/17

AUTHOR: Vaynshteyn, L.A.

TITLE: Non-linear Theory of the Travelling Wave Tube. Part I. Equations and the Conservation Laws. (Nelineynaya teoriya lampy begushchey volny. Ch.I. Uravneniya i zakony sokhraneniya)

PERIODICAL: Radiotekhnika i Elektronika, 1957, Vol.II, No.7, pp. 883 - 894 (USSR).

ABSTRACT: The contents of this article were read at the first International Congress on Electronic Devices for Ultra-high Frequencies, Paris, 1956. The equations of the non-linear theory of the travelling wave tube operating as an amplifier were formulated by the author in an earlier paper [Ref.1]. Here, these equations are modified in such a way as to take into account the mutual interaction between the electrons. Only the uni-direction motion of the electrons is considered, i.e. every electron moves along the positive direction of the axis z. The time of the appearance of an electron at the input to the tube is denoted as t_o. The current through the input cross-section of the tube is j_o and that through the cross-section at a distance z is j. The equations of the non-linear theory are expressed by:

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Non-linear Theory of the Travelling Wave Tube. Part I. Equations and the Conservation Laws.

$$\frac{dF_n}{d\zeta} - i\xi_n F_n = -\chi_n J_n, \quad (16)$$

$$-\frac{\partial^2 \vartheta}{\partial \zeta^2} = \mathrm{Re} \sum (F_n - i\sigma_n^2 J_n) e^{-in(t_o + \vartheta)} \quad (17)$$

$$J_n = \frac{1}{\pi} \int_0^{2\pi} e^{in(t_o + \vartheta)} dt_o \quad (18)$$

in which the functions $F_n(\zeta)$, $J_n(\zeta)$ and $\vartheta(\zeta, t_o)$ are the slowly-changing functions whose meaning can be understood from the author's previous article. Eq. (16) gives the relationship between the n-th harmonic of the convection current J_n in the beam and the n-th harmonic F_n of the wave in the line.

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109-7-7/17

Non-linear Theory of the Travelling Wave Tube. Part I. Equations and the Conservation Laws.

Eq. (17) describes the motion of an electron having the initial phase t_0 : here, the lefthand side is the acceleration and the righthand side is the force (in dimensionless units) acting on an electron. This force is composed of all the harmonics of the field. Finally, eq. (18) permits the calculation of the harmonic of the convection current in the beam, provided the function $\vartheta(\zeta, t_0)$ which describes the forced motion of the electrons is known. The equations can be referred to as the non-linear, integral - differential equations since they contain the integrals of t_0 and the derivatives of ζ (which is the length co-ordinate). The initial conditions to be fulfilled by these equations are:

$$\vartheta = \frac{\partial\vartheta}{\partial\zeta} = 0 \quad \text{and} \quad F_n = A_n \quad \text{at} \quad \zeta = 0.$$

Equations (16) to (18) can be used to determine the laws of conservation and conversion of energy. The laws are derived in two alternative forms; one is given in a fixed system of co-ordinates (eq.(26)), while the other is related to a system

Card3/5

Non-linear Theory of the Travelling Wave Tube. Part I. Equations and the Conservation Laws.

of co-ordinates which is moving at a uniform velocity equal to the initial velocity of the electrons (eq.(32)). A method of taking into account the Coulomb forces (interaction of the electrons) is indicated. For calculating the interaction, it is assumed that all the higher harmonics of the field in the line can be neglected, in which case, eq. (17) can be simplified and written as:

$$-\frac{\partial^2 u}{\partial \zeta^2} = \mathrm{Re}(Fe^{-iu}) + \int_0^{2\pi} \Delta(u_1 - u)dt_1 \qquad (54)$$

where:

$$\Delta(x) = \frac{1}{\pi}\sum_{n=1}^{\infty} \sigma_n^2 \sin nx \qquad (52)$$

and:

$$u_1 = t_1 + \vartheta(\zeta, t_1) \qquad (53)$$

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Non-linear Theory of the Travelling Wave Tube. Pat I. Equations and the Conservation Laws.

Two alternative expressions for $\Delta_2(x)$ are found (eqs. (60) and (72)) from which the coefficient σ^2 and the dispersion coefficient for the n-th harmonic Γ_n are found (eq.74)) where:

$$r = \frac{\omega b}{v_0 \sqrt{2}} \qquad (69)$$

where b is the radius of the electron beam and v_0 is the initial velocity of the electrons.

There are 27 references, of which 5 are Slavic, and 2 figures.

SUBMITTED: July 23, 1956.

AVAILABLE: Library of Congress

Card 5/5

VAYNSHTEYN, L.A.

109-8-8/17

AUTHOR: Vaynshteyn, L.A.

TITLE: Non-Linear Theory of the Travelling Wave Tube. (Part II): Numerical Results. (Nelineynaya teoriya lampy begushchey volny. (Ch.II.) Chislennyye rezul'taty.

PERIODICAL: Radiotekhnika i Elektronika, 1957, Vol.II, Nr 8, pp.1027-1047 (USSR)

ABSTRACT: (Note: The contents of this paper were read at the First International Congress on Ultra High Frequency Electronic Devices, Paris, 1956).
The theory of the travelling wave tube was given by the author in his previous work (1). The basic equations of the system are given by expressions 1, 2 and 3:

$$\frac{dF}{d\zeta} - i\xi F = -J, \tag{1}$$

$$J = \frac{1}{\pi}\int_0^{2\pi} e^{iu}\,dt_0 , \tag{2}$$

$$-\frac{\partial^2 u}{\partial\zeta^2} = \mathrm{Re}(F - i\sigma^2 J)e^{-iu}, \tag{3}$$

where equation 3 takes into account only the first harmonic

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109-8-8/17

Non-Linear Theory of the Travelling Wave Tube. (Part II) Numerical Results.

of the Coulomb forces. If it is necessary to have a more accurate description, then the equation of motion is in the form of equation 4:

$$-\frac{\partial^2 u}{\partial \zeta^2} = \mathrm{Re}(Fe^{-iu}) + \int_0^{2\pi} \Delta(u_1 - u)dt_1 \quad .$$

The basic equations can be integrated by assuming that the initial conditions are as given by equation 7 where A is the dimensionless amplitude of the electrical field at the input to the tube. For the integration, equation 2 can be written as a sum expressed by equation 8 so that the equation of motion is in the form of equation 10. The integration was carried out for N = 48 . The results of integration for N = 24 are shown in Fig.1 and for N = 48 are shown in Fig.2. In the above figures the parameter p (defined by equation 15) can be referred to as the dimensionless power of the electromagnetic field in decibels and

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109-8-3/17

Non-Linear Theory of the Travelling Wave Tube. (Part II) Numerical Results.

ζ is the dimensionless length coordinate of the tube. The figures show that an approximation based on N = 48 is quite sufficient. The calculated results for the amplification of small signals in the absence of losses and of Coulomb forces are shown in Figures 3 to 11 for various parameters ζ and A. The relationship between the maximum power and the relative velocity of the wave and the electron beam are shown in Fig.12. The case of a tube operating at finite input signals but in the absence of losses and Coulomb forces is illustrated by Figs.13 to 15. The numerical results relating to the amplification of small signals in the presence of losses in the line but in the absence of Coulomb forces are illustrated in Figs. 16 to 19. Response of a travelling wave tube to finite and large signals in the presence of losses is shown in Fig.20. Finally, the amplification of small signals in the presence of Coulomb forces can be illustrated by the curves of Fig.21. The relationship between the input and output powers in a travelling wave tube is represented by the curves of Figs.22 to 25. It is concluded on the basis of the above results and the available experimental data

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109-9-7/

Non-Linear Theory of the Travelling Wave Tube. (Part II) Numerical Results.

that the non linear theory is valid only qualitatively. It is interesting, however, that the theory gives the output powers much larger than those encountered in practice. This seems to indicate that the principle of the travelling wave tube has some as yet unexplored possibilities. A large part of the above numerical results was obtained by means of an electronic computer, type M-2, of the Power Institute of the Soviet Academy of Sciences.

There are 25 figures, and 6 references, 3 of which are Slavic.

SUBMITTED: July 23, 1956.

AVAILABLE: Library of Congress.

