



# Banff International Research Station

for Mathematical Innovation and Discovery

## 2014 Annual Report



**NSERC**  
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Consejo Nacional de Ciencia y Tecnología

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## 5-Day Workshops 2014

Jan 12	Jan 17	Modern Developments in M-theory
Jan 19	Jan 24	Theoretical Foundations of Applied SAT Solving
Jan 26	Jan 31	Mathematicians and School Mathematics Education: A Pan-American Workshop
Feb 2	Feb 7	Positivity of Linear Series and Vector Bundles
Feb 2	Feb 7	Convex Bodies and Representation Theory
Feb 9	Feb 14	Statistical and Computational Theory and Methodology for Big Data Analysis
Feb 16	Feb 21	Computational Contact Mechanics: Advances and Frontiers in Modeling Contact
Feb 23	Feb 28	Multifractal Analysis: From Theory to Applications and Back
Mar 2	Mar 7	Advances in Scalable Bayesian Computation
Mar 9	Mar 14	Geometric Tomography and Harmonic Analysis
Mar 16	Mar 21	Global/Local Conjectures in Representation Theory of Finite Groups
Mar 23	Mar 28	Parameterized Morse Theory in Low-Dimensional and Symplectic Topology
Mar 30	Apr 4	Specialization of Linear Series for Algebraic and Tropical Curves
Apr 6	Apr 11	Complex Monge-Ampère Equations on Compact Kähler Manifolds
Apr 13	Apr 18	Subfactors and Fusion Categories
Apr 20	Apr 25	WIN3: Women in Numbers 3
Apr 27	May 2	Recent Advances and Trends in Time Series Analysis: Nonlinear Time Series, High Dimensional Inference and Beyond
May 4	May 9	Dynamics in Geometric Dispersive Equations and the Effects of Trapping, Scattering and Weak Turbulence
May 11	May 16	Mathematical Finance: Arbitrage and Portfolio Optimization
May 18	May 23	Imaging and Modeling in Electron Microscopy - Recent Advances
May 25	May 30	Geometric Aspects of Semilinear Elliptic and Parabolic Equations: Recent Advances and Future Perspectives
Jun 1	Jun 6	The Future of Trace Formulas
Jun 8	Jun 13	Integrability in Holography
Jun 8	Jun 13	Programming with Chemical Reaction Networks: Mathematical Foundations
Jun 15	Jun 20	Quantum Curves and Quantum Knot Invariants
Jun 22	Jun 27	Emerging Statistical Challenges and Methods For Analysis of Massive Genomic Data in Complex Human Disease Studies
Jun 29	Jul 4	Entropy Methods, PDEs, Functional Inequalities, and Applications
Jul 6	Jul 11	New Directions in Financial Mathematics and Mathematical Economics
Jul 13	Jul 18	Stochastic Network Models of Neocortex (a Festschrift for Jack Cowan)
Jul 20	Jul 25	Spin Glasses and Related Topics
Jul 27	Aug 1	Statistics and Nonlinear Dynamics in Biology and Medicine
Aug 3	Aug 8	Approximation Algorithms and the Hardness of Approximation
Aug 10	Aug 15	Recent Progress in Dynamical Systems and Related Topics
Aug 17	Aug 22	Mathematical Modelling of Particles in Fluid Flow
Aug 24	Aug 29	Communication Complexity and Applications
Aug 31	Sep 5	Front Propagation and Particle Systems
Sep 7	Sep 12	Mathematics of the Cell: Integrating Genes, Biochemistry and Mechanics
Sep 14	Sep 19	Probability on Trees and Planar Graphs
Sep 21	Sep 26	Multiscale Models of Crystal Defects
Sep 21	Sep 26	Rigorously Verified Computing for Infinite Dimensional Nonlinear Dynamics
Sep 28	Oct 3	Vojta's Conjectures
Oct 5	Oct 10	Sparse Representations, Numerical Linear Algebra, and Optimization
Oct 12	Oct 17	Optimal Cooperation, Communication, and Learning in Decentralized Systems
Oct 19	Oct 24	Dynamics and $C^*$ -Algebras: Amenability and Soficity
Oct 26	Oct 31	Biological and Bio-Inspired Information Theory
Nov 2	Nov 7	Geometric Scattering Theory and Applications
Nov 9	Nov 14	Particle-Based Stochastic Reaction-Diffusion Models in Biology
Nov 16	Nov 21	Algorithms for Linear Groups
Nov 23	Nov 28	Algebraic and Model Theoretical Methods in Constraint Satisfaction
Nov 30	Dec 5	Families of Automorphic Forms and the Trace Formula
Nov 30	Dec 5	Motivic Integration, Orbital Integrals, and Zeta-Functions
Dec 7	Dec 12	Cohomological Realizations of Motives

## 2-Day Workshops 2014

Apr 18	Apr 20	Alberta Number Theory Days VI
Apr 25	Apr 27	Ted Lewis Workshop on SNAP Math Fairs 2014
Jul 11	Jul 13	Algebraic Design Theory with Hadamard Matrices: Applications, Current Trends and Future Directions
Jul 25	Jul 27	Recent Advances in Survey Sampling Techniques
Aug 8	Aug 10	The Fourth International Workshop on the Perspectives on High-dimensional Data Analysis
Aug 29	Aug 31	Canadian Abstract Harmonic Analysis Symposium 2014
Oct 3	Oct 5	Connecting Women in Mathematics Across Canada
Nov 7	Nov 9	53rd Cascade Topology Seminar

## Summer Schools

Jun 22	Jul 5	2014 Summer IMO Training Camp
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## Research In Teams

Mar 2	Mar 9	Operator Limits of Random Matrices
Mar 30	Apr 6	On a System of Hyperbolic Balance Laws Arising from Chemotaxis
Apr 6	Apr 13	Subfactors, Twisted Equivariant K-theory and Conformal Field Theory
Apr 27	May 4	Effective Field Theory Outside the Horizon
May 4	May 11	Alexandrov Geometry
Jun 15	Jun 22	Dirichlet Spaces and de Branges-Rovnyak Spaces
Jul 20	Jul 27	Spectrum Asymptotics of Operator Pencils
Aug 24	Aug 31	Statistical Predictions for Chain Ladder Data

## Focused Research Groups

Apr 20	Apr 27	Hyperplane Arrangements, Wonderful Compactifications, and Tropicalization
Aug 10	Aug 17	Borel Complexity and Classification of Operator Systems
Oct 26	Nov 2	Geometric Aspects of $p$ -adic Automorphic Forms



# **Banff International Research Station**

**2014**

**5-Day Workshops**



# Modern Developments in M-theory

## January 12-17, 2014

### Organizers:

**Keshav Dasgupta** (McGill University)  
**Sunil Mukhi** (Indian Institute of Science Education and Research)

**Mark Van Raamsdonk** (University of British Columbia)



M-theory is the leading candidate today for a quantum theory of physical laws that is rich enough to incorporate all the fundamental particles and interactions seen in nature. The challenge is to use this elegant and highly symmetrical formalism, that operates in a total of eleven space-time dimensions, to describe the dynamics of the real world with its gravitational and other interactions in four observable space-time dimensions, with the remaining seven spatial dimensions being curled up into a small volume. This workshop focused on the definition of M-theory; the effective action of M-theory; M2-branes; M5-branes; M5-branes and superconformal theories; generalised geometry; knot theory and branes and wall-crossing.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5076>

### Participants:

**Anguelova, Lilia** (Perimeter Institute for Theoretical Physics)  
**Basu, Anirban** (Harish-Chandra Research Institute)  
**Becker, Katrin** (Texas A&M University)  
**Behan, Connor** (University of British Columbia)  
**Berman, David** (Queen Mary, University of London)  
**Castro, Alejandra** (University of Amsterdam)  
**Cederwall, Martin** (Chalmers University of Technology)  
**Chu, Chong-Sun** (National Tsing Hua University)  
**Dasgupta, Keshav** (McGill University)  
**Green, Michael** (Cambridge University)  
**Gwyn, Rhiannon** (Max Planck Potsdam)  
**Harvey, Jeff** (University of Chicago)  
**Horava, Petr** (Berkeley Center for Theoretical Physics)  
**Kim, Seok** (Seoul National University)  
**Kovacs, Stefano** (Dublin Institute for Advanced Study)  
**Lambert, Neil** (King's College)  
**Lee, Kimyeong** (Korea Institute for Advanced Study)

**Mariño, Marcos** (Université de Genève)  
**McDonough, Evan** (McGill University)  
**Mia, Mohammed** (Purdue University)  
**Mukhi, Sunil** (Indian Institute of Science Education and Research)  
**Nilsson, Bengt** (Chalmers University of Technology)  
**Papageorgakis, Costis** (Rutgers University)  
**Quigley, Callum** (University of Alberta)  
**Rastelli, Leonardo** (YITP Stony Brook, and IAS)  
**Robbins, Daniel** (University of Amsterdam)  
**Sethi, Savdeep** (University of Chicago)  
**Shimada, Hidehiko** (Okayama Institute for Quantum Physics)  
**Sorokin, Dmitri** (INFN Padova)  
**Sully, James** (SLAC National Accelerator Laboratory)  
**Tomasiello, Alessandro** (Università di Milano-Bicocca)  
**Van Raamsdonk, Mark** (University of British Columbia)

