PERSONALIA

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Sergei Glebovich Rautian (on his 80th birthday)

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On December 18, 2008, advisor to the Russian Academy of Sciences (RAS) and Corresponding Member of the RAS Sergei Glebovich Rautian celebrates his eightieth birthday.

S G Rautian is a world-renowned scientist, a specialist in optics, spectroscopy, laser physics, and physical kinetics, and the author of more than 300 scientific papers, two monographs, and three textbooks. S G Rautian is a founder of nonlinear laser spectroscopy.

The scientific biography of S G Rautian started in the early 1950s under the direction of that classic of Russian physics, Academician G S Landsberg, from whom he adopted (and subsequently exacted from his pupils) an approach to scientific work which can be briefly formulated as thoroughly examining a scientific problem followed by obtaining an absolutely clear result. The fruitfulness of such an approach was already revealed in the candidate dissertation of S G Rautian devoted to the theory of real spectral devices and their reduction to an ideal device, which became a classical work and is cited nowadays by specialists all over the world.

After the invention of lasers, the scientific interests of S G Rautian were focused on laser optics and spectroscopy. He obtained a series of fundamental and at the same time pioneering results (some of them in collaboration with I I Sobel'man) already by the middle 1960s while working at the P N Lebedev Physical Institute. It was found that the kinetics of induced radiation transitions depend substantially on the relaxation constants of the combining energy levels, spectral composition, and the geometric configuration of the radiation field. In addition, they exhibit specific features due to the thermal motion and collisions of gas particles. He first suggested and then developed the so-called probe light field method which became an efficient instrument for studying the properties of a medium subjected to laser radiation. The method became a fundamental one in modern nonlinear spectroscopy. In the framework of this method, radical modification of the absorption spectrum of a weak signal was observed in the presence of intense resonance radiation. This modification is so strong that absorption in certain spectral regions changes to amplification and vice versa. Thus, 'amplification without inversion' effect was predicted well before it became a popular field of investigation. It was established that the Autler – Townes effect (splitting of the energy levels subjected to radiation) plays a fundamental role in the formation of the spectral properties of a medium embedded in an intense optical radiation field. In particular, this became a basis for predicting the triplet structure of the resonance scattering spectrum (resonance fluorescence) by S G Rautian and I I Sobel'man well before the works by B R Mollow, whose name was given to this triplet.

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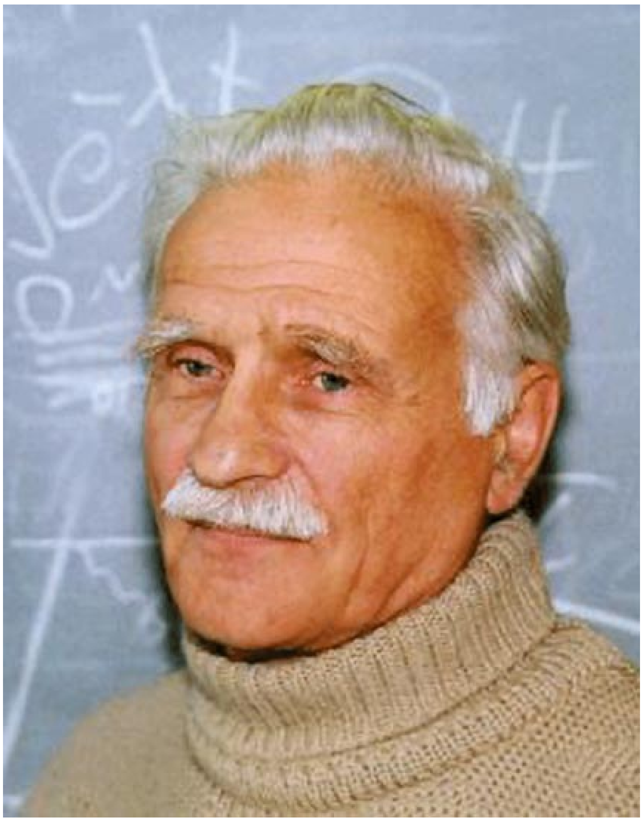

Sergei Glebovich Rautian

S G Rautian was one of the first to call attention to the 'sub-Doppler' possibilities of laser spectroscopy. In 1963, he established that the spontaneous emission spectrum of atoms executing thermal motion comprises a sharp spectral structure with a natural width against the Doppler background. This structure, along with the Lamb dip observed in the same year, were the first nonlinear resonances which introduced sub-Doppler ultrahigh-resolution spectroscopy.

