

Workshops

1. Complex Approximations, Orthogonal Polynomials and Applications, Mar 28 - Apr 3, 2021

Description: The goal of the workshop is to bring together leading experts to discuss the latest achievements in the area of complex approximations and orthogonal polynomials. The main direction of the workshop is to communicate recent results in the theory of rational approximation of analytic functions. Important tools for rational approximation are the Riemann-Hilbert problems, the theory of orthogonal polynomials, the theory of the logarithmic potential and the operator theory for difference operators. The main objective of the workshop is to discuss the applications of complex approximations and orthogonal polynomials in the spectral theory of difference operators, random matrices models and special functions, which play an important role in applied and computational mathematics.

Organizers: Alexander Aptekarev (Keldysh Institute of Applied Mathematics), Vladimir Lysov (Keldysh Institute of Applied Mathematics).

External website: <http://caopa2020.tilda.ws/>

2. Complex Analysis and Spectral Theory, postponed to April of 2021

Description: The conference will bring together leading experts in complex and functional analysis who are working in the area of approximation theory, on gap and density, sampling and interpolation problems in various spaces of analytic functions, as well as on their applications to spectral theory, harmonic analysis, and random analytic functions. We will explore new advances in these areas emphasizing the interplay between complex function theory, harmonic analysis, and operator theory on the one side, and mathematical physics and probability on the other. We hope to be able to state some new ambitious fundamental problems, and to brainstorm various ideas for solving them. The conference will initiate new exciting interactions and collaborations between groups of participants. The participation of young researchers will be especially encouraged.

Organizers: Ujue Etayo (TU Graz), Håkan Hedenmalm (KTH), Nikolai Makarov (Caltech), Alexei Poltoratski (University of Wisconsin-Madison), Roman Romanov (St. Petersburg University).

3. Multidimensional Residues and Tropical Geometry, postponed to April of 2021

Description: Integral representations and residues is a powerful tool for studying functions and computing integrals. By integrals one can represent a number of solutions of a system of equations, the roots, solutions to differential equations, many special functions of mathematical physics. As a rule, construction of residues is closely related to analytic sets; therefore, the residue theory goes deep into algebraic geometry, in particular in the problem of ideal membership and the effective Nullstellensatz. In the last decades the ideas of the multidimensional residue theory proved to be useful in tropical geometry thanks to important notions of the Jensen-Ronkin counting function and of a supercurrent, which is related to the Monge-Ampere problem in the pluripotential theory. In the last decades the studies led to discovery of new regularizations of residue currents, Koppelman formulas for solution of a $\bar{\partial}$ -problem on analytic sets. There have been constructed residue currents associated to weakly holomorphic functions; a non-standard interpolation problem for holomorphic functions has been solved using the Grothendieck residues; a k -convexity (according to Gromov) for a complement of an amoeba for a complete intersection has been proved. The major topic for discussions during the proposed workshop are: k -convexity (according to Gromov) for complements of amoebas in case of incomplete intersections; tropical Hodge theory; tropical version of the Gelfond-Khovansky theorem; logarithmic Gauss mapping and non-standard interpolation in analytic spaces; computation of the Mellin-Barnes integrals with applications to mathematical physics.

Organizers: August Tsikh (Siberian Federal University), Mats Andersson (Chalmers tekniska högskola och Göteborgs universitet).

4. Geometric and Quantum Control, Jun 6 - 12, 2021

Description: Differential geometry has been the source of an original viewpoint to investigate typical questions arising in the control framework: controllability, observability, stabilization, optimal control... Such a viewpoint, and the powerful tools developed in its framework, is known as the geometric control theory. The geometric control theory, in turn, has shown its strengths as an approach to study geometric problems, and in particular sub-Riemannian geometry. The goal of this workshop is to present recent advances sharing this approach, both theoretical and applicative (with a particular emphasis to quantum control). In the workshop, three main lines of research will be presented: Sub-Riemannian geometry from the control viewpoint and applications, Structural properties in geometric control, Control of quantum dynamics. The workshop is organized with the purpose of foster the interactions between researchers from Russia, Europe and USA. We encourage in particular participation of young researchers.

Organizers: Andrei Agrachev (SISSA, Trieste, Italy & Steklov Mathematical Institute, Moscow, Russia), Ugo Boscain (CNRS, LJLL, Sorbonne Université, Paris, France), Yuri Sachkov (PSI RAS, Pereslavl, Russia), Mario Sigalotti (INRIA, LJLL, Sorbonne Université, Paris, France).

