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PERSONALIA

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In memory of Aleksandr Fedorovich Andreev

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The remarkable theoretical physicist, academician of the Russian Academy of Sciences (RAS), vice-president of RAS from 1991 to 2013, director of the P.L. Kapitza Institute for Physical Problems (IPP) RAS from 1990 to 2017, editor-in-chief of *Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki ZhETF*) (the *Journal of Experimental and Theoretical Physics* (*JETP*)) from 1997 to 2022 and the journal *Priroda* (*Nature*) from 1998 to 2020, Aleksandr Fedorovich Andreev, died on March 15, 2023.

Aleksandr Fedorovich (AF) was born on December 10, 1939 in Leningrad. By his own admission, as a schoolboy, AF had not heard of either Landau or Kapitza, despite the physics craze at that time. A remark his father made about the Moscow Institute of Physics and Technology (MIPT, Fiztekh or PhysTech) turned out to be decisive. After finishing school with a gold medal in 1956, AF became a student in the 622nd group of the radio physics department of MIPT. It was a fateful choice, for it was at Fiztekh that AF met his lifelong partner and found his true vocation, which began, when he was a first-year student, with the concept of derivative, which he 'liked very much.' In general, the highest praise from AF was that he liked some idea very much.

Already in 1957, AF came to IPP for the theoretical minimum examination. He considered 1959 the beginning of his scientific activity when after the last exam L D Landau insisted that he graduates from MIPT ahead of schedule, a year and a half earlier than his fellow students. AF more than compensated for his shortened student life when working at MIPT: he was the chair of the coordination council and the head of the IPP-based chair, supervising students and postgraduates. In the lectures he delivered over many years, students could get the real 'taste' of theoretical physics. In 1961, AF entered the IPP postgraduate program and in 1963 took an active part in organizing the first All-Soviet-Union Symposium in Bakuriani, devoted to superfluidity and superconductivity. Subsequently, this symposium was held regularly until the collapse of the USSR. In 1964, AF defended his candidate thesis, "The features of heat transfer at low temperatures."

AF considered Landau to be his teacher, whom he always remembered with great love and respect and whose work he successfully carried forward. The similarity of their styles is clearly seen in the choice of problems worthy of consideration and appropriate methods to solve them. The preference for a general phenomenological description instead of a model one, the ability to distinguish the main effect and not to digress for minutiae, the yearning for beauty comprise the message that he left for us. Continuing his teacher's traditions, AF was a universal physicist, and theoretical physics in his work appears as a coherent consistent approach to observed phenomena.

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Translated by N A Tsaplin

Aleksandr Fedorovich Andreev
(10.12.1939 – 15.03.2023)

AF published 66 original papers by himself, one paper together with his research supervisor I M Khalatnikov (see the problem in §77 in volume X of the Course of Theoretical Physics by Landau and Lifshitz) before defending his candidate thesis and one more paper 10 years later; 33 of AF's papers were published with his students and 8 with colleagues. The list of AF's works (see http://kapitza.ras.ru/~andreev/Welcome.html) shows what a wide range of topics he was interested in, namely, superfluidity and solid state, superconductivity and magnetism, Boltzmann kinetics and hydrodynamics, Fermi liquids and Bose condensation, mesoscopics and gravity, thermodynamics and glasses. However, the overwhelming majority of AF's papers, as well as the graduate theses and dissertations of his students, was directly related to experimental studies carried out at IPP.

AF's most famous discovery (which was included in his doctoral thesis defended in 1968) was made during a study of the intermediate state of the superconductor. He showed that many properties of this system are determined by an unusual character of reflection of charge carriers from interfaces between normal and superconducting regions: the change in

the momentum upon reflection is small compared to the momentum itself, while the velocity and charge of the quasiparticles are reversed. Such a 'reflection with a small momentum transfer' (this was what AF himself called Andreev reflection) is now being examined in various systems and is widely used. The popularity of this particular result is presumably due not only to its practical value but also to its apparent simplicity. AF could always find beautiful and simple (as they seemed after his explanation) phenomena.

AF was a welcome guest in the world's leading low-temperature laboratories: in Holland (the birthplace of liquid helium), France, and Great Britain. A long-term collaboration linked AF with Finnish physicists, who considered him to be the 'godfather' of helium-3 rotation research. He was at the center of the world's low-temperature community; neither domestic low-temperature conferences nor the International Conference on Low Temperature Physics took place without him. Another international conference, QFS (Quantum Fluids and Solids), owes its name to the fundamental study by AF and I M Lifshitz on a new class of solids with a noticeable amplitude of zero atomic vibrations. Defects in them (e.g., vacancies) are not localized, but are band quasiparticles.

