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Kh. Gul'medov and A. P. Savrukhin. Research in Astrophysics and the Physics of the Upper Atmosphere in the Turkmenian SSR.

Turkmenia is the southernmost republic of the Soviet Union and enjoys a large number of clear days in the year, a fact that permits systematic observations of meteors, the skyglow, and other celestial phenomena in this region. Broad astrophysical research on meteors, comets, and the gegenschein were begun in Turkmenia in 1942. During the International Geophysical Year, the work on meteors was expanded and research on night-sky emissions was begun.

A system of radar stations for meteor observations, working in continuous generation at 25 MHz, has now been created. It has been used to obtain data on the deceleration of meteors in the earth's atmosphere and to determine the orbital elements of faint meteors[1,2]. Comparison of these data with the results of photographic observations of bright meteors indicates substantial differences between bright and faint ones.

During the approach of the Leonid meteor swarm to the earth in 1965—1967, Turkmenian astrophysicists obtained a great wealth of material from photographic and telescopic observations of the glowing trains of the meteors and their drift. Spectra of the meteor trains were obtained. Reduction of these spectra indicated that most of the emission is in the yellow and red parts of the spectrum, and several emission lines were resolved[3].

Electrophotometric investigations of the atomic-oxygen emission lines at λ 5577 Å and λ 6300 Å in the intrinsic luminescence of the upper atmosphere made it possible to establish morphological features of the emission-line strengths and to investigate their diurnal and seasonal variations and their relation to geomagnetic activity and lunar tidal phenomena in the atmosphere. A peculiarity of the λ 5577 Å emission is the presence of space-time inhomogeneities in the distribution of the emission intensities over the celestial vault. The shape, dimensions, and strength of the inhomogeneity luminescence experience rather rapid changes in time[4].

The kinetic temperature of the atmosphere at heights of 250—300 km was determined by measuring the profile of the λ 6300 Å emission on a Fabry-Perot interferometer. Its value at night during magnetically quiet periods is 700—1500°K, with minima around local midnight. At times of geomagnetic disturbances, the upper atmosphere heats up sharply, with a simultaneous increase in the strength of the emission[5].

Spectrographic observations of the rotational-vibrational bands of hydroxyl in the skyglow brought out short-period variations in the intensity of the emission. The average rotational temperature of the OH molecule is 240°K.

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A. Ashirov, A. V. Anikin, O. Gandymov, and A. S. Vasilevskaya. Results of X-ray Structural and X-ray Spectral Investigations of Certain Compounds.

Research on the topic "Formation and Structure of Crystals" is being conducted in two trends at the Physico-technical Institute of the Turkmenian Academy of Sciences: deciphering the atomic structure of crystals and experimental and theoretical study of fine structure in the x-ray absorption spectra of metals and metallic alloys.

In the first trend, the monoclinic structure of the hydrated magnesium borate inderite $Mg_2B_6O_{11} \cdot 15H_2O$ was exhaustively resolved by direct determination of the signs. Especially characteristic for the deciphered structure are the discrete neutral complexes $MgB_3O_3(OH)_5 \cdot 4H_2O$, in whose composition, in turn, the "island" anion trinuclear radical $[B_3O_3(OH)_5]^{-2}$ is distinguished; the "molecular" complexes are combined into a single structure by hydrogen bonds.

The doubts that existed as to the summetry of hydroboracite $CaMg[B_3O_4(OH)_3]_2 \cdot 3H_2O$ were eliminated, and its monoclinic structure was fully deciphered. The efficiency of two-stage harmonic analysis with Fourier syntheses of higher symmetry in the presence of pseudosymmetry in Patterson syntheses was demonstrated. Colemanite-type $[B_3O_4(OH)_3]_n^{-2n}$ boron-oxygen chains emerge most characteristically in the structure of hydroboracite and are bound into a single architectural motif by parallel chains of Mg octahedra and columns of Ca octagons. The heavy-atom method was used to determine the crystal structure of p-veatchite $Sr_2[B_5O_8(OH)]_2 \cdot B(OH)_3 \cdot H_2O$. For the first time, boron-oxygen radicals $[B_5O_8(OH)]_n^{-2n}$ that are infinite in two dimensions were identified in the structure of this hydrated borate. It was established that witschite and p-veatchite are two dimorphic modifications whose structures are composed of identically constructed boron-oxygen network layers and differ only in the relative arrangement of these layers. Insular triangular boron-oxygen complexes $B(OH)_3$ are present simultaneously in the structures of these minerals. These first known mixed borates permit an expansion of the borate classification scheme by addition of a fifth class of "mixed borates," the first representatives of which must be recognized in the witschite and p-veatchite that we have deciphered...