# Theoretical Foundations of Applied SAT Solving

## January 19-24, 2014

### Organizers:

**Albert Atserias** (Universitat Politecnica de Catalunya)    **Antonina Kolokolova** (Memorial University of Newfoundland)  
**Armin Biere** (Johannes Kepler University)            **Jakob Nordström** (KTH Royal Institute of Technology)  
**Sam Buss** (University of California, San Diego)        **Karem Sakallah** (University of Michigan)



This workshop gathered leading theoreticians and practitioners to stimulate an increased exchange of ideas between the mathematics and computer science communities. The workshop provided great opportunities for fruitful interplay between theoretical and applied research in this area. The organizers believe that a more vigorous interaction between the two has potential for major long-term impact in computer science and mathematics, as well for applications in industry.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5101>

### Participants:

**Atserias, Albert** (Universitat Politecnica de Catalunya)    **Kolokolova, Antonina** (Memorial University of Newfoundland)  
**Audemard, Gilles** (Université d'Artois)                    **Kullmann, Oliver** (Swansea University)  
**Beame, Paul** (University of Washington)                    **Lauria, Massimo** (KTH Royal Institute of Technology)  
**Beck, Chris** (Princeton University)                         **Le Berre, Daniel** (Université d'Artois)  
**Ben-Sasson, Eli** (Technion)                                     **Malik, Sharad** (Princeton University)  
**Beyersdorff, Olaf** (University of Leeds)                    **Manthey, Norbert** (TU Dresden)  
**Biere, Armin** (Johannes Kepler University)                **Marques-Silva, Joao** (IST/INESC-ID)  
**Bonacina, Ilario** (Università degli Studi di Roma La Sapienza)    **Miksa, Mladen** (KTH Royal Institute of Technology)  
**Bueno, Denis** (University of Michigan)                    **Narodytska, Nina** (University of Toronto)  
**Buss, Sam** (University of California, San Diego)           **Nordström, Jakob** (KTH Royal Institute of Technology)  
**Darwiche, Adnan** (University of California, Los Angeles) **Oliveras, Albert** (Universitat Politecnica de Catalunya)  
**Een, Niklas** (University of California, Berkeley)           **Razborov, Alexander** (University of Chicago)  
**Fichte, Johannes Klaus** (Vienna University of Technology) **Sabharwal, Ashish** (IBM Watson Research Center)  
**Franco, John** (University of Cincinnati)                    **Sakallah, Karem** (University of Michigan)  
**Galesi, Nicola** (Università degli Studi di Roma La Sapienza) **Santhanam, Rahul** (University of Edinburgh)  
**Ganesh, Vijay** (University of Waterloo)                    **Seidl, Martina** (Johannes Kepler University)  
**Ghasemloo, Kaveh** (University of Toronto)                **Simon, Laurent** (Labri, Bordeaux Institute of Technology)  
**Goultiaeva, Alexandra** (University of Toronto)           **Sinz, Carsten** (Karlsruhe Institute of Technology)  
**Gurevich, Yuri** (Microsoft Research)                     **Szeider, Stefan** (Vienna University of Technology)  
**Heule, Marijn** (University of Texas at Austin)           **Toran, Jacobo** (University of Ulm)  
**Järvisalo, Matti** (University of Helsinki)                   **Urquhart, Alasdair** (University of Toronto)  
**Johannsen, Jan** (LMU Munich)                                **Van Gelder, Allen** (University of California, Santa Cruz)  
**Kalla, Priyank** (University of Utah)                         **Vardi, Moshe** (Rice University)  
   **Vinyals, Marc** (KTH Royal Institute of Technology)  
   **Weaver, Sean** (US Department of Defense)



# Mathematicians and School Mathematics Education: A Pan-American Workshop January 26 - January 31, 2014

## Organizers:

**Ed Barbeau** (University of Toronto)

**José Antonio de la Peña** (Centro de Investigación en Matemáticas)

**Patricio Felmer** (Universidad de Chile, The Chilean Academy)

**Solomon Friedberg** (Boston College)

**William McCallum** (University of Arizona)



The workshop took advantage of the international character of the community of mathematicians to strengthen that involvement in North, Central and South America and the Caribbean. It provided an opportunity for mathematicians to share knowledge of their efforts and learn from the experiences of others, to develop strategies for the effective participation of mathematicians in improving school mathematics education and to continue the development of a regional network of mathematicians working in school education.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5128>

## Participants:

**Baldin, Yuri** (Universidade Federal de São Carlos)

**Baldridge, Scott** (Louisiana State University)

**Barbeau, Ed** (University of Toronto)

**Bass, Hyman** (University of Michigan)

**Bisk, Richard** (Worcester State University)

**Bosch, Carlos** (Instituto Tecnológico Autónomo de México)

**Cafure, Antonio** (Universidad Nacional de General Sarmiento)

**Clemens, Herb** (University of Utah)

**da Silva, Aparecida Francisco** (Universidade Estadual Paulista)

**de la Peña, José Antonio** (Centro de Investigación en Matemáticas)

**Dlab, Vlastimil** (Carleton University)

**Felmer, Patricio** (Universidad de Chile and Member of the Chilean Academy)

**Ford, Ben** (Sonoma State University)

**Friedberg, Solomon** (Boston College)

**Gomez Pasquali, Gabriela** (Organización Multidisciplinaria de Apoyo a Profesores y Alumnos)

**Gourdeau, Frédéric** (Université Laval)

**Hodgson, Bernard** (Université Laval)

**Howe, Roger** (Yale University)

**Hughes Hallett, Deborah** (University of Arizona)

**Labarca, Rafael** (Universidad de Santiago de Chile)

**Lahme, Brigitte** (Sonoma State University)

**Lai, Yvonne** (University of Nebraska)

**Lewis, Jim** (University of Nebraska-Lincoln)

**Limonta, Manuel** (Director ICSU-ROLAC Mexico)

**Madden, James** (Louisiana State University)

**Madras, Neal** (York University)

**Martinez, Salome** (Universidad de Chile)

**McCallum, William** (University of Arizona)

**Pineda, Angel** (California State University, Fullerton)

**Varas, Leonor** (Universidad de Chile)

**Zabrocki, Mike** (York University)

# Positivity of Linear Series and Vector Bundles

## February 2-7, 2014

### Organizers:

**Sándor Kovács** (University of Washington)

**Tomasz Szemberg** (Pedagogical University Cracow)

**Alex Küronya** (Budapest University of Technology and Economics)



Algebraic geometry studies geometric objects described by simple – polynomial – equations. Since such spaces occur quite often in nature, the applicability of modern algebraic geometry is vast; it ranges from theoretical physics and differential equations to cryptography and error-correcting codes. The way we study these objects (which we call algebraic varieties) is to see in what way they can be embedded in larger spaces, or to look at what kind of interesting functions can exist on them. This workshop studied projective algebraic varieties from several points of view, and tried to relate the results coming from different directions.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5056>

### Participants:

**Bayer, Arend** (University of Edinburgh)

**Bertram, Aaron** (University of Utah)

**Chiecchio, Alberto** (University of Washington)

**Chou, Chih-Chi** (University of Illinois at Chicago)

**Di Rocco, Sandra** (KTH Stockholm)

**Greb, Daniel** (Ruhr-Universität Bochum)

**Harbourne, Brian** (University of Nebraska-Lincoln)

**Huizenga, Jack** (University of Illinois at Chicago)

**Jabbusch, Kelly** (University of Michigan-Dearborn)

**Kitchen, Sarah** (University of Michigan)

**Kovács, Sándor** (University of Washington)

**Küronya, Alex** (Budapest University of Technology and Economics)

**Mistretta, Ernesto Carlo** (University of Padova)

**Mustopa, Yusuf** (Northeastern University)

**Palka, Karol** (Polish Academy of Sciences)

**Pareschi, Giuseppe** (Università di Roma "Tor Vergata")

**Popa, Mihnea** (University of Illinois at Chicago)

**Roé, Joaquim** (Universitat Autònoma de Barcelona)

**Schmitz, David** (Phillips-Universität-Marburg)

**Smith, Gregory G.** (Queen's University)

**Szemberg, Tomasz** (Pedagogical University Cracow)

**Urbinati, Stefano** (Università degli Studi di Padova)



# Convex Bodies and Representation Theory

## February 2-7, 2014

### Organizers:

**Megumi Harada** (McMaster University)  
**Kiumars Kaveh** (University of Pittsburgh)

**Askold Khovanskii** (University of Toronto)



The workshop concerned a research topic that forms an effective training program for future scientists. The long-term benefits of this research area are two-fold: first, the results of this research will bring to light many new combinatorial techniques for analyzing the algebraic geometry of important spaces which arise in many real-world applications (e.g. Mirror Symmetry, cryptography, fluid mechanics, optimization theory), and second, the training of young scientists in this area will result in highly trained individuals at the undergraduate, graduate and postgraduate level, who possess competitive research and technical skills in important areas of geometry.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5013>