5. International Computer Science Symposium, Jun 27 - Jul 3, 2021

Description: The CSR conference series is an annual meeting in theoretical computer science. Started in 2006, it is held during the summers in different places in Russia, past venues including Moscow, St. Petersburg, Novosibirsk, Ekaterinburg, Kazan, Nizhny Novgorod and Lake Baikal. Since 2015, the conferences have been organized in partnership with European Association for Theoretical Computer Science (EATCS). It has a single track consisting of 4-8 invited talks and 20-30 contributed talks.

Organizers: Daniil Musatov (MIPT), Alexander Kulikov (PDMI RAS), Alexander Razborov.

6. Classical and Quantum Integrable Systems, Jul 18 - 24, 2021

Description: This workshop continues the series of CQIS workshops held in 2004-2019 in Dubna, Protvino, Chernogolovka and St. Petersburg. The idea of the workshop is to bring together 70-100 mathematical physicists and mathematicians working in the field of integrable models and related fields. Traditionally, we anticipate strong participation of scientists from Russia and FSU countries. At the same time, we welcome scientists from all around the world and we expect that their participation will contribute considerably to the objectives of the workshop. The scientific scope of the workshop covers recent results in integrable models of classical and quantum mechanics, field theory and statistical physics, various algebraic, geometric and combinatorial aspects of integrability including quantum algebras and quantum groups, cluster algebras, conformal field theory, W-algebras etc, integrable probability and asymptotic representation theory.

Organizers: Sergei Lando (HSE University), Andrey Pogrebkov (Steklov Mathematical Institute), Alexander Povolotsky (Joint Institute for Nuclear Research), Pavel Pyatov (HSE University), Pavel Saponov (HSE University).

7. Russian-German Workshop on Numerical Methods and Mathematical Modelling in Geophysical and Biomedical Sciences, Aug 1 - 7, 2021

Description: The workshop focuses on the mathematical challenges and computational modelling in geophysics (subsurface flows, environmental problems, and other challenges in Earth sciences) and biomedicine (blood flows in the heart, arteries and microcirculatory networks, interactions of blood flow with the surrounding elastic tissues, bioengineering problems). The resulting research topics encompass several traditional mathematical fields such as mathematical fluid mechanics, nonlinear PDEs, fluid-structure interaction models, numerical analysis and computational mathematics, as well as emerging

research topics such as multi- physics simulations. The workshop brings together experts and early career researchers across disciplines to report on the progress, assess critically the current state of the art and discuss open problems. The workshop will provide an opportunity for participants to share their vision of future directions in the field of mathematical modelling. Due to the multidisciplinary nature of the proposed topic, it provides an excellent opportunity to early career researchers to be enthused and nurtured.

Organizers: Yuri Vassilevski (INM RAS, MIPT, Sechenov University), Peter Malte (University of Augsburg, Germany), Yuri Iliash (University of Augsburg, Germany).

8. Integrable Systems and Their Applications, Aug 8 - 14, 2021

Description: The purpose of the conference is to establish international contacts for the subsequent involvement of world experts in cooperation with Russian scientists in the field of geometry and topology, dynamical systems, as well as other related areas of mathematics.

Organizers: Huijun Fan (Peking University), Andrey Mironov (Sobolev Institute of Mathematics), Iskander Taimanov (Sobolev Institute of Mathematics), Youjin Zhang (Tsinghua University), Jian Zhou (Tsinghua University).

9. Lower Bounds in Computational Complexity, Aug 15 - 21, 2021

Description: The aim of the workshop is to bring together researchers working on algorithms and complexity theory to discuss recent progress on these questions including new techniques for proving lower bounds and connections to other fields including: circuit complexity (what is the minimum number of basic operations needed to compute a given function?), proof complexity (what is the minimum number of steps needed to prove a given tautology?), communication complexity (what is the minimum amount of information that two or more parties need to exchange in order to compute a given function?), fine-grained complexity and conditional lower bounds (what is the minimum running time exponent for algorithms computing given functions, and what relationships exist between the running times for different functions?).

Organizers: Alexander Kulikov (PDMI RAS), Ryan Williams (MIT).