Card 4/4

VAYNSHTEYN, L.A. 109-11-1/8

AUTHOR: None given

TITLE: Years 1917 - 1957 (1917 - 1957 gg)

PERIODICAL: Radiotekhnika i Elektronika, 1957, Vol.II, No.11, pp. 1319-1343 + 2 plates (USSR)

ABSTRACT: The forty years of the Soviet Government in Russia have not only changed the social structure of the country but have also resulted in a great industrial and technological progress. Thus, by 1957, the industrial output increased by thirty times as compared with that of the pre-Revolutionary Russia, the number of universities increased to 800, the number of scientific establishments increased up to 3 000 and the number of scientific workers up to 240 000. Also, the radio and electronic science and industry has progressed greatly since the days of A.S.Popov, who conducted his first radio experiments in 1895. From the very beginning, the Soviet Government has paid attention to the future possibilities to be offered by radio communications and in 1918 a radio laboratory was established at Nizhegorod under M.A. Bonch-Bruyevich, whose main task was to develop powerful transmitting tubes. The laboratory fulfilled its task very satisfactorily and, in 1922, the Central Moscow Radio Station was fitted with a 12 kW transmitter operating at 3.2 km wave-length. The laboratory developed also a shortwave transmitter

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Years 1917 - 1957.

which, in 1925, gave a power of 15 kW at a wavelength of 100 m. A radio laboratory (primarily for the armed forces) was also established at Kazan' under the leadership of A.T. Uglov and A.V. Dikarev. A.L. Mints developed and constructed a number of powerful broadcasting stations: a 100 kW longwave transmitter in 1929, a 500 kW transmitter in 1933 and a medium-wave 1 200 kW transmitter in 1943. Apart from the engineering achievements, a considerable number of engineers and scientists have been engaged in experimental and theoretical research. In the field of radio-broadcasting reception, a number of original, theoretical works and practical designs have been carried out by Ye.G. Momot, V.A. Kotel'nikov, N.N. Krilov, V.I. Siforov and I.B. Slepyan. During 1927-28, the first battery receiver was produced in quantity, while the first mains-fed receiver was put in production in 1934. Since then, a number of new designs have been put into production, so that in 1956, the total output of radio-receivers was over three million, while in 1960 it is planned to produce ten million. Soviet scientists have also investigated the field of vacuum technology, cathode electronics and the theory of thermionic devices.

109-11-1/8

Years 1917 - 1957

The works of I.Ye.Tamm and S.I. Shubin, who proposed the theory of external photo effect, are of particular importance. The development and production of electronic tubes (both transmitting and receiving) were originated by M.A. Bonch-Bruyevich in 1916. In 1919, a tube fitted with an aluminium anode was already in production, while the first electron tube factory was established in Petrograd in 1922. M.A. Bonch-Bruyevich and his collaborators developed power rectifiers and water-cooled power tubes in 1919, while oscillator and transmitter tubes of up to 500 kW were developed during the years 1935 - 1956. Soviet scientists have also been successful in the development of magnetrons. The first multi-resonator magnetron for frequencies up to 12 kMc/s was developed by V.P. Ilyasov in 1939. Klystrons were developed in 1940, while travelling-wave tubes and backward-wave tubes were developed a few years later. Today, the annual production of electron tubes in the Soviet Union is one hundred million, while that of semi-conductor devices is twenty million.
The first experimental television transmissions were commenced in the Soviet Union in 1931; these were based on the mechanical Nipkow-type scanning. The first Soviet iconoscope was developed by A.V. Moskvin in 1933 and its first production samples

Card3/7

Years 1917 - 1957.

appeared in 1937. The electronic television system was first tried in 1938 both in Moscow and Leningrad, but the real development of the Soviet television dates from the end of World War II. Since then, 75 television transmission centres have been established and a mass production of television receivers has been commenced. Thus, in 1956, the Soviet industry produced half-a-million television receivers. Soviet scientists have been working also in the field of antennae and antenna feeders. In 1927, I.G. Klyatskin proposed the so-called induced-current method for the investigation of the radiation-resistance of a single conductor; the method was generalised by A.A.Pistol'kors. In 1935, M.S. Neyman introduced the reciprocity principle to the solution of the antenna problems and later investigated the radiation properties of slot antennae. L.A. Vaynshteyn calculated the radiation of an open-ended waveguide, while A.S. Pistol'kors investigated the properties of coupled transmission lines. The radio propagation studies were first commenced by M.V. Shuleykin in 1923, who modified and corrected the Sommerfeld equations. A school, led by L.I. Mandl'shtam and N.D. Papaleksi, determined the velocity of propagation and the structure of radio waves in the vicinity of the Earth's surface (years 1933 to 1941).

109-11-1/8

Years 1917 - 1957

Soviet scientists have also made original contributions to the theory of ionospheric propagation, shortwave propagation, wave-guide tropospheric propagation, radio wave diffraction and ultra-shortwave propagation. The problem of combating the noise in radio communications has been studied intensively and, in 1933, V.A. Kotel'nikov published a work entitled "The Transmission Capacity of Ether and a Conductor in Electrical Communications". The same author has also made valuable contributions to the statistical communication theory and the information theory. V.I. Siforov has been investigating similar phenomena since 1929 and has published a number of works dealing with: cross-modulation, theory of amplitude phase and time discrimination, theory of fading, coding, pulse transmission and theory of noisy active quadrupoles. The contribution of the Soviet scientists to the theory of non-linear oscillations is well known. In particular, the contributions of A.A. Andronov and A.A. Vitt, also of S.Ye.Khaykin and N.M. Krylov have been regarded as standards and translated into various languages. Radio-engineering and electronics have entered and, in fact, created various scientific fields such as radio navigation, radar, radio-spectroscopy, geodesy, physics and meteorology. The first

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109-11-1/8

Years 1917 - 1957.

Soviet range-finders were developed in 1930 and, since then, such complex equipment as radio-telescopes, molecular standard clocks and finally a ten thousand million eV synchro-phasotron have been developed.
The first radio-engineering courses were established in the Soviet Union in 1920, while, in 1930, special radio-engineering faculties were created at several Soviet universities. In 1955, the training system was reorganised and the following specialisations were established: electro-vacuum technology (radio and industrial electronics), radio-engineering (communications, radar, navigation and television), radio-physics (electronics, theory of oscillations, electron optics and the physics of ultra-high-frequency), and electrical instrumentation technology (automation, telemechanics, measurements techniques, navigational equipment). Soviet scientists and pedagogues have published a number of textbooks suitable for engineering students and for research workers. Since 1924, a technical journal "Radio" has been published without interruption and by now its circulation has reached 200 000 copies. At this stage, three scientific-technical journals are being published regularly: "Radiotekhnika", "Elektrosvyaz" and "Radiotekhnika i Elektronika".

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VAYNSHTEYN, L.A.

51-4-3/26

AUTHOR: Vaynshteyn, L. A.

TITLE: Calculation of Atomic Wave-functions and Oscillator Strengths using an Electronic Computer. (Vychisleniye atomnykh volnovykh funktsiy i sil ostsillyatorov na elektronnoy schetnoy mashine.)

PERIODICAL: Optika i Spektroskopiya, 1957, Vol.III, Nr.4, pp. 313-321. (USSR)

ABSTRACT: The author discusses certain problems of application of the semi-empirical method (Refs.2-4) of calculation of radial wave-functions for an optical electron of an atom. A simplified variant of this method was described by Bates and Damgaard (Ref.3). The present paper deals with some problems in application of another variant of the same empirical method, and gives results of calculation of wave-functions and oscillator strengths made using an electronic computer. The energy parameter in the self-consistent Fock equations (Eq.2 on p.314) was found from the experimental value of the ionization energy of the energy level studied. An approximate relationship between the parameter α^2 and the ionization

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51-4-3/26

Calculation of Atomic Wave-functions and Oscillator Strengths using an Electronic Computer.

energy ϵ is given by Eq.4 on p.314, where Δ_p is the polarization energy. Field of the atomic residue was calculated using linearly deformed wave-functions and taking into account the effect of polarization of the optical electron on the charge distribution of atomic residue. The calculations were carried out using 2 electronic computers: БЭСМ (memory of more than 5000 units, speed of 8000 operations per second) and M-2 (1024 memory units and 2000 operations per second). The majority of calculations were carried out on M-2. The author discusses behaviour of the solutions obtained from the electronic computers at large values of distance r. To test the reliability of calculations using the semi-empirical method, solutions of the wave equation for hydrogen and sodium were obtained. It was found that the computed values of the radial integrals for transitions 1s-np (n = 3-6) differed from exact values by only 0.3-0.8%. Similar results were obtained for sodium.

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Calculation of Atomic Wave-functions and Oscillator Strengths using an Electronic Computer.

