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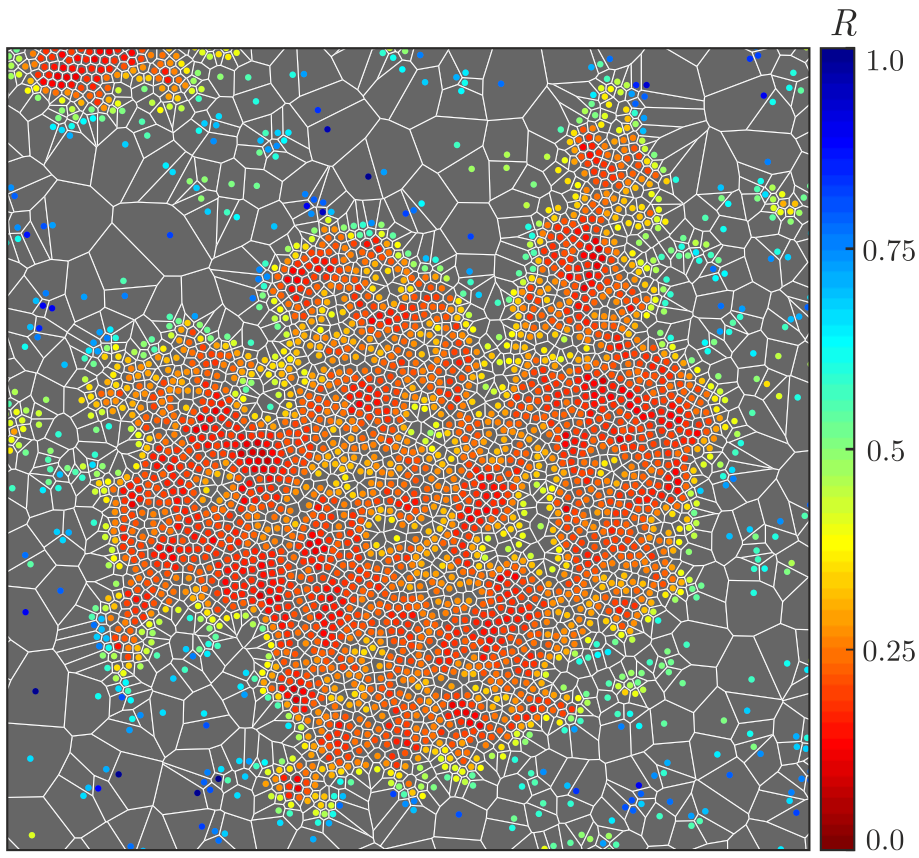
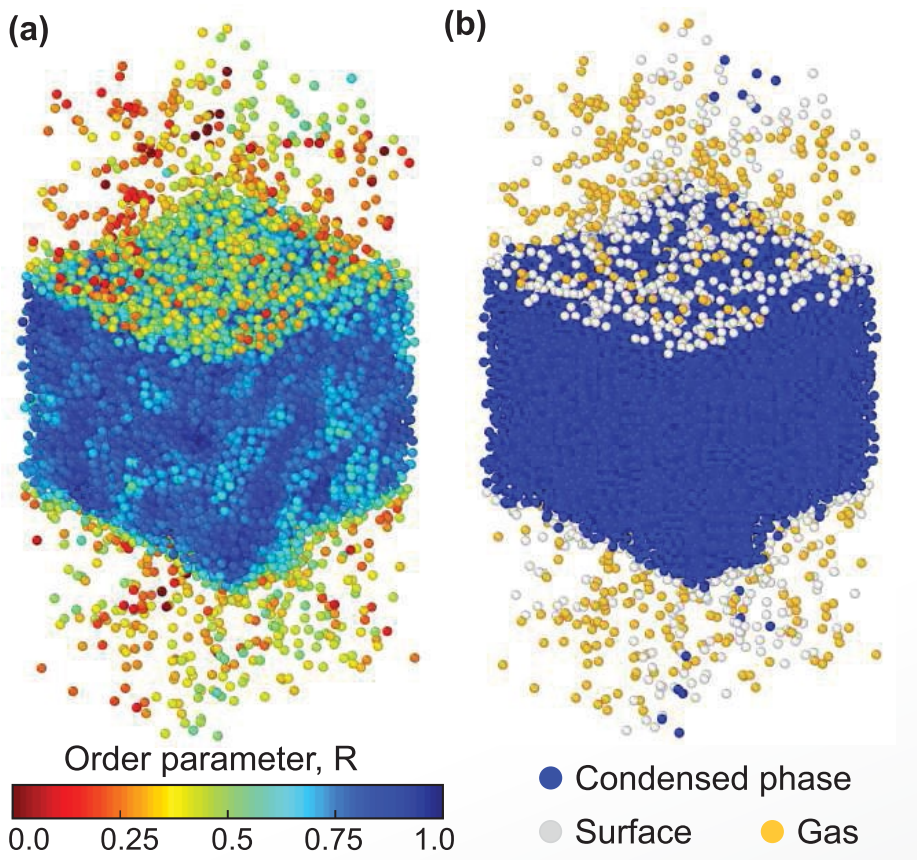
When: Thursday, Dec 13, at 16:00-17:00
Where: Skoltech, Blue Bldg, room 402
Computational Materials Science Seminar

