

## Editorial

### Nikolai Ivanovich Koroteev

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The news of the untimely and tragic death of Nikolai Ivanovich Koroteev, director of the International Laser Centre, M.V. Lomonosov Moscow State University, Head of the Chair of General Physics and Wave Processes, Faculty of Physics, M.V. Lomonosov Moscow State University, came as a great shock to the other members of the Editorial Board of the *Journal of Raman Spectroscopy*. The Raman community lost with Nikolai a leading scientist in the field of non-linear optics and particularly of non-linear Raman spectroscopy. He was one of the pioneers of what he first called 'Active Raman Spectroscopy' and which became later on known as 'Coherent Anti-Stokes Raman Spectroscopy (CARS)'. His premature death at the age of 51 deprived the world of physics of an outstanding member, a brilliant leader and a very bright personality, whose talents and personal charm were appreciated by everyone who had the pleasure of knowing him.

Nikolai Ivanovich Koroteev was born on 2 April, 1947, in the city of Stalingrad, which was later given the name of Volgograd and which will forever remain in history as the city where one of the bloodiest battles—the Stalingrad battle—took place. We know very well how much time and effort it takes to become a physicist. Nikolai became a student of the Physics Faculty of Moscow State University in 1965. Having graduated from this faculty, he became a PhD student at the same faculty in 1971 and received his Candidate of Science (PhD) degree in 1974. Being a PhD student, he was in a research team supervised by Sergei Aleksandrovich Akhmanov, one of the pioneers of non-linear optics in the former Soviet Union, developing new applications of coherent anti-Stokes Raman scattering. It was in 1972 that they published one of the first papers on this subject. The abbreviation CARS was not as widely accepted at that time as it is now. So, the four-photon process they used for spectroscopic purposes, which is now well known as CARS, was called active spectroscopy of Raman scattering, as already mentioned above. This term is still very often used in Russian literature. It should be mentioned that they already used an optical parametric oscillator as a source of frequency-tunable radiation for coherent Raman measurements at that time. OPOs are nowadays very popular as elements of CARS and femtosecond laser systems.

In 1978, Nikolai received a fellowship at Stanford University. At that time, it was not very often that a person from the Soviet Union could go and work abroad for a relatively long period, and many people who knew him then are sure that it was another very important point in his biography, as he had an opportunity to work in one of the best American laboratories and meet many people who later became famous for their research in coherent non-linear spectroscopy. He also published several important papers on polarization spectroscopy while staying with the Stanford group, including a paper in *Physical Review Letters* on coherent ellipsometry, substantially extending the opportunities of coherent four-photon techniques.

Back in the USSR, he published a comprehensive monograph together with S.A. Akhmanov entitled 'Methods of Nonlinear Optics in Light Scattering Spectroscopy' (Nauka, Moscow, 1981). It was published in Russian and is widely cited in Russian literature, but it was never translated into English. Very soon, Nikolai Koroteev received his Doctor of Science degree in Physics and Mathematics (1983) and became a full professor in 1986.

By that time Nikolai had published several review papers on polarization-sensitive four-photon spectroscopy, which summarized the results of his efforts in the development of this technique. One of these papers was a review in

*Soviet Physics Uspekhi*, published in 1987, where the fundamentals of polarization four-photon spectroscopy were presented and numerous applications of this technique were discussed.

He also initiated research into the non-linear optical properties of excited and ionized gases. The studies carried out in that direction allowed the research team he supervised to develop several efficient non-linear optical methods for laser-produced and gas-discharge plasma diagnostics and to propose a scheme of frequency up-conversion in laser-produced plasmas, which was successfully employed in the 1990s by many research groups in Japan, the United States, Germany and Uzbekistan.

The International Laser Centre (ILC) was organized in 1989. The idea of this centre was to promote the co-operation of laser laboratories and institutes in the countries from the Eastern block. Many research projects were initiated and accomplished at that time. Many members of the ILC were involved in making laser systems for research groups in Bulgaria, Hungary, Slovakia and other countries. Several important scientific meetings were also organized in Moscow. Of course, the ILC could not resist general tendencies that existed in Eastern Europe and could not keep laser physicists from Eastern European countries together in a situation when political processes generally had an opposite direction. However, for many physicists, chemists and biologists working in Moscow State University and many other institutes, the ILC always provided, and still provides, an opportunity to accomplish many of their projects that would be difficult to realize otherwise.

Sergei Aleksandrovich Akhmanov, the Head of the Chair of General Physics and Wave Processes, died suddenly and so prematurely in the summer of 1991 at the age of 61. It was a common opinion of everybody working at the Chair then that Nikolai Ivanovich Koroteev should take over the responsibilities of the head of the Chair. So, beginning in 1992, Nikolai headed the Chair of General Physics and Wave Processes, being simultaneously the Director of the International Laser Centre and the Vice Rector of Moscow State University. Nikolai remained at the post of the Vice Rector of Moscow University on international relations until 1996, and during this period, he inspired many international projects and promoted many ideas of international collaboration.

With difficult times that came for science in Russia in the 90s, and with the way both the Chair and the laser centre faced these hard times, everybody could see that there was just the right person in the right place, guiding scientists through. Looking back, one can say that both the Chair of Wave Processes and the ILC not only survived these years, but increased their scientific and teaching potential, with many new projects accomplished and many new lecture courses developed. One of the most ambitious projects the ILC was, and still is, involved in is three-dimensional optical memory. The main idea of this project is to extend optical memory to three dimensions, to use the third dimension to store more data. With many things of technological and engineering importance, much is also being done within the framework of this project to provide a better understanding of fundamental phenomena in this and related areas.