Calculations of the wave-functions and oscillator strengths were made for the following elements: sodium, potassium, caesium, helium, magnesium, calcium, cadmium, mercury and oxygen. Comparison of the calculated wave-functions with the self-consistent field functions is rather difficult because of differences in the energy parameters. Figs.2 and 3 show radial functions of the optical electron of ground states of oxygen and calcium. Continuous curves are the values computed by the method described in the present paper, and dashed curves represent the values obtained by Fock's self-consistent field method (Refs.7-8). These two figures show good agreement which is further improved by using identical energy parameters. Tables 1 and 2 give the values of the oscillator strengths for various elements. In both tables Col.1 gives the element, Col.2 - the transition, Col.3 - the results obtained by the present author, Col.4 - the results of Bates and Damgaard (Ref.3), Col.5 - the experimental values of oscillator strengths. The following conclusions are made

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Calculation of Atomic Wave-functions and Oscillator Strengths using an Electronic Computer.

on the basis of the results in Tables 1 and 2:
(A) For the resonance transition in alkali metals the oscillator strength increases from 0.98 (Na) to 1.17 (Cs). The experimental values show a similar trend. Kvater's measurements (Ref.14) yield oscillator strengths higher than the theoretical values. An attempt to explain Kvater's results is made in Ref.25. (B) For the resonance transitions in divalent elements the oscillator strengths are 2.2-2.4 compared with the experimental values of 1.2-1.6. (C) For the main series in alkali metals good agreement with experiment was obtained only for sodium. For caesium and potassium the calculated values are about 1.5-2 times higher than the experimental values.
(D) For certain spectral series of Mg, Ca and Cd the calculated relative values of the oscillator strengths differ by 10-25% from the experimental ones, while the absolute oscillator strengths (for Ca and Cd) are greater than the experimental values by a factor of 3-5. The

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calculated lifetime of the 7^3S state of mercury agrees with experiment. (E) For oxygen the agreement with experiment varies greatly from line to line. The results of Tables 1 and 2 show that the differences between the oscillator strengths calculated by Bates and Damgaard (Ref.3) and those calculated in the present paper do not exceed 10%, except when the oscillator strength is less than 0.005. In many cases (e.g. Cs) the difference between the results of Ref.3 and the present results is considerably smaller than the departure from the experimental values. This indicates that such departures are due to the single-configuration approximation used rather than due to inaccuracy of the calculated values. For the resonance transitions in divalent metals departures from experimental values may be mitigated by taking into account configurational interaction (Ref.8). The author thanks K. S. Vul'fson, S. L. Mandel'shtam and B. M. Yavorskiy for their interest and criticisms. There are 3 figures, 2 tables and 26 references, 4 of which are Slavic.

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51-4-3/26

Calculation of Atomic Wave-functions and Oscillator Strengths using an Electronic Computer.

ASSOCIATION: Physical Institute imeni P. N. Lebedev, Academy of Sciences of USSR. (Fizicheskiy institut im. P. N. Lebedeva AN SSSR.)

SUBMITTED: January 31, 1957.

AVAILABLE: Library of Congress.

Card 6/6

VAYNSHTEYN, L.A., kandidat fiziko-matematicheskikh nauk; SOKOLOV, N.D., doktor fiziko-matematicheskikh nauk.

Theoretical spectroscopy and quantum mechanics of molecules. (Conference in Moscow). Vest. AN SSSR 27 no.6:101-104 Je '57. (MIRA 10:7)

(Quantum theory--Congresses) (Spectrum, Molecular)

Vaynshteyn, L.A.

57-9-26/40

AUTHOR: Vaynshteyn, L.A.

TITLE: A Method of Approximate Separation of Variables and Its Application to Border Problems of Electro-Dynamics and Accoustics (Metod priblizhennogo razdeleniya peremennykh i yego primeneniye k granichnym zadacham elektrodinamiki i akustiki)

PERIODICAL: Zhurnal Tekhn. Fiz., 1957, Vol. 27, Nr 9, pp. 2109 - 2128 (USSR)

ABSTRACT: An approximated method for the solution of twodimensional border problems of electrodynamics and accoustics is dealt with. The method is based upon the approximate separation of variables in the wave equation found in conformal curved coordinates. The method is analogous to the approximated method by Khartri (Hartree) - V.Fook (Zs. f. Phys., 61, 126, 1930) in quantum mechanics. In the second chapter the basic equations for the method of approximated separation of variables by means of averaging are derived. The method is applied to a flat wave guide which develops into a funnel. For this purpose the conformal transformations derived in the second chapter are used. It is shown that good results are obtained for the reflection coefficient, viz. for its absolute quantity. The phase of the reflection coefficient is less accurate. The radiation characteristic for

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A Method of Approximate Separation of Variables and Its Application to Border Problems of Electro-Dynamics and Accoustics

the open end is not fully represented by means of this method. The method is then used for surface waves propagated along a well conductive wave-shaped surface of cycloidal or trochoidal shape. There are 10 figures and 8 Slavic references.

SUBMITTED: November 11, 1956

AVAILABLE: Library of Congress

Card 2/2

VAYNSHTEYN, L.A.

57-10-20/33

AUTHOR: Vaynshteyn, L. A.

TITLE: Electronic Waves in Periodical Structures (Elektronnyye volny v periodicheskikh strukturakh).

PERIODICAL: Zhurnal Tekhn. Fiz., 1957, Vol. 27, Nr 10, pp. 2340-2352 (USSR)

ABSTRACT: At first the excitation of the periodical structure is investigated here according to given sources as well as the system of integral equations for functions of the spatial current harmonic vibration distribution and the variation method in order to analyse by means of the theory of the excitation of the periodical wave guidew and the variation method the electronic waves in periodical structures. The relations for "smooth" retarding systems obtained in former papers of the author (Zhurnal Tekhn.Fiz., 1956, Vol. 26, 126 and Zhurnal Tekhn.Fiz., 1953, Vol. 23,654) are generalized for periodical systems. In special the characteristic equation is derived by means of which the linear properties of tubes with traveling- and returning wave can be computed. There are 5 Slavic references.

SUBMITTED: March 8, 1957

AVAILABLE: Library of Congress.

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APPROVED FOR RELEASE: 08/31/2001 CIA-RDP86-00513R001859120008-7"

Vaynshteyn, L. A.

57-11-22/33

AUTHOR: Vaynshteyn, L.A.

TITLE: Group Velocity of Damping Waves. (Gruppovaya skorost' zatukhayushchikh voln)

PERIODICAL: Zhurnal Tekhn.Fiz., 1957, Vol 27, Nr 11, pp. 2606-2614 (USSR)

ABSTRACT: If the complex wave number K is known as a function of the frequency, it is possible to put down an equation for the field in the form of an Fourier integral. But the propagation velocity of the quasimonochromatic signals in a non-absorbing medium does not depend on the form of the signal and can be found without an actual computation of the Fourier integrals. Here the propagation velocity of the quasimonochromatic waves is defined for an absorbing medium and it is shown that it depends very slightly on the form of the signal and in a series of important cases it can be determined by the aid of a simple "energy" formula $v = \bar{S}_z/\bar{w}$, where $\bar{w}$ denotes the density of energy and $\bar{S}_z$ the density of the energy current in the corresponding monochromatic wave. Essentially here the group velocity of flat electromagnetic waves is investigated. The results, however, can be applied for any (damped) waves that fade away on the occasion of their propagation. The group velocity is defined as the velocity of the "energy centre" of the quasimonochromatic signal. This definition can also be applied for absorbing media in which the signals are deformed during their propagation. According to this definition the group velocity- as quoted above-

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Group Velocity of Damping Waves.

$v = \bar{S}_z/\bar{w}$. $\bar{S}_z$ is the component of the Umov-Poynting's vector along the propagation direction of the flat wave. Here the electromagnetic energy and the group velocity in a medium of the simplest properties of material (where the fields satisfy the telegraph equations), in a plasma and in dielectrics with elastically bound electrons are computed. There 4 figures and 2 Slavic references.

SUBMITTED: March 8, 1957

AVAILABLE: Library of Congress.

Card 2/2

VAYNSHTEYN L.A.

109-1-9/18

AUTHORS: Vaynshteyn, L.A. and Filimonov, G.F.

