Physics – Uspekhi **42** (4) 407 – 408 (1999)

PERSONALIA

PACS number: **01.60.+q**

In memory of Georgiĭ Sergeevich Krinchik

Georgiĭ Sergeevich Krinchik
(06.08.1927 – 05.12.1998)

Professor of Moscow State University, Georgiĭ Sergeevich Krinchik, a widely known magnetologist, the founder of the modern optics of ferromagnets, died on December 5th, 1998. Georgiĭ Sergeevich was born to the family of an accountant and a school teacher on August 6, 1927 in the village Brozha of the Mogilev region (in Byelorussia). During World War II he fought against occupation as a guerrilla in Byelorussia, took part in the 'war of rails' and received the 'For Victory over Germany' medal. He entered the physics faculty of Moscow State University in 1945, specialized in magnetism and graduated in 1950. The same year Krinchik was called up for military service; in the army he served for three years as an army representative (quality control officer) in industry. In the 1950s he worked on his thesis for Candidate of Physicomathematical Sciences, which he successfully defended in 1954. Having demobilized after the Candidate degree was conferred on him, Krinchik joined the department of magnetism of the Physics Faculty of the M V Lomonosov Moscow State University and worked there for the rest of his life.

G S Krinchik made a decisive contribution to the magnetooptics of ferromagnets. He was able to establish experimentally that the specific rotation of the plane of polarization in light-transparent ferromagnetic garnets does not tend to zero as the light wavelength increases — this behavior was expected before his study — but remains constant, at the level of several tens of degrees per centimeter. The frequency-independent rotation of the polarization plane in ferromagnets is determined by the off-diagonal component of the permeability tensor at infrared frequencies, which is a consequence of the ferromagnetic and exchange resonances, or the precession of the magnetic moment in the magnetic field of the light wave. In the near-infrared frequency range, ferromagnetic garnets are bigyrotropic media in which off-diagonal tensor components of the dielectric and magnetic constants provide comparable contributions to the rotation of the plane of polarization. These results led to the rejection of the accepted opinion that the permeability of ferromagnets in the optical frequency range is identically unity, and were registered as a discovery.

In his subsequent work, the sign reversal of the Faraday effect was discovered at the compensation point of ferrimagnets. This was a direct proof that the magnetic moments of sublattices reverse their orientation at the compensation point, and thus provided confirmation of the Néel theory of ferrimagnetism. A Zeeman triplet was detected in the infrared absorption spectrum of ferrimagnetic-garnet trivalent europium, split by the exchange field of hundreds of kilooersted that acts on these ions from the side of iron sublattice. This splitting is the cause of the exchange resonance Faraday rotation of the polarization plane and was not discussed previously as the mechanism of this phenomenon.

Uspekhi Fizicheskikh Nauk **169** (4) 475 – 476 (1999)
Translated by V I Kisin

In the visible and infrared spectral ranges, it was shown that the magnetic field greatly influences the Faraday effect, linearly reducing it with increasing field.

Krinchik and his co-workers developed a phenomenological theory of magnetooptic effects in bigyrotropic ferromagnets. The theory demonstrated, among other things, that the equatorial Kerr effect in a gyroelectric medium is nonzero if the electric field of the light wave is perpendicular to the magnetization vector. This effect was used to study magnetooptic properties and the electronic structure of ferromagnetic metals and alloys. In a gyromagnetic medium, the equatorial Kerr effect is nonzero if the magnetic field of the light wave is perpendicular to the magnetization vector. This effect was detected experimentally in ferromagnetic nickel. The off-diagonal component of nickel's permeability tensor at optical frequencies was measured in the experiment and proved to be in excellent agreement with the values calculated using the Landau–Lifshitz equations of motion of magnetic moments, as was the case for transparent ferromagnets.

Krinchik showed that observing the specific properties of the energy spectrum using magnetooptical techniques was considerably easier than by light reflection methods. The signs of magnetooptical effects depend on the signs of the electron spin. The magnitude of the exchange splitting in ferromagnetic nickel was first examined by magnetooptical methods and was later confirmed in experiments that measured the Fermi surface in Ni. On the basis of magnetooptical experiments, a model of the electronic structure of nickel was proposed, with an arrangement of levels that was reversed in comparison with convention. Nowadays this model of ferromagnetic nickel is universally accepted.

The phenomenon of surface magnetism was then discovered experimentally. The symmetry of the environment of magnetic ions on the surface of a sample differs from that in the bulk. It may seem that the magnetic structure would be rearranged in the first atomic layer only. In fact, the exchange interaction makes this perturbation propagate into the bulk of the crystal. The subsurface region is thus magnetically reconstructed, which produces the surface magnetism predicted earlier by theoreticians.

The thickness of the layer in which magnetooptical effects are formed (measured by reflection techniques) was found to be drastically smaller than the depth of penetration of light into a ferromagnetic metal.

In addition to studies in fundamental magnetooptics, G S Krinchik paid much attention to problems of applied magnetooptics, including light modulation, domain and domain boundary structures, and especially the application of magnetooptical effects to analyze magnetic fields in microscopic volumes (magnetooptical micromagnetometer). A description of such an instrument that would record magnetic fields in a volume of $10^{-13}-10^{-14}$ cm^3 and the results of measuring the distribution of the horizontal and vertical components of the magnetic field in magnetic recording heads were published by G S Krinchik with his co-authors more than 30 years ago. More than 15 years later, the instrument was repeated at IBM, where it works successfully even now. It is used to study magnetic fields in the newest film magnetic heads for superhigh-density recording of data.

For many years Georgiĭ Sergeevich read brilliant lectures to students and postgraduates on magnetism and magnetooptics. His monograph *Physics of Magnetic Phenomena*, which went through two editions, is well known in Russia and in the West. Not a few people remember the schools on magnetooptics that Georgiĭ Sergeevich Krinchik founded and conducted. He was the founder of the modern school of magnetooptics of ferromagnetics; he loved art, books, sport, had an excellent sense of humour, was an optimist and thought highly of his friends. That was what we saw in him, and this is how he will live in the hearts of the people who knew him.

A F Andreev, K P Belov, Yu V Gulyaev,
A B Granovskiĭ, V A Magnitskiĭ, V P Maslov,
V V Migulin, Yu A Osip'yan, V I Trukhin,
M V Chetkin, V G Shavrov, I A Yakovlev