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PERSONALIA

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In memory of Sergei Dmitrievich Korovin

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Sergei Dmitrievich Korovin, Full Member of the Russian Academy of Sciences (RAS), DSc in physics and mathematics, Chairman of the Presidium of the Tomsk Scientific Center of the RAS Siberian Branch (SB), Director of the Institute of High-Current Electronics (IHCE) of the SB RAS and one of the best specialists in relativistic microwave electronics and the physics and technology of high-current electron accelerators, departed this life, much too soon, on 7 January 2006.

Korovin was born on October 6, 1953 in the town of Belovo of the Kemerovo region, into a family of communication engineers. In 1970, he graduated with highest possible grades from a secondary school in the city of Biisk, and in 1975 graduated from the Physics Department of Novosibirsk State University, majoring in plasma physics.

Korovin's career in research began in 1975 in Tomsk, in the Physical Electronics Department of the Institute of Atmospheric Optics of the USSR Academy of Sciences Siberian Branch. In 1977, IHCE, headed by G A Mesyats, was established at the USSR Academy of Sciences SB, and Korovin transferred to IHCE where he occupied the position of Junior Researcher.

The young research worker unmistakably proved to be a born leader even at that early stage in the life of the Institute. Three years after maintaining his thesis for Candidate of Physicomathematical Sciences, at the age of 30, he became Head of the Physical Electronics Laboratory which later grew to become the Department and one of the largest subdivisions of IHCE. This team of scientists has worked for more than twenty years in two main fields: development of repetitively pulsed high-current electron accelerators, and generation of high-power pulses of microwave radiation.

Korovin led research and development for high-power microwave generators in the millimeter, centimeter, and decimeter wavelength ranges: various versions of the Cherenkov type generator [relativistic backward-wave oscillator, or BWO, double-section BWO – TWT (traveling wave tube) generator, generator without external magnetic field], Smith – Purcell radiation generator, cyclotron-resonance maser (CRM), and relativistic ubitron. The effect of high-frequency stimulated scattering in a relativistic BWO was exposed for the first time.

Korovin was among the ideologues developing and producing repetitively pulsed high-current accelerators of the SINUS family. He led the design and construction of a number of accelerators with record output parameters, including the SINUS-7 accelerator with a mean power of the electron beam of up to 100 kW; it is listed as one of the unique research facilities in Russia. To create these accelerators, efficient methods of converting electric energy were applied, powerful power supply units were developed, new explosive-emission long-lifetime cathodes were proposed, and special systems were developed for the diagnostics and parameter control of high-current charged-particle beams.

Sergei Dmitrievich Korovin
(06.10.1953 – 07.01.2006)

While studying the functioning of the Tesla transformer, which was incorporated into the pulse-forming line of the high-voltage generator in the accelerator and was responsible for the pulsed charging of the line, Korovin was able to formulate the principles of load matching for such pulsed generators. By analyzing the specifics of processes in the gas-filled gap in the high pulse repetition frequency mode, he determined the optimal rate of the working gas forced circulation that sustained the stable generation of pulses at a frequency of hundreds of Hz; his analysis of factors that limited the maximum operating frequency at the generator output made it possible to reach the 1 kHz level. Korovin discovered the effect of mutual screening of emission centers in a system with a tubular explosive-emission cathode — it was established that the number of centers is dependent on the magnetic field strength. He was the first to solve many physical and technical problems involved in generating

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nanosecond gigawatt pulses of microwave radiation, thus preparing the foundation for practical implementations. More than twenty accelerators and accelerator-based microwave generators designed under his guidance are used in a number of research and development centers in Russia and abroad.

In 1990, Korovin was elected IHCE Deputy Director for Research. As he was being promoted up the administrative ladder, he continued his active personal research and in 1991 submitted and defended his doctoral dissertation. Beginning in 1996 he led the development of a new class of efficient gigawatt generators with virtual cathode — two-sectional vircators with electrodynamic feedback. Korovin then constructed an analytical theory of the interaction of the electron stream with the electromagnetic field under conditions that sustain a virtual cathode, making it possible to evaluate the contribution of various physical mechanisms to the process of the generation of microwave-range oscillations in vircators.

Owing to the research conducted under Korovin's supervision in the last several years, progress was achieved in understanding the processes of the generation of ultrashort microwave pulses (lasting only a few periods of oscillation). It was shown for the first time that owing to the effect of spatial accumulation of energy in the traveling microwave pulse, its output power may greatly exceed that of the electron beam. This principle was used as the basis for designing sources of ultrashort gigawatt microwave pulses. The dimensions of these devices are smaller by an order of magnitude than those of 'ordinary' relativistic microwave sources with the same peak radiation power.