TITLE: Nonlinear Theory of the Travelling-Wave Tube. Part III: Influence of the Space-Charge Forces. (Nelineynaya teoriya lampy begushchey volny. Ch.III: Vliyaniye sil rastalkivaniya)

PERIODICAL: Radiotekhnika i Elektronika, 1958, Vol.III, Nr 1, pp.80-84 (USSR)

ABSTRACT: The nonlinear equations (see Ref.1) of the travelling-wave tube contain the following normalised coefficients: a complex parameter $\xi = \xi' + i\xi''$, whose real part represents the relative velocity of the electron beam in the steady state, while the imaginary part represents the attenuation of the wave; a parameter σ which determines the relative magnitude of the space charge forces and is proportional to the volume charge density in the beam; and r, which is the effective radius of the electron beam. The operation of the tube for $\sigma = 0$ was considered in an earlier paper (Ref.2). In the present work the influence of σ is taken into account and the investigation is based

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Nonlinear Theory of the Travelling-Wave Tube. Part III: Influence of the Space-Charge Forces

on a numerical solution of the basic equations given in the previous work (Ref.2). The solutions are found for ξ' contained in the limits $\xi_0 \leqslant \xi' \leqslant \xi_m$, where ξ_0 corresponds to the maximum and ξ_m to the minimum gains of the tube as evaluated from the linear theory for a given σ. The region in which $\xi' < \xi_0$ is not considered since it is of no interest in view of the fact that the power P_{max} in this region is very low. The values of σ range from 0 to 2, which coresponds to the normal experimental conditions. The calculated results are shown in Figs.1 and 2. The curves of Fig.1 represent P_{max} as a function of ξ' for three different values of σ, while Fig.2 represents P_{max} as a function of σ for $\xi' = \xi_0$ and for $\xi' = \xi_m$. Further results are illustrated in Figs.3, 4 and 5 in which the relative power of the field is plotted as a function of the length coordinate, ζ. These curves are plotted for various values of ξ'', σ and A (A denotes the

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Nonlinear Theory of the Travelling-Wave Tube. Part III: Influence of the Space-Charge Forces

amplitude of the input signal). The effect of the finite cross-section of the electron beam is illustrated in Figs.6 and 7. Two curves of p_{max} against $1/r$ are plotted in Fig.6 while Fig.7 shows p_{max} versus σ for r ranging from 0.1 to ∞. The authors thank P.S. Mikazan, O.A. Merkulova and V.M. Khapayeva, who prepared the programme for the computer used in the numerical solution of the equations. There are 8 figures and 7 references, 2 of which are Russian, 4 English and 1 French.

SUBMITTED: November 29, 1956

AVAILABLE: Library of Congress

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SOV/109-3-12-1/13

AUTHORS: Fok, V.A., ~~Vaynshteyn, L.A.~~ and Belkina, M.G.

TITLE: Duct Propagation of Radio Waves in the Lowest Layer of Troposphere (Rasprostraneniye radiovoln po prizemnomu troposfernomu volnovodu)

PERIODICAL: Radiotekhnika i Elektronika, 1958, Vol 3, Nr 12, pp 1411 - 1429 (USSR)

ABSTRACT: The work is devoted to the theory of propagation of radio waves in the tropospheric waveguide (inversion layer), which is elaborated on the assumption that the points of transmission and reception are both inside the waveguide. This type of propagation can be referred to as the inside-layer propagation. The basic formulae of the work are taken from a number of the authors' previous works (Refs 1-3). It is assumed that the attenuation coefficient for the case when the refraction index of the atmosphere is an arbitrary function of height can be expressed by:

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$$V(x, y, y', q) = \sqrt{\frac{x}{\pi}} e^{-i\frac{\pi}{4}} \int_C e^{ixt} F(t, y, y', q) dt \quad (1)$$

where the contour C extends over all the poles of the integrated function in the positive direction. If the parameter $q = \infty$, which corresponds to an arbitrary polarisation at cm and short waves and to horizontal polarisation at longer waves, the integrated function F can be written as shown in Eq (2), where y and y' are normalised heights of the point of transmission and the point of reception, as defined by Eqs (3). The parameter x is the normalised distance between the two points, as expressed by Eq (4), where the parameter m is given by Eq (5) in which a is the radius of the Earth. The functions f_1 and f_2 are the independent solutions of the differential equation which is expressed by Formula (6). The function p(y) in Formula (6) depends on the refractive index M(h) in the manner shown in Eq (7), where n is the refractive index for the air. The sub-integral function F, for the case of the inside-waveguide propagation, can be expressed by Eq (20), where Λ is defined by Eq (21). Various auxiliary functions in Eqs (20) and (21) are defined by Eqs (12) - (19). The attenuation coefficient V can be represented as a series:

$$V(x, y, y') = 2\sqrt{\pi x}\, e^{i\frac{\pi}{4}} \sum_{m=1}^{\infty} R_m e^{ixt_m} \qquad (22),$$

where R_m is the residue of the function F at the m-th pole t_m. The expression for R_m is therefore in the form of Eq (24). Most of the numerical results presented in this work are based on the use of Eqs (22), (23) and (24). The accuracy of these equations is borne out by the fact that the attenuation coefficient evaluated by using them is only slightly different from that determined by using accurate formulae; the results are indicated in Figures 1. The heavy curves of Figures 1 were found from the accurate

Duct Propagation of Radio Waves in the Lowest Layer of the Troposphere

formulae (Eqs (25) and (26)) while the fine curves correspond to the results obtained from Eqs (23) and (24). The functions f_1 and f_2 of Eq (2), which are referred to as the height factors, can be evaluated by using the Airy functions. Thus, it is shown that f_1 and f_2 are in the form of Eqs (31), where ψ_1 and ψ_2 are given by Eqs (32); ζ_1 is found from Eqs (33), for which y_1 is the smaller root of Eq (34); v and u in Eqs (32) are the Airy functions. From Eqs (31), it follows that R_1 can be expressed by Eq (36). If R_1 is evaluated approximately by employing Eq (24) and more accurately by employing Eq (36), it is found that Eq (24) gives erroneous results. This is shown in Table 2, where R_1 is evaluated for two values of Y and two values of y_1. In this case, it is therefore necessary to employ Eqs (31), (32) and (33). The attenuation coefficient V is dependent on x, y and y' and on the function $p(y)$ which is dependent on the parameters y_i and y_l. The function p(y) is characterised by three parameters which are expressed by Eqs (38), (39) and (40). These parameters are shown in Tables 3a and 3b for two groups of propagation conditions (see p 1418). The curves of $p(y) - p(y_i)$ for all the cases of Tables 3 are shown in Figures 2. The attenuation functions for these cases are shown in Figures 3 and 4. The curves of Figures 2, 3 and 4 can be used to investigate the conditions of actual propagation routes. The conditions represented by the first row of Table 3a and the first row of Table 3b were chosen for special investigation. The results are shown in Figures 10, 11 and 12; Curves 1 in these figures correspond to the wavelength of 3.33 cm, Curves 2 are for the wavelength of 10 cm, Curves 3 are for 30 cm, Curves 4 of Figure 10 are for the 90 cm wavelength. In an earlier work (Ref 3), it was shown that Eq (23) can be written as Eq (45), where m is the number of a given root and S_1 is in the form of the integral given by Eq (46). Eq (45) can also be written in the form of Eq (52) where G is expressed by Eq (53) and z_1 is the root of

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Eq (54). From Eq (52) and Eq (55), it follows that the critical wavelength for the tropospheric waveguide is in the form of Eq (58). The term "critical wavelength" does not imply a discontinuity in the attenuation coefficient of the system; it is therefore a purely arbitrary term. It is of interest to find what factors, apart from M(0) and $M(h_i)$, determine the magnitude of the critical wavelength. It is found that $M''(h_i)$ is also one of the principal parameters which determines the value of the attenuation coefficient. This is borne out by the fact that the factor $\varkappa_m$, which is defined by Eq (67), can be expressed in the form of Eq (70). By employing parameters h, $M(0)-M(h_i)$ and $M''(h_i)$, it is found that the attenuation coefficients for simple waves are approximately equal for widely differing types of propagating conditions, i.e. M-profiles. This means that it is necessary to take into account also some additional parameters but this problem has not yet been solved. One of the most important results of

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the analysis is the fact that long-distance tropospheric propagation of the waveguide type is only slightly dependent on the wavelength. Thus, even if the propagated wavelength is longer by an order than the critical wave, a long-distance propagation is still possible. The calculations for this work were carried out by the mathematical group, consisting of O.A. Merkulova, V.M. Khapayeva, A.M. Soboleva, L.Ye. Molodtsova, Z.G. Repina and A.G. Mayorova. There are 17 figures, 4 tables and 7 references, 3 of which are English and 4 Soviet.

SUBMITTED: June 1, 1957

VAYNSHTEYN, L.A.

Calculation of wave functions and forces of oscillators on the electronic calculating machines. Fiz.sbor. no.4:89-92 '58. (MIRA 12:5)

1. Moskovskiy gorodskoy pedagogicheskiy institut imeni V.P. Potemkina.
(Wave mechanics) (Electrons) (Electronic calculating-machines)

SOV/48-22-6-8/28

AUTHOR: Vaynshteyn, L. A.

