Digest of Translated Russian Literature

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BULLETIN OF THE ACADEMY OF SCIENCES USSR, PHYSICAL SERIES (*Izvestiia Akademii Nauk SSSR, Seriia Fizicheskaia*). Published by Columbia Technical Translations, White Plains, N.Y.

Volume 25, number 6, 1961

Vacuum System Selector Valve with One Control Knob, D. V. Fetisov, B. I. Pochtarev, and A. N. Kabanov, pp. 785–788.

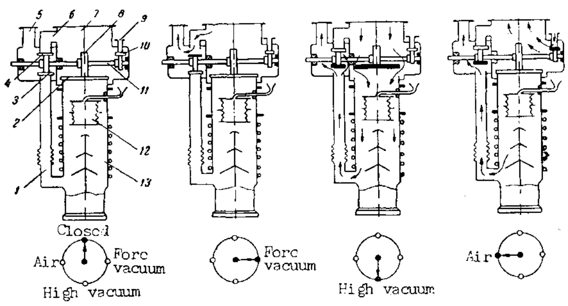

Fig.1. Operation of the vacuum selector valve.

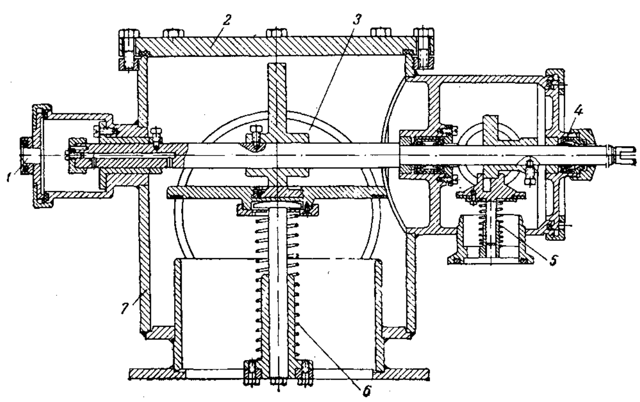

Fig.2. Sectional view of the valve chamber.

Among the many types of vacuum equipment employed in modern laboratories, an important place is occupied by demountable metal instruments operating at pressures of 10^{-4}–10^{-5} mm Hg. Such instruments include electron microscopes, diffraction cameras, vacuum evaporation units, etc.

Most such instruments require a systematic alternation of vacuum and atmospheric pressure in the working space, which leads to the necessity of using special commutation devices for interconnecting the tubes and pumps in a certain sequence. Such devices should be simple as regards operation and reliable in service.

We developed a vacuum selector valve with one control knob, a distinctive feature of which is location of the distributor cam mechanism in the vacuum.

Volume 25, number 7, 1961

Calculation of the Probability of the Auger Effect, M. A. Listengarten, pp. 803–809.

The probability of the Auger effect in the nonrelativistic approximation has been calculated by many investigators. Comparison of results of these calculations with experimental data showed that the relative intensities of the K-LL Auger lines obtained in this approximation disagree with the experimental results. This disagreement is of the order of 30–50% for medium values of atomic number Z and reaches a factor of 3–4 in the case of elements with large Z ($Z \geqslant 80$). It might be supposed that this disagreement is due to neglect of relativistic effects. However, the relativistic calculations of Massey and Burhop did not lead to any better agreement with experiment as regards the relative intensities of the K-LL group Auger lines. Therefore we undertook new calculations for the K-LL group Auger line intensities in the relativistic approximation. Using the general formulas of quantum electrodynamics, we obtained more accurate relativistic expressions for the probability of Auger transitions and carried out numerical evaluations of these probabilities for $Z = 81$. The effect of screening was taken into account by the Thomas-Fermi-Dirac statistical model of the atom.

Total Ionization Produced by Alpha Particles in Gas Mixtures, G. E. Kocharov, pp. 873–876.

Resonance Scattering of Gamma Rays by Nuclei in a Solid, I. P. Dzyub and A. F. Lubchenko, pp. 911–918.