In 1981, AF became a corresponding member and after six years a full member of the USSR Academy of Sciences. After four more years, he was elected vice-president of RAS. In the period of 2002–2008, he was also an academician-secretary of the Division of General Physics and Astronomy of RAS. AF said that fundamental science is the most important thing in our country. He spared no effort to maintain the great traditions of Soviet and Russian science and was an example of passion and an unconditional devotion to it.

From 1957, AF's whole life was linked with IPP, the place where these traditions had been formed and where, as he said, "the walls give support." In 1984, AF became deputy director and in 1990 director of IPP. AF, a theoretician, managed to be director of a predominantly experimental institute. He found sobering words for both theoreticians ("physics is an experimental science") and experimentalists ("an experiment should fit the correct theory"). Under AF's leadership, the tradition of scientific independence was preserved, which had reigned at the institute since the time of P L Kapitza, the founder and the first director of IPP: everybody can be freely engaged in their interesting task and bring it to a result, and the task of the administration is to help them in this. The same was AF's attitude towards his disciples.

As the administrative workload increased, the time for discussing scientific problems with AF decreased. But the style of communication with his colleagues and disciples remained practically unchanged, and anyone could ask a question of interest and expect clear explanations.

Up to the last days of AF's life, the place for such talks was the coffee club, which had originated back in the 1970s among his friends — experimentalists at IPP: Yu D Anufriev, K O Keshishev, I P Krylov, I L Landau, and A Ya Parshin. In fact, the club now remains a permanently acting colloquium in physics. This is the place where the meetings of IPP's Academic Council and talks at seminars are followed by discussions, and conceptions of future experimental and theoretical work are improved. Many ideas of AF, his colleagues, and disciples were born here, in the eyes of those present. Here is a striking example: the idea of quantum crystallization arose in a conversation between AF and Parshin about the effect of zero oscillations on elementary steps of the helium crystal–liquid interface. A month later, the work was submitted to *ZhETF*, and, in a year, a note appeared in *Pis'ma v ZhETF* (*JETP Letters*) reporting the discovery of crystallization waves, with gratitude to "P L Kapitsa for his interest in the work, A I Shal'nikov for his constant attention and assistance, and to the Institute of Physics Problems Coffee Club for helpful discussions."

A more formal discussion of studies takes place at the IPP Seminar. AF always took an active part in it, and his questions and remarks were often the most interesting part of the talk. Considerations concerning many issues are esteemed both at the institute and far beyond. It was very difficult to out-argue AF at a seminar, but the aim of his criticism was always a constructive search for truth. This dictated his principle of positive citation: only those publications should be cited where a correct result, necessary for your work, was obtained.

AF was conferred the rank of honorary professor at several universities and was a member of academies of sciences of many countries and a laureate of many prestigious scientific prizes, including the international Simon Prize, the P L Kapitza Medal of RAS, and the USSR Lenin Prize.

When asked about the meaning of life, AF once answered: "to enjoy it and give pleasure to others." He was a person of integrity, despising show-offs and all kinds of sciolism. On the other hand, he supported and was sincerely happy for colleagues who 'succeeded.' Indicative was AF's advice to his own grandson, when he was choosing between continuing his chess career and entering a technical institute: "You should try to do what you like and what you do well." AF himself found satisfaction in his creative work until the very last days, enthusiastically used the electronic subscription to leading physics journals, and regularly looked through arXiv. A quarter of a century ago, addressing his friends and colleagues after a 'kapustnik' (skit party) on the occasion of his 60th birthday, he said: "If a person is busy with his favorite thing, if he does what he likes and what works for him, then he is happy. Let everyone keep this feeling of 'happiness,' and then we have nothing to worry about."

Science has lost an outstanding physicist. A wonderful family was left without a beloved and loving man, without an attentive grandfather and an enthusiastic great-grandfather. A colleague and leader, a friend and teacher, has left us.

V V Dmitriev, M Yu Kagan, V G Kamenskii,
E I Kats, V V Kveder, N M Kreines, V V Lebedev,
V I Marchenko, L A Melnikovsky, A I Smirnov,
I M Suslov, I A Fomin, V S Edelman