TITLE: Computation of the Monoelectron Wave Function and the Oscillator Strengths on an Electronic Computer (Vychisleniye odnoelektronnykh volnovykh funktsiy i sil ostsillyatorov na elektronnoy schetnoy mashine)

PERIODICAL: Izvestiya Akademii nauk SSSR, Seriya fizicheskaya, 1958, Vol. 22, Nr 6, pp. 671- 672 (USSR)

ABSTRACT: Computation of the monoelectron function was carried out by programing and solution by means of the electronic computer "Strela"; the solution of the following equation was aimed at:

$$\frac{d^2\phi}{dx^2} + \left[\frac{2\xi(x)}{x}\omega - \frac{\ell(\ell+1)}{x^2} - \alpha^2\omega^2\right]\phi = -\frac{\omega}{x}G(\phi/x)$$

$f(r) = \phi(r\omega)$ - the radial function of the optical electron to be sought

Card 1/3 $\xi(r)$ - effective charge of the residual atom

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$x = r/\omega$; $\alpha^2 = E_{exper.}$

ω - deformation parameter

G - exchange operator which is a functional of ϕ ,

In the presence of equal synergetic parameters the wave function obtained agrees well with the Hartree-Fock (Khartri-Fok) function within range of the principal maximum and in the case of large radii.
Nevertheless, computation of oscillator forces shows no agreement with experimental data for resonance transitions in In and Tl in spite of the introduction of the exchange. Therefore, there is nothing left but to venture beyond the scope of monoelectron approximation. There are 1 figure and 6 references, 4 of which are Soviet.

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

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SOV/48-22-6-8/28

Computation of the Monoelectron Wave Function and the Oscillator Strengths on an Electronic Computer

1. Mathematical computers--Performance 2. Electrons--Properties 3. Perturbation theory

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SOV/48-22-6-20/28

AUTHORS: Vaynshteyn, L. A., Koloshnikov, V. G., ~~Mazing, M. A.,~~ Mandel'shtam, S. L., Sobel'man, I. I.

TITLE: On the Broadening and Displacement of Spectral Lines in a Highly Ionized Plasma (Ob ushirenii i sdvige spektral'nykh liniy v vysokoionizovannoy plazme)

PERIODICAL: Izvestiya Akademii nauk SSSR, Seriya fizicheskaya, 1958, Vol. 22, Nr 6, pp. 718-719 (USSR)

ABSTRACT: The investigation of the breadth and shape of spectral lines does not characterize the excitation of atoms with sufficient accuracy, and therefore an investigation of the breadth and the displacement of the lines is more advantageous for determining the causes of these phenomena. The principal cause of the broadening and displacement of spectral lines in a highly ionized plasma is its interaction with charged particles. For lines with quadratic Stark effect the impact theory of broadening results in the following expressions for the breadth of lines and their displacement:

$$\gamma = 11,4C_4^{2/3} v^{1/3} N, \quad \Delta = 9,8C_4^{2/3} v^{1/3} N,$$

where C_4 denotes the constant of the quadratic Stark effect,

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v - velocity, $\mathcal{N}$ - the density of the excited particles. Herefrom it follows that the ratio between the breadth and the displacement of C_4. v and $\mathcal{N}$ is independent and equal to: $\gamma/\Delta = 1.16$. In the case of interaction of a different kind, as e.g. according to the equation by Van der Vaal $\gamma/\Delta = 2.8$. The task to be carried out by the present paper was to find a correct explanation of the interaction between radiating atoms and charged particles, i.e. the applicability of the aforementioned γ- formula with respect to the lines with quadratic Stark effect. As objects the lines Ar II, which are excited in the channel of the spark discharge, were selected. Measurements of breadths and displacements of lines were carried out photographically. Results are given by a table. By checking these results it was found that those obtained by experiment contradicted theoretical results completely. This is explained by the fact that the initial expression for the displacement of the frequency of the atom oscillator $\Delta\omega = C_4/R^4$, where R denotes the distance to the exciting electron, is not applicable in this case because the electrons playing the principal part in

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On the Broadening and Displacement of Spectral Lines in a Highly Ionized Plasma

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the broadening of the lines form a Weisskopf radius that is too small. The field formed by the electrons turns out to be so strong on this occasion that the Stark effect ceases to be quadratic and goes over to linearity. There is no reason to believe that the field changes slowly and is quasistatic as is alleged by a well-known theory. The problem is still being discussed. There are 1 table and 3 references, 2 of which are Soviet.

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

1. Spectroscopy 2. Electron gas--Spectra 3. Perturbation theory

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24(7)

AUTHORS: Vaynshteyn, L. A., Dolgov, G. G. SOV/48-22-11-1/33

TITLE: Measurement and Calculation of the Polarization of Luminescence With Excitation of the Helium Atoms by Means of an Electron Impact (Izmereniye i raschet polyarizatsii svecheniya pri vozbuzhdenii atomov geliya elektronnym udarom)

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1958, Vol 22, Nr 11, pp 1294 - 1296 (USSR)

ABSTRACT: Experimental and theoretical investigations of the polarization of luminescence caused by impact are of considerable importance for the theory of electronic impacts. After publication of the paper (Ref 1) no more experimental or theoretical investigations have been carried out with respect to this important problem. This phenomenon was studied by the authors both experimentally and theoretically in connection with the excitation of helium atoms. A block scheme of the device used for investigating polarization is shown by figure 1. Control tests showed that the

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Measurement and Calculation of the Polarization of Luminescence With Excitation of the Helium Atoms by Means of an Electron Impact SOV/48-22-11-1/33

polarization of luminescence is independent of the voltage of the magnetic field within a range of from 0 to 1000 Gs. Measurements were carried out at a field voltage of 100 Gs. Figure 2 represents polarization as a speed function of inciding electrons for 3 helium lines. Polarization curves show a non-monotonous dependence on the energy of the impinging electrons. In the course of the theoretical investigation of results the excitation of $1^1S - n^1P$ atom transitions was taken into account. The polarization curve determined in this case in first Born's approximation is also shown in figure 2. It is easy to show that in Born's first approximation

$\sigma \sim k_0^{2l_0} \cdot k_1^{2l_1}$. The indices 0 and 1 correspond to the initial and final state. Herefrom it follows that near the threshold $\sigma_{s-p} \ll \sigma_{p-s}$ and $\Pi(v_{thresh.})$ are equal to 1.

Card 2/4 By taking the distortion of an inciding and a diffuse wave

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by the average atomic field into account the relations between s-p and p-s scattering near the threshold are hardly modified at all (Ref 3). This depends on the small range of action of the exponentially damped atomic field. In order to obtain a more correct course of polarization near the threshold it is apparently necessary to take remote-effect terms in the equations for inciding and diffuse Schrödinger (Shredinger) waves into account. The system of equations (5) was calculated with the electronic computer "Strela". At present only preliminary results have been obtained. For the $1^1S - 3^1P$ transition of the helium atom $\sigma_{s-p} > \sigma_{p-s}$ was obtained (with $k_1 = 0,2$). There are 2 figures and 3 references, 2 of which are Soviet.

ASSOCIATION: Fizicheskiy institut imeni P.N.Lebedeva Akademii nauk SSSR (Physics Institute imeni P.N.Lebedev, AS USSR)

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24(3) SOV/57-28-10-38/40

AUTHOR: Vaynshteyn, L. A.

TITLE: On the Critical Remarks by G. L. Suchkin (Po povodu kriticheskikh zamechaniy G. L. Suchkina)

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1958, Vol 28, Nr 10, pp 2349-2352 (USSR)

ABSTRACT: This paper refers to the properties of monochromatic electromagnetic waves propagating in periodic wave guides of infinite length. This is a comment on the letter (Ref 2) by G. L. Suchkin, in which he doubts the correctness of the formulae (1) and (3) and also that of formula (2), which is established beyond any doubt. Suchkin also thinks that it is not permissible to express the periodic structures with the help of formulae (4), giving an incomprehensible substantiation of this assertion. This comment gives a repeated validation of the correctness of formulae (1) and (2), using a practical example as a vehicle of reasoning. The suggestion advanced by Suchkin to ascribe a specific wave number h_s to each component of the electric and the magnetic field is incompatible with Maxwell's equations and without sense from a physical viewpoint. There is

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On the Critical Remarks by G. L. Suchkin SOV/57-28-10-38/40

1 reference, 1 of which is Soviet.

SUBMITTED: June 12, 1958

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SOV/109-4-7-1/25

AUTHOR: Vaynshteyn, L.A.

