Physics – Uspekhi **59** (9) 937 – 938 (2016)

PERSONALIA

PACS number: **01.60.+q**

In memory of Lyudmila Andreevna Prozorova

DOI: 10.3367/UFNe.2016.08.037887

A Corresponding Member of the Russian Academy of Sciences (RAS) and one of the oldest research scientists at the Kapitza Institute for Physical Problems of RAS, Lyudmila Andreevna Prozorova, passed away on 27 April 2016.

Lyudmila Andreevna worked in science for more than 60 years. She became the author of many brilliant experimental studies in the field of the physics of magnetic phenomena and low-temperature physics.

Lyudmila Andreevna was born in Moscow on 8 October 1928 in a family belonging to Moscow intelligentsia. Her grandfather was a well-known psychiatrist, her father was a physician, and her mother was a teacher and director of a secondary school. Her young years passed during the Great Patriotic War. At that time, she lived with her mother in evacuation in the town of Vyatskie Polyany not far from Kazan. After finishing secondary school back in Moscow, she entered the Faculty of Physics of Lomonosov Moscow State University (MSU). Then, beginning with the undergraduate practice and to the end of her life, she worked at the Institute for Physical Problems (IPP) of RAS.

Lyudmila Andreevna's scientific supervisor was one of the founders of Soviet low-temperature physics, A I Shal'nikov, and her work in the laboratory was under the guidance of M S Khaikin, who was engaged in extremely accurate and highly sensitive measurements of the microwave properties of metals.

Lyudmila Andreevna told the following story about her graduate work. When a complex setup was ready, one of the glass parts was accidentally broken and the planned measurements could not be performed on time. A possible way out was discussed, and L D Landau suggested high-accuracy measurements of the helium dielectric constant at low temperatures on M S Khaikin's microwave devices and the possibility of obtaining a very pure helium which does not contain impurities at low temperatures. Thus, measurement of the dielectric constant of gaseous helium with an accuracy of 10^{-7} became the subject of her successful graduate work and the first paper by Lyudmila Andreevna published together with M S Khaikin in 1952 in the *Journal of Experimental and Theoretical Physics* (*JETP*).

Further on, Lyudmila Andreevna exploited the methods of resonance microwave spectroscopy in preparing her Candidate of Sciences thesis under the guidance of A I Shal'nikov and M S Khaikin. In this work, high-accuracy superhigh-frequency (microwave) measurements were used for one of the first high-frequency studies of superconductors at energies comparable to the energy gap in the superconductor's spectrum. Lyudmila Andreevna always considered the possibility of working at the IPP (in 'Physproblems') on the team of remarkable scientists and friends to be a good fortune. It was as if the fate prompted her to get into 'the best place on Earth', as she thought of the IPP.

Lyudmila Andreevna Prozorova
(08.10.1928 – 27.04.2016)

After defending her Candidate's degree thesis, Lyudmila Andreevna worked for some time together with P L Kapitza designing and testing microwave elements for high-frequency high-power devices.

After that, she was long engaged in the study of the dynamic properties of antiferromagnets using microwave techniques. It is this work, and in the first place fundamental investigations of antiferromagnetic resonance, that ranks among the basic scientific achievements of Lyudmila Andreevna. Together with A S Borovik-Romanov and N M Kreines, she observed magnetic resonance in antiferromagnetic crystals with 'easy-plane' anisotropy in which the spin-wave spectrum is gapless. The lack of energy gap makes possible the study of different weak interactions becoming apparent in magnetic resonance spectra. Here are L A Prozorova's most prominent results, which found their place

Uspekhi Fizicheskikh Nauk **186** (9) 1029 – 1030 (2016)
DOI: 10.3367/UFNr.2016.08.037887
Translated by M V Tsaplina

among the most significant work on antiferromagnetism: an experiment on inducing antiferromagnetic order by a magnetic field in an antiferromagnet with weak ferromagnetism, the observation of mutual repulsion of intersecting spin-wave branches, and the discovery of the energy gap due to the interaction of electron and nucleus spins (the so-called 'hyperfine' gap). In this work done in the 1970s, Lyudmila Andreevna successfully extended the range of microwave measurements to the millimeter-wave and submillimeter-wave regions.