Being very busy with all the administration affairs, Nikolai still continued research in many areas, including the non-linear optics of surfaces, coherent spectroscopy of plasmas and biological objects, and wave mixing and frequency conversion. He seemed to be at the peak of his scientific creativity in the 1990s, working in different areas of non-linear optics and generating new ideas in various fields, including chiral non-linear optics, three-dimensional optical memory, harmonic generation and wave mixing in plasmas, non-linear optics of photonic crystals, and many others. An author of four monographs and of more than 250 scientific papers, and a supervisor of about 30 candidate dissertations, he was very enthusiastic about the development of time-resolved techniques of non-linear spectroscopy, providing an opportunity to achieve a high spectral, temporal and spatial resolution. In many of these techniques, non-linear Raman processes were involved. He actively promoted ideas of femtosecond non-linear optical spectrochronography, contributing to the formation and rapid growth of this promising area of non-linear optical spectroscopy. For this research, he was awarded the 1996 Lomonosov Prize.

Beginning in 1985, he contributed greatly to the development of a new area of research: non-linear optics of chiral media. In a preprint of the Physics Faculty published in 1985, he put forward an idea of new spectroscopic

schemes of chiral media based on even-order non-linearities, pointing out that some of the prohibition rules common for non-linear optics of centrosymmetric media are lifted in chiral media, opening up new horizons for non-linear optics. In the 1990s, he predicted several new non-linear optical effects for such media, including frequency up-conversion, optical rectification and electro-optical effect, thus revealing the practical importance of implementing three- and five-wave mixing in media with broken mirror symmetry and contributing to the fundamentals of non-linear optics. One of the things that kept him interested was that non-linear optics may provide a clue for puzzling out the mystery of the chiral purity of nature. Keeping non-linear optics alive in Russia during the most difficult times, he was excited with the opportunity to apply non-linear optics to understanding life itself. Many times he mentioned that this area of non-linear optics is still to be adequately explored, calling it 'the unwritten chapter of non-linear optics', meaning that many non-linear optical effects that were generally believed to be forbidden in centrosymmetric media can be observed in media with broken symmetry and can be employed in conceptually new spectroscopic schemes, expanding the area of spectroscopic applications of non-linear optics. With his contribution to this field, with his papers published in many international journals and many of his lectures given on that subject at many international conferences, symposia and seminars, this chapter of non-linear optics is no longer unwritten. This is one of the chapters that he left unfinished. His colleagues and his former students are to finish them for him.

We are sure that many will remember very well what an excellent speaker he was and what a strong response his talks and lectures always produced. Many colleagues attending the International Conference on Raman Spectroscopy (ICORS) in Capetown in September 1998, three months before Nikolai's death, had the chance to listen to his plenary lecture on 'Coherent and Non-linear Optical Techniques in Raman Spectroscopy at the End of the 20th Century'. Even after some time has passed since his sudden death, we cannot believe that he is no longer involved in the fascinating development of this research area in the present, new century.

Nikolai Ivanovich Koroteev was a member of programme committees and advisory boards of the largest conferences, including CLEO and IQEC, a member of editorial boards of many journals (*Journal of Raman Spectroscopy*, *Optics Communication*, *Quantum Electronics* and *Nonlinear Optics* among them). He agreed to be on the editorial board of *Applied Physics B* in October 1998, so he was supposed to start working as a member of it beginning in January 1999. He was an active member of national, European and American committees. But, probably the most important thing is that, wherever he was, he just enjoyed meeting new people and making new friends everywhere.

Being on the programme and organizing committees of many important conferences, Nikolai Ivanovich devoted much time to the promotion of conferences on coherent and non-linear optics (ICONO), which were initiated by R.V. Khokhlov and S.A. Akhmanov, remaining one of the largest conferences on non-linear optics. Nikolai Ivanovich chaired the last two conferences in 1995 and 1998, and what he, together with Professor Bagayev, the Co-Chair of these conferences, was able to do is to keep and improve the scientific level of these conferences, which were traditionally held, first, in the Soviet Union and then in Russia.

The 90s was a difficult time for science in Russia. With funds severely reduced and with many talented people gone abroad, Russian science with all its tremendous potential just struggled to survive through never-ending problems of collapsing economy and finances, crises in all spheres of life, eventually growing into even deeper crises, leading to universal indifference and ignorance. Many research groups and many institutes in Russia had to reduce their large-scale research programmes and give up their most ambitious plans. What Nikolai Ivanovich was able to do in this situation was to shine a light of hope for people he worked with, making his chair and his laser centre an oasis of new ideas, creativity and optimism in a desert of despondency and disappointment. Keeping this oasis blossoming, keeping this light of hope shining would be the best way to honour the memory of Nikolai Ivanovich Koroteev. The memory of him will live forever.

The death of Nikolai Ivanovich Koroteev is a tragic loss for his wife, Nina Koroteeva, for the Russian laser spectroscopists and for the international non-linear Raman community. Those who had the privilege to benefit from his friendship and share his enthusiasm will surely miss him.

Aleksei Zheltikov<sup>1</sup> and Wolfgang Kiefer<sup>2</sup>

<sup>1</sup> Moscow State University, Russia

<sup>2</sup> University of Würzburg, Germany