2D COLLOIDS IN ROTATING ELECTRIC FIELDS: TUNABLE INTERACTIONS AND PARTICLE-RESOLVED STUDIES





Speaker:
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ABSTRACT

Tunable interparticle interactions in colloidal suspensions are of great interest because of their fundamental and practical significance. In this work, we present our results of theoretical and experimental studies of two-dimensional colloidal systems wherein attractive interparticle interactions are induced and controlled by external rotating electric fields [1-2]. Self-assembly process in suspensions of micro- and nanoparticles is a common phenomenon in nature, and it can be used to create new materials in photonics and catalysis. Apart from practical interest, colloidal systems are of great importance for fundamental studies, since they mimic molecular behavior and can be used in particle-resolved studies of generic phenomena in condensed matter. By placing two-dimensional colloidal systems in external electric field rapidly rotating in the plane of system, we can effectively induce interparticle attraction, which is long-range, tunable, and non-pair. Magnitude of the interaction is controlled by electric field, evolution of the system can be visualized using video-microscopy, that opens a way for particle-resolved studies of such fundamental phenomena as self-assembly, condensation and evaporation, melting and crystallization, spinodal decomposition, dislocation dynamics, nucleation and coalescence, surface phenomena etc. In the framework of presentation, we consider (i) novel experimental technology for particle-resolved studies of colloidal suspensions in rotating electric field [1]; (ii) optimal experimental regimes; (iii) results of pair interaction analysis [3]; (iv) a novel method for experimental data post-processing [2]; (v) phase diagram of a monodisperse system in external fields [4].

These results open novel prospects in fundamental and applied studies of many-body systems with tunable interaction, and, therefore, will be of interest to wide range of scientists in the fields of soft matter, physical chemistry, chemical physics, photonics, and materials science.

[1] Tunable two-dimensional assembly of colloidal particles in rotating electric fields / Egor V. Yakovlev, Kirill A. Komarov, Kirill I. Zaytsev, Nikita P. Kryuchkov, Kirill I. Koshelev, Arsen K. Zotov, Dmitry A. Shelestov, Victor L. Tolstoguzov, Vladimir N. Kurlov, Alexei V. Ivlev, Stanislav O. Yurchenko // SCIENTIFIC REPORTS 96, 043201 (2017).

[2] Particle-resolved phase identification in two-dimensional condensable systems / Pavel V. Ovcharov, Nikita P. Kryuchkov, Kirill I. Zaytsev, and Stanislav O. Yurchenko // JOURNAL OF PHYSICAL CHEMISTRY C 121 (48), pp 26860–26868 (2017).

[3] Tunable interactions between particles in conically rotating electric fields / Kirill A. Komarov, Nikita P. Kryuchkov and Stanislav O Yurchenko // SOFT MATTER, 2018,

[4] Phase diagram of a two-dimensional system with Yukawa repulsion and dipolar attraction / Nikita P. Kryuchkov, Frank Smallenburg, Alexei V. Ivlev, Stanislav O. Yurchenko, and Hartmut Löwen // (To be published)

BIOGRAPHY

Stanislav O. Yurchenko graduated with honours in 2009 from the Bauman Moscow State Technical University (BMSTU) and already in 2009 obtained his PhD in Physics from the same university. In 2010 he became an assistant professor, at the end of 2010 an associate professor, and in 2014 a leading researcher at BMTSU. The expertise areas of Prof. Yurchenko and his lab include both theoretical and experimental studies: collective dynamics, statistical mechanics, and thermodynamics of classical many-body systems; colloidal suspensions and complex (dusty) plasmas on particle-resolved level; aqua solutions of electrolytes, micro- and nanobubbles in these solutions; self-assembly and phase transitions, interfacial and surface phenomena in systems with tunable interaction between particles, including non-equilibrium and open systems.