The crystal structure of the n-hydroxy isomer of cyclohexyl-o-cresyl ketone was determined by a direct method. It was established that the packing of the molecules forms endless chains in which the molecules are bound crystallographically to one another at planes of glancing reflection. Formation of the chains is explained by the presence of intermolecular hydrogen bonds O—H...O of length 2.70 Å.

In the second trend, a number of studies of the fine structure of x-ray absorption spectra have been carried out. The K, L_I, L_{II}, and L_{III} absorption spectra of metallic silver and the absorption spectra of silver and zinc in the α, β, and ϵ phases of the silver-zinc system have been studied experimentally. Basically, the experimental spectra obtained agree with those calculated by the "short-range-order" theory. This theory was generalized to the case of the L_{II} and L_{III} spectra; a formula was derived for calculation of the relative L_{II} and L_{III} coefficients for the absorption of x-rays by the crystal lattices. Further, this theory was applied for the first time to the binary metallic alloys Ag—Zn and Cu—Zn and to the spectra of relatively heavy metals (Pb, Ag, Cd, In). The "short-range-order" theory made it possible to ascertain the basic laws governing the x-ray absorption spectra of the metals and alloys studied.

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V. M. Agranovich and V. L. Ginzburg. Scattering of Light with Formation of Excitons.

The classical method of studying exciton spectra is to obtain absorption spectra. Some data can also be obtained from measurements of the frequency dependence of the refractive index. Finally, as far as the optical methods are concerned, dispersion curves for excitons (the dependence of their frequency $\omega_l(\mathbf{k})$ on the wave vector $\mathbf{k}$) can be found in a number of cases by investigating Raman scattering of light in crystals with exciton formation. The latter method has recently been undergoing steady development as a result of the efficiency of using laser light for these purposes[1]. The Raman-scattering method has actually made it possible[2] to obtain a very definite indication of the existence of a "new" (third) normal wave[3-5] in a gyrotropic crystal (quartz), one that has not yet been observed by other methods. In addition to the problem of the "new" wave, the paper, which is based on[6], discusses the general theory of Raman scattering of light in crystals with formation of excitons with allowance for absorption (in particular, the authors discuss the so-called polaritons or real excitons, which correspond to exact solutions (normal waves) of the homogeneous electromagnetic-field equations; for details see[4]). Special attention is given to Raman scattering of light with formation of surface excitons (polaritons).

It may be supposed that the Raman-scattering method will be developed vigorously and turn out to be one of the most effective ways to study various optical bulk and surface excitons and spatial dispersion in crystals, as well as in other media (liquid crystals, amorphous bodies, polymer formations, inhomogeneous structures of the layered-compound type, etc.).

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G. A. Smolenskiĭ. Certain Problems in the Physics of Nonmetals.[1)]

1. Magnetooptical phenomena in magnetic semiconductors and dielectrics. The discovery of coherent light sources, the preparation of transparent magnetically ordered materials, and progress in the technique of growing them have given powerful impetus to the development of optical and magnetooptical research[1-3]. It is a well-known fact that this research yields a wealth of information on the energetic structure of crystals. Types of elementary excitations that are associated with exchange interaction can also be brought out in magnetically ordered crystals in this way.

A number of new optical phenomena were predicted: the Cotton-Mouton effect in antiferromagnetics, the Faraday effect in an electric field in magnetoelectrics and under pressure in piezomagnetics.

An unusually large magnetooptical effect, quadratic in the magnetization, has been observed and explained by taking exchange interactions into account.

It is shown that magnetically ordered crystals constitute a gyroanisotropic medium, since the Faraday (gyrotropy) and Cotton-Mouton (anisotropy) effects are comparable in magnitude.

Features of the optical indicatrices of magnetic crystals are studied, and it is shown that these crystals are generally optically biaxial. The positions of the optical axes depend strongly on temperature in many crystals. Anomalies in light scattering and the magnetooptical effects are observed at the points of magnetic phase transformations (Curie, Neel, Morin, and magnetization cancellation).

2. Hypersonic waves in nonmetallic crystals. The production of hypersonic waves in crystals is associated with the name of K. N. Baranskiĭ (Moscow State University, 1957).

Measurements of the frequency and temperature dependences of hypersonic-wave attenuation were made in

*In his paper, the author was concerned principally with those divisions of solid-state physics that are being developed in the Institutes of the Turkmenian Academy of Sciences.