TITLE: Radar Detection of a "Flickering Object" in the Presence of Correlated Noise. Part II. Non-coherent Signal Packets

PERIODICAL: Radiotekhnika i elektronika, 1959, Vol 4, Nr 7, pp 1071 - 1078 (USSR)

ABSTRACT: In the first part of this work (see this journal, 1959, Nr 5), the author investigated an optimum radar receiver which was used to detect a "flickering object" by processing a packet of coherent signals in the presence of correlated noise. Here, a similar problem is investigated, except that the signal packet is non-coherent. A packet of L non-coherent signals, which appear at the receiver after being reflected from a flickering object, can be represented in the form:

$$m_{\varkappa}(t) = G_{\varkappa} e_{\varkappa}(t) \cos \left[\omega_0 t - \psi_{\varkappa}(t) - \vartheta_{\varkappa}\right] \quad (\varkappa = 1, \ldots, L) \qquad (2),$$

where the phases of the high-frequency signals $\vartheta_1, \ldots, \vartheta_L$ are independent, since the radiated signals have unknown random phases. The amplitudes $G_{\varkappa}$ are statistically

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correlated with each other. If the quantity $G_\varkappa$ is normalised in accordance with:

$$\overline{G_\varkappa^2} = 2 \quad (3),$$

the uni-dimensional amplitude probability distribution function is given by Eq (4), while the two-dimensional distribution is represented by Eq (5). For fixed values of $G_\varkappa$ and $\vartheta_\varkappa$, the probability coefficient (the author - Ref 1) is given by:

$$\Lambda(G_1, \ldots, G_L; \vartheta_1, \ldots, \vartheta_L) = e^{\varphi - \frac{\mu}{2}} \quad (6)$$

where φ and μ are expressed by Eq (7); μ represents the signal-to-noise ratio over one repetition period. The probability coefficient Λ can also be expressed by Eq (9), where $z_\varkappa$ is given by Eq (10). For $L = 1$, Λ is given by Eq (11), while for $L = 2$, Λ is expressed

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by Eq (12). For $L \geqslant 3$, it is difficult to obtain explicit expressions for Λ. For special cases, when the fluctuations of the signal are uncorrelated (rapid flickering) or fully correlated (slow flickering), the probability coefficient can be expressed by Eqs (16) and (17), respectively. An optimum receiver should form the probability coefficient Λ; the determination of the presence or absence of the object can be determined on the basis of Λ. If the receiver is intended to detect a rapidly flickering object, it should form a quantity:

$$S = \sum_{\kappa=1}^{L} z_{\kappa}^2 = \sum (x_{\kappa}^2 + y_{\kappa}^2) \qquad (20)$$

i.e. produce an optimum intra-periodic processing of the input signal and carry out a storage process after the detection. Eq (20) can also be used to evaluate Λ for the case of slow flickering. The distribution of the quantity S is given by Eq (23) (Ref 1), while the

Radar Detection of a "Flickering Object" in the Presence of Correlated Noise. Part II. Non-coherent Signal Packets

probability of a false alarm is defined by Eq (24). For the case of rapid flickering, Eq (23) is applicable, while the probability of a correct detection is given by Eq (25), where S_* denotes the threshold. For the case of slow flickering, the distribution function for S is expressed by Eqs (27) or (28). The probability of a correct detection for this case is given by Eqs (29) or (30). For a packet consisting of two signals (L = 2), it is possible to evaluate the probability of a correct detection D for any correlation of the flickering signals. The probability for S is now given by Eq (35) or Eq (36). The probability D is expressed by Eq (37). The above formulae were employed to construct two sets of graphs; these are shown in Figures 1 and 2. Figure 1 represents the detection characteristics for a rapidly flickering object. The axis of abscissae represents the number of signals in a packet, while the axis of ordinates shows the parameter ρ (signal-to-noise ratio for each repetition period) and parameter μ (signal-to-noise ratio

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for L repetition periods). The 'solid' curves of Figure 1 were evaluated from Eqs (24) and (25), while the 'dashed' curves were calculated by means of the approximate formulae (Eg 41). Figure 2 shows the detection characteristics for a slowly flickering object; the accurate curves (solid lines) were calculated on the basis of Eq (30), while the dashed lines were determined by means of Eq (43) (in approximate formula). There are 2 figures and 8 references, of which 2 are English, and 6 Soviet; 2 of the Soviet references are translated from English.

SUBMITTED: June 9, 1958

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24(7), 24(3) SOV/51-6-4-5/29

AUTHORS: Vaynshteyn, L.A. and Sobel'man, I.I.

TITLE: A Non-Stationary Theory of the Stark Broadening of Spectral Lines in Plasma (Nestatsionarnaya teoriya shtarkovskogo ushireniya spektral'nykh liniy v plazme)

PERIODICAL: Optika i Spektroskopiya, 1959, Vol 6, Nr 4, pp 440-446 (USSR)

ABSTRACT: Collisions of atoms with charged particles (electrons and ions) play an important role in broadening of atomic spectral lines in plasma. Theory of the effect is at the moment in an unsatisfactory state. The main deficiency of the theory lies in its use of the adiabatic approximation. The present paper describes a non-stationary quasi-classical theory which is free from the deficiencies of the adiabatic approximation. It is found that even a comparatively simple quasi-classical model gives the main characteristics of the mechanism of broadening due to fast charged particles. At velocities possessed by plasma electrons the spectral line broadening is due to inelastic collisions. The authors found that the width and displacement of lines at large electron velocities decrease approximately in proportion v^{-1}, where v is the electron velocity. This means that at high electron velocities the role of ions becomes more important (displacement of

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A Non-Stationary Theory of the Stark Broadening of Spectral Lines in Plasma

lines in a wide range of temperatures is almost entirely due to ions). The results obtained are easily generalized to the case when the motion is no longer quasi-classical. The paper is entirely theoretical. Acknowledgments are made to S.L. Mandel'shtam and M.A. Mazing for their advice. There are 3 figures, 1 table and 11 references, 4 of which are Soviet, 2 translations from English into Russian and 5 English.

SUBMITTED: April 15, 1958

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24(7), 21(1) SOV/51-7-1-1/27

AUTHORS: Vaynshteyn, L.A. and Dolgov, G.G.

TITLE: Effective Cross-Sections of Excitation of He n^1P-Levels by Slow Electrons (Effektivnyye secheniya vozbuzhdeniya n^1P-urovney He medlennymi elektronami)

PERIODICAL: Optika i spektroskopiya, 1959, Vol 7, Nr 1, pp 3-9 (USSR)

ABSTRACT: Values of the effective cross-sections of excitation of atoms by slow electrons (up to 100 eV) are required in theoretical calculations dealing with gaseous discharges, astrophysical problems etc. The present paper reports a numerical calculation (using a "Strela" electronic computer) of the effective cross-sections of excitation of He n^1P-levels (n = 2, 3, 4) by slow electrons. Although the exchange interactions are important in low-energy excitation, these interactions were neglected in the present paper since their inclusion would have meant a lot more computational work. The values of the excitation cross-sections obtained can be used as the first approximation in further calculations when the exchange interactions are allowed for. The results obtained were the numerical solutions of radial differential equations which allowed for the strong coupling. The effect of individual partial waves with different values of ℓ was studied and it was found that at

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Effective Cross-Sections of Excitation of He n^1P-Levels by Slow Electrons

energies higher than 1 eV from the threshold, excitation is almost entirely due to electrons whose moments are $l \gg 1$ (this is shown in Table 1 and Fig 1). Fig 2 shows the polarization of the emitted radiation as a function of the energy of the incident electrons: curve 1 (continuous) shows the results deduced from the exact solution obtained in the present paper, while curve 2 (dashed) was obtained using Born's approximation. Fig 2 shows that the exact solution of radial equations (without exchange) leads to the same polarization curve as the results deduced from Born's approximation. This is in contrast to the low-energy excitation cross-sections which cannot be deduced correctly using Born's approximation. Acknowledgments are made to G.F. Drukarev and S.L. Mandel'shtam for their advice. There are 2 figures, 4 tables and 8 references, 2 of which are Soviet, 2 translations from English into Russian and 4 English.

SUBMITTED: July 21, 1958.

Card 2/2

24.3000

75324
SOV/57-29-10-1/[illegible]

AUTHORS: Kapitsa, P. L., Fok, V. A., Vaynshteyn, L. A.

