F. M. Gashimzade and Yu. M. Seidov, Spectrum of Elementary Excitations in Magnetically Ordered Crystals (Carbonates of Transition Metals).

Group-theoretical methods were used to investigate the change of the spectrum of single-particle states in crystals of $FeCO_3$, $MnCO_3$, and $CoCO_3$ during the transition from the disordered phase into the magnetically-ordered phase, as well as the spectrum of the new excitations (magnons). These crystals have a rhombohedral structure, whose Brillouin zone is shown in the figure. In the ordered structure of $FeCO_3$, the spins of the magnetic ions lie along the rhombohedral axis of the crystal, and in the structures of $MnCO_3$ and $CoCO_3$ they are perpendicular to the rhombohedral axis on the symmetry plane and perpendicular to the asymmetry plane, respectively. The tables of the characters of the irreducible representations of the corresponding magnetic space groups were used to determine the multiplicity of degeneracy and the law of transformation of the Bloch functions. Account was taken of the symmetry against time reversal, which is encountered in magnetic crystals in combination with other symmetry elements of the space group. The locations of the extremal points of the spectrum in k-space were determined by generalizing the criteria of Rashba and Sheka to include magnetic space groups. The method of Luttinger and Pikus was used to find the dispersion laws for the spin waves at arbitrary points of the Brillouin zone.

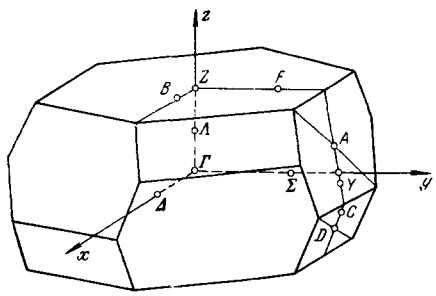
In the $FeCO_3$ structure, it was found that degeneracy of two branches of spin waves is lifted in all the directions, with the exception of Λ, but at the point A on the boundary of the Brillouin zone they are again degenerate.

The extrema are located at the points Γ and D, on the line B, and also on the plane Σ along the direction DA parallel to the z axis.

In the structure of $MnCO_3$, the degeneracy of the two branches of the spin waves is present at the point Z and at the point A, which lies on the symmetry plane. The extrema are located at the same points as for $FeCO_3$, and in addition, at the point A which does not lie in the symmetry plane.

In the structure of $CoCO_3$, the degeneracy of the two branches of spin waves was observed along the line B (the symmetry axis of the spins). The extrema are located at the points Γ, D, and also on the line Λ and the plane Σ.

The employed method of finding the dispersion law of the magnons makes it possible to study also the influence of external fields (magnetic, electric, and stress) on the magnon spectrum.



The obtained features of the spectrum should become manifest in the optical spectra of magnetically ordered crystals and in the expression for the cross section of the inelastic scattering of neutrons in these crystals.

G. D. Guseĭnov. Certain Results and Prospects of the Search for Complex Semiconductor Analogs.

The author presents new principles, in addition to the existing ones, for the finding of new complex semiconductor analogs—rational substitution, substitution with respect to "equivalent valence," equiatomization of defective lattices, atomic-coordination and semiconductor analogy, etc. The possible existence of new groups of complex semiconductor analogs, which follow from the proposed principles, is pointed out. Results are reported of comprehensive investigations of definite groups of new semiconductor materials: $A^{II}B^{III}X_2^{VI}$, $A^{II}B^{IV}X_2^{VI}$, $A^{III}B^{III}X_2^{VI}$, $A^{I}B^{III}C_4^{V}$, $A^{I}B^{II}C^{III}X_3^{VI}$, $A^{I}B^{IV}C^{V}X_3^{VI}$, etc.

The features and prospects of the investigated materials are emphasized. The results of structural-physical investigations of the revealed complex semiconductors, in particular, are discussed from the point of view of the scientific hypothesis on which their predictions are based. It is indicated that there is a direct relation between the structural-coordination and semiconductor parameters.

On the basis of this connection, it is indicated that it is possible to deduce the location of the atoms within the limits of concrete crystal lattices from the known width of the forbidden band, and vice versa. Regularities are also revealed in the change of the characteristic parameters of the semiconductors as functions of the chemical composition, lattice structure, and the parameters of the constituent components. It is indicated, in particular, that the functional dependence of the width of the forbidden band on the average energy of atomization of the components of complex semiconducting phases has a periodic character.

A new equation proposed for this relation:

$$\Delta E_g = \left(\frac{z}{N_0}\right)^n \frac{(0.26\cdot 10^{23})^n}{U_0^{n-1}} C_k \hat{H}_s^n, \qquad (1)$$

where ΔE_g is the width of the forbidden band (in eV), $\hat{H}_s$ is the atomization energy (in kcal/g-at), z is the number of atoms in the formula unit, N_0 is Avogadro's number (6.2×10^{23} mole^{-1}), U_0 is the ionization potential of hydrogen (13.5 eV), n is the exponent proportional to the number of different components α (n = 3.5 α), and C_k is the numerical factor, which is constant for definite groups of materials. For equiatomic three-component compounds in particular, with a transition from a group with average serial number $\bar{N}_{k-1}$ to $\bar{N}_k$, we have

$$C_k = \left[\frac{25}{12}\frac{\bar{N}_k - \bar{N}_{k-1}}{18} \sin\left(\frac{\bar{N}_k - \bar{N}_{k-1}}{18}\frac{\pi}{2}\right)\right] C_{k-1}. \qquad (2)$$

G. B. Abdullaev, V. B. Antonov, R. Kh. Nani, E. Yu. Salaev, and T. É. Mekhtiev, Recombination Radiation in Certain Broad Band Semiconductors under the Influence of a Beam of Fast Electrons.