10. Hamiltonian Systems and Dispersive PDE's, Aug 29 - Sep 4, 2021

Description: Stability, decay and collapse are key properties found in nature. To predict the asymptotic behavior of solutions to PDE's, and the stability/instability properties of some particular solutions is of uttermost importance for several mathematical models motivated by the applied sciences. In the recent years, some new tools have been developed by different communities of mathematicians, in order to address answers to some natural questions in the above direction, which are among the most fascinating and hard challenges of modern Nonlinear Analysis, such as the soliton resolution for globally defined waves in non compact domains, or the weak turbulence, or long-time behaviour for small-amplitude solutions of Hamiltonian PDEs in finite volume. There are several different approaches to the study of the stability/instability properties of special solutions to nonlinear PDEs (such as solitons, quasi-periodic or almost-periodic solutions. A useful paradigm is, for example, to generalize to the infinite dimensional setting, methods coming from finite dimensional dynamical systems and to merge them with approaches more typical of Cauchy theory, such as pseudo and para differential calculus, energy estimates, multiscale analysis, etc. The study of the spectral properties of the linearized operator around the special solution and the inherent rigidity related to the particular PDE are the main ingredients. Those arguments have been extensively investigated, in the last years, by the communities of mathematicians interested in Hamiltonian Systems and Dispersive PDEs, who are recently sharing many interesting questions about analogous topics. The aim of this workshop is to bring together some of the main world experts in these communities, such that they could share the knowledge and possibly produce advances in different directions.

Organizers: Luca Fanelli (Ikerbasque, Bilbao, Spain), Sergei Kuksin (IMJ-PRG, Paris, France), Michela Procesi (Roma 3, Rome, Italy).

11. Computer Algebra in Scientific Computing, Sep 12 - 18, 2021

Description: The topics addressed at the workshop will cover algorithmic and applied issues of scientific computing by means of computer algebra systems used for symbolic and numerical computations. They will comprise algorithms and methods of symbolic computation used in automated proof theory, parallel symbolic computations, symbolic methods for solving ordinary differential equations, partial differential equations and systems of such equations, complexity theory including analytic complexity for holomorphic functions, methods for data analysis including big data analytics, design of software and hardware environments for symbolic and algebraic computation, as well as applications of the above in various fields of natural sciences and technology. The goal of the workshop is to explore and discuss recent developments related to the field of scientific computing and symbolic computation, with specific focus on the role of software development and data analysis.

Organizers: Timur Sadykov (Plekhanov Russian University, Moscow, Russia), Vladimir Gerdt (Joint Institute for Nuclear Research, Dubna, Russia).

12. Future and Emerging Mathematical Technologies for Innovations in Industry and Society, Sep 19 - 25, 2021

Description: The primary objective of the meeting is to discuss future and emerging mathematical technologies, and to share experience and best practices of organizing collaborative research projects with industry, as well as to discuss and brainstorm about joint future activities. One of the major obstacles to be addressed is the low visibility of mathematical technologies in European programs. Therefore, an important objective is to discuss measures facilitating awareness about existing expertise in Europe and knowledge transfer. Another prime objective of this workshop is to discuss a strategic research agenda (SRA) for the mathematical sciences. The writing process for such SRA is currently being started up, and the workshop would be an ideal opportunity to discuss the SRA and its contents in detail. The workshop is organized under the auspices of EU-MATHS-IN – a European Network of Mathematics for Industry and Innovation. This network is a collaboration of national organizations from 20 European countries. The promoting partners of EU-MATHS-IN are the European Mathematical Society and the European Consortium for Mathematics in Industry.

Organizers: Wil Schilders (Eindhoven University), Zoltán Horváth (SZE, Győr, Hungary).

13. Mathematics Applied to Immunology and Virology, Sep 26 - Oct 2, 2021

Description: Mathematics plays an increasing role in the description and analysis of the immune system. Indeed, modern research in immunology is characterized by an unprecedented level of detail that has progressed towards viewing the immune system as numerous components that function together as a whole network. The research community is facing significant difficulties in making inferences from the data being generated from high-throughput technologies for understanding immune system functioning, a problem known as the ‘curse of dimensionality’. Shifting our view of the immune system from a static schematic perception to a dynamic multi-level system is a daunting task. It requires the development of appropriate mathematical models and methods for a holistic and quantitative analysis of multi-level molecular and cellular networks underpinning the immune reactions in health and immune-related diseases. Traditional mathematical categories such as multi-stability, switches, ultra-sensitivity, distributed systems, graph dynamics, hierarchical control as well as emergent frameworks of multiscale and hybrid modelling will be discussed at the workshop in the context of question-driven data-based multidisciplinary studies of the immune system. The overall goal of this workshop is to: review state-of-the-art knowledge in mathematical immunology and discuss open problems in mathematics generated by these new complex models of various classes (graph and network type, hybrid and hierarchical systems, etc.) derived to understand various

immunological phenomena. Therefore, the main topics of the workshop include the analysis and numerical implementation of the models described by ODEs, DDE and PDE systems, development of hybrid and multiscale models, inverse problems, automatic and optimal control of the immune system dynamics.