TITLE: Static Boundary Problems for a Hollow Cylinder of Finite Length

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1959, Vol 29, Nr 10, pp 1177-1187 (USSR)

ABSTRACT: The paper considers the electrostatic potential of an ordinary layer of charges distributed at a certain surface density over a hollow cylinder of finite length. Such a cylinder may be a piece of a round tubing. The purpose of the study is to develop a general method of solution of integral equations for electrostatic problems giving the relationship between the surface density and its potential in conducting cylinders of finite length. Such problems frequently occur in mathematical physics, there being no general method for their solution. When the length of hollow cylinders is sufficiently big the problem is practically equivalent to a case of solid cylindrical conductors. The paper is of a highly mathematical nature. A hollow cylinder is represented in cylindrical coordinates, and a Laplacian equation for the potential

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Static Boundary Problems for a Hollow Cylinder of Finite Length

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V_s of an ordinary layer of surface charge of density S is written. It is stated that this equation may be reduced to an infinite number of linear equations, if the known function $V_s(z)$ may be resolved within $-L < z < L$ (L being one half of the length of the cylinder) range into a series of any system of functions. The equation may also be applied to sufficiently short cylinders (narrow rings) when $L/a \ll 1$, where a represents the radius of the cylinder. Each of the infinite number of linear equations is the summation of A_{nq} Uq products, where U_q are unknown coefficients and $A_{\mu\nu}$ represents the system coefficients. For very long cylinders the system coefficients A [illegible] of L/a. Two methods are discussed for the [illegible] of $A_{\mu\nu}$ coefficients. The first method applies to [illegible]tively short cylinders where $0 < L/a \leq 1$. Here the A [illegible] represented as a summation of a convergent [illegible] functions, and at values L/a [illegible] 1 an explicit [illegible] these coefficients may be had by using the iterative method. The second method discusses cases where L/a [illegible] 1. [illegible] [illegible] transformation [Ref 4], Bessel and Gamma functions [Ref [illegible]], [illegible] Meyer functions [Ref 2], A [illegible] is represented [illegible]

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matrix form the solution of which results in a fourth-order linear differential equation which can be applied to cases where $L/a > 1$ as well as to those where $L/a \leq 1$. The shape of this fourth-order equation is suitable for the solution on high-speed computing machines of electrostatic problems of the type discussed. There are 6 references, 1 Soviet, 3 U.S., 1 Swedish, 1 non-Soviet.

ASSOCIATION: Institute for Physical Problems, Academy of Sciences, USSR, Moscow (Institut fizicheskikh problem, AN SSSR)

SUBMITTED: March 4, 1959

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9.1000,24.3000

75325
SOV/57-29-10-2/18

AUTHORS: Kapitsa, P. L., Fok, V. A., Vaynshteyn, L. A.

TITLE: Symmetrical Electrical Oscillations of an Ideally Conducting Hollow Cylinder of Finite Length

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1959, Vol 29, Nr 10, pp 1188-1205 (USSR)

ABSTRACT: The subject matter of the paper is the problem of electromagnetic oscillations of an ideally conducting cylinder. It is a problem with which radio engineering is concerned when antenna vibrators are designed. This study, however, is limited to the case when current density on the surface of the cylinder is uniform and has a longitudinal component only, but it applies to very thin as well as to larger-size solid conductors. Oscillations that take place in such cases are called symmetrical electrical oscillations. The study is of a highly mathematical nature. Basically, it operates with two functions: potential V, which is known, and current density U, which is unknown. The reasoning starts with an integral equation of the potential written within boundary conditions of the

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surface of the cylinder so as to satisfy the Sommerfeld radiation principle. After the application of Bessel, Macdonald, and Hankel functions to the solution of this equation, and using the Neumann multiplier and Legendre polynomial, a relationship in the form of an integral equation is obtained between the V and the U functions. This latter equation is then transformed into an infinite system of linear equations relating V and U. In order to accomplish this an approximate expression is developed for the potential function V resolved in a Fourier series. The approximate expression is good for conditions when $a/L \ll 1$ and $ka^2/2L \ll 1$, where L is one half of the cylinder length, a is its radius, and $k = 2\pi/\lambda$; λ being the wavelength. The current density function U may also be resolved in a Fourier series for any even or odd function. It is stated that when the function V is neither even nor odd it may always be represented as a sum of the even and odd functions, for each of which a corresponding U function, even and odd, must be found. The sum of the latter will give the sought-for current on the surface of the cylinder. The coefficients of the members of these equations, resolved in series, form infinite matrices. These are resolved into the sum of the diagonal matrix and the general

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one; expressions are then given for their computation, and it is shown that a solution may be obtained without the necessity of calculating the determinants but by the application of the iterative method. Prior to using this method, however, the undetermined constants of the equations must first be found, for the calculation of which formulas are developed. The developed theory is compared with the theory of thin antenna vibrators. A distinction is made between short vibrators, with $k \ll g$, and long vibrators, with $k \gg g$ (here, $g = \pi/2L$; the other symbols have already been defined). The fact that electrostatic charges accumulate at the ends of the vibrators causes the error in short vibrators to be greater than in the long ones. In either case current distribution along the axis of the vibrator is similar to that in an open-circuit homogeneous transmission line. Conditions are given for the system of equations to have full regularity, in which case they represent cylinders that are very thin, with $a \to 0$, and to the solution of which the iterative method may be applied [Ref 3]. The method discussed in the paper may also be applied to the solution of electrostatic problems. The difference between this method and the one proposed in Ref 2 is that in the

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latter the density of the electric charge on the surface of a hollow cylinder was represented by a series each member of which showed absence of a requirement for a charge at the ends of the cylinder, while in the presently proposed method the poor convergence of the series signifies that charges are being concentrated at the cylinder ends. The ends of the cylinder have effect only in case of short cylinders ($L/a \lesssim 1$). When long cylinders are being considered ($L/a \gg 1$), the proposed method may well be used. For large values of kL this method is cumbersome. In such a case, if the antenna vibrator is thin ($ka \ll 1$), the method given in Ref 6 is the more preferable. The method discussed in this paper is suitable for the solution on high-speed computing machines of the type of problems discussed. There are 6 references, 4 Soviet, 1 U.S., 1 Swedish.

ASSOCIATION: Institute for Physical Problems, Academy of Sciences, USSR, Moscow (Institut fizicheskikh problem, AN SSSR)

SUBMITTED: March 4, 1959

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Vaynshteyn, L.A.

66702

24,2120 SOV/109-4-8-22/35

AUTHORS: Granovskiy, V.L., Luk'yanov, S.Yu., Spivak, G.V. and Sirotenko, I.G.

TITLE: Report on the Second All-Union Conference on Gas Electronics

PERIODICAL: Radiotekhnika i elektronika, 1959, Vol 4, Nr 8, pp 1339 - 1358 (USSR)

ABSTRACT: The conference was organised by the Ac.Sc.USSR, the Ministry of Higher Education and Moscow State University.
A.A. Timofeyev - "Measurement of the Gas Density During the Dynamic Operation of a Discharge" (see p 1306 of the journal). A.V. Nedospasov - The Nature of a Striated Positive Column".
V.I. Perel' and Yu.M. Kagan - "The Theory of Probes for Arbitrary Pressures".
Yu.M. Kagan et al. - "The Positive Column of a Discharge in a Diffusion Regime".
M.V. Konyukov - "Influence of the Processes of the Annihilation of the Negative Ions on Their Concentration in the Column".
M.D. Gabovich and L.L. Pasechnik - "Anomalous Scattering, Excitation of Plasma Oscillations and Plasma Resonance"
Yu.L. Klimantovich - "Energy Lost by Charged Particles for the Excitation of the Oscillations in Plasma (the Langmuir paradox)" and "The Theory of Non-linear Plasma Oscillations".
Ye.G. Martinkov and I.G. Nekrashevich - "Dependence of the Temperature in the Near-electrode Region of a Pulse Discharge on the Material of the Electrodes".
N.A. Neratina and B.N. Klyarfel'd - "Formation of Light Spots on the Anode of a Gas Discharge (see p 1301 of the journal).
N.A. Matveyeva -"Distribution of Binary Mixtures of Inert Gases in a d.c. Discharge".
V.G. Stepanov and V.F. Zakharchenko - "Some Phenomena in Rarified Plasma".
V.G. Stepanov and V.S. Bazel' - "The Possibility of Obtaining Highly Concentrated Plasmas".
G.V. Smirnitskaya and E.M. Reykhrudel' - "Some Characteristics of the Discharge in an Ion Pump and in a Magnetic Ionisation Vacuum Gauge".
Ye.T. Kucharenko and O.K. Nazarenko - "Properties of a Discharge with Electron Oscillations in a Magnetic Field" (see p 1255 of the journal).
The paper by L.M. Biberman and B.A. Veklenko considered the approximate methods for determining the concentration of atoms at the radiation levels.
I.I. Sobel'man and L.A. Vaynshteyn read a paper on "A Non-stationary Theory of the Stark Broadening of the Spectral Lines in Plasma".
M.A. Mazing and S.L. Mandel'shtam - "The Broadening and the Shift of Spectral Lines in a Gas-discharge Plasma".
R. Lunt (England) - "The Kinetics of Electron Collisions Leading to the Excitation of the Molecular Hydrogen in a Hydrogen Discharge".
V.E. Kolesnikov et al. - "Some Properties of the Arc Discharge in an Atmosphere of Inert Gases".
A.A. Mak and M.P. Vanyukov - "Production of High Temperatures By Means of Spark Discharges".

