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Lyudmila Andreevna Prozorova (on her 80th birthday)

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Lyudmila Andreevna Prozorova, Corresponding Member of the Russian Academy of Sciences and outstanding physicist-experimentalist in the field of microwave spectroscopy of condensed matter, whose works contributed much to the development of the modern concepts of superconductivity and magnetically ordered structures, celebrated her eightieth birthday on October 8, 2008.

Lyudmila Andreevna was born in Moscow into a family with long-standing scientific traditions. Her grandfather, L A Prozorov, was a prominent scientist, one of the founders of psychiatry in Russia and the Soviet Union; her mother, Nina Adamovna, was a high school principal. L A Prozorova's school years came at the time of the Great Patriotic War; together with her mother, Lyudmila Andreevna was evacuated from Moscow. After they returned to Moscow in 1946, she joined the Physics Department at Moscow State University. In 1952, she graduated from the university after she completed her graduation thesis "Measurements of the permittivity of gaseous helium at microwave frequencies" at the Chair of Low-Temperature Physics, Moscow State University, and at the Institute for Physical Problems, USSR Academy of Sciences, under the guidance of A I Shal'nikov and M S Khaikin.

Her life since then has been closely tied with the Institute for Physical Problems. She completed her postgraduate studies there and later worked with many outstanding scientists such as P L Kapitza, A I Shal'nikov, M S Khaikin, A S Borovik-Romanov, and many others. There she also prepared many of her students. In her experimental investigations in the fields of microwave electronics, superconductivity, and physics of magnetic phenomena she successfully used the broad experience obtained in the laboratories headed by M S Khaikin and P L Kapitza.

L A Prozorova's candidate dissertation was devoted to the investigation of the surface impedance of superconductors at frequencies in the centimeter range. The results obtained in her dissertation were among the first in which the resistive response of superconductors was observed.

Later on, Lyudmila Andreevna worked in Kapitza's laboratory where she dealt with the development and experimental study of elements of large-power microwave devices, in particular, with convertors of electromagnetic waves in waveguides. Of this series of works, the investigation of a spider converter of wave modes in a cylindrical waveguide is most widely known, which was performed in cooperation with P L Kapitza.

In the 1960s, L A Prozorova joined in the research of antiferromagnets that was being performed under the leadership of A S Borovik-Romanov. Lyudmila Andreevna turned

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to the experimental study of spin dynamics of antiferromagnets using microwave spectroscopy. With her active participation, many pioneering results have been obtained in this most important field of magnetism; in particular, the phenomenon of antiferromagnetic resonance in easy-plane antiferromagnets characterized by a gapless mode of spin excitations was discovered. Her work concerning the discovery of magnetic-field-induced antiferromagnetism in weak ferromagnets, the detection of a gap in the spectrum of spin oscillations that is determined by the coupling between electron and nuclear spins, etc., is part of the classic collection of work on antiferromagnetism.

The series of brilliant work by L A Prozorova in the field of nonlinear spin dynamics of antiferromagnets is also widely known. She was the first to observe the parametric excitation of spin waves in antiferromagnets utilizing the method of so-called 'parallel pumping'. This approach makes it possible to excite short-wavelength spin waves via uniform microwave pumping at a frequency corresponding to a doubled magnon frequency. The parametric excitation of spin waves in antiferromagnets proved to be an efficient method of study-

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ing spin waves and other elementary excitations. In an elegant experiment on the observation of the intersection of magnon and phonon spectra, she successfully determined the velocity of spin waves.

Studying the strongly excited spin system of an antiferromagnet, in which the level of excitation of parametric spin waves exceeds the thermal level by many orders of magnitude, became a separate theme of investigations into nonlinear spin dynamics. Some results obtained by L A Prozorova in this field are of fundamental importance. For example, she revealed that the damping of spin waves decreases strongly at high excitation levels (so-called negative nonlinear damping). The discovery of the phenomenon of negative nonlinear damping raised the question of the mechanism for restricting the number of parametrically excited magnons, since in the simple theory this restriction was supposed to be related to a damping enhancement at a large amplitude.

It has been established by precision measurements of high-frequency magnetic susceptibility and observations of the response to a rapid change in the phase of microwave pumping that in an antiferromagnet the so-called 'phase' mechanism of restriction predicted by V E Zakharov, V S L'vov, and S S Starobinets for nonlinear wave systems is realized in an ideal way. In this case, the restriction of the excitation level occurs in a dissipationless manner, via the phase detuning of the spin system with respect to the microwave pumping.

Another distinctive feature of the nonlinear regime that develops in the presence of phase mechanism is an extremely narrow spectral width of the excited packet of spin waves. In a specially arranged experiment, L A Prozorova detected electromagnetic radiation emitted by parametric magnons. An analysis of the spectral composition of this radiation confirmed the theoretical predictions on the delta-like character of the excited packet of spin waves.

In experiments on parametric excitation, L A Prozorova also obtained many other original results. For example, she measured the amplitude of the dissipationless interaction of magnons that is equivalent to attraction; observed collective excitations similar to second sound in the gas of magnons, etc. Among the most brilliant experiments in this field, we can mention the observation of the propagation of packets of parametric magnons from one microwave resonator into another, with an original scheme of detecting 'incoming' magnons with the employment of the negative nonlinear damping effect.

In the 1990s, L A Prozorova, in cooperation with her students, explored exotic antiferromagnetic structures arising in crystals with a triangular lattice and a lowered dimensionality of the spin subsystem. A partial frustration of the exchange interaction and the quasi-one-dimensionality of the spin structure lead here to the development of an unusual 'triangular' ordering with a noncollinear orientation of spins and strong quantum reduction of spin. L A Prozorova was the first to measure the spectrum of antiferromagnetic resonance of a new type in triangular antiferromagnets. Using a magnetic resonance method, she revealed specific phase transitions with a spin reorientation of a three-sublattice spin structure. In triangular quasi-one-dimensional antiferromagnets, L A Prozorova discovered an anomalously strong influence of impurities on the order parameter and ordering temperature. This effect was explained as being due to the strong influence of quantum fluctuations in quasi-one-dimensional systems.

In recent years, L A Prozorova and her students have been engaged in the investigation of strongly frustrated spin systems in crystals with a specific structure that ensures the formation of spin-liquid ground states.

Over the entire time of working at the P L Kapitza Institute for Physical Problem, RAS, L A Prozorova has always been surrounded with students and young researchers with whom she willingly shares her wide experience in physical investigations and interest in science. The scientific school headed by L A Prozorova is well known in all centers in Russia and abroad where low-temperature and magnetic laboratories exist. Among her students, there are many candidates and doctors of science.

L A Prozorova and her many disciples are in constant scientific contact and fruitful cooperation. Over many years, L A Prozorova was engaged in teaching students at the Chair of Low-Temperature Physics at the Moscow Institute of Physics and Technology. At present, she is chair of the 'Magnetism' Section of the Scientific Council of the Russian Academy of Sciences on the Problem of the 'Physics of Condensed Matter'. Since 1990, L A Prozorova has continuously been a Secretary of the Scientific Council of the P L Kapitza Institute for Physical Problems, RAS.

Her colleagues, friends, and students all wish L A Prozorova the best on this jubilee and wish her sound health, fruitful work, and happiness.

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