

Aleksandr Alekseevich Boyarchuk (on his 80th birthday)

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Academician Aleksandr Alekseevich Boyarchuk, an outstanding Soviet and Russian astrophysicist, whose research in astrospectroscopy, physics of stars, extraterrestrial astronomy, and telescope construction are widely known, and who is the prominent organizer of Russian science, celebrated his 80th birthday on June 21, 2011.

A A Boyarchuk was born in Grozny; both his parents were teachers. In 1953, he graduated from the Department of Mathematics and Mechanics at Leningrad State University, where he majored in astronomy. His teacher and supervisor was Academician V V Sobolev. After University, he entered postgraduate school at the Crimean Astrophysical Observatory (CrAO) of the USSR Academy of Sciences and in 1958 defended his PhD thesis, “Spectroscopic study of Be stars”, supervised by E R Mustel’, Corresponding Member of the Academy. In 1969, A A Boyarchuk defended his DSc thesis “The study of symbiotic stars”. In 1976, he was elected Corresponding Member, and in 1987 Full Member of the USSR Academy of Sciences.

A A Boyarchuk contributed greatly to astrophysics in the field of interacting binary stars of different types. He continues the research in this field of astrophysics that he started more than half a century ago together with a team of his current and former students.

The study of the nature of symbiotic stars occupies an essential, perhaps even central, place in the scientific career of A A Boyarchuk — he was the first to propose the nowadays classic model of a symbiotic star. First, he proved that the complex spectra of symbiotic stars are due to radiation emitted by their three components: the cool giant star, the white dwarf, and the hot gas excited by the radiation of the hot white dwarf. Second, A A Boyarchuk showed that such a compound system represents a natural stage of evolution of binary stars with the components of stars of different masses: the initially more massive component has already reached the stage of white dwarf, while the less massive component emitting brighter in a visible range continues to stay in the red giant state. Boyarchuk’s model has received numerous confirmations in subsequent optical, infrared, ultraviolet, and radio observations. Nowadays, it is generally accepted. This was essentially the first concept that closely tied the general principles of the theory of stellar evolution to observations of a broad class of nonstationary stars, and it brought A A Boyarchuk international fame. A team of researchers at the Institute of Astronomy of the RAS, working under A A Boyarchuk’s guidance, continues to study symbiotic stars. In recent years, gasdynamic simulation of these stars has been conducted, and some interesting results were obtained concerning their flare activity. In particular, the



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team proposed a new mechanism to explain the occurrence of an outburst in a symbiotic star, gave an explanation of the peculiarities of the brightness evolution of the system during the outburst development, and have very recently published a scenario that explains the behavior of a symbiotic system over the activity cycle, including the series of outbursts. In 2001, A A Boyarchuk was awarded the F A Bredikhin Prize of the Russian Academy of Sciences for a series of papers on the topic ‘Symbiotic stars’.

A A Boyarchuk obtained important results in the study of Be stars, i.e., stars of spectral class B with prominent emission lines in the spectrum. He was able to determine physical parameters of the envelopes of these stars and substantiated the concept of the now generally accepted phenomenon of Be star, namely that these objects are a certain stage in the evolution of rapidly rotating massive stars. The cumulative catalog of rotational velocities of 2362 stars that he compiled during his work at the Crimean Astrophysical Observatory was unique for its time. A few years ago, a group headed by A A Boyarchuk succeeded in proposing the envelope formation mechanism of binary Be stars based on the results of numerical simulation. In short, he came to the conclusion that, owing to rapid rotation, a small-sized star in a binary system may fill up the so-called rotational Roche lobe and as a

result the pull of the second component causes the matter of the first one to escape even before the critical rotational velocity is reached, and this leads to the formation of the envelope.

Progress in science and technology has opened a new field in the investigation of interacting binary systems, which combines astrophysical observations with gasdynamic simulations. A team of researchers led by A A Boyarchuk developed two- and three-dimensional numerical models, whose application to various classes of interacting binary stars significantly changed the overall picture of matter exchange between the components in these systems. Notably, it was shown that the so-called model of a ‘hot spot’ on the accretion disk, which in the past was widely used by all researchers, is a poor representation of the real complex physical process when stellar material flows from one component to another. What happens in reality is the generation of an extended shock wave of variable intensity, so that the shape of the emission region in the hot gas is not a ‘hot spot’ but a ‘hot line’ located at the edge of the accretion disk. Another elegant result achieved by numerical simulation was the discovery of a new type of ‘precessional’ spiral waves in the inner parts of accretion disks in close binary systems. Application of numerical models to a number of close binary systems of different types has made it possible to explain many of the observed phenomena.

Another important area of work conducted under A A Boyarchuk’s guidance is the study of red giants using astrospectroscopic techniques. Excessive amounts of the Na, Mg, Al, and Si elements that he discovered in red giants allowed him to conjecture that these elements were formed in the depths of the stars at the main sequence stage in nuclear reactions of hydrogen combustion in NeNa- and MgAl-cycles; before that, it had been assumed that these cycles are typical only for stars of much higher mass. Notable progress has been made in studies of a peculiar group of red giants, namely, barium stars with higher-than-ordinary content of elements heavier than iron. A A Boyarchuk’s team was able to show that the so-called moderate barium stars are in fact the normal red giants at a more advanced stage of evolution. As for the excessive amounts of heavy elements in their atmospheres, they are caused not by pollution from the companion star but by the specifics of the photoneutron reactions in which high-energy gamma quanta are able to knock out neutrons from atomic nuclei which subsequently take part in the formation of heavy elements.