Many experiments have recently been performed on recoil-less Rayleigh and resonance scattering of γ rays by nuclei in solids. These experiments show that at low temperatures (for instance, at 90°K for tin) both resonance and Rayleigh scattering may occur but that resonance scattering predominates. Thus, for investigation of solids one can use not only resonance emission and absorption (the Mössbauer effect) but also resonance and Rayleigh scattering. It is interesting to note that the difference between the diffraction patterns for Rayleigh and resonance scattering can be used to verify Weisskopf's theory of coherence of incident and resonance-scattered photons.

The present paper discusses the characteristics of resonance scattering. We determine the angular distribution of the scattered γ rays, the excitation spectrum, and the spectrum of the scattered γ rays. We point out the possibility of determining the normal frequencies of the scatterer both from the scattered γ-ray spectrum and from the intensity of the Mössbauer line, which we shall show exists at other than the Bragg angle. In determining the probability for resonance scattering we consider the general case in which a unit cell of the scatterer contains several resonance-scattering nuclei. We sum over intermediate and final states of the lattice and average over initial states without making any approximations.

Volume 25, number 8, 1961

Microfocus X-Ray Spectrograph, I. B. Borovskii, S. A. Ditsman, and V. G. Bogdanov, pp. 932–934.

We describe the design of a new microfocus x-ray spectrograph intended for investigation of the fine structure of x-ray emission spectra.

Investigation of the Region of a Microfocus Source in an X-Ray Microanalyzer, S. A. Ditsman, pp. 935–939.

Our experimental and theoretical investigations of the conditions of reflection of radiation from a crystal bent by the Kapitsa-Johann method showed that with displacement of the microsource from the Rowland circle within the boundaries of a certain region there is obtained acceptable reflection of the radiation. This region has a clearly pronounced section corresponding to maximum intensity of the reflected radiation; under our experimental conditions the dimensions of this maximum intensity section were approximately $20 \times 500\ \mu$.

Use of a bent quartz crystal in the x-ray spectrograph of a scanning microanalyzer under the conditions in the present work is difficult owing to the extremum character of the microsource region. Increase of the region of maximum intensity is feasible by using a larger working surface, but this leads to decrease of the resolution and sensitivity of the instrument.

Evaluation of the accuracy of adjustment of conventional microanalyzers to obtain the maximum intensity of the radiation reflected from the crystal (maximum transmission) shows that the tolerance in matching the radius of curvature of the crystal and the kinematic system of the instrument should not exceed 1 mm.

It is not expedient to investigate the size of the microsource region using the geometric theory of reflection of radiation from crystals for the cases of focusing of the radiation by the DuMond and Johansson method. The dimensions and shape of the microsource region, as shown, are determined by the character of reflection of the radiation from the crystal. This for the DuMond method of focusing depends on the quality of bending of the crystal and can be considered only for ideal curvature of the crystal to a cylindrical surface. This, however, is not realized in practice. Hence in such cases, instead of theoretical analysis, it is expedient to carry out experimental determination of the microsource region.

Experimental Investigation and Calculation of the L Absorption Spectra of Noble Gases, R. L. Barinskii, pp. 958–964.

Investigation of the Binding Forces in Ni-Mo Solid Solutions by Observing the Fine Structure of the Absorption Spectra, V. A. Trapeznikov, pp. 1003–1005.

Information on the variation of the binding forces in solid solutions can be obtained by observing the fluctuations of the fine structure of their absorption spectra. This was demonstrated by the Kostarev theory in an experimental study noted and by calculation in two variants. Both variants of the calculations show that the binding forces increase or decrease with increase or decrease of the ratio $\Phi_{K''}/\Phi_{K'}$, where $\Phi_{K''}$ is the amplitude of the short wavelength fluctuation and $\Phi_{K'}$ is the amplitude of the long wavelength fluctuation $(K'' > K')$. Variation of $\Phi_{K''}/\Phi_{K'}$ in the treatment noted occurs owing to change of the characteristic temperature θ, whereas in another paper it is assumed to occur due to variation of the mean radial electron density which changes in the amplitude of the thermal vibrations of the atoms in the lattice.