Organizers: Gennady Bocharov (INM RAS, Lomonosov Moscow State University, Sechenov First Moscow State Medical University), Irina Gainova (Sobolev Institute of Mathematics), Andreas Meyerhans (Pompeu Fabra University, Barcelona, Spain), Sergey Nedospasov (Lomonosov Moscow State University, Engelhardt Institute of Molecular Biology, Sirius University of Science and Technology).

14. Variational Methods in Nonlinear Nonlocal PDEs, Oct 3 - 9, 2021

Description: This workshop will focus on recent developments of mathematical analysis tools and variational methods in some selected new applications of the field of nonlinear nonlocal aggregation/diffusion PDEs. Kinetic modelling typically concentrates on situations which can be identified, at the modelling stage, as systems made out of a large number of individuals showing a collective behaviour. The main question is how to obtain from them averaged information. The behavior of individuals can be usually modelled via stochastic/deterministic ODEs from which one obtains mesoscopic and/or macroscopic descriptions based on mean-field type PDEs. The interplay between the aggregation/interaction behavior (nonlocal, nonlinear), the transport phenomena, and the diffusion, is the main goal of this workshop both at the stationary and the dynamical level.

Organizers: José Antonio Carrillo (University of Oxford), Lucia Scardia (Heriot-Watt University), Bruno Volzone (Università "Parthenope"), Yao Yao (Georgia Institute of Technology).

15. Mathematics of modern mathematical physics, Oct 10 - 16, 2021

Description: The goal of the workshop is to bring together specialists in different branches of mathematics who work on important and physically meaningful problems. The main research topics covered by the workshop include: dynamics and geometry of moduli spaces (with applications to mathematical physics); determinantal point processes and related topics; hyper-Kähler geometry, reduction algebras, metric geometry, and moduli spaces; statistical mechanics of spin glasses. On the one hand, we invite world-leading researchers in each directions that already have successful experience of collaboration and several challenging joint projects. On the other hand, we hope that multi-disciplinary format of the workshop will stimulate cross-fertilization between different branches of mathematical physics; at the same time, due to this diversified scope of subjects we plan to keep majority of the talks understandable for rather broad auditory, including graduate students.

Organizers: Semen Shlosman (SkolTech and IITP), Pascal Hubert (Aix-Marseille University, France), Alexandra Skripchenko (HSE and SkolTech).

16. Topology of torus actions and related topics, Oct 24 - 30, 2021

Description: Toric topology is the study of topological spaces with well-behaved toric symmetries. The subject was first identified 20 years ago and has developed rapidly, with remarkably varied input from cobordism and homotopy theory, algebraic and combinatorial geometry, commutative algebra, and symplectic geometry and integrable systems. Central objects are quasitoric manifolds and torus manifolds (topological generalizations of toric varieties), moment angle manifolds and moment angle complexes. Torus manifolds are often algebraic or symplectic but need not be, instead having more flexibility in terms of studying topological and combinatorial properties. In particular, these properties give valuable information about the topology of toric varieties themselves. Moment angle complexes provide powerful links between homotopy theory, theory of space arrangements, the construction of symplectic reduction, Coxeter and Artin groups and hyperbolic geometry. Recently, there is a strong interest in the generalization of torus manifolds: methods of toric topology proved useful in the study of torus actions of positive complexity, such as the torus actions on Grassmann manifolds and flag manifolds. This variety of

mathematical disciplines related to the subject explains the attractiveness of toric topology for young researchers. Many problems in this field are accessible for students, yet their solution has certain interest in theoretical mathematics. The workshop is followed by the school 'Toric topology and combinatorics'.

Organizers: Anton Ayzenberg (HSE), Taras Panov (Lomonosov Moscow State University), Alexander Gaifullin (SkolTech and Steklov Institute of Mathematics).