A A Boyarchuk’s reputation in fundamental space research is exceptionally high. He is known as a leading specialist in extraterrestrial astronomy. In the 1970s–1980s, the ASTRON space experiment was successfully carried out under Boyarchuk’s supervision and with his direct participation; this was, in fact, a large-scale space astrophysical observatory designed in the Soviet Union for observations in the ultraviolet range of the spectrum. A A Boyarchuk participated in the project development and computations for ASTRON’s space telescope, the formation of the scientific payload, the actual assembly and testing of the telescope, the formation and implementation of the research program of the experiment, designing the methods of data acquisition, and processing most of the collected data. Many important scientific results were obtained during the ASTRON observatory’s life in orbit (1983–1989): in particular, the evolution of the rate of matter outflow from the nucleus of Halley’s Comet was monitored as it was approaching the Sun and then moved

away from it, the gradient of the excess of heavy elements was discovered in the expanding envelope of the 1987A supernova, energy distributions were determined in the spectra of more than a hundred stars covering almost the entire Hertzsprung–Russell diagram, the predicted hot white dwarfs were indeed found in symbiotic systems, estimates were obtained for the gradient of the velocity of matter outflow from hot stars, the spectral composition of the radiation from active galactic nuclei was studied, and data were obtained about active processes on red dwarfs. The development and implementation of the ASTRON astrophysical station brought A A Boyarchuk the USSR State Prize in Science and Technology.

With rich experience in managing a successful space experiment, A A Boyarchuk continues to work on the new generation of space projects. At the moment, he is supervising two major space projects included in the Russian Federal Space Program for 2006–2015: the international project World Space Observatory—Ultraviolet (Spektr-UF), and the Russian national-priority project Astrometry (Osiris).

A A Boyarchuk readily shares his rich store of knowledge and experience. He has headed the Chair of Experimental Astronomy at the Astronomy Division of the Department of Physics of Moscow State University ever since it was created in 1997. Three generations of his students—many of whom have already climbed to prominent places in astrophysics—make the nucleus of his scientific school, Studies of the Interacting Stars, that has a high international reputation.

A A Boyarchuk spends a great deal of energy on publishing activities. For many years now, he has served as Editor-in-Chief of the *Astronomical Journal*, and in addition he sits on the editorial boards of a number of astrophysical publications.

A A Boyarchuk has been awarded numerous prizes in the Russia and abroad, and we find among his awards the orders For Merit For The Fatherland of the IV and III Class; the Order of Honor; the Order of Badge of Honor; the medal For Heroic Labor; Marking the Centenary of the Birth of Vladimir Ilyich Lenin; the medal Tribute to the Memory of the 850th Anniversary of Moscow; Prizes of the International Academic Publishing Company ‘Nauka’ (1995, 1998 and 2009); the Award of the Federal Space Agency of the Russian Federation, Badge of Tsiolkovsky, and the St. George medal ‘Honor. Glory. Labor’ of the III Class (Ukraine). As a sign of recognition of A A Boyarchuk’s achievements in science, the small planet MPC 7785 was given the name Boyarchuk.

A A Boyarchuk is a member of several foreign and Russian scientific societies and academies. He is Emeritus Professor and Honorary Professor of Moscow State University, Honorary Doctor of St. Petersburg State University, Honorary Member of St. Petersburg Physical–Technical Institute, Foreign Member of the National Academy of Sciences of Ukraine, Member of the Royal Astronomical Society (United Kingdom), Member of the American Astronomical Society, Member of the American Physical Society, Full Member of the International Astronautical Federation, and Member of the International Academy of Astronautics. A A Boyarchuk is also a charter member of the European Astronomical Society.

It can be said that the highest degree of international recognition of A A Boyarchuk was his election in 1991 to the presidency of the International Astronomical Union (he held this position until 1994; he also held various posts among the top leaders of the IAU from 1988 till 1997). Aleksandr

Alekseevich was for many years a member of the bureau of the International Committee on Space Research (COSPAR).

Administrative functions always took and continue to take a prominent place in A A Boyarchuk's life in science. His time in the CrAO gave Aleksandr Alekseevich good schooling as a science organizer — during 18 years there (from 1969 till 1987) he was deputy director of the observatory. Ever since 1987, A A Boyarchuk has been inseparably linked to the Institute of Astronomy of the RAS (earlier known as the Astronomical Council of the USSR AS): director until 2003, and scientific advisor of the Institute after 2003.

A A Boyarchuk held and still holds lofty positions in the Russian Academy of Sciences: member of the Presidium of the RAS between 1990 and 2002, Adviser to the Academy of Sciences after 2002. In the period from 1987 till 2002, he was first deputy secretary-academician and then (since 1996) secretary-academician of the Division of General Physics and Astronomy of the RAS (until 1990 — of the USSR AS). In 2002, A A Boyarchuk became deputy secretary-academician of the RAS Physical Sciences Division and chair of the Section of General Physics and Astronomy of the RAS Physical Sciences Division. He is also chair of the National Committee of Russian Astronomers.

In addition, Academician A A Boyarchuk holds the posts of deputy chair of the RAS Space Council and deputy chair of the Interdepartmental Expert Commission on Space with the Government of the Russian Federation, and sits on the Integrated Scientific and Technical Council of Roskosmos. A A Boyarchuk was a member of the section of Mathematical and Physical Sciences of the Commission on State Prizes of the Russian Federation in Science and Technology with the Russian President, is chair of the Expert Commission for awarding the A A Belopolsky RAS Prize, and is a member of the Expert Commission on awarding the RAS M V Lomonosov Great Gold Medal.

Aleksandr Alekseevich Boyarchuk's colleagues, friends, and disciples wish him happy birthday and hope that he feels strong, happy, healthy, creative, and successful!

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