Korovin's work was widely recognized and appreciated both in this country and abroad. In 1980, he received the Lenin Young Communist League Prize for a series of papers investigating the stimulated emission of high-current electron beams, and in 1998, together with a team of collaborators, he received the State Prize of the Russian Federation in Science and Technology for comprehensive fundamental research in fast electric discharge processes and in creating on their basis a new class of high- and superhigh-power nano- and picosecond electrophysical devices. Korovin obtained nine Author's Certificates and published more than 250 papers; two of the six Candidates of Sciences amongst his pupils submitted and defended their DSc theses.

In the year 2000 Korovin was elected Corresponding Member, and in 2003 Full Member of the RAS.

In 2002, Korovin became Director of the Institute of High-Current Electronics. He always emphasized that only the highest standards in fundamental research will secure a long-term expansion program for the Institute, and strictly ensured that the entire 'output' of the Institute — that is, its research publications, the devices and equipment designed, and finally the conferences and seminars conducted there — be of the highest quality.

Owing to Korovin's initiatives, close ties were established between IHCE and the largest and most prestigious research centers and universities in the USA, France, the United Kingdom, Germany, Israel, Poland, and China. He paid the greatest attention to the practical application of the results of pure research. One example of successful international cooperation in the field of the application of relativistic microwave generators was the creation of the integrated facility NAGIRA ordered by GEC-Marconi (United Kingdom). Well-coordinated and intense work by IHCE SB RAS, IAP RAS, the Special Instruments-for-Science Design Bureau (in Ekaterinburg), and the 'Almaz' Central Design Bureau ensured the successful implementation of this project.

Korovin knew full well that it was necessary to find civilian applications for the results of fundamental research and development. Thus, electron-beam sterilizers were created on the basis of small-sized electron accelerators of the SINUS series for use in pharmacology, and work was launched on a large scale in the last several years for possible applications of powerful pulse-periodic electromagnetic radiation in biology and medicine.

In 2003, Korovin was elected Chairman of the Presidium of the Tomsk Scientific Center (TSC) of the SB RAS and member of the Presidium of the SB RAS. It was during this period that real collaboration was started under his leadership between the institutes of the TSC; the reputation of academic research in Tomsk began to grow appreciably. In his capacity as member of the Presidium of the SB RAS, Korovin campaigned convincingly for the expansion of other scientific centers of the Siberian Branch of the RAS, not only the Tomsk Scientific Center.

Korovin possessed the ability to analyze a situation rapidly and comprehensively and, in the light of later events, strived for the best possible decisions. His approach was to give a clear and unambiguous formulation even of not very simple problems, both for himself and for his subordinates.

Korovin sat on the board of the Russian Foundation for Basic Research (RFBR). On his initiative, joint contests under the auspices of the RFBR, together with the Tomsk regional administration, became regular occurrences beginning in 2005.

Korovin paid special attention to working with young scientists. He taught for many years, held a professorship at the Chair of Plasma Physics at Tomsk State University and delivered lecture courses on pulsed power and relativistic microwave electronics. Korovin realized that science needs young blood and had no objections to the proposal of opening a Chair of High-Current Electronics of Tomsk Polytechnic University on the base of the IHCE. Despite his permanently overloaded agenda, he always had time for discussions with his students and postgraduates.

Korovin devoted himself to his work entirely and unselfishly. He had a brilliant multifaceted personality, possessing talents not only in science but also in communicating with people. His enthusiasm in whatever he was engaged in enriched people around him, and his firm principles and evident confidence and skill in defending his point of view disarmed his interlocutors. He was generous with his ideas, knew how to be grateful, and openly enjoyed when people achieved success. But Korovin showed no tolerance when confronted with careless attitudes towards science, work, or people. He was sincere and compassionate when confronted with people's problems and always ready to help. When surrounded with his friends, he was invariably the heart and soul of the party.

The death of Sergei Dmitrievich Korovin is an unbearable loss to our science. May his all-too-brief but remarkable life leave warm memories in the hearts and accomplishments of all those who had the good fortune of living and working alongside this man.

A F Andreev, N L Dobretsov, B M Koval'chuk,
O N Krokhin, A G Litvak, G A Mesyats,
N A Ratakhin, A N Skrinsky, V Yu Khomich,
V G Shpak, M I Yalandin