Excursion scientific session of the Division of General Physics and Astronomy, Academy of Sciences of the USSR (Sverdlovsk, 21–22 April 1982)

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An excursion scientific session of the Division of General Physics and Astronomy of the USSR Academy of Sciences in observance of the 50th anniversary of the Order of the Red Banner of Labor Institute of Metal Physics of the Ural Scientific Center of the USSR Academy of Sciences was held on 21–23 April 1982. The following papers were presented:

April 21

1. Keynote address by Academician S. V. Vonsovskiĭ, Chairman of the Presidium of the Ural Sientific Center.

2. *E. A. Turov*, Violated symmetry and elementary excitations in solids.

3. *A. A. Samokhvalov*, Active electron-magnon interaction in magnetic semiconductors.

4. *I. M. Tsidil'kovskiĭ*, Gapless semiconductors: A new class of substances.

5. *Ya. S. Shur*, Magnetization reversal of magnetically uniaxial highly anisotropic ferromagnetics.

6. *Yu. A. Izyumov*, Symmetry of magnetically ordered crystals and the scattering of slow neutrons.

7. *S. K. Sidorov*, Neutron-diffraction study of alloys of transition metals with mixed exchange interaction.

8. *B. N. Goshchitskiĭ*, Nonequilibrium state of defective ordered crystals.

9. *S. M. Klotsman*, Structure, properties, and interactions of point defects and their influence on radiation-stimulated phenomena in metals.

April 22

10. *V. D. Sadovskiĭ*, Structural heredity in steel.

11. *V. V. Sagaradze*, Strengthening austenitic nonmagnetic steels by phase surface hardening.

12. *V. I. Syutkina*, New hardening mechanisms of ordered alloys.

13. *V. A. Trapeznikov*, Investigation of the surface layers of solids by electron spectroscopy.

14. *V. E. Shcherbinin*, Magnetic, magnetoelastic, and magnetoacoustic nondestructive quality-control methods.

15. *M. N. Mikheev*, Scientific activity of the Institute of Metal Physics, Ural Scientific Center, USSR Academy of Sciences.

We publish below brief contents of the papers.

E. A. Turov. *Violated symmetry and elementary excitations in solids*. The notion of spontaneously violated symmetry (SVS) is one of the most important concepts of the theory of elementary particles (TEP) on its path toward a unified field theory that encompases various natural forces. Although the SVS concept came into this theory from solid-state physics, the ideas associated with it have now been developed to such a degree that it is helpful in some cases to reapply them to analysis of solid-state physics phenomena.[1–4]

There is a well-known analogy between the Higgs mechanism of formation of mass in the TEP and the Meissner effect in Ginzburg-Landau superconductivity theory.[5] Both effects are consequences of SVS in a system consisting of two interacting subsystems. Situations that are similar in this sense are very frequently encountered in solid-state physics. The existence of acoustic and optical vibration modes in a lattice with a basis or in a multisublattice magnetic can be considered from these premises, as can the bound-vibration spectra of electron and nuclear spins in magnetically ordered crystals. The paper, however, focuses on the spectrum of the bound magnetoelastic (ME) vibrations in such crystals. A result of SVS on magnetic ordering with consideration of the spontaneous ME deformations

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is that even in an isotropic magnetic (and as $H \to 0$), one of the branches of the spectrum (the quasimagnon branch) acquires a gap, and the quasiphonon branch associated with it softens to the degree that the elastic modulus corresponding to it vanishes. The gap ME effect, which is analogous in this sense to the Higgs effect, was discovered experimentally[6] and explained theoretically[6,7] even before the Higgs effect.

In anisotropic magnetics, SVS ME effects are manifested in pure form only near the points of magnetic (orientational) phase transitions, at which the ground state of the system is either quasidegenerate or unstable. Phase transitions were examined in Ref. 3 as functions of temperature, field, and pressure in ferro- and antiferromagnetics of various types.

Effects related to violation of translational symmetry, which are governed by domain boundaries (DB) in magnetic crystals,[1,2,8] were also discussed. New ME resonances of DBs, resonant generation of hypersound by oscillating DBs, and other effects were predicted.

[1]E. A. Turov and A. A. Lugovoĭ, USSR Academy of Sciences Ural Scientific Center Institute of Metal Physics Preprint No. 79/1. Sverdlovsk, 1979; Fiz. Met. Metalloved. **50**, 717 (1980).

[2]E. A. Turov, G. G. Taluts, and A. A. Lugovoi, J. MMM **15-18**, 582 (1980).

[3]E. A. Turov and V. G. Shavrov, USSR Academy of Sciences Ural Scientific Center Institute of Metal Physics Preprint No. 81/1. Sverdlovsk, 1981 (A complete bibliography is given in this paper.)

[4]E. A. Turov, in: Élektronnaya struktura i svoĭstva tverdykh tel. (Electronic Structure and Properties of Solids). Sverdlovsk, USSR Academy of Sciences Ural Scientific Center, 1982, p. 49.

[5]D. A. Kirzhnits, Usp. Fiz. Nauk **125**, 169 (1978) [Sov. Phys. Usp. **21**, 470 (1978)].

[6]A. S. Borovik-Romanov and E. G. Rudashevskiĭ, Zh. Eksp. Teor. Fiz. **47**, 2095 (1964) [Sov. Phys. JETP **20**, 1407 (1965)].

[7]E. A. Turov and V. G. Shavrov, Fiz. Tverd. Tela (Leningrad) **7**, 217 (1965) [Sov. Phys. Solid State **7**, 166 (1965)].

[8]E. A. Turov and A. A. Lugovoĭ, Pis'ma Zh. Eksp. Teor. Fiz. **31**, 308 (1980) [JETP Lett. **31**, 283 (1980)].