The article reports research carried out at the Physics Institute of the Azerbaĭdzhan Academy of Sci-

ences on recombination radiation, under the influence of a beam of fast electrons, from certain semiconductors grown at the Institute. These investigations add to the presently available information concerning the parameters of semiconducting materials. A study is made of the influence of impurities and growth methods on the spectrum, power, and temporal characteristics of the recombination radiation of the ternary compounds $CdIn_2S_4$, $CdGa_2S_4$, and $ZnIn_2S_4$. The influence of the quality of the crystal on the properties of the radiation of GaSe is investigated.

I. M. Kopylov. Results of Investigations on the Physics of Stars at SAO Observatory of the USSR Academy of Sciences During the Last Two Years.

Work on the physics of stars and nebulas at the SAO Observatory of the USSR Academy of Sciences was initiated in 1967, after organization of an appropriate topical group.

1. Wolf-Rayet stars. S. V. Rublev has developed theoretically the following: a procedure for determining the electron temperatures of the envelopes of Wolf-Rayet stars, a procedure for estimating the relative abundance of hydrogen and helium in the atmospheres of these stars. The absolute magnitudes of several dozen Wolf-Rayet stars have been determined.

2. Planetary nebulas. S. V. Rublev proposed a new method for calculating the theoretical Balmer decrement for planetary nebulas, which gives better agreement with observation than previously obtained.

3. A group of members of the SAO Observatory, headed by Yu. V. Glagolevskiĭ, carried out spectrophotometric studies of the so-called "magnetic stars." For several stars of this type, the chemical composition and the physical conditions in the atmosphere were determined by Yu. V. Glagolevskiĭ (temperatures, turbulent velocities, densities, etc.). The hydrogen spectrum of α^2CV_n was investigated; this is a remarkable star of this type (including the use of spectrograms with a dispersion of 1.3 Å mm). A connection was established between the changes of the intensity of the hydrogen lines (the nuclei of the lines in the last observed numbers of the Balmer series) with the period of variation of the magnetic field of the star. K. I. Kozlova and R. N. Gumaĭgorodskaya presented preliminary interpretations.

V. V. Lenshin is developing a system for quantitative three-dimensional spectral classification of stars of this type using several hundred spectrograms of 56 stars of this type.

4. A statistical study of the changes of the laws governing the rotation of hot stars during the course of evolution within the limits of the main sequence has shown that in the region of location of magnetic and peculiar A-stars the law of constancy of the (observed) angular momentum is violated.

The dependence of the average rotation velocity on the mass of the star (for recently formed stars) has a maximum for stars B with masses equal to 5—9 solar masses, but even the most rapidly rotating stars do not reach critical velocity (I. M. Kopylov).

5. An analysis of the Procyon spectrograms, obtained with high dispersion, has made it possible to determine, by the growth-curve method, the previously unknown oscillator strengths of more than 300 lines of ionized metals. The accuracy of such determinations is comparable with the laboratory accuracy (A. M. Bogudlov).

A thorough spectrophotometric study was made of four cold stars of spectral class K. The physical parameters of the atmospheres and their chemical composition have been determined (N. F. Voĭkhanskaya).

6. A Comparison of the "dynamic" accelerations of the force of gravity on the surfaces of supergiant stars, obtained from the masses and radii of these stars, with the "spectrocosmical" values, obtained from a comparison of the observed contours and intensities of the hydrogen lines with the theoretical ones, has shown good agreement. In earlier investigations, the discrepancies reached 1.5—2 orders of magnitude (I. M. Kopylov).

7. E. L. Chentsov has shown that large differential displacements of the lines of neutral helium compared with the lines of the metal ions in the spectra of the supergiants cannot be attributed to the Stark effect, but are due to the stratification and dynamics of the extended atmospheres of such stars.

8. Yu. P. Korovyakovskiĭ calculated theoretically the trajectories of gas streams in close binary stars of the dwarf type, determined the rates of encounter of the stream with the envelope of the principal stars, the coefficients of the encounter "points," and the dimensions of the so-called "hot spot."

9. Yu. P. Korovyakovskiĭ and A. A. Korovyakovskaya, during the time of their year and a half stay at the Crimean Astrophysical Observatory of the USSR Academy of Sciences, have carried out, in collaboration with the staff members of that observatory, investigations of exploding stars of the UV Ceti type.

In the first two volumes of the Izvestiya SAO AN SSSR and other publications, approximately 15 articles of the staff members of the SAO Observatory on physics of stars and nebulas have been published or submitted. The research work on these topics has been carried out at the Observatory with allowance for the forthcoming work on the large telescope. Light-receiving apparatus for the telescope has been developed in order to carry out investigations in this field.

G. F. Sultanov. Features of the Structure of the Planetoid Belt and Their Explanation.

Planetoids occupy a special place in the solar system. Their number increases every year, and their shapes are irregular and fragmentized. They move essentially in a belt and are contained between the orbits of Mars and Jupiter. Moreover, depending on the parameters of the motion, the entire aggregate of the planetoids is subdivided into a number of individual groups (families).

This structural feature of the family of planetoids is already of great interest among astronomers. The astronomers have long thought that the features of the structure of the planetoid belt can be explained to some degree by some hypothesis concerning the origin of the planetoids.

So far, there is no universally accepted hypothesis