It must be noted that the inferences arrived at in previous papers regarding the variation of the binding forces in a given specimen with variation of the temperature T of the experiment owing to decrease of θ with increase of T do not now seem convincing, as was shown in formulating the problem noted. Only the negative aspect of the arguments set forth in a previous paper seems pertinent, namely, our proof of the inapplicability of the temperature variant of Kostarev's theory to the entire temperature range; we consider the temperature coefficient S, proposed by Kostarev, which yields a temperature dependence of $\Phi_{K''}/\Phi_{K'}$ of opposite sign to that observed experimentally. In positive agreement as regards the temperature variant are deductions noted and the results of the recent work of Schmidt, carried out on the basis of the work of Kozlenkov, who developed the theory of the fine structure of absorption spectra from the standpoint of the determining influence of short range order on the structure.

In the present work we obtained experimental data on the ratio of the amplitudes of the fluctuations in the K edge of nickel in Ni-Mo solid solutions with molybdenum concentrations of 0, 0.5, 1, 2, 4, 5, and 16% by weight. Specifically, we measured the ratio of the fifth fluctuation E to the third fluctuation C at room temperature.

Computer for Correcting the Shape of Emission Spectra, M. I. Korsunskii and Ya. E. Genkin, pp. 1020–1022.

Distortions of emission spectra due to interaction of the x-ray photons with the instrument and the width of the inner levels are usually allowed for by methods involving the use of special tables, charts, or matrices. In such calculations, it is particularly convenient to employ accumulator or storage devices capable of algebraic summation (mechanical or electrical calculators).

In general, the corrected ordinate f_i is given by

$$f_i = \sum_{k=1}^{n} b_{ik}F_k \qquad (i = 1, 2, \ldots, s) \qquad [1]$$

where $||b_{ik}||$ is an s by n transformation matrix, and F_k is the corresponding ordinate of the experimental spectrum.

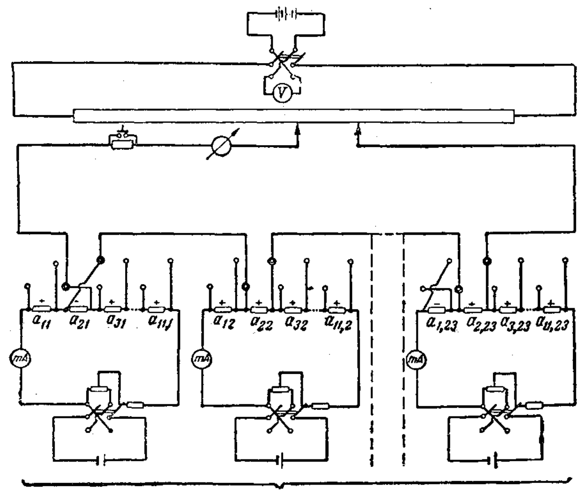

Fig.1. Schematic of the computer for correcting spectra.

We designed a simple computer for correcting x-ray spectra for distortions introduced by the instrument and the width of inner levels. This device can be constructed easily in any laboratory. Fig. 1 gives a schematic of the computer for correcting spectra (CCS).

Comparison of Two Methods of Correcting Experimental Curves (Column and Matrix Methods), Ya. E. Genkin and I. A. Rumyantsev, pp. 1023–1032.

The column and matrix methods of correcting experimental curves have been described elsewhere. The purposes of the present paper are to establish the advantages and disadvantages of each method and to determine its range of applicability.

Conclusions:

1) It makes no sense, in any correction method, to try to use information concerning experimental points separated by less than 0.6–0.7β.

2) Both methods satisfactorily correct emission curves without abrupt rises and drops. It is impossible, however, to avoid errors due to the way the curves are approximated outside the correction interval.

3) The error of the approximation is evaluated easily in the matrix method. In the column method this evaluation is impossible due to uncertainty in the choice of the height of the approximating semi-infinite step functions.

