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.

various types of crystals over a broad range of temperatures and frequencies. It was found that the attenuation of elastic waves is well described by the Akhiezer mechanism in all crystals. Among other things, it was shown that injection of impurities into the crystal lowers the attenuation.

One of the possible mechanisms of elastic-wave attenuation in crystals is their interaction with the free carriers. It is shown that the experimental results are in good agreement with the theory of V. L. Gurevich.

The interaction of elastic and spin waves in magnetically ordered crystals has been studied in detail. A new phenomenon—natural magnetoelastic resonance, a resonant interaction between elastic and spin waves in the absence of an external field—was detected in the internal fields of the magnetocrystallographic anisotropy. The acoustic Faraday and birefringence effects in magnetic crystals were investigated.

The generation of acoustic harmonics was studied, yielding information on the anharmonicity of the interaction forces in the crystals and its third-order elastic moduli. The appearance and development of this trend is associated with the name of V. A. Krasil'nikov (Moscow State University).

The phenomenon of diffraction of light on hypersonic waves is useful in the study of various crystal properties. The case in which scattering of light on elastic waves is attended by rotation of the polarization plane of the light proved highly interesting. There are two possible scattering geometries in an optically anisotropic crystal at a given elastic-wave frequency: two angles of incidence and two angles of diffraction.

Study of the velocity and attenuation of sound waves in crystals can yield useful information on the nature of phase transformations and on the so-called "soft" modes[4].

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U. Kh. Kopvillem, V. N. Osipov, B. P. Smolyakov, and R. Z. Sharipov. Analogs of Electron Spin Echo in Ferroelectrics and Glasses.

E. K. Zavoĭskiĭ's discovery of electron paramagnetic resonance[1] resulted in the rapid development of resonance methods for the study of condensed media. Nuclear spin echo, which was detected by E. Hahn[2] by the nuclear spin induction method developed theoretically and experimentally by F. Bloch[3], occupies a special position among these methods of studying matter. The high promise of the use of spin-echo technique in electronic systems was defended theoretically in[4,5] and confirmed experimentally in[6,7]. The possibility of using sound to excite the spin echo was investigated in[8,9]. Then the proposition that all of the observed resonances in matter can be studied in greater detail by observing the spin-echo-type signals corresponding to them was demonstrated theoretically[10]. A method of selecting the appropriate external coherent fields for excitation of these signals was also indicated. Signals of the spin-echo type were indeed observed in ferromagnetics[11,12], on Landau levels[13,14], and in optical systems[15,16].

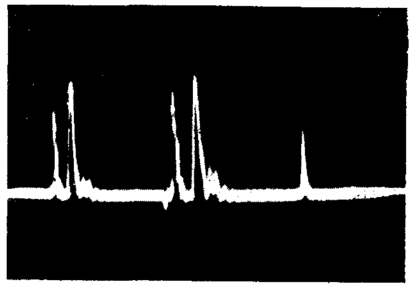

FIG. 1. Oscillogram of echo signal in KH_2PO_4 single crystal at 4.2°K. After each exciting pulse (narrow spikes), we observe a sequence of hypersonic pulses reflected from domain walls. The echo signal follows the second hypersonic signal at an interval $\tau \sim 10^{-6}$ sec. The abscissa is signal amplitude.

Observation of a signal of the spin-echo type on fluxoids in class two superconductors was reported in[17]. A theoretical analysis indicated[18] that observation of the fluxoid echo also augurs well for the detection of spin-echo-type signals in other systems that have quasi-continuous spectra and in which resonances do not occur on a change in the static magnetic, electric, and elastic fields, e.g., on the vibrations of domains and their boundaries in ordered states of matter (ferro- and antiferromagnetics, ferro- and antiferroelectrics, ferroelastic systems[19]), on vortex filaments in superfluid helium, and on dislocations in crystals and tubes of channeled optical and acoustic radiation (filaments)[20]. All of the systems enumerated above have definite natural frequencies and can produce spin-echo-type signals. The theory indicates that these signals will exhibit a number of distinctive properties inherent to the cyclotron echo[14]. An investigation of ferroelectric single crystals at 4.2°K using electronic spin-echo apparatus[21] led to the detection of electrical analogs of signals of the ferromagnetic-echo and stimulated-ferromagnetic-echo types at a frequency of 10^{10} sec^{-1} and an exciting-pulse duration of 3×10^{-8} sec[12].

Figure 1 shows an oscillogram of the echo signals in KH_2PO_4. The longitudinal and reversible and irreversible transverse relaxation times were found to be of the order of $T_1 \sim 10^{-5}$ sec, $T_2^* \sim 10^{-8}$ sec, and $T_2 \sim 1.6 \times 10^{-6}$ sec, respectively. Similar signals were observed in single crystals of KD_2PO_4, CsD_2AsO_4, CsH_2AsO_4, RbH_2PO_4, and RbH_2AsO_4, but the signals were absent in $LiNbO_3$ and Rochelle salt.

Basic properties of the signals: 1) When a sample is ground to a powder, the signals from the hypersonic pulses excited in it vanish, but the echo signals persist. 2) The signals are one order higher in strength than electron spin-echo signals from radicals. 3) Signal strength does not change in the range (8.9—9.6) $\times 10^9$ sec^{-1}. 4) The echo is excited by the electric component of the alternating electromagnetic field. 5) In the range from 0—1.2×10^4 G, the signals are independent of the static magnetic field. 6) In the 0—10 kV/cm range, there is no dependence on the static electric field.