Even more widely known is Lyudmila Andreevna's work on 'parallel pumping' of spin waves in antiferromagnets. She applied this method of parametric excitation of short spin waves by uniform pumping to study spin-wave interactions with other quasiparticles and to create a strongly non-equilibrium spin system. This resulted in some unusual observations. In particular, negative nonlinear magnon damping was revealed: the magnon lifetime in a strongly excited antiferromagnetic spin system proved to be much longer than that in the equilibrium low-temperature state. This unexpected effect was successfully employed in the original experiment on the detection of magnons propagating from one end of an antiferromagnetic rod to the other. The 'arriving' magnons prolonged the lifetime of other magnons, thus revealing themselves. In this series of studies, the mutual magnon attraction was also fixed and the energy distribution function of magnons in the regime of strong excitation was examined. Lyudmila Andreevna's series of studies on the parametric excitation of spin waves (1970–1990) is well known to those who investigate spin dynamics and nonlinear wave media.

Later on, Lyudmila Andreevna was engaged in research on low-dimensional and frustrated spin structures with properties greatly differing from what was expected from the classical point of view, in particular, antiferromagnets with the so-called 'triangular' ordering. The experiments examining microwave spectra, magnetization curves, and the influence of impurities on spin structure allowed revealing a whole number of effects and specific magnetic phases in which zero quantum spin fluctuations and frustration of exchange interaction show up.

During her work, Lyudmila Andreevna taught many students for whom she not only was a teacher and scientific supervisor but became a kind and reliable friend for life. The students and youth always felt Lyudmila Andreevna's support. Her guidance (she was a tutor of 14 students working on graduation theses) never displayed strict requirements and commands, but was always effective. Many became candidates and doctors of sciences and work in various physical laboratories in Russia and abroad.

Lyudmila Andreevna had many friends, including childhood friends, fellow students, colleagues from various institutions and cities, neighbors and, of course, those at the IPP — these were people of all generations — from students to veterans of Physproblems. Everybody at the Institute went the extra mile for her, and she found common interests with different people of any age and any specialty. And everybody loved her. Many called her simply Mila. Her many talents made her an interesting interlocutor for experts in physics, mathematics, classical music, bard songs, and theatre. Her stories about the history and life of the IPP were always attractive and surprising for their unusual and original plots. Her kindness and worldly wisdom were prepossessing. She attracted many people with her infatuation for music, theatre, and painting. For the research group of Lyudmila Andreevna, the trips to conferences in other towns were always accompanied, owing to her enthusiasm, by a strong cultural program with visiting theatres, philharmonics, museums, and places where something extraordinary and splendid was going on at the moment. She always knew where the offices for bying tickets were situated in different towns and quickly learnt from her friends in these places what interesting things were on at the moment. She always wanted to travel and was eager up to the last year of her life. The 2015 Spin-Wave Conference in St. Petersburg could not for the world have been missed. And the same with the trip to Spain as a tourist.

Lyudmila Andreevna had a very good family. Together with her husband Marat Ivanovich Adamovich, the well-known physicist engaged in elementary particle physics, she brought up two daughters. She had four grandchildren and ten great-grandchildren. All generations of this large united family inherited talent, diligence, and disposition to exact sciences.

In her last two years, Lyudmila Andreevna wrote excellent autobiographical notes about the years of her childhood, her youth, and her first steps in science, and she distributed these notes among her inner circle, sending them to disciples and friends. These are captivating and sincere private pages about the beginning of her long, difficult, and brilliant life. She wrote ironically about herself and gave many report-like exact sketches from the middle of the 20th century and from the history of the IPP.

The memory of Lyudmila Andreevna Prozorova will forever remain in the hearts of her students, colleagues, and friends. The sound of her voice will long be remembered in Physproblems.

A F Andreev, G D Bogomolov, S S Gershtein, I E Dzyaloshinskii, V V Kveder, N M Kreines, V I Marchenko, L P Pitaevskii, M P Ryutova, L E Svistov, A I Smirnov, S S Sosin