17. Algorithmic Presentations in Mathematics, Nov 7 - 13, 2021

Description: The general area of computable (or effective) mathematics is devoted to understanding the algorithmic content of mathematical objects. Interest in effectiveness is already apparent in the famous Hilbert problems, in particular the second and the tenth, and in early 20th century work of Dehn, initiating the study of word problems in group theory. Turing, Gödel and others in the 1930s came up with a formal notion of an algorithm. Nowadays, computable mathematics is a flourishing research area with its leading researchers working in the top universities worldwide. In Russia, there are strong research groups in Kazan, Moscow, and Novosibirsk. Over the last decade, computable mathematics has seen a lot of new important developments in different areas, including effective algebra, computable analysis, and feasible mathematics. No firm line can be drawn between these topics. One of our main goals is to bring experts in these areas together.

Organizers: Nikolay Bazhenov (Sobolev Institute of Mathematics, Novosibirsk, Russia), Iskander Kalimullin (Kazan Federal University, Kazan, Russia), Julia Knight (University of Notre Dame, South Bend, USA), Frank Stephan (National University of Singapore, Singapore), Alexander Melnikov (Massey University, Auckland, New Zealand).

Schools

1. Spectral and Functional Inequalities and Their Applications, postponed to April of 2021

Description: We shall start with some preliminary material describing basic concepts of self-adjoint operators in Hilbert Space such as compact, bounded and unbounded operators, semi-bounded operators and Friedrichs extensions, variational principle, Birman-Schwinger principle. Read more

Lecturers: Ari Laptev (Imperial College London), Lukas Schimmer (University of Copenhagen), Baibulov Inur (SPb State University).

2. Black Sea spring school on new developments in mathematical finance, April 18 - 24, 2021

Description: TBA

Lecturers: TBA

3. Mathematics, theoretical physics and mathematical methods of data analysis in neuroscience, Jul 25 - Aug 4, 2021

Description: The mission of the School is to bring together graduate students, PhD students and young researchers who are already working, or plan to work in the field of theoretical neuroscience, to explore the frontiers of this hot scientific field.

Lecturers: TBA

4. Mathematics of Many-Body Quantum Systems, Oct 17 - 23, 2021

Description: The school will focus on the rigorous aspects of certain questions of high physical interest for many-body quantum systems, such as Bose-Einstein condensation in Bose gases, Cooper pairing and superconductivity in Fermi gases, screening effects in Coulomb systems. Each topic will be reviewed by a main lecturer, followed by several shorter talks on more advanced questions. A particular emphasis will be put on the derivation of effective nonlinear equations from the true many-body Schrödinger linear equation in limits where the number of particles tends to infinity. This problem has indeed generated a large amount of works in the last 10 years. The targeted audience is composed of graduate or advanced master students as well as postdocs and young researchers in Mathematical Physics and related areas.

Lecturers: Mathieu Lewin (CNRS & University of Paris-Dauphine), Robert Seiringer (IST Austria).

5. Toric topology and combinatorics, Oct 31 - Nov 6, 2021

Description: The school follows the workshop 'Topology of torus actions and related topics'.

Lecturers: TBA

6. Computational Bayesian Statistics in Ecology, Dec 12 - 18, 2021

Description: Bayesian Statistics is a rich and self-contained branch of Statistics that offers both theoretical guarantees like consistency and admissibility, and practical advantages when compared with other branches. It is however often dismissed for using probability distributions on the parameters and for being associated with controversies and paradoxes. The course intends to expose the modern theory of Bayesian statistics and to demonstrate its practicality, through programming sessions with Bayesian packages and realistic applications inspired from Ecology and Genetics. A part of the course will be dedicated to so-called intractable environments when the likelihood function is well-defined but unavailable in closed form and replaced with substitutes that also guarantee convergence with the number of observations. The school is aimed at a mixed audience made both of statisticians who want to use Bayesian methods and computational tools, and biostatisticians involved in applications requiring computational statistical methods. We would like to favour the presence of younger researchers at this school. It is indeed paramount that young researchers in our research areas are exposed as early as possible to modelling and experimenting methods and analysis outside their immediate scientific surrounding. We will also seek a maximal level of interaction during and around the classes with "bring-your-own-problem" sessions. Read more.

Lecturers: Sophie Donnet (INRAE, Paris), Jean-Michel Marin (Université de Montpellier), Christian Robert (Université Paris Dauphine and University of Warwick), Julien Stoehr (Université Paris Dauphine).