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.

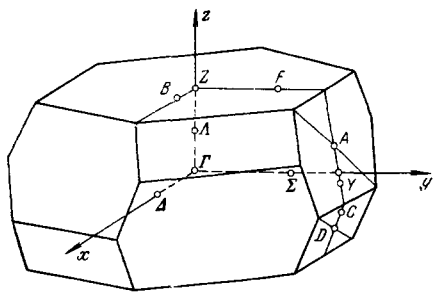
In the $FeCO_3$ structure, it was found that degeneracy of two branches of spin waves is lifted in all the directions, with the exception of Λ, but at the point A on the boundary of the Brillouin zone they are again degenerate.

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-