### Participants:

**Altmann, Klaus** (Freie Universität Berlin)  
**Brion, Michel** (Université de Grenoble)  
**Carrell, Jim** (University of British Columbia)  
**Caviedes Castro, Alexander** (University of Toronto)  
**Kaveh, Kiumars** (University of Pittsburgh)  
**Kazarnovskii, Boris** (Institute for Information  
Transmission Problems)  
**Khovanskii, Askold** (University of Toronto)  
**Kiritchenko, Valentina** (Higher School of Economics)  
**Küronya, Alex** (Budapest University of Technology  
and Economics)  
**Kuttler, Jochen** (University of Alberta)

**Lee, JaeHyounk** (Ewha Womans University)  
**Manon, Chris** (George Mason University)  
**Perrin, Nicolas** (Heinrich-Heine-Universität Düsseldorf)  
**Purbhoo, Kevin** (University of Waterloo)  
**Seppänen, Henrik** (Georg-August Universität  
Göttingen)  
**Smirnov, Evgeny** (Higher School of Economics)  
**Timorin, Vladlen** (Higher School of Economics)  
**Tolman, Susan** (University of Illinois, Urbana-  
Champaign)  
**Weitsman, Jonathan** (Northeastern University)  
**Zhou, Xin** (University of Michigan)



# Statistical and Computational Theory and Methodology for Big Data Analysis February 9-14, 2014

## Organizers:

**Ming-Hui Chen** (University of Connecticut)  
**Radu Craiu** (University of Toronto)

**Faming Liang** (Texas A&M University)  
**Chuanhai Liu** (Purdue University)



The integration of computer technology into science and daily life has enabled the collection of big data sets. Today we live in an era of observations: data come from many disparate sources, such as sensor networks, scientific instruments, financial transactions, internet communications, and scientific simulations. These new sources of data and their increasing complexity contribute to an explosion of information. Opportunities abound for learning from massive-scale data sets, which can provide researchers and decision makers with information of enhanced range, quality, and depth. This workshop brought together scientists and statisticians to stimulate and exchange innovative ideas for theoretical and methodological advances in analyzing and modeling big data.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5086>

## Participants:

**Andrieu, Christophe** (University of Bristol)  
**Chen, Ming-Hui** (University of Connecticut)  
**Chen, Kun** (University of Connecticut)  
**Chen, Yuguo** (University of Illinois, Urbana-Champaign)  
**Craiu, Radu** (University of Toronto)  
**Dicker, Lee** (Rutgers University)  
**Farshidfar, Farshad** (University of Calgary)  
**Gao, Xin** (King Abdullah University of Science and Technology)  
**Gautier, Philip** (Purdue University)  
**Huang, Jianhua** (Texas A&M University)  
**Katzfuss, Matthias** (Texas A&M University)  
**Kong, Linglong** (University of Alberta)  
**Kuo, Lynn** (University of Connecticut)  
**Kvam, Paul** (Georgia Tech)  
**Li, Bo** (University of Illinois, Urbana-Champaign)  
**Li, Hongzhe** (University of Pennsylvania)  
**Li, Ping** (Rutgers University)  
**Liang, Faming** (Texas A&M University)  
**Lin, Nan** (Washington University in St. Louis)  
**Liu, Chuanhai** (Purdue University)

**Min, Xiaoyi** (Yale University)  
**Qiu, Peihua** (University of Florida)  
**Salakhutdinov, Russ** (University of Toronto)  
**Schifano, Elizabeth** (University of Connecticut)  
**Shen, Xiaotong** (University of Minnesota)  
**Shestopaloff, Alexander** (University of Toronto)  
**Suchard, Marc** (University of California, Los Angeles)  
**Wang, Xiao** (Purdue University)  
**Wang, Xiaojing** (University of Connecticut)  
**Wu, Yingnian** (University of California, Los Angeles)  
**Xiao, Guanghua** (University of Texas Southwestern Medical Center)  
**Xie, Min-ge** (Rutgers University)  
**Xiong, Momiao** (University of Texas School of Public Health)  
**Yan, Jun** (University of Connecticut)  
**Zhang, Jian** (University of Kent)  
**Zhang, Lingsong** (Purdue University)  
**Zhang, Zhang** (Beijing Institute of Genomics, Chinese Academy of Sciences)  
**Zhang, Heping** (Yale University)  
**Zhu, Hongtu** (University of North Carolina at Chapel Hill)

# Computational Contact Mechanics: Advances and Frontiers in Modeling Contact

## February 16-21, 2014

### Organizers:

**Vincent Acary** (INRIA Rhône-Alpes)  
**Robert Bridson** (University of British Columbia)  
**Danny Kaufman** (Adobe Research)

**Jong-Shi Pang** (University of Southern California)  
**Jeff Trinkle** (Rensselaer Polytechnic Institute)



This workshop brought active researchers in contact mechanics together, many for the first time, along with practitioners in the aligned areas of constrained optimization and numerical analysis. Together, they addressed current challenges to the design and analysis of predictive and efficient computational methods for contact simulation. By bridging communities and bringing together highly recognized experts in the area, we forged new interdisciplinary links between mathematicians, computational scientists and mechanics, enriched ongoing collaborative efforts and helped advance significantly the state of the art. These advances are anticipated to lead to the accurate and reliable computational tools currently demanded by today's contact intensive scientific and industrial applications.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5147>

### Participants:

**Acary, Vincent** (INRIA Rhône-Alpes)  
**Anitescu, Mihai** (Argonne National Lab)  
**Bridson, Robert** (University of British Columbia)  
**Duriez, Christian** (INRIA Lille)  
**Erleben, Kenny** (University of Copenhagen)  
**Faure, Francois** (INRIA)  
**Ferris, Michael C.** (University of Wisconsin)  
**Harrison, Darcy** (University of British Columbia)  
**Kaufman, Danny** (Adobe Research)  
**Kovacs, Jozsef** (McGill University)  
**Kry, Paul** (McGill University)  
**Lin, Ming** (University of North Carolina)  
**Lu, Ying** (Rensselaer Polytechnic Institute)  
**Mazhar, Hammad** (University of Wisconsin, Madison)  
**Melanz, Daniel** (University of Wisconsin, Madison)  
**Negrut, Dan** (University of Wisconsin, Madison)

**Pang, Jong-Shi** (University of Southern California)  
**Peters, Steven** (Open Source Robotics Foundation)  
**Posa, Michael** (Massachusetts Institute of Technology)  
**Ruina, Andy** (Cornell University)  
**Shen, Jinglai** (University of Maryland Baltimore County)  
**Smith, Breannan** (Columbia University)  
**Stam, Jos** (Autodesk Research)  
**Stark, Colin** (Columbia University)  
**Stewart, David** (University of Iowa)  
**Tamstorf, Rasmus** (Walt Disney Animation Studios)  
**Tassa, Yuval** (University of Washington)  
**Tedrake, Russ** (Massachusetts Institute of Technology)  
**Trinkle, Jeff** (Rensselaer Polytechnic Institute)  
**Waechter, Andreas** (Northwestern University)  
**Williams, Jededyah** (Rensselaer Polytechnic Institute)  
**Wohlmuth, Barbara** (Technische Universität München)



# Multifractal Analysis: From Theory to Applications and Back

## February 23-28, 2014

### Organizers:

**Patrice Abry** (CNRS, ENS de Lyon)  
**Stephane Jaffard** (Université Paris est Créteil)

**Ursula Molter** (Universidad de Buenos Aires)  
**Vladas Pipiras** (University of North Carolina)



Multifractal analysis is an emerging field that aims to provide tools for the practical analysis and modeling of data exhibiting multifractal properties and to build a mathematical theory for the underlying phenomenon. It finds its roots and is of growing interest in at least three communities: functional analysis and geometric measure theory which are theoretical mathematics; probabilistic and statistical modeling and signal and image processing, and applications at large. This workshop gathered a select group of interested experts from these communities in order to foster cross-fertilization and knowledge transfer between the communities, to identify open and key issues in multifractal analysis and to serve as the starting point of new collaborations to tackle these issues.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5045>

### Participants:

**Abry, Patrice** (CNRS, ENS de Lyon)  
**Arneodo, Alain** (École Normale Supérieure de Lyon)  
**Bai, Shuyang** (Boston University)  
**Balança, Paul** (École Centrale de Paris)  
**Barral, Julien** (Université Paris 13)  
**Bruna, Joan** (New York University)  
**Ciuciu, Philippe** (CEA)  
**Didier, Gustavo** (Tulane University)  
**Durand, Arnaud** (Université Paris-Sud)  
**Esser, Céline** (Université de Liège)  
**Flandrin, Patrick** (École Normale Supérieure de Lyon)  
**Hamonier, Julien** (École Normale Supérieure de Lyon)  
**Kigami, Jun** (Kyoto University)  
**Kiyono, Ken** (University of Osaka)  
**Lau, Ka-Sing** (Chinese University of Hong Kong)  
**Leonarduzzi, Roberto** (Universidad Nacional de Entre Rios)  
**Leonenko, Nikolai** (Cardiff University)

