

Alexander F. Dodonov: 1939–2005



Alexander Fedorovich Dodonov was born in the small village of Kuvandyk in Kazakhstan on January 18, 1939. His childhood years coincided with World War II, when his father was serving in the army. Difficulties of the war time were intensified by serious illness of his mother. Alexander and his two brothers were placed into an orphanage, from which they tried to escape. They got home only after the war ended in 1945.

From 1958 until 1966, Dodonov studied at Moscow Institute of Physics and Technology (“Phystech”), the most prestigious establishment for higher education in natural sciences and technology in the USSR. Apart from studying hard during those years, he also went into track-and-field athletics, was trained by an Olympic champion, V. Kutz, and became a champion at the Institute in running for all distances from 800 to 10,000 m. (An old story says that he won because he was in a rush to get to a date after the competition). Although Alexander abandoned athletics soon after graduation,

he preserved the spirit of a sportsman and a competitor for the rest of his life, bringing the best of it into his scientific career—the instruments he built had to be the best, his experiments had to be the most accurate.

After graduation in 1966, Dodonov started working at the Institute of Chemical Physics of the Academy of Sciences of USSR, first in Moscow, then in its branch in Chernogolovka, a small academic center near Moscow. In 1987, his laboratory became part of a newly-formed Institute of Energy Problems of Chemical Physics (with Victor Talrose as a Director), where he worked actively till his last days.

Dodonov received his Ph.D. in Chemical Physics in 1968. His Ph.D. thesis titled “Investigation of H-atom reactions with molecules and free radicals by mass-spectrometric probing of diffusion cloud in a flow” laid the basis for the new method of studying mechanisms and measuring rate constants of the gas-phase reactions. This method was implemented on several unique experimental installations that were built according to Dodonov’s ideas and, to a significant extent, with his own hands. Together with his colleagues and students, he studied mechanisms and determined the reaction rate constants in systems CS_2/O_2 and F_2/H_2 , which had

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important implications in the chemistry of gas-phase lasers. Several studies explored the mechanism of reactions involving particles present in stratosphere: atoms of H, O, Br, radicals BrO, OH(v), HO₂, molecules H₂(v), O₂(X³Σ_g⁻, a¹Δ_g, b¹Σ_g⁺), O₃, Br₂, with their direct detection. In 1981, the Academy of Sciences of the USSR awarded Dodonov the degree of Doctor of Science for his outstanding achievements in the field of kinetic mass spectrometry.

Although Dodonov's contribution to the field of kinetic mass spectrometry is fundamental, he is probably more known in the mass spectrometry community for his pioneering work in time-of-flight (TOF) mass spectrometry. In the late 80s, his group was the first to develop a reflecting TOF instrument with orthogonal injection of ions, at first with atmospheric pressure ionization and later with electrospray. Starting with zero experience in TOF MS in mid-80s, he first demonstrated the "proof-of-principle", and then showed that this geometry can provide relatively high-resolution (>20,000 FWHM) and sensitivity when used with continuously operating ion sources. The orthogonal injection principle revolutionized the field of TOF, as it became possible to perform accurate and sensitive MS and MS/MS analysis of the electrosprayed biomolecules. The addition of electrospray to the arsenal of TOF contributed significantly to the renaissance of this type of mass spectrometry, which was already starting to develop because of MALDI. TOF instruments based on the principle of orthogonal injection became an essential part of modern analytical instrumentation and are produced commercially either as single MS "oTOF" machines or as hybrid tandem quadrupole-TOF mass spectrometers.

Dodonov was a true "Kapitsa"-style experimentalist who was professional in every aspect of instrumentation: mechanical design, electronics, data acquisition, spectra processing, ion-molecular physics, and chemistry. When working on the projects, he was often helped by his late wife Tamara, who participated in many of his undertakings as a mechanical designer. Alexander had a passion for building novel mass spectrometers, but he also liked to put them to a good use. Most importantly, he was open to share his experience with colleagues. Although he wasn't a professor in the classic sense (he never gave lectures), he had many students working in his laboratory, both undergraduate and graduate. Seven Ph.D. projects were completed successfully under the supervision of Professor Dodonov. A number of established mass spectrometrists came out of his laboratory or interacted with him during their careers.

Alexander was an optimist. He was never afraid to venture into the unknown. In trying to pinpoint the essence of Dodonov's school, what comes to mind is the simplicity with which he discussed seemingly complex matters. Sometimes a dispute would spark during the tea-break, where one would have to defend his point of view with no more than a tiny piece of paper, Avogadro's number, and a few other fundamental constants.

He used to show us that in most cases "puzzles" and "miracles" could be easily explained if one viewed them from a proper angle. Finding this angle may be difficult, but once found, the solution to the problem becomes trivial. Dodonov had a great scientific intuition and broad research interests. He managed to be equally successful in complex theoretical calculations or estimates as well as in delicate experiments and in mechanical or electronic design.

Another experience from Dodonov's laboratory was his attention to details. He often said that a mass spectrometrist is like a sapper (a field engineer dealing with explosives) because he can only make one mistake. He explained that one lost screw or one forgotten connection can spoil the result of the whole experiment and can often ruin weeks of work. The rule also applies to the data collection and interpretation.

Alexander Dodonov will be remembered by his friends, colleagues, and former students scattered all over the world as a talented scientist, a generous person, and a great optimist. Many of us are sure to look back and remember something bright about him, and that means he is still with us.

Alexander Fedorovich Dodonov passed away on August 31, 2005, in Chernogolovka, a region in Moscow, leaving a daughter, Natasha and son, Fedor.

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Selections From More Than One Hundred of Dodonov's Publications:

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