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### IN MEMORY OF IVAN MAKAROVYCH PROTSENKO (1935–2022)

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On April 27, 2022, Ivan Makarovich Protsenko, one of the famous Ukrainian scientists in the fields of gas and plasma electronics and physics of plasmodynamic medium-energy systems and ion beam plasma, Ph.D. in physics and mathematics, died at the age of 87. More than 60 years of his life were devoted to fundamental experimental studies in plasma physics. For 40 years, he had held the position of senior researcher, and for more than 10 years, he had carried on the duties of the head of the Department of Gas Electronics at the Institute of Physics of the National Academy of Sciences of Ukraine (IP NASU).

Ivan Makarovich Protsenko was born on October 4, 1935, in the village of Pishchyky (the Irkhiiv district, the Cherkasy region) in the family of a peasant collective farmer. In 1943, after the region

had been liberated from fascist invaders, he went to school, where he showed great abilities in mathematics and physics, and left it in 1953. The same year, I.M. Protsenko entered the Radiophysics Faculty of the T.G. Shevchenko State University of Kyiv. The faculty was newly created for training the scientific personnel in new, at that time, directions of science and technology. Ivan Makarovich graduated from the University with honors in 1958.

Since that time, the entire creative life of I.M. Protsenko had been associated with the IP NASU. He was among the key personalities who became pioneers in thermonuclear research in Kyiv. In 1961–1965, without interrupting his professional activity, he successfully fulfilled his postgraduate training, created an experimental bench, and presented the results of research concerning the magnetohydrodynamic stability of thermonuclear plasma in powerful pulsed tubular discharges. After I.M. Protsenko had made a report at the meeting of the academic council, Academician O.S. Davydov noted that the presented material actually comprised a complete thesis and should be defended urgently.

As time went by, I.M. Protsenko changed the direction of his scientific interest: instead of powerful thermonuclear systems with magnetic confinement of hot plasma, he got interested in systems with magnetic confinement of electrons and free ions. His previous experimental and design experience in creating powerful electric and magnetic fields with required configurations turned out to be very useful for the development and creation of novel vacuum-plasma equipment, as well as tools for the diagnostics of electro-physical parameters of examined systems. This circumstance made it possible to carry out comprehensive theoretical and experimental fundamental studies

and to obtain physical results that became a basis for the development and creation of a number of original medium-energy plasmodynamic devices of new generation.

I.M. Protsenko was among the pioneers in researching plasma-optical and plasma-dynamic medium-energy systems. With his direct participation, electrostatic plasma lenses with a large aperture were created, and their interaction with ion beams with low and high currents (from 10 mA to 2 A) and low and medium energies (100–30 000 eV) was studied. With his participation, a high efficiency of plasma-optical electrostatic lenses for focusing the heavy-element ion beams with energies up to 40 keV was established. Specific features were found both for the interaction in the longitudinal magnetic field in ion beam-plasma systems and for focusing the high-current (up to 2 A) medium-energy ion beams with large initial diameters (up to 6 cm) by means of electrostatic plasma lenses. I.M. Protsenko also designed a series of new plasma-optical devices with crossed electromagnetic fields on the basis of permanent magnets for technological purposes. He also participated in the study of the peculiarities of the interaction of ion-plasma fluxes with dielectrics and polyamide films.

I.M. Protsenko made a large contribution to the creation and research of a new plasma-optical filter for destructing microdroplets in fluxes of dense low-energy plasma emitted by erosive plasma sources. Such systems play an essential role in modern innovative technologies, such as the synthesis of novel materials and functional coatings, the technology for creating commercially attractive, small-sized, and efficient electrojet space engines.

I.M. Protsenko successfully combined his scientific work with the scientific and organizational activities. For a long time, he had been the scientific secretary of the Scientific Council on “Plasma Physics” and the deputy head of the Department of Gas Electronics. He was an exclusively communicative person, always open to communication; he easily shared his extensive knowledge with his colleagues and young people. He knew how to listen to people, so his colleagues were drawn to this authoritative person. The high authority of I.M. Protsenko at the IP is evidenced by his repeated elections as the secretary of the Communist Party bureau of the IP and the head of the commission for monitoring the administration activity during the rather stormy and hard 1970–1980s. For more than a decade, I.M. Protsenko had successfully carried on the duties of the head of the Department of Gas Electronics at the IP NASU.

I.M. Protsenko was completely devoted to science, which was the sense of his life. Until his last days, he worked with enthusiasm as an authoritative scientist in the field of medium-energy plasma dynamics and a talented designer who made a significant contribution to the development of plasma physics and physical electronics. His death is a heavy loss for Ukrainian science, as well as for everyone who knew and respected him. The cherished memory of Ivan Makarovich – the talented scientist, the outstanding personality, and the devoted citizen of Ukraine – will remain forever in our hearts.

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