**Lina, Jean-Marc** (École de technologie supérieure)  
**Lovejoy, Shaun** (McGill University)  
**Mendivil, Franklin** (Acadia University)  
**Moerters, Peter** (University of Bath)  
**Pipiras, Vladas** (University of North Carolina)  
**Rendon de la Torre, Stephanie** (UNAM)  
**Ruedin, Ana** (University of Buenos Aires)  
**Scarola, Cristian** (IMAS UBA-CONICET)  
**Seuret, Stephane** (Université Paris Est Créteil)  
**Taqqu, Murad** (Boston University)  
**Torres, Maria Eugenia** (National University of Entre Rios)  
**Vedel, Beatrice** (Université de Bretagne Sud)  
**Wang, Yang** (Michigan State University)  
**Waymire, Edward** (Oregon State University)  
**Wendt, Herwig** (Centre national de la recherche scientifique, University of Toulouse)  
**Yang, Xiaochuan** (Université Paris Est Créteil)  
**Zinsmeister, Michel** (Université d'Orléans)

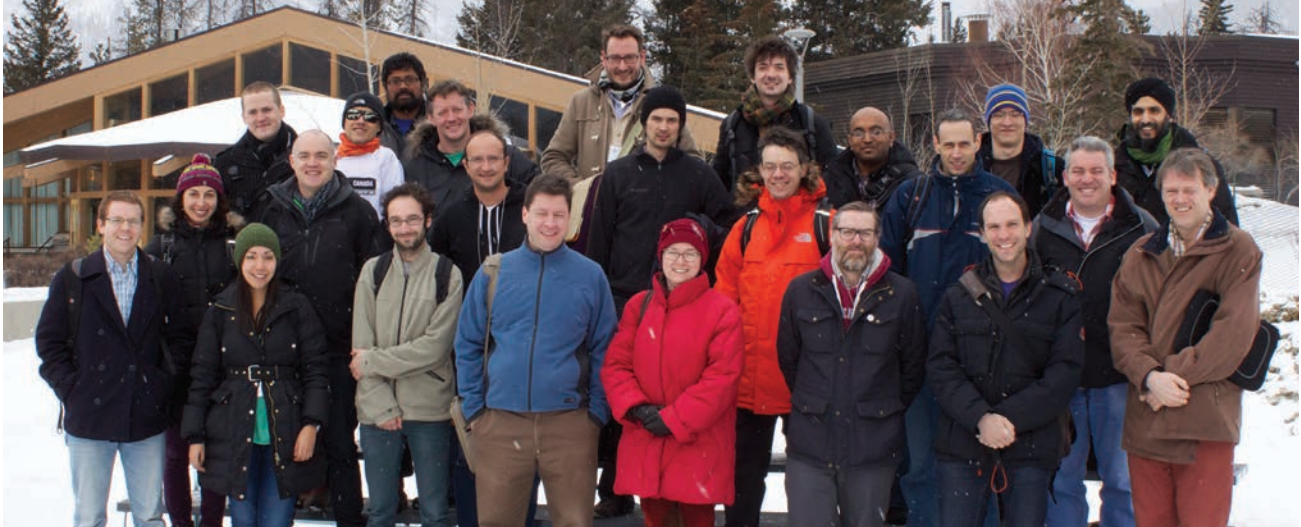
# Advances in Scalable Bayesian Computation

## March 2-7, 2014

### Organizers:

**Luke Bornn** (Harvard)  
**Nando de Freitas** (University of British Columbia)

**Christian Robert** (Université Paris-Dauphine)  
**Scott Schmidler** (Duke University)



Computational advances are always accompanied by new challenges, due both to the growth in data processing and in the possible exploration of new models. While highly innovative statistical computing methods from the early 1990's still are at the core of today's statistical practice, new models, especially in population genetics and statistical signal processing cannot be readily handled by such methods. Solutions at the interface between improved computing algorithms and controlled model approximations are now appearing in several fields and this workshop brought together experts from those different fields.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5125>

### Participants:

**Barthelmé, Simon** (University of Geneva)  
**Bornn, Luke** (Harvard)  
**Chopin, Nicolas** (ENSAE)  
**Craiu, Radu** (University of Toronto)  
**Fearnhead, Paul** (Lancaster University)  
**Fox, Emily** (University of Washington)  
**Fruhirth-Schnatter, Sylvia** (Wirtschaftsuniversität Wien)  
**Girolami, Mark** (University College London)  
**Jacob, Pierre** (National University of Singapore)  
**Lee, Anthony** (University of Warwick)  
**Lenkoski, Alex** (Norwegian Computing Center)  
**Lomeli, Maria** (University College London)  
**Mansinghka, Vikash** (Massachusetts Institute of Technology)  
**Murray, Lawrence** (CSIRO)  
**Pudlo, Pierre** (Université Montpellier 2)

**Quinonero Candela, Joaquin** (Facebook)  
**Robert, Christian** (Université Paris-Dauphine)  
**Rue, Håvard** (Norwegian University of Science and Technology Trondheim)  
**Sainudiin, Raazesh** (University of Canterbury)  
**Salakhutdinov, Russ** (University of Toronto)  
**Schmidler, Scott** (Duke University)  
**Scott, Steve** (Google)  
**Singh, Sumeetpal** (University of Cambridge)  
**Strickland, Chris** (University of New South Wales)  
**Suchard, Marc** (University of California, Los Angeles)  
**VanDerwerken, Doug** (Duke University)  
**Wilkinson, Darren** (Newcastle University)  
**Wood, Frank** (Oxford)  
**Woodard, Dawn** (Cornell University)



# Geometric Tomography and Harmonic Analysis

## March 9-14, 2014

### Organizers:

**Alexander Koldobsky** (University of Missouri)  
**Dmitry Ryabogin** (Kent State University)

**Vladyslav Yaskin** (University of Alberta)  
**Artem Zvavitch** (Kent State University)



Geometric Tomography is the area of mathematics which investigates properties of solids based on the information about their sections and projections. It overlaps with many fields of mathematics, such as convex geometry, differential geometry, functional analysis, harmonic analysis, combinatorics and probability. The aim of the proposed meeting is to discuss most recent developments in the area and to share new methods, especially those based on Fourier analysis.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5085>

### Participants:

**Berg, Astrid** (Vienna Technical University)  
**Besau, Florian** (Vienna University of Technology)  
**Bianchi, Gabriele** (Università di Firenze)  
**Colesanti, Andrea** (University of Florence)  
**Dann, Susanna** (University of Missouri)  
**Eldan, Ronen** (Microsoft Research)  
**Fradelizi, Matthieu** (Université Paris-Est Marne-la-Vallée)  
**Grinberg, Eric** (University of Massachusetts, Boston)  
**Hug, Daniel** (Karlsruhe Institute of Technology)  
**Iurchenko, Ivan** (University of Alberta)  
**Kallus, Yoav** (Princeton University)  
**Koenig, Hermann** (Universität Kiel)  
**Koldobsky, Alexander** (University of Missouri)  
**Lehec, Joseph** (Université Paris-Dauphine)  
**Litvak, Alexander** (University of Alberta)  
**Livshyts, Galyna** (Kent State University)  
**Martinez-Maure, Yves** (Institut de Mathématiques de Jussieu)  
**Meyer, Matthieu** (Université Paris-Est Marne-la-Vallée)  
**Milman, Vitali** (Tel Aviv University)  
**Pivovarov, Peter** (University of Missouri)

**Rademacher, Luis** (Ohio State University)  
**Reitzner, Matthias** (University of Osnabrück)  
**Rivasplata, Omar** (University of Alberta)  
**Rotem, Liran** (Tel-Aviv University)  
**Rudelson, Mark** (University of Michigan, Ann Arbor)  
**Ryabogin, Dmitry** (Kent State University)  
**Saroglou, Christos** (Texas A&M)  
**Schneider, Rolf** (University of Freiburg)  
**Schuett, Carsten** (Christian-Albrechts-Universität)  
**Schuster, Franz** (Vienna University of Technology)  
**Spektor, Susanna** (University of Alberta)  
**Spencer, Patrick** (University of Missouri)  
**Stancu, Alina** (Concordia University)  
**Tikhomirov, Konstantin** (University of Alberta)  
**Tomczak-Jaegermann, Nicole** (University of Alberta)  
**Valettas, Petros** (Texas A&M University)  
**Weil, Wolfgang** (Karlsruhe Institute of Technology)  
**Werner, Elisabeth** (Case Western Reserve University)  
**Yaskin, Vladyslav** (University of Alberta)  
**Youssef, Pierre** (University of Alberta)  
**Zvavitch, Artem** (Kent State University)

# Global/Local Conjectures in Representation Theory of Finite Groups

## March 16-21, 2014

### Organizers:

**Gunter Malle** (Technische Universität Kaiserslautern)

**Pham Tiep** (University of Arizona)

**Gabriel Navarro** (University of Valencia)



The proposed meeting brought together leading experts and young researchers in the representation theory of finite groups and algebraic groups to exploit the substantial recent advances on these fundamental conjectures and facilitate significant progress along the lines of all of them. This was a unique opportunity for young mathematicians to learn about these exciting developments and become directly involved in this fascinating area of research.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5024>