Obviously, numerous relaxation processes occurring in a medium, which are caused, in particular, by particle collisions, should affect the spectral properties of the radiation that interacts with the medium. In linear spectroscopy, this problem was considered using the correlation function method. As applied to nonlinear spectroscopy, the method becomes cumbersome and tedious. S G Rautian suggested and substantiated the method of the quantum kinetic equation for the density matrix, which is adequate to the problems arising in nonlinear spectroscopy. This equation is often referred to as the Rautian equation. Later on, the method became an essential operating tool in solving problems on the interaction of laser radiation with gas media. S G Rautian and his disciples obtained a series of fundamental results based on this equation. In particular, the probe field method was ultimately formulated and with its aid resonance radiation processes were analyzed with allowance made for particle movement and various relaxation processes. It was ascertained that, in addition to 'ordinary' saturation effects, the nonlinear interference phenomena caused by a radiation-induced coherent superposition of quantum states are of principal importance in this case, as is the field splitting effect for levels. Doppler-free narrow nonlinear resonances were predicted and investigated, which correspond to two-photon processes in level systems with various configurations (Λ-scheme, V-scheme, two-photon absorption and luminescence schemes). The dependence was established of the width and shape of nonlinear resonances on the mutual orientation of the wave vectors for laser fields, their polarizations and intensities, and collisions of various types (quenching, depolarizing, dephasing, and changing velocity). The slow particle effect was exposed, which reduces to the fact that nonlinear resonances are not actually subjected to the so-called time-of-flight broadening. The splitting of nonlinear resonances due to the recoil effect was also predicted. These results provided the basis for high- and ultrahigh-resolution sub-Doppler spectroscopy and were widely developed in many research teams all over the world, as well as in the laboratory headed by S G Rautian. New branches of spectroscopy were developed, in particular, the nonlinear spectroscopy of low-temperature plasma, polarization spectroscopy based on difference nonlinear resonances, magneto-optical nonlinear spectroscopy, and the spectroscopy of multiphoton cooperative processes. The probe field method allowed obtaining a large body of data on the interaction of gas particles with high-power laser radiation and on the physics of collisions in gas and plasma.

S G Rautian made a considerable contribution to investigations of the physics of lasers themselves. He established an important role for the microscopic inhomogeneities induced by radiation, calculated the hysteresis phenomena in lasers with an absorbing cell, suggested new excitation methods and active media (photodissociation, organic dyes), created the theory of laser generation on superluminescence with an unstable cavity, etc.

S G Rautian and his apprentices were among the first to study nonlinear optical effects in gases. They experimentally detected and explained specific effects concerning the frequency conversion of radiation in resonance multiphoton processes that, as a rule, are related to stimulated Raman scattering and multiphoton parametric processes. Presently, these effects, in addition to the nonlinear interference effects mentioned above, are getting more attention due to rising interest in inversion-free lasers.

Some important results were obtained by S G Rautian and under his guidance concerning the specific action of laser radiation on matter. They comprise, in particular, the discovery of address laser photomodification of biomolecules (RNA and DNA), and observation of giant nonlinear optical responses of fractal clusters and their photomodification. In his laboratory, the new phenomenon of light-induced drift of atoms and molecules was discovered, which formed a new area of investigations, namely, light-induced gas kinetics.

Over the course of his scientific activity, S G Rautian has passed on his knowledge to young researches, continuously involved young people in science, and expanded the team of scientists involved in new laser physics. As a result, a wide scientific school was formed by S G Rautian and he is always surrounded by numerous students.

S G Rautian must be highly credited with the creation of the laser physics school in Siberia. He started his work there in 1965 when laser physics was in its first stages of development. The scientific groundwork laid by him while working at the P N Lebedev Physical Institute in Moscow gave a powerful incentive to quickly increase the qualifications of young specialists who dedicated their activity to this promising new field of science. Under S G Rautian's guidance, the late 1960s and early 1970s were marked by the rapid progress of laser physics in Novosibirsk. This was a period of great enthusiasm, the active generation of new ideas, and the formation of the basis for the S G Rautian Siberian school. Later on, Siberian laser-physicists and their achievements became known and appreciated by scientists all around the world. In the scientific works of most of them one can easily recognize traces of the approaches to the choice of themes, systems of physical conceptions, and methods developed by S G Rautian.

S G Rautian has always paid particular attention to teaching students and training them as professional specialists. His pedagogical activity was connected with the Moscow Institute of Physics and Technology (MIPT) and, particularly, with Novosibirsk State University. In 1965, he organized at NSU the specialty of optics, which later was transformed into the Quantum Optics Chair. S G Rautian was the head of the chair until 2002. In this period, the chair saw more than 400 graduates, including more than 80 candidates of science and 17 doctors of science. They work not only at the Novosibirsk scientific center, but also in other scientific centers in Siberia, in other regions of Russia, and abroad. Most of them are recognized as high-quality specialists.

Twenty-seven candidate dissertations were defended under the direct guidance of S G Rautian, 15 of his apprentices became doctors of science, and one became a corresponding member of the RAS. These are the cases satisfying formal criteria. Actually, there are even more CdScs and DScs who count themselves among the followers of the S G Rautian school. These are pupils of pupils and those who, having an academic degree, substantially enriched their scientific skill as the result of fruitful contacts with S G Rautian.

The creative activity of S G Rautian always was and still is very high. Apprentices and colleagues of Sergei Glebovich know well the style of his scientific work based on endless diligence and dedication to science. An example of such style is his work on seminars, which he organized and headed for dozens of years. It is no exaggeration to say that in all these seminars he was the most attentive and experienced listener.

In listing the merits of S G Rautian, one should start not from his scientific results, but from his achievements in the human sphere. This was always the highest-priority domain for Sergei Glebovich. People around him can always ask him for advice or help and he will never turn down their request; suspending other work, he will start solving your problem thoroughly and delicately. The solutions obtained have successfully passed the test of time.

Despite health problems, Sergei Glebovich still exhibits much scientific activity. Suffice it to say that during the last two years he has published a dozen works, six of them without co-authors. We wish him new scientific achievements, happiness, and health for many more years.

E B Aleksandrov, L M Barkov, E V Vinogradov,
V L Ginzburg, O N Krokhin, É P Kruglyakov,
I B Khriplovich, A V Chaplik, A M Shalagin