Dr. Andrei F. KOSTKO

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EDUCATION AND DEGREES

Ph.D., Physics and Mathematics, Leningrad (St. Petersburg) State University, Russia, 1988.
Thesis: "Photon-correlation of multiply scattered light from Brownian particles and critical fluctuations." Photon diffusion has been introduced in Dynamic Light Scattering (DLS). Experiments with latex suspensions were used to develop a technique that breaks the single-scattering limitation of DLS, which provides the opportunity to study milk-like samples. The technique is now well known as diffusing-wave spectroscopy and is utilized widely in soft matter physics.

M.S., Physics (Molecular Optics), Leningrad (St. Petersburg) State University, Russia, 1974.
Orientational relaxation of anisotropic molecules in viscous liquids studied with Fabri-Perot spectroscopy of depolarized light scattering.

SPECIAL DEGREE AND AWARDS

Associate Professor of Physics Chair, Academic rank awarded by State Committee of Russian Federation on Higher (University) Education, 1993

Optical Society of America Travel Grant Award for participation in the OSA Topical Meeting "Photon Correlation and Scattering", Capri, Italy, 1996

NATO Travel Grant Award to deliver invited lecture at the NATO Advanced Workshop "Light Scattering and Photon Correlation Spectroscopy", Krakow, Poland, 1996

PROFESSIONAL EXPERIENCE

Associate Professor, 1993 – 2019; **Assistant Professor**, 1989 – 1993; **Senior Engineer,** 1988 – 1989; **Doctoral Graduate student,** 1985 – 1988; **Engineer,** 1977 – 1985; Department of Physics, St. Petersburg State University of Refrigeration and Food Engineering (now integrated with ITMO University, Faculty of Physics and Engineering), St. Petersburg, Russia.

Research Associate, 2000 – 2003, Department of Chemical Engineering and the Institute for Physical Science and Technology, University of Maryland, College Park MD, USA.

Assistant Research Scientist, 2003 – 2004, The Institute for Physical Science and Technology, University of Maryland, College Park, USA.

Research Associate, 2004 – 2009, Department of Chemical and Life Science Engineering, Virginia Commonwealth University, Richmond VA, USA

Engineer, 1974 – 1977, Department of Molecular Optics and Biophysics, Leningrad (St. Petersburg) State University, St. Petersburg, Russia.

RESEARCH EXPERIENCE

Current research

Application of laser light scattering to detect antibiotic resistance of bacteria.

Previous research

Experimental studies of complex fluids, liquid crystals, polymers in liquid and supercritical fluid solvents, and gels by static and dynamic light scattering.

Dynamic light scattering research on Polymers in Compressible Supercritical Fluid (SCF) Solvents at pressures to 2500 bar.

Investigations of the solvent quality of an SCF solvent, such as CO_2, utilizes high-pressure dynamic light scattering to probe coil-coil interactions in an SCF solvent environment, to determine changes in SCF solvent quality.

Light scattering study of solutions of a fluorocarbon surfactant in supercritical CO_2 was performed to find evidence of inverse micelles.

Physical properties of Lyotropic Chromonic Liquid Crystals.

Pretransitional formation of aggregates was studied with static and dynamic light scattering. This research was performed in collaboration with the Liquid Crystal Institute and Chemical Physics Interdisciplinary Program at Kent State University.

Studies of structure of N phase with neutron scattering and the effects of salts on the phase behavior and structure of cromolyn solutions.

Static and dynamic light scattering studies of Critical Phenomena in polymer solutions and in ionic aqueous solutions.

Crossover critical behavior controlled by competition of mesoscales was studied. Avoided crossing of dynamic modes was observed and investigated in near-critical dynamics of entangled polymer chains. A method was developed for probing the microrheology of complex fluids by critical fluctuations. Conflicting interpretations of critical behavior of ionic aqueous solutions were resolved.

Transient biogels. Such transient biogels are promising materials for medical applications.

Dynamics of gelation and degradation processes in transient biogels was studied with dynamic light scattering. Intriguing symmetry in these processes was observed.

Primary research interests before 2000: Development of basic principles of diffusing photon correlation (diffusing-wave spectroscopy) and applications of this method to systems with multiple light scattering.

Diffusing photon correlation spectroscopy.

Diffusion approximation was introduced in photon-correlation spectroscopy for milk-like media. Particle sizing method in milk-like media by dynamic light scattering was developed. Location of the effective diffusive source and diffusion and non-diffusion contributions to decay rate were studied in diffusing-wave spectroscopy.

Application of diffusing photon correlation to critical opalescence.

Critical opalescence was studied in the immediate vicinity of the critical point. Estimation of the effect of multiple scattering was performed for conditions of real experiments where multiplicity of scattering is continuously increasing with approach to the critical point.

TEACHING EXPERIENCE

"Dynamic Light Scattering" - introductory lectures (3 hours) developed and contributed as part of the course by Professor McHugh, "Introduction to Polymer Science and Engineering" at Virginia Commonwealth University. Graduate and undergraduate level (2005).

Teaching and mentoring of a Ph.D. student on the application of Static and Dynamic Light Scattering methods to characterize candidate polymers for drug delivery. University of Maryland (2005).

"Introduction to Dynamic Light Scattering" - two-hour lecture and subsequent four-hour hands-on laboratory training developed and delivered to graduate students. Participated as an instructor in a new graduate level course "Mesoscale and Nanoscale Thermodynamics" by Professor Anisimov, Department of Chemical and Biochemical Engineering, University of Maryland at College Park (2003 – 2004).

General Physics three-semester (Fall-Spring-Fall) lecture course developed and delivered continuously (50-80 undergraduates, 2-4 lecture hours weekly, 17 weeks per semester), St. Petersburg State University of Refrigeration and Food Engineering (now integrated with ITMO University). Brief versions of this course (one and two semesters) have been also delivered (1993 – 2000, 2009 – present).

General Physics (Application) courses (training on problem solving) and laboratory practicum for 3-5 groups of undergraduates every semester (over 20 students in each group), about 10 hours weekly, St. Petersburg State University of Refrigeration and Food Engineering (now integrated with ITMO University) (1977 – 2000, 2009 – present).