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PHASE I BOOK EXPLOITATION SOV/4035

Vaynshteyn, L.A., and V.D. Zubakov

Vydeleniye signalov na fone sluchaynykh pomekh (Signal Separation Against a Background of Random Interference) Moscow, Izd-vo "Sovetskoye radio," 1960. 446 p. Errata slip inserted. No. of copies printed not given.

Ed.: N.D. Ivanushko; Tech. Ed.: A.A. Sveshnikov.

PURPOSE: This monograph is intended for physicists and engineers working with fluctuation noise and interference problems. It may also be used as a textbook by students and aspirants studying statistical radio physics, information theory, and random processes in radio devices.

COVERAGE: The monograph contains an exposition of statistical theory of optimal receivers which not only detect signals having various characteristics against a background of random noise, but also measure the parameters of such signals. The theory of linear

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filters, filters which separate useful processes from interfering ones, is presented in the introduction. Major attention is paid to radar problems. The book also describes some new experiments carried out by the authors. Parts I and III and Ch. VII of Part II were written by L.A. Vaynshteyn. V.D. Zubakov wrote the rest of Part II except Ch. VIII, which was written jointly by both authors. The authors thank Yu.B. Kobzarev. There are 48 references: 29 Soviet (8 of which are translations), 18 English, and 1 German.

TABLE OF CONTENTS:

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S/051/60/008/02/001/036
E201/E391

24.6520

AUTHORS: Vaynshteyn, L.A. and Norman, G.E.

TITLE: Calculation of the Photo-ionization Cross-sections of Aluminium and Gallium Atoms

PERIODICAL: Optika i spektroskopiya, 1960, Vol 8, Nr 2, pp 149 - 151 (USSR)

ABSTRACT: The photo-ionization cross-section of an atom is given by:

$$\sigma = \frac{2\pi^2 a_o^2}{3 \cdot 137} \cdot \frac{\varepsilon - E_{nl}}{g_{nl}} \sum_{l = l \pm 1} Q_{l,l'} \left| \int_0^\infty P_{nl}(r) P_{\varepsilon l}(r) rdr \right|^2 \quad (1)$$

where a_o is the Bohr radius; E_{nl}, g_{nl} and $P_{nl}(r)$ are, respectively, the energy, statistical weight and the radial function of an optical electron in the initial state of the atom; the radial function of the final state $P_{\varepsilon l}(r)$, is normalized to $\delta(\varepsilon - \varepsilon')$. The energy is given in Rydberg units and the other quantities are given in

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atomic units. The multiplier $Q_{l,l}$ depends only on the orbital and spin quantum numbers; in the case of a single electron outside a filled shell $Q_{l,l} = 2 \max (l', l)$.
To find the radial function of continuous spectrum $P_{\varepsilon l}(r)$ the authors used Seaton's "quantum defect" expression (Refs 2,3) for the case $\varepsilon \ll 4\pi^2$;

$$P_{\varepsilon l}(r) = A(\varepsilon, l)[u_{\varepsilon l}(r)\cos \pi\mu_l(\varepsilon) - v_{\varepsilon l}(r)\sin \pi\mu_l(\varepsilon)], \quad (2)$$

$$A^2(\varepsilon, l) = \prod_{s=0}^{l-1} [1 - (l - s)^2 \varepsilon]$$

where $u_{\varepsilon l}(r)$ and $v_{\varepsilon l}(r)$ are linearly independent solutions of the Schrödinger equation with a coulomb field $-\frac{1}{r}$; $\mu_l(\varepsilon)$ is the quantum number defect extrapolated

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to optical electron states with positive energies. For states with negative energies E_{nl}, we have

$$\mu_{nl} = n - n^{*}_{nl}; \quad n^{*}_{nl} = \frac{1}{\sqrt{-E_{nl}}} \qquad (3).$$

The functions $u_{\varepsilon l}(r)$ and $v_{\varepsilon l}(r)$ were expanded as series of Bessel's functions of the first and second type (Eqs 4-6). The calculated values of $u_{\varepsilon l}(r)$ and $v_{\varepsilon l}(r)$ are tabulated for $l = 2$ and for ε from 0 to 0.1 (Tables 1, 2). Using Tables 1 and 2 and the published values of the self-consistent field functions for the ground state (Refs 4,5), the photo-ionization cross-sections of Al and Ga atoms were calculated. For both atoms $l' = 1$ for the ground state. Trial calculations

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showed that, of the two possible values $l = l' \pm 1$, only $l = 2$ contributes appreciably to the cross-section. The cross-sections obtained in this way ($\sigma \times 10^{18}$ cm^2) are plotted as functions of the energy (ε) of the electrom removed (in Rydberg units) in a figure on p 149. In the case of Al the cross-section decreases almost linearly with the energy ($\sigma = 30 \times 10^{-18}$ cm^2 at $\varepsilon = 0$ and $\sigma \simeq 4 \times 10^{-18}$ cm^2 at $\varepsilon = 0.12$ Rydberg units). In the case of Ga the cross-section falls more rapidly with energy (from $\sigma = 6 \times 10^{-18}$ cm^2 at $\varepsilon = 0$) reaching zero at $\varepsilon = 0.08$ Rydberg units; then the cross-section of Ga rises with the energy, reaching $\sigma \simeq 0.6 \times 10^{-18}$ cm^2 at $\varepsilon = 0.12$ Rydberg units. This shows that, in spite of the similarity of the external shells of Al and Ga, the energy dependences of the photo-ionization cross-sections

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Calculation of the Photo-ionization Cross-sections of Aluminium and Gallium Atoms

of these two atoms differ very considerably. Unfortunately, the calculated values could not be compared with the experimental ones because no empirical values are yet available for these atoms. Acknowledgment is made to L.M. Biberman for his advice. There are 1 figure, 2 tables and 5 references, 3 of which are English, 1 a translation from English into Russian and 1 German.

SUBMITTED: June 20, 1959

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VAYNSHTEYN, L.A.

Calculating the wave functions and oscillator strength of complex atoms. Trudy Fiz. inst. 15:3-54 '60. (MIRA 14:7)
(Coulomb functions)
(Nuclear forces)

82826

S/048/60/024/008/002/017
B012/B067

24.6200

AUTHORS: Vaynshteyn, L. A., Sobel'man, I. I.

TITLE: Methods of Calculating the Cross Sections of Atom Excitation by Electrons

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, 1960, Vol. 24, No. 8, pp. 943-945

TEXT: With reference to the papers by S. Frish (Ref. 1), W. Fite (Ref. 2), and H. Massey (Ref. 3), first, general equations from the theory of collisions between atoms and electrons are studied. Proceeding from these studies the authors give a short description of the approximation methods. The problem in the theory of collisions consists in solving the Schrödinger equation for the wave function Ψ of a system consisting of one atom with N electrons and one outer electron. The atomic wave functions are assumed to be known. Hence, the problem is reduced to the determination of the radial parts of the wave functions $F_{\Gamma}(r)$ of the outer electron. The system (1) of integrodifferential equations with the corresponding boundary conditions

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for these functions is written down for the general case. The system of equations for $F_{\Gamma}(r)$ is obtained from the variational principle (2). Formula (3) for the excitation cross section is written down. It is pointed out that the explicit form of the equations depends on the type of the approximation wave functions if exact functions are possible only in the case of a hydrogen atom. The functions by Hartree-Fok are found to be the most accurate, and they are recommended for practical calculations. The equations for $F_{\Gamma}(r)$ show a very complicated form in the general case. It is shown that these equations can be considerably simplified if 1) the nonorthogonality of the radial functions of the outer electrons and of the valence electrons is considered, and 2) if the terms with the products of the integrals of the nonorthogonality and the multipole interactions of second and higher order are omitted. Formulas (4) and (5) for such a simplified system of equations are written down and explained. It is pointed out that in most of the calculations carried out at present, the two-state approximation was used where system (4) was restricted to one pair of equations (6). This means

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the neglect of all virtual transitions and no consideration of the perturbation of the atom by outer electrons. If, in the first equation of system (6) the right part is neglected, the so-called method of distorted waves is obtained. It is shown that this method furnishes the most exact solution of the problem in first perturbation-theoretical approximation. The exact solution of system (6) is often termed the approximation of strong coupling, since in this connection the influence exercised by inelastic scattering on the elastic one is taken into consideration. The integrodifferential equations (6) can be transformed into integral equations. The first approximation of the method of integral equations occupies an intermediate position between the method of Born and the method of the distorted waves. This complex of problems was dealt with in detail in the papers by G. Drukarev (Ref. 7). In conclusion, formula (3) is studied, which contains the sums of the partial waves 1 and 1_0. It is pointed out that Born's method is of increasing importance because of the necessity of taking into account a large number of partial waves and since only in this method summation over 1 and 1_0 can be carried out analytically. This corresponds to the transformation

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