4) Sections of spectra close to abrupt changes are poorly approximated in both methods.

5) Experiment shows that the time needed to correct an experimental curve of width 10.5 $\pi\beta$ is 3–4 hr when using the matrix method, and 30–35 hr in using the column method.

Finding the True Shape of Spectra Using the Shannon Approximation, V. P. Sachenko, pp. 1043–1047.

To find the true shape of spectra, as well as to solve many other problems in different fields of physics and information theory, one must solve the integral equation of the convolution type:

$$F(x) = \int_{-\infty}^{+\infty} f(t)\varphi(x - t)dt \qquad [1]$$

where $F(x)$ is the experimentally observed shape of the spectrum, $f(x)$ its true shape, and $\varphi(x)$ the distortion function. Difficulties arising in solution of Eq. (1) are related to the fact that in reality $F(x)$ is always given either graphically or in tabular form and always with some (experimental) uncertainty. There are many approximation methods for solving this equation (see Rautian's review article), differing as regards the way in which $F(x)$ is approximated. None of these methods, however, can be used to find the best approximation for $f(x)$, whose existence follows from the instability of the solution of (1) with respect to experimental error. Further, it is not clear which of the methods is best from the viewpoint of time expended and accuracy of results obtained. In this paper we propose a new method for solving (1) which may be used to answer these questions.

"Derivative Method" for Correcting the Shape of Spectra, V. P. Sachenko, pp. 1052–1056.

The convolution type of equation

$$F(x) = \int_{-\infty}^{+\infty} f(t)\varphi(x - t)dt \qquad [1]$$

is encountered in many fields of physics. For this reason much work has been devoted to numerical procedures for solving this equation. In the present paper we suggest a new method for solving the equation, a method in which the solution is obtained as a series of derivatives of $F(x)$.

Comparison of Different Methods of Correcting the Shape of Spectra, I. Ya. Nikiforov, V. P. Sachenko and M. A. Blokhin, pp. 1057–1062.

SOVIET ASTRONOMY (*Astronomicheskii Zhurnal*). Published by American Institute of Physics, New York

Volume 5, number 5, March–April 1962

Equilibrium Configurations of Superdense Degenerate Gas Masses, V. A. Ambartsumyan and G. S. Saakyan, pp. 601–610.

Equilibrium densities of stellar masses possessing a density of the same order as the density of the atomic nucleus, and consisting of a highly degenerate baryon gas, are discussed. This treatment differs from that of Oppenheimer and Volkoff in that the presence of hyperons at high densities is considered. The treatment is based on the Einstein gravitational equations. The possible existence of some equilibrium configurations containing a large number of hyperons is pointed out. The equilibrium models are computed for both an "ideal" Fermi gas and a real gas in which interaction between particles is taken into account.

Propagation of Low-Frequency Oscillations along the Magnetic Field in a Viscous Compressible Plasma, E. A. Ponomarev, pp. 673–677.

The propagation along the magnetic field of low frequency electromagnetic, transverse viscous and longitudinal oscillations in a plasma is considered. Relations are obtained which generalize the well-known magnetohydrodynamic equations to the case of higher frequencies. The connection between the electric conductivity and viscosity is given. The energy exchange between different forms of waves is considered. Qualitative estimates applicable to conditions in the solar corona are made.

Lunar and Solar Perturbations of the Lunik III, V. T. Gontkovskaya and G. A. Chebotarev, pp. 728–732.

The lunar and solar perturbations of the orbit of Lunik III are estimated separately. Tables 1–5 and Figs. 1–4 summarize the results.

