

**ANATOLY ANATOLYEVICH MIHAJLOV**  
**(1941-2016)**

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**Abstract.** Life and work of Anatoly Anatolyevich Mihajlov (1941-2017) is presented.

After severe illness, on September 27, 2016, in the 75 years, Anatoly Anatolyevich Mihajlov, a prominent Serbian physicist and astrophysicist, a retired Research Professor at the Institute of Physics, a long-term external associate of the Astronomical Observatory, abandoned us forever. His life was full of creative dedication and was adorned by a great professional enthusiasm and research passion.

Mihailov was born on October 20, 1941 in Krasnoyarsk, Russia. He studied in Leningrad, where he lived since 1947. He graduated in 1967 at the Faculty of Physics, at the Department of Optics, and also passed all exams at the Department of Quantum Mechanics, where from the middle of the second year until the end of his studies, he worked on the project of creating current-free gas plasmas, and from this topic, in December 1967 he defended Diploma work, which was the basis for the paper Voroncev et al. (1970). After graduation, he was employed at the State Optical Institute and until 1976 published six papers in journals. Particularly significant is the article Smirnov and Mihajlov (1971), in which, for the first time, a new mechanism of energy conversion within the electronic component of the atomic system - the Rydberg atom was introduced. It was immediately accepted as one of the two basic mechanisms of inelastic processes in the slow collisions of Rydberg's atoms with atoms of the same kind in the ground state.

He married in 1975 with Dr. Jelica Jokanović Mihajlov, who is today a professor of Serbian language at the Faculty of Philology, and in 1976 he and his family settled in Belgrade, where his son Anatolij was born that year. He was employed in the Institute of Physics in 1977, where he obtained a permanent position in March 1978. He completed his postgraduate studies in 1977 - Theoretical physics at the Faculty of Natural Sciences and Mathematics, defended his MSc thesis in 1979 and his PhD dissertation in 1981. The basic results of these theses were published in the articles Janev and Mihajlov (1979, 1980) (master's) and, Mihajlov and Janev (1981) and Mihajlov and Popović (1981) (doctoral).

In works Janev and Mihajlov (1979, 1980) and Mihajlov and Janev (1981), based on the aforementioned new mechanism, have been elaborated, in practice, applicable constructive methods for calculation of effective cross sections and rate coefficients

for processes of ( $n - n'$ ) mixing and of chemi-ionization processes in slow collisions of Ridberg's atoms with the atoms of the same kind in the ground state. The method developed in Mihajlov and Janev (1981) for symmetric and weakly asymmetric chemi-ionization processes began to be referred to as DShMJ (Duman, Shamaev, Mihajlov, Janev) method, together with the method independently developed by Duman and Shamaev in the 1980s.

In 1981, Mihailov was elected a scientific associate, in 1987 associate professor, and in 1994 he received the title of Research Professor. From 1991 to 1995, he led the subproject "Transport Processes in Low Temperature Plasma", at the Republic Community for Science, and from 1996-2001 the subproject "Radiation and Transport properties of low temperature plasmas". From 2002 to 2005 he was leader of the project "Radiation and Transport Properties of Nonideal Laboratory and Ionospheric Plasma" and from 2006 until retirement he led the project "Nonideal Laboratory and Ionospheric Plasma".

He has developed a broad and impressive international cooperation. With universities in Rostock and Greifswald, in 1982-1995 he has an intensive scientific collaboration (W. D. Kraeft, M. Luft) in the topic of physics of nonideal plasmas and obtained results has been published in Kraeft et al. (1983), Mihajlov et al. (1986, 1987, 1989), in which a model way of describing the screening in dense plasma, using the so-called cut-off potential of Coulomb, has been developed. Mihailov was invited there in 1992 as a visiting professor and in 1995 he was in research mission.

From 1990 to 2010, he collaborated with Odessa State University, which later included and the Polytechnic University of Valencia (V. M. Adamyan, I. M. Tkachenko). The collaboration was in the topic of physics of dense nonideal plasma, including extremely dense plasmas. The results were published in Djurić et al. (1991), Adamyan et al. (1994a,b, 2004, 2006, 2009), Mihajlov et al. (1991), Tkachenko et al. (2006) and Srećković et al. (2010). In these publications has been developed the original modified RPA (Random Phase Approximation) method for the calculation of electrical conductivity and other transport properties of extremely dense nonideal plasmas, which are in good agreement with the existing experimental data.

From 1988 to 1996, Mihailov co-operated with the University of Durham in England (A. M. Ermolaev) in the topic of ion-atomic radiation collisional processes and electron-ion scattering in plasma, until 1992 within the frame of the project with the British Council in Belgrade. The result is eight papers in international journals (Ermolaev and Mihajlov 1991, Mihajlov et al. 1993a,b, 2004a,b, Adamyan 1994a,b, Ermolaev et al. 1995). Thanks to this collaboration, which enabled to him and his collaborators to have study missions in England and access to, at that time, one of the most powerful computer systems (Cray), the equations in Drukarev and Mikhajlov (1974), were transmitted in a constructive quantum-electrodynamic method for the calculation of the spectral characteristics of spontaneous electromagnetic emissions in symmetric ion-atom collisions at mean collision energies (10-50 keV in a hydrogen case).

