

Research Team

Soft condensed mater and the physics of macromolecular systems

Department of Physics, FEEI, Technical University of Košice, Park Komenského 2, 042 00 Košice, Slovakia

<http://web.tuke.sk/feikf/sk/index.html>

Team members

prof. RNDr Vladimír Lisý, DrSc.

doc. RNDr. Jana Tóthová, PhD.

RNDr. Branislav Brutovský, CSc., Faculty of Science, P. J. Šafárik University, Košice, Slovakia

Ing. Katarína Paulovičová, Institute of Experimental Physics, Slovak Academy of Sciences, Košice, Slovakia

Research Direction

The team is oriented on the experimental and theoretical study of the so called soft condensed mater media, such as complex fluids, first of all the suspensions of macromolecules and various types of nanoparticles.

The Importance and Benefits of Research

The main aim is the study of phenomena, which contradict to existing models in the physics of condensed mater. The team tries to explain various anomalous observations in suspensions – disordered systems of micro- and nanoparticles, such as the Brownian tracers, synthetic and biological macromolecules. Unusual displays of these systems are experimentally investigated mainly by the rheometry methods, and theoretically described using the methods of statistical physics. The goal is to contribute to the creation of adequate phenomenological and microscopic models, and thus to a better understanding of the studied complex systems.

Solving Current problems

At present, the team is oriented to the study of physical systems with nonmarkovian dynamics, first of all the polymeric liquids. The description of such systems comes from the theory of the Brownian motion with memory. Efficient methods have been developed to solve generalized Langevin equations for stochastic dynamics of particles. The thermal noise driving the particles has been characterized and its influence on the tiny forces acting at micro- and nanoscales has been determined. An attention is given to the dynamics of long polymer chains and to the memory effects of the hydrodynamic and visco-elastic character on macroscopic properties of the macromolecular solutions. Among important outputs a generalization of the so called bead-spring models can be mentioned. A new description of the behaviour of polymer coils at short times has been proposed and the existence of long-

time tails in the correlation functions of the coils was predicted. The calculations of the internal viscosity of polymer solutions are in a good agreement with experiments conducted in collaboration with IEP SAS in Košice.

Current Projects

Anomalous Brownian motion, grant VEGA No. 1/0370/12

Anomalous properties of suspensions of nanoparticles and polymers, grant VEGA 1/0348/15

Cooperation with Academic Institutions and Industry

Institute of Experimental Physics, Slovak Academy of Sciences, Košice, Slovakia; Faculty of Science, P. J. Šafárik University in Košice, Slovakia; Laboratory of Radiation Biology, Joint Institute for Nuclear Research, Dubna, Russian Federation

Selected Publication

TÓTHOVÁ, Jana - LISÝ, Vladimír: Unusual Brownian motion. In: *Statistical Mechanics and Random Walks: Principles, Processes and Applications*. - New York: Nova Science Publishers, 2012 P. 39-63. - ISBN 978-1-61470-966-4

LISÝ, Vladimír - TÓTHOVÁ, Jana - GLOD, Lukáš: On the correlation properties of thermal noise in fluids. In: *International Journal of Thermophysics*. Vol. 34, no. 4 (2013), p. 629-641.

TÓTHOVÁ, Jana - GLOD, Lukáš - LISÝ, Vladimír: Thermal noise and hydrodynamic memory effects on force measurements at microscales. In: *International Journal of Thermophysics*. Vol. 34, no. 4 (2013), p. 701-709.

LISÝ, Vladimír - TÓTHOVÁ, Jana: Comment on "Spherical particle Brownian motion in viscous medium as non-Markovian random process". In: *Physics Letters A*. Vol. 377, no. 34-36 (2013), p. 2251 - 2252.

TÓTHOVÁ, Jana - LISÝ, Vladimír: Intrinsic viscosity of PVP polymers in extremely diluted solutions. In: *e-Polymers*. Vol. 13, no. 1 (2013), p. 1-6.

LISÝ, Vladimír - TÓTHOVÁ, Jana: Brownian motion of charged particles driven by correlated noise in magnetic field. In: *Transport Theory and Statistical Physics*. Vol. 42, no. 6-7 (2013), p. 365-380.

LISÝ, Vladimír - TÓTHOVÁ, Jana: Effect of magnetic field on the fluctuations of charged oscillators in viscoelastic fluids. In: *Acta Physica Polonica A*. Vol. 127, no. 1 (2014), p. 413-414.

LISÝ, Vladimír - TÓTHOVÁ, Jana - GLOD, Lukáš: Diffusion in a medium with nonlinear friction. In: *International Journal of Thermophysics*. (2014) 35:2001–2010.

TÓTHOVÁ, Jana - TIMKO, Milan - KOPČANSKÝ, Peter - LISÝ, Vladimír: Search for anomalous temperature behavior of the viscosity of Polyethylene glycol solutions. In: *International Journal of Thermophysics*. (2014) 35:2150–2157.

BRUTOVSKÝ, Branislav – HORVÁTH, Denis: Towards inverse modeling of intratumor heterogeneity, In: Open Phys. (2015) 15:232–141.

HORVÁTH, Denis – BRUTOVSKÝ, Branislav: Study of selected switching strategies in time varying environment. In: Physics Letters A (2016) 380:1267–1278.

TÓTHOVÁ, Jana – PAULOVIČOVÁ, Katarína - LISÝ, Vladimír: Viscosity measurements of dilute Poly(2-ethyl-2-oxazoline) aqueous solutions near theta temperature analyzed within the joint Rouse-Zimm model. Int. J. Polymer Sci. (2015) Article ID 690136, 1-7.