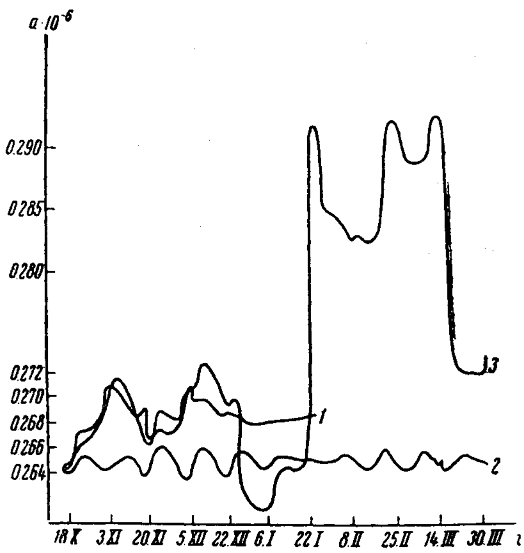

Fig. 1. Variation of the major semiaxis of the orbit of Lunik III. 1) Lunar perturbations only; 2) solar perturbations only; 3) lunar and solar perturbations.

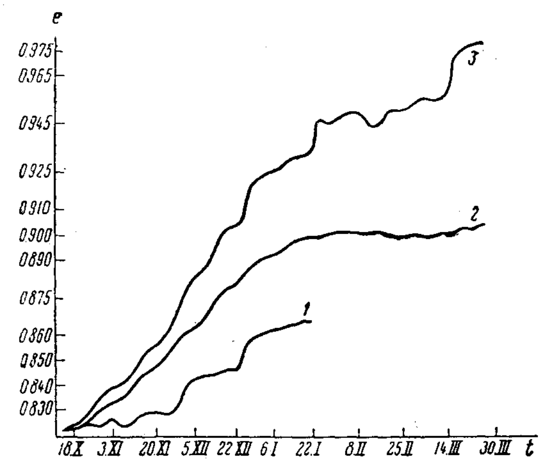

Fig. 2. Variation of the eccentricity of the orbit of Lunik III. 1) Lunar perturbations only; 2) solar perturbations only; 3) lunar and solar perturbations.

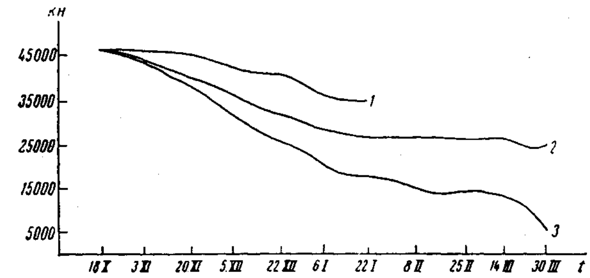

Fig. 3. Variation of the perigee distance of Lunik III. 1) Lunar perturbations only; 2) solar perturbations only; 3) lunar and solar perturbations.

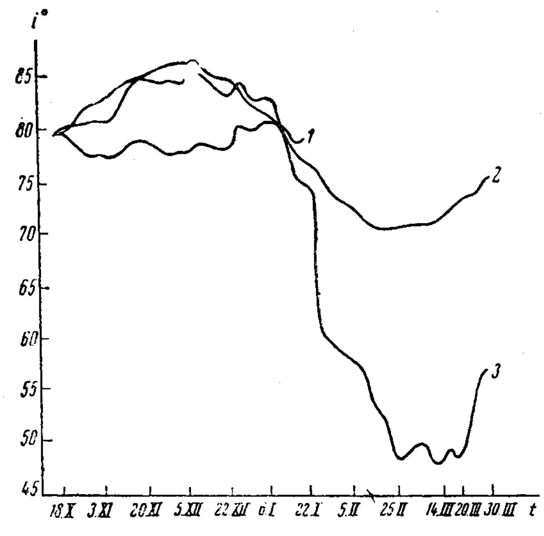

Fig. 4. Variation of the inclination of the orbit of Lunik III. 1) Lunar perturbations only; 2) solar perturbations only; 3) lunar and solar perturbations.

Origin and Evolution of Solar Flares and Generation of Cosmic Rays in Them, V. P. Shabanskii, pp. 647–650.

A previously proposed model of a flare as an external manifestation of processes occurring deep in the solar photosphere is improved. A possible mechanism of formation of the soft component ($\epsilon \sim 10^8$ ev) of solar cosmic rays observed before the Forbush decrease is considered.