### Participants:

**Boltje, Robert** (University of California, Santa Cruz)

**Brunat, Olivier** (Université Paris 7)

**Cabanes, Marc** (Université Paris Diderot)

**Chuang, Joe** (City University London)

**Craven, David** (University of Birmingham)

**Danz, Susanne** (University of Kaiserslautern)

**Denoncin, David** (Institut Mathématique de Jussieu - PRG)

**Dietrich, Heiko** (Monash University)

**Dudas, Olivier** (Université Denis Diderot - Paris 7)

**Eaton, Charles** (University of Manchester)

**Elias, Ben** (Massachusetts Institute of Technology)

**Evseev, Anton** (University of Birmingham)

**Fayers, Matthew** (Queen Mary University of London)

**Fong, Paul** (University of Illinois at Chicago)

**Geck, Meinolf** (Universität Stuttgart)

**Geline, Michael** (Northern Illinois University)

**Gluck, David** (Wayne State University)

**Gramain, Jean-Baptiste** (University of Aberdeen)

**Hiss, Gerhard** (RWTH Aachen University)

**Koshitani, Shigeo** (Chiba University)

**Kuelshammer, Burkhard** (University of Jena)

**Lassueur, Caroline** (TU Kaiserslautern)

**Linckelmann, Markus** (City University London)

**Livesey, Michael** (TU Kaiserslautern)

**Lübeck, Frank** (RWTH Aachen)

**Lux, Klaus** (University of Arizona)

**Malle, Gunter** (Technische Universität Kaiserslautern)

**Müller, Juergen** (Friedrich-Schiller-Universität Jena)

**Nath, Rishi** (City University of New York)

**Navarro, Gabriel** (University of Valencia)

**Olsson, Jorn B.** (University of Copenhagen)

**Rickard, Jeremy** (University of Bristol)

**Sambale, Benjamin** (Friedrich Schiller University of Jena)

**Schaeffer Fry, Amanda** (Michigan State University)

**Schulte, Elisabeth** (TU Kaiserslautern)

**Srinivasan, Bhama** (University of Illinois at Chicago)

**Taylor, Jay** (Technische Universität Kaiserslautern)

**Tiep, Pham** (University of Arizona)

**Turull, Alexandre** (University of Florida)

**Vallejo, Carolina** (Universidad de Valencia)



# Parameterized Morse Theory in Low-Dimensional and Symplectic Topology

## March 23-28, 2014

### Organizers:

David Gay (University of Georgia)

Michael Sullivan (University of Massachusetts)



Morse theory is a tool which, if applied to the surface of the earth, would mark all the mountain peaks, all the deepest points in oceans and lakes, and all the saddles between mountains and between basins, and would then identify all the watersheds so we could see how water flows across the surface and whether rain falling in Banff flows to the Atlantic, the Pacific, the Arctic, or to an internal drainage basin. Parameterized Morse theory would then look at how all this information changes over time as tectonic plates rise and fall; what changes would make the rain in Banff flow to the Gulf of Mexico? The mathematicians working together in Banff concentrated on higher-dimensional versions of exactly these kinds of questions, applied to many different generalizations of this simple idea of water flowing across the surface of the earth.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5119>

### Participants:

**Auckly, David** (Kansas State University)  
**Baker, Ken** (University of Miami)  
**Bartlett, Bruce** (University of Oxford)  
**Baykur, Inanc** (University of Massachusetts)  
**Behrens, Stefan** (Max Planck Institute for Mathematics)  
**Bourgeois, Frédéric** (Université Paris-Sud)  
**Bryant, Kathryn** (Bryn Mawr College)  
**Budney, Ryan** (University of Victoria)  
**Castro, Nick** (University of Georgia)  
**Douglas, Christopher** (Oxford University)  
**Eliashberg, Yakov** (Stanford University)  
**Frohman, Charles** (University of Iowa)  
**Gay, David** (University of Georgia)  
**Hass, Joel** (University of California, Davis)  
**Hayano, Kenta** (Osaka University)  
**Henry, M. Brad** (Siena College)  
**Hutchings, Michael** (University of California)  
**Johnson, Jesse** (Oklahoma State University)  
**Kirby, Robion** (University of California, - Berkeley)  
**Kirszenblat, David** (University of Melbourne)  
**Koytcheff, Robin** (University of Victoria)  
**Li, Jiayong** (Massachusetts Institute of Technology)

**Licata, Joan** (Australian National University)  
**Lowell, Mark** (University of Massachusetts)  
**Melvin, Paul** (Bryn Mawr College)  
**Myer, Ziva** (Bryn Mawr College)  
**Nguyen, Khoa** (Stanford)  
**Ravelomanana, Huygens** (Université du Québec a Montréal)  
**Rubinstein, J. Hyam** (University of Melbourne)  
**Rutherford, Daniel** (University of Arkansas)  
**Sabloff, Joshua** (Haverford College)  
**Scharlemann, Martin** (University of California, Santa Barbara)  
**Schommer-Pries, Christopher** (Max Planck Institute for Mathematics)  
**Sullivan, Michael** (University of Massachusetts)  
**Teichner, Peter** (University of California)  
**Thompson, Abigail** (University of California, Davis)  
**Traynor, Lisa** (Bryn Mawr College)  
**Vicary, Jamie** (University of Oxford)  
**Wehrheim, Katrin** (University of California, Berkeley)  
**Williams, Jonathan** (University of Georgia)  
**Zupan, Alexander** (University of Texas at Austin)



# Specialization of Linear Series for Algebraic and Tropical Curves

## March 30 - April 4, 2014

### Organizers:

**Matthew Baker** (Georgia Institute of Technology)  
**Lucia Caporaso** (University of Rome: Roma Tre)  
**Maria Angelica Cueto** (Columbia University)

**Eric Katz** (University of Waterloo)  
**Sam Payne** (Yale University)



This workshop brought together leading experts and young researchers from tropical geometry and the classical theory of linear series on algebraic curves. These largely separate mathematical research communities rarely meet together at conferences, but recent breakthroughs have created important links connecting fundamental techniques, theorems and open problems on both sides. This workshop was a very timely occasion for serious dialogue between the experts on both sides, and for these two communities to join forces to address open problems, such as the maximal rank conjectures.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5133>

### Participants:

**Abramovich, Dan** (Brown University)  
**Amini, Omid** (Centre national de la recherche scientifique and École Normale Supérieure)  
**Backman, Spencer** (Sapienza University of Rome)  
**Baker, Matthew** (Georgia Institute of Technology)  
**Brown, Morgan** (University of Michigan)  
**Brugallé, Erwan** (École Polytechnique)  
**Cartwright, Dustin** (Yale University)  
**Cavaliere, Renzo** (Colorado State University)  
**Chan, Melody** (Harvard University)  
**Chen, Qile** (Columbia University)  
**Cools, Filip** (Katholieke Universiteit Leuven)  
**Coppens, Marc** (Katholieke Universiteit Leuven)  
**Cornelissen, Gunther** (Utrecht University)  
**Cotterill, Ethan** (Universidade Federal de Fluminense)  
**Cueto, Maria Angelica** (Columbia University)  
**Draisma, Jan** (TU Eindhoven)  
**Esteves, Eduardo** (Instituto Nacional de Matemática Pura e Aplicada)  
**Jensen, Dave** (Yale University)  
**Kass, Jesse** (University of South Carolina)

**Katz, Eric** (University of Waterloo)  
**Kawaguchi, Shu** (Kyoto University)  
**Kool, Janne** (Max Planck institute for Mathematics)  
**Len, Yoav** (Yale University)  
**Leykin, Anton** (Georgia Institute of Technology)  
**Liu, Fu** (University of California, Davis)  
**López Martín, Alberto** (Tufts University)  
**Maclagan, Diane** (University of Warwick)  
**Manjunath, Madhusudan** (University of California, Berkeley)  
**Osserman, Brian** (University of California, Davis)  
**Payne, Sam** (Yale University)  
**Pflueger, Nathan** (Harvard University)  
**Shaw, Kristin** (University of Toronto)  
**Shokrieh, Farbod** (Cornell University)  
**Ulirsch, Martin** (Brown University)  
**Vakil, Ravi** (Stanford University)  
**Viviani, Filippo** (Università Roma Tre)  
**Yamaki, Kazuhiko** (Kyoto University)  
**Yu, Josephine** (Georgia Institute of Technology)  
**Zureick-Brown, David** (Emory University)

# Complex Monge-Ampère Equations on Compact Kähler Manifolds

## April 6-11, 2014

### Organizers:

**Sébastien Boucksom** (Institut de Mathématiques de Jussieu)

**Philippe Eyssidieux** (Université Joseph Fourier)  
**Vincent Guedj** (Université Paul Sabatier)



The unifying theme of the present project is analytic methods in complex algebraic and Kähler geometry, with a special emphasis on complex Monge-Ampère equations. These important, fully nonlinear partial differential equations of second order are a very active area of research, related in particular to the complex version of Hamilton's Ricci flow, existence of Kähler-Einstein metrics, and other problems of Kähler geometry. This workshop was an opportunity to bring the most senior experts of the field together with junior mathematicians working in the area.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5033>