Collaboration with the University of Pierre and Marie Curie in Paris (Yves Vitel) takes place between 1996 and 2011, on the research of intra-plasma electrostatic screening and the obtained results are published in Vitel et al. (2001) and Mihajlov et al. (2008, 2009a,b, 2011a,b). In Vitel et al. (2001), the elaborated before semi-classical method for the calculation of electrical conductivity of the nonideal plasma



Figure 1: Anatolij Anatolyevich Mihajlov.

(Mihajlov et al. 1993b) has been verified experimentally. The other significant result is the development of a new, non-Debyan method for describing intra-plasma electrostatic screening, formulated when Mihajlov, as a guest professor, was in Paris in October 2003 and has been published in Mihajlov et al. (2008, 2009a,b).

Cooperation with the Institute V. A. Fok, of the Physics Faculty of the University of St. Petersburg (A. N. Klyucharev, N. N. Bezuglov), dedicated to atom-atomic (primarily chemi-ionization) collision processes, started in 2005, took place until the death of Anatolij in 2017, and continued further by his co-workers (V. A. Srećković, M. S. Dimitrijević). The basic results are published in Klyucharev et al. (2007), Ignjatović et al. (2008a,b), Gnedin et al. (2009), Srećković et al. (2012), Bezuglov et al. (2014), Mihajlov et al. (2015) and Arefieff et al. (2015, 2017). Since May 2008, Pulkovo Observatory (Yu. N. Gnedin, paper Gnedin et al. 2009) was also included in this cooperation.

Mihailov also collaborated with the Institute of Physics in Zagreb, where he held a series of lectures, often followed by useful discussions.

Anatoly Anatolyevich Mihajlov payed great attention to the scientific development of young people. He relentlessly transferred his rich experience to collaborators and encouraged their development, both through mentoring dissertations and by engaging youngs in his own research and preparation of scientific papers for top international scientific journals. As a mentor or co-mentor he led four master's theses (N. Ljepojević, Z. Djurić, Lj. Ignjatović and N. Sakan), and four PhD dissertations (N. Ljepojević, Z. Djurić, Lj. Ignjatović and N. Sakan).

A very important result of Anatoly is the creation of new Laboratory for the physics of nonideal plasma, becoming its Head in 1986, the modernization of the

Spectrochemical laboratory, as well as the creation of the first in the region Laboratory for the Physics of the ionosphere (Earth-ionosphere waveguide) and its interaction with the solar emission, which enabled to begin the work on the study of the effects of solar eruptions on the Earth's ionosphere and the possibilities of forecasting seismic events. Mihajlov was dedicated to this task since mid-1995 and with the help of the Ministry of Science, in mid-2003, the laboratory received the first ionospheric station. This enabled to start, in cooperation with the University of Nova Gorica (Slovenia) studies of the impact of solar eruptions on the Earth's ionosphere within the frame of the European project COST-724 (Space Weather). In the period 2003-2007 cooperation with Slovenia took place on the basis of two-year bilateral agreements.

I would especially like to point out his collaboration with the Astronomical Observatory since 1985 in the field of atomic collisions in weakly ionized plasmas, and especially in the plasma of stellar atmospheres. From the 96 scientific papers in international journals, cited several hundred times, 39 are in international astronomical journals, usually of the highest rank. In these papers, the effects of various atomic collisions on radiation of the Sun, cold stars and white dwarfs - one of the final phases in the evolution of a star, are analyzed. From mid-80s until the mid-90s, Mihailov is an external associate of the Astronomical Observatory, and until 2006 he is a member of the Joint scientific council of the Astronomical Observatory, Geomagnetic and Seismological Institute.



Figure 2: Anatolij Anatolyevich Mihajlov.

Mihailov was awarded for his scientific work by the Institute of Physics in 1994 and by Astronomical Observatory in 1999. He is a member of the governmental board of the Eurasian Astronomical Society, based in Moscow, and he founded, together with Milan S. Dimitrijević, its Serbian branch in 2008, and the representative office in Belgrade. He is a member of the European Physical Society and the International Astronomical Union. He always worked tirelessly, developed and transferred new knowledge, confirming the idea that "work is the first human need and greatest satisfaction". He loved life, people, things big and small. His work was always devoted to the service of everything that elevates the thought and dignity of man. With his knowledge, directness, inexhaustible energy, he attracted and enchanted interlocutors and enriched his students and associates. His works and scientific contributions make an honor to Serbian science, both physics and astronomy.

I met Tolya in 1976, and since then, we have been working together and collaborating creatively. And when a severe illness began to overcome him, behaving in the spirit of Njegos' message - "let the struggle be constant, let it be what is impossible", he continued to work on his dreams and raise life to meaning and value, so that from Sickbed he sent two scientific papers to astronomical journals of highest rank. He is an example of how to rise above life's troubles, find strength for work, life and friends, despite all bad circumstances, and will remain in our lasting memory as a model of dignified and honorable life.

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