### Participants:

**Arezzo, Claudio** (International Centre for Theoretical Physics)

**Auvray, Hugues** (École normale supérieure, Cachan)

**Boucksom, Sébastien** (Institut de Mathématiques de Jussieu)

**Campana, Frédéric** (Université de Lorraine)

**Collins, Tristan** (Columbia University)

**Coman, Dan** (Syracuse University)

**Darvas, Tamas** (Purdue University)

**Delcroix, Thibaut** (Institut Fourier)

**Di Nezza, Eleonora** (Università Tor Vergata)

**Dinew, Slawomir** (Jagiellonian University)

**Eyssidieux, Philippe** (Université Joseph Fourier)

**Gauduchon, Paul** (Centre National de la Recherche Scientifique)

**Guedj, Vincent** (Université Paul Sabatier)

**Guenancia, Henri** (Institut Math. Jussieu)

**Haskins, Mark** (Imperial College London)

**Hisamoto, Tomoyuki** (Nagoya University)

**Jonsson, Mattias** (University of Michigan)

**Kolodziej, Slawomir** (Jagiellonian University)

**Li, Chi** (Stony Brook University)

**Lu, Hoang Chinh** (Chalmers University of Technology)

**Murphy, Tommy** (McMaster University)

**Paul, Sean** (University of Wisconsin, Madison)

**Paun, Mihai** (Korea Institute for Advanced Study)

**Ross, Julius** (Cambridge University)

**Sano, Yuji** (Kumamoto University)

**Seyyedali, Reza** (Waterloo University)

**Song, Jian** (Rutgers University)

**Spotti, Cristiano** (École normale supérieure, Paris)

**Szekelyhidi, Gabor** (University of Notre Dame)

**Tosatti, Valentino** (Northwestern University)

**Tsuji, Hajime** (Sophia University)

**Varolin, Dror** (Stony Brook University)

**Wang, Xiaowei** (Rutgers University)

**Weinkove, Ben** (Northwestern University)

**Witt Nyström, David** (University of Cambridge)

**Zeriahi, Ahmed** (Université Paul Sabatier)

**Zheng, Kai** (Leibniz Universität Hannover)

**Zhu, Xiaohua** (Beijing University)



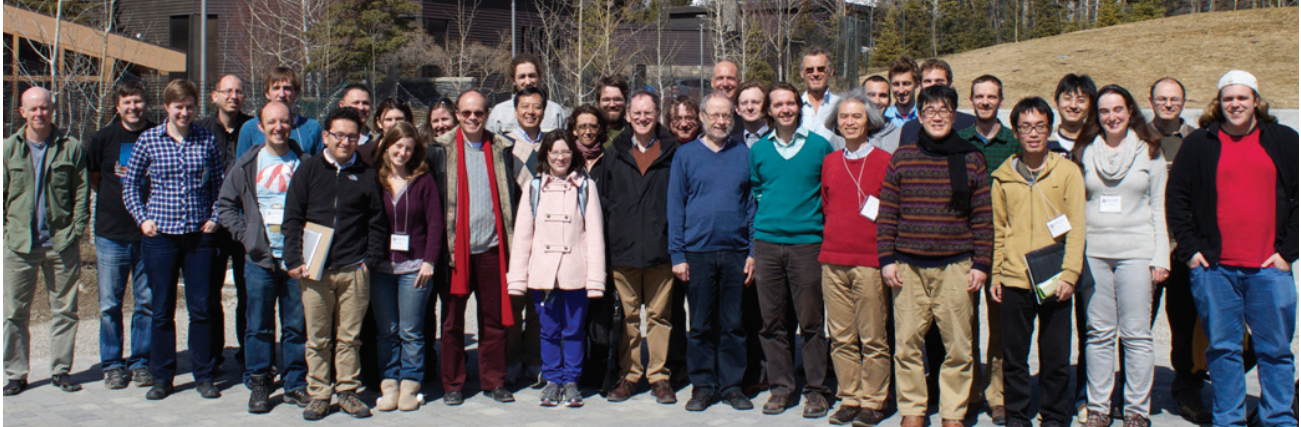
# Subfactors and Fusion Categories

## April 13-18, 2014

### Organizers:

**Vaughan Jones** (Vanderbilt University)  
**Scott Morrison** (Australian National University)  
**David Penneys** (University of Toronto)

**Emily Peters** (Northwestern University)  
**Noah Snyder** (Indiana University)



Symmetry has long played a key role in mathematics and the sciences. Classically, the symmetries of an object form a group. In the past few decades it has become clear that in certain “quantum” settings the notion of group doesn’t capture all possible symmetries. One very early place that these more general symmetries were observed was in the study of von Neumann factors. These quantum analogues of finite groups are called fusion categories. It turns out that these kinds of quantum symmetries turn up in other places in mathematics, like knot theory and representation theory. Surprisingly, fusion categories also crop up in solid state physics, where they govern the behavior of certain exotic materials which may be useful in quantum computing. The aim of this workshop is to bring together experts working on subfactors and fusion categories. With both of these fields developing in new and interesting directions, our goal is to build stronger connections and bridge the gaps between the languages and techniques used by the two communities. We will work towards gaining as rich an understanding of these finite quantum groups as we have of ordinary finite groups.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5083>

### Participants:

**Boblin, Travis** (University of Alberta)  
**Brothier, Arnaud** (KU Leuven)  
**Davydov, Alexei** (Ohio University)  
**Eric, Rowell** (Texas A&M University)  
**Erljman, Juliana** (University of Regina)  
**Evans, David** (Cardiff University)  
**Galindo, César** (Universidad de los Andes)  
**Gannon, Terry** (University of Alberta)  
**Gelaki, Shlomo** (Technion - IIT)  
**Grossman, Pinhas** (University of New South Wales)  
**Haagerup, Uffe** (University of Copenhagen)  
**Hagge, Tobias** (University of Texas at Dallas)  
**Hong, Seung-Moon** (University of Toledo)  
**Izumi, Masaki** (Kyoto University)  
**Jordan, David** (University of Edinburgh)  
**Kashina, Yevgenia** (DePaul University)  
**Kawahigashi, Yasuyuki** (University of Tokyo)  
**Liu, Zhengwei** (Vanderbilt University)  
**Morrison, Scott** (Australian National University)  
**Mueger, Michael** (Radboud Universiteit Nijmegen IMAPP)  
**Naidu, Deepak** (Northern Illinois University)

**Natale, Sonia** (Universidad Nacional de Córdoba. CIEM-CONICET)  
**Nelson, Brent** (University of California, Los Angeles)  
**Ostrik, Victor** (University of Oregon)  
**Palcoux, Sebastien** (Institut de mathématiques de Luminy)  
**Penneys, David** (University of Toronto)  
**Peters, Emily** (Northwestern University)  
**Plavnik, Julia** (Universidad de Buenos Aires)  
**Riepel, Brianna** (University of New Hampshire)  
**Schauenburg, Peter** (Université de Bourgogne)  
**Siu-Hung, Ng** (Louisiana State University)  
**Snyder, Noah** (Indiana University)  
**Tener, James** (University of California, Berkeley)  
**Titsworth, Matthew** (University of Texas at Dallas)  
**Tucker, Henry** (University of Southern California)  
**Viola, Maria Grazia** (Lakehead University)  
**Walker, Kevin** (Microsoft Station Q)  
**Wang, Zhenghan** (University of California, Santa Barbara)  
**Wenzl, Hans** (University of California, San Diego)  
**Yamashita, Makoto** (Ochanomizu University)

# WIN3: Women in Numbers 3

## April 20-25, 2014

### Organizers:

Ling Long (Iowa State University)  
Rachel Pries (Colorado State University)

Katherine Stange (University of Colorado, Boulder)



Number theory has its roots in the study of the integers, but the great variety of tools and techniques motivated by these ancient questions are now allowing us to address questions intimately connected to a wide variety of fields, from geometry to physics and information theory. This workshop was a continuation of the previous two successful BIRS workshops for women in numbers. It brought together women at all stages in their research careers, from senior faculty to graduate students, to do new research in some of the most important and vibrant areas of modern number theory and to continue to build a thriving community of women working in the area.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5009>

### Participants:

Balakrishnan, Jennifer (University of Oxford)  
Berg, Jennifer (University of Texas at Austin)  
Bouw, Irene (University Ulm)  
Bucur, Alina (University of California, San Diego)  
Caraianni, Ana (Princeton University)  
Ciperiani, Mirela (University of Texas at Austin)  
Cojocaru, Alina Carmen (University of Illinois at Chicago)  
Davis, Rachel (Purdue University)  
Deines, Alyson (University of Washington)  
Eischen, Ellen (University of North Carolina at Chapel Hill)  
Elias, Yara (McGill University)  
Feaver, Amy (University of Colorado Boulder)  
Fintzen, Jessica (Harvard University)  
Fuselier, Jenny (High Point University)  
Graham, Bonita (Wesleyan University)  
Haensch, Anna (Max Planck Institute for Mathematics)  
Ho, Wei (Columbia University)  
Lalin, Matilde (Université de Montréal)  
Lang, Jaclyn (University of California, Los Angeles)  
Lauter, Kristin (Microsoft Research)  
Liu, Jingbo (Wesleyan University)  
Long, Ling (Iowa State University)  
Malmskog, Beth (Colorado College)

Manes, Michelle (University of Hawaii at Manoa)  
Mantovan, Elena (California Institute of Technology)  
Mirza, Bahare (McGill University)  
Nebe, Gabrielle (RWTH Aachen)  
Newton, Rachel (University of Leiden)  
Ozman, Ekin (University of Texas-Austin)  
Park, Jennifer (Massachusetts Institute of Technology)  
Pierce, Lillian (Hausdorff Center for Mathematics)  
Pries, Rachel (Colorado State University)  
Scheidler, Renate (University of Calgary)  
Srinivasan, Padmavathi (Massachusetts Institute of Technology)  
Stange, Katherine (University of Colorado, Boulder)  
Stojanoska, Vesna (Massachusetts Institute of Technology and Mathematical Sciences Research Institute)  
Swisher, Holly (Oregon State University)  
Tu, Fang-Ting (National Center of Theoretical Sciences in Taiwan)  
Varma, Ila (Princeton University)  
Vincent, Christelle (Stanford University)  
Viray, Bianca (Brown University)  
Wickelgren, Kirsten (Georgia Institute of Technology)



# Recent Advances and Trends in Time Series Analysis: Nonlinear Time Series, High Dimensional Inference and Beyond

## April 27 - May 2, 2014

### Organizers:

**Yulia Gel** (University of Waterloo)  
**Rafal Kulik** (University of Ottawa)

**Hao Yu** (University of Western Ontario)



The unifying theme for the conference was state-of-the-art methodology and applications of time series, in a general sense. The workshop aimed to enhance exchange of research ideas on new challenges for the theoretical foundations as well as the implementation and numerical properties of modern time series. In particular, the workshop explored the current state and future directions needed for such very important class of data problems as nonlinear time series and high dimensional inference for time series.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5171>

### Participants:

**Ahmed, Ejaz** (Brock University)  
**Bai, Shuyang** (Boston University)  
**Baron, Michael** (University of Texas at Dallas)  
**Basrak, Bojan** (University of Zagreb)  
**Chen, Gemai** (University of Calgary)  
**Dahlhaus, Rainer** (Heidelberg University)  
**Dehling, Herold** (Ruhr University)  
**Drees, Holger** (University of Hamburg)  
**Fryzlewicz, Piotr** (London School of Economics)  
**Gel, Yulia** (University of Waterloo)  
**Giraitis, Liudas** (Queen Mary University of London)  
**Gombay, Edit** (University of Alberta)  
**Ivanoff, Gail** (University of Ottawa)  
**Kokoszka, Piotr** (Colorado State University)  
**Kreiss, Jens-Peter** (Technical University of Braunschweig)  
**Kulik, Rafal** (University of Ottawa)  
**Kulperger, Reg** (University of Western Ontario)  
**Li, Fuxiao** (University of Alberta)  
**Lin, Zhengyan** (Zhejiang University)  
**Lund, Robert** (Clemson University)  
**Lyubchich, Slava** (University of Waterloo)  
**Mamon, Rogemar** (University of Western Ontario)

**McMurry, Timothy** (University of Virginia)  
**Menezes, Eniuse** (Maringa State University)  
**Mikosch, Thomas** (University of Copenhagen)  
**Nordman, Dan** (Iowa State University)  
**Olhede, Sofia** (University College London)  
**Palma, Wilfredo** (Pontificia Universidad Catolica de Chile)  
**Pena, Daniel** (Universidad Carlos III Madrid)  
**Pipiras, Vladas** (University of North Carolina)  
**Pourahmadi, Mohsen** (Texas A&M University)  
**Ramirez-Ramirez, Lilia Leticia** (Mexico Autonomous Institute of Technology)  
**Robinson, Peter** (London School of Economics)  
**Roueff, Francois** (TELECOM ParisTech)  
**Singpurwalla, Nozer** (City University of Hong Kong)  
**Soulier, Philippe** (Université Paris Ouest)  
**Stoffer, David** (University of Pittsburgh)  
**Taqqu, Murad** (Boston University)  
**Torgovitsky, Leonid** (Mathematical Institute of the University of Cologne)  
**Wendler, Martin** (Ruhr University)  
**Yu, Hao** (University of Western Ontario)  
**Zhou, Zhou** (University of Toronto)

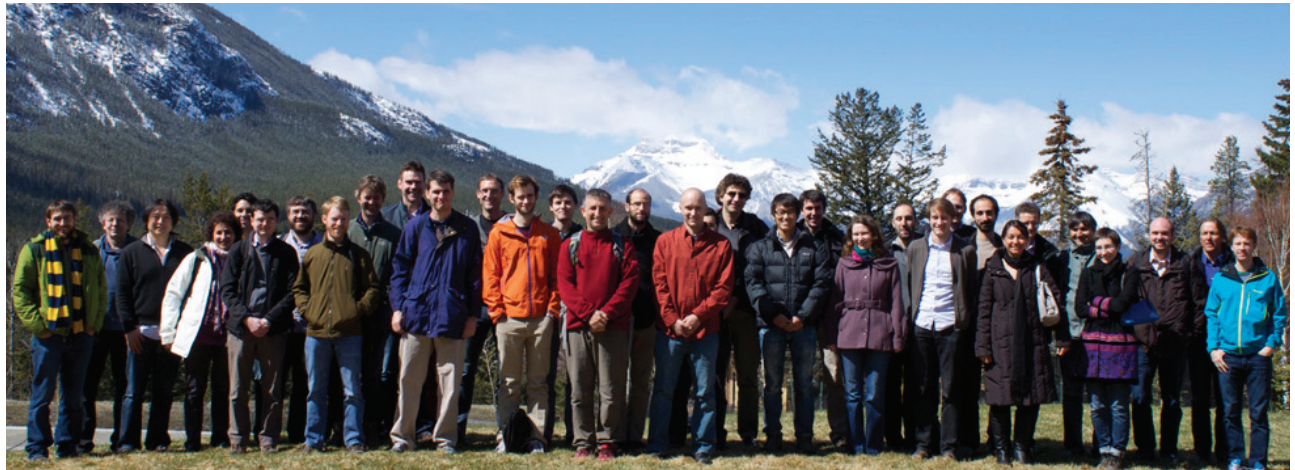
# Dynamics in Geometric Dispersive Equations and the Effects of Trapping, Scattering and Weak Turbulence

## May 4-9, 2014

### Organizers:

**Stephen Gustafson** (University of British Columbia)  
**Jeremy Marzuola** (University of North Carolina, Chapel Hill)

**Daniel Tataru** (University of California, Berkeley)



The advances and methods of late in the mathematical analysis of general relativity, Schroedinger/wave maps, nonlinear bound states, water waves, optics and the evolution of dispersive equations on curved surfaces have been quite rapid. As a result, there are often links to open problems, related questions and applications of techniques that may go unnoticed in other related fields. This workshop brought together a number of mathematicians working in geometric analysis, dynamical systems and dispersive equations with overlapping interests related to mathematical models on spaces with curvature, boundary, obstacles, or other possible obstructions to dispersion.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5080>

### Participants:

**Alazard, Thomas** (École Normale Supérieure)  
**Ambrose, David** (Drexel University)  
**Baskin, Dean** (Northwestern University)  
**Bejenaru, Ioan** (University of California, San Diego)  
**Bizon, Piotr** (Jagiellonian University)  
**Bulut, Aynur** (University of Michigan)  
**Burq, Nicolas** (Université Paris-Sud)  
**Camassa, Roberto** (University of North Carolina)  
**Coles, Matthew** (University of British Columbia)  
**Dodson, Benjamin** (University of California)  
**Grébert, Benoit** (Université de Nantes)  
**Gustafson, Stephen** (University of British Columbia)  
**Haberman, Boaz** (University of California, Berkeley)  
**Harrop-Griffiths, Benjamin** (University of California, Berkeley)  
**Herr, Sebastian** (Universität Bielefeld)  
**Ifrim, Mihaela** (McMaster University)  
**Ionescu, Alexandru** (Princeton University)  
**Koch, Herbert** (University of Bonn)  
**Krieger, Joachim** (École Polytechnique Fédérale de Lausanne)

**Lawrie, Andrew** (University of California, Berkeley)  
**Marzuola, Jeremy** (University of North Carolina, Chapel Hill)  
**Mattingly, Jonathan** (Duke University)  
**Metcalf, Jason** (University of North Carolina)  
**Murphy, Jason** (University of California, Los Angeles)  
**Nahmod, Andrea** (University of Massachusetts)  
**Oh, Tadahiro (Choonghong)** (University of Edinburgh)  
**Oh, Sung-Jin** (University of California, Berkeley)  
**Oliver, Jesus** (University of California, San Diego)  
**Pavlovic, Natasa** (University of Texas at Austin)  
**Pocovnicu, Oana** (Institute for Advanced Study)  
**Pusateri, Fabio** (Princeton University)  
**Roxanas, Dimitrios** (University of British Columbia)  
**Shahshahani, Sohrab** (University of Michigan)  
**Smith, Paul** (University of California, Berkeley)  
**Sterbenz, Jacob** (University of California, San Diego)  
**Tataru, Daniel** (University of California, Berkeley)  
**Wilkening, Jon** (University of California, Berkeley)



# Mathematical Finance: Arbitrage and Portfolio Optimization

## May 11-16, 2014

### Organizers:

**Constantinos Kardaras** (London School of Economics) **Gordan Zitkovic** (University of Texas at Austin)  
**Walter Schachermayer** (University of Vienna)



The workshop focused on recent developments in the foundations of mathematical finance and its applications. It covered a variety of topics, with special emphasis on two pillars of our field: arbitrage theory and portfolio optimization. Both of these have seen tremendous and unfaltering growth in the past years with no sign of fatigue. After the breakthroughs in the study of general semimartingale markets made in the 1990s, today's research takes its inspiration from even more realistic models of both financial markets and the investors' objectives. One such class of models incorporates market frictions and seeks minimal conditions for the absence of arbitrage when transaction costs are present. In parallel, utility maximization (portfolio optimization) in markets with transaction costs yields some of the most interesting singular stochastic optimal control problems and presents with some of the most challenging puzzles. Another active direction of expansion is towards models with multiple interacting agents. These incorporate various equilibrium- and principal-agent-type problems, and pose interesting mathematical questions which range from fixed-point-theoretic to those related to (Forward-) Backward Stochastic Differential Equations and their systems.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5116>

### Participants:

**Acciaio, Beatrice** (London School of Economics)  
**Anthropelos, Michail** (University of Piraeus)  
**Bank, Peter** (Technische Universität Berlin)  
**Beiglboeck, Mathias** (University of Vienna)  
**Biagini, Sara** (University of Pisa)  
**Bouchard, Bruno** (University Paris-Dauphine and ENSAE-ParisTech)  
**Campi, Luciano** (London School of Economics)  
**Çetin, Umut** (London School of Economics)  
**Cox, Alexander** (University of Bath)  
**Cuchiero, Christa** (Technical University of Vienna)  
**Cvitanić, Jakša** (California Institute of Technology)  
**Czichowsky, Christoph** (London School of Economics)  
**Delbaen, Freddy** (ETH Zurich, UNI Zurich)  
**Föllmer, Hans** (Humboldt Universität zu Berlin)  
**Fouque, Jean-Pierre** (University of California, Santa Barbara)  
**Frei, Christoph** (University of Alberta)  
**Frittelli, Marco** (Università degli Studi di Milano)  
**Guasoni, Paolo** (Boston University, Dublin City University)  
**Henderson, Vicky** (University of Warwick)  
**Ichiba, Tomoyuki** (University of California, Santa Barbara)

**Jeanblanc, Monique** (University d'Evry Val d'Essonne)  
**Kallsen, Jan** (University of Kiel)  
**Karatzas, Ioannis** (Columbia University)  
**Kardaras, Constantinos** (London School of Economics)  
**Kramkov, Dmitry** (Carnegie Mellon University)  
**Larsen, Kasper** (Carnegie Mellon University)  
**Larsson, Martin** (École Polytechnique Fédérale de Lausanne)  
**Muhle-Karbe, Johannes** (ETH Zürich)  
**Nutz, Marcel** (Columbia University)  
**Oblój, Jan** (University of Oxford)  
**Pulido Nino, Sergio** (Swiss Finance Institute at EPFL)  
**Robertson, Scott** (Carnegie Mellon University)  
**Ruf, Johannes** (Oxford University)  
**Schachermayer, Walter** (University of Vienna)  
**Schweizer, Martin** (ETH Zurich)  
**Shreve, Steve** (Carnegie Mellon University)  
**Sirbu, Mihai** (University Of Texas at Austin)  
**Sircar, Ronnie** (Princeton University)  
**Tankov, Peter** (Université Paris Diderot - Paris 7)  
**Teichmann, Josef** (ETH Zurich)  
**Xing, Hao** (London School of Economics)  
**Zitkovic, Gordan** (University of Texas at Austin)



# Imaging and Modeling in Electron Microscopy - Recent Advances

## May 18-23, 2014

### Organizers:

**Peter Binev** (University of South Carolina)  
**Nigel Browning** (Pacific Northwest National Lab)  
**Wolfgang Dahmen** (Rheinisch-Westfälische  
Technische Hochschule - Aachen)

**Ronald DeVore** (Texas A&M University)  
**Thomas Vogt** (University of South Carolina -  
NanoCenter)  
**Paul Voyles** (University of Wisconsin - Madison)



The workshop's goal was to connect mathematicians with specialists in imaging, material science and electron microscopy to advance modeling, simulation and analysis by incorporating state-of-the-art mathematical and computational tools and methods in electron microscopy. It provided the opportunity to present and exchange ideas, share data and introduce new tools and develop new imaging and sensing paradigms needed in a variety of fields. Participants shared their latest results in processing data received from a variety of probes exploring materials at the atomic level with application in materials and life sciences, such as scanning transmission electron microscopy, cryo-electron microscopy, and electron tomography.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5048>

### Participants:

**Anden, Joakim** (Princeton University)  
**Arslan, Ilke** (Pacific Northwest National Laboratory)  
**Bajaj, Chandrajit** (University of Texas at Austin)  
**Berkels, Benjamin** (Rheinisch-Westfälische  
Technische Hochschule - Aachen)  
**Bhamre, Tejal** (Princeton University)  
**Binev, Peter** (University of South Carolina)  
**Blom, Douglas** (University of South Carolina)  
**Browning, Nigel** (Pacific Northwest National Lab)  
**Chen, Yutong** (Princeton University)  
**Dahmen, Wolfgang** (Rheinisch-Westfälische  
Technische Hochschule - Aachen)  
**Davenport, Mark** (Georgia Institute of Technology)  
**Dwyer, Christian** (Forschungszentrum Juelich)  
**Findlay, Scott** (Monash University)  
**Haight, Sarah** (University of Manchester)  
**Han, Bin** (University of Alberta)  
**Huang, Chen** (University of Oxford)  
**Kelly, Kevin** (Rice University)  
**Krahmer, Felix** (University of Göttingen)  
**Kutyniok, Gitta** (Technische Universität Berlin)  
**Lamby, Philipp** (Texas A&M University)  
**Lobato Hoyos, Ivan Pedro** (University of Antwerp)

**Mayer, Joachim** (Rheinisch-Westfälische  
Technische Hochschule - Aachen)  
**Mevenkamp, Niklas** (Rheinisch-Westfälische  
Technische Hochschule - Aachen)  
**Reed, Bryan** (Lawrence Livermore National Laboratory)  
**Sadowski, Jerzy** (Brookhaven National Laboratory)  
**Saghi, Zineb** (University of Cambridge)  
**Sanders, Toby** (University of South Carolina)  
**Scherzer, Otmar** (University of Vienna)  
**Shen, Zuwei** (National University of Singapore)  
**Shen, Yi** (University of Alberta)  
**Shkolnisky, Yoel** (Tel-Aviv University)  
**Singer, Amit** (Princeton University)  
**Stevens, Andrew** (Duke University)  
**Tantardini, Francesca** (University of South Carolina)  
**Van Dyck, Dirk** (University of Antwerp)  
**Vogt, Thomas** (University of South Carolina -  
NanoCenter)  
**Voyles, Paul** (University of Wisconsin - Madison)  
**Ward, Rachel** (University of Texas at Austin)  
**Yankovich, Andrew** (University of Wisconsin-Madison)  
**Zhang, Teng** (Princeton University)

# Geometric Aspects of Semilinear Elliptic and Parabolic Equations: Recent Advances and Future Perspectives

## May 25-30, 2014

### Organizers:

**Manuel del Pino** (University of Chile)  
**Peter Polacik** (University of Minnesota)

**Jun Cheng Wei** (University of British Columbia)



This workshop brought together two groups of mathematicians: one working on PDEs, especially in construction and classification of entire and eternal solutions of semilinear elliptic and parabolic equations, and a second group, in differential geometry, specialists in constant mean curvature and minimal surface theories and in geometric flows. A particular emphasis was given to pursue the understanding of connections between semilinear elliptic equations and minimal surfaces in the static case, and between traveling waves of parabolic problems and self translating solutions of mean curvature type flows in the time-dependent framework. The related issue of blow-up in reaction-diffusion equations and formation of singularities in geometric flows was also considered.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5017>

### Participants:

**Angenent, Sigurd** (University of Wisconsin)  
**Cabre, Xavier** (ICREA and Universitat Politècnica de Catalunya)  
**Chan, Hardy** (University of British Columbia)  
**Cowan, Craig** (University of Alabama in Huntsville)  
**Dancer, Norman** (University of Sydney)  
**Daskalopoulos, Panagiota** (Columbia University)  
**del Pino, Manuel** (University of Chile)  
**Fila, Marek** (Comenius University)  
**Ghoussoub, Nassif** (University of British Columbia)  
**Gui, Changfeng** (University of Connecticut)  
**Hamel, Francois** (Université d'Aix-Marseille)  
**Hauswirth, Laurent** (Université Marne La Vallée)  
**Jerrard, Robert** (University of Toronto)  
**Kapouleas, Nicolaos** (Brown University)  
**Kim, Seunghyeok** (Pontifical catholic university of Chile)  
**King, John R.** (University of Nottingham)  
**Li, Yanyan** (Rutgers University)  
**Lin, Chang-Shou** (National Taiwan University)  
**Liu, Yong** (North China Electric Power University)  
**Mazzeo, Rafe** (Stanford University)  
**McCann, Robert** (University of Toronto)

**Nguyen, Xuan Hien** (Iowa State University)  
**Ninomiya, Hirokazu** (Meiji University)  
**Pistoia, Angela** (Università di Roma La Sapienza)  
**Polacik, Peter** (University of Minnesota)  
**Quittner, Pavol** (Comenius University)  
**Robert, Frédéric** (Université de Lorraine)  
**Sesum, Natasa** (Rutgers University)  
**Sire, Yannick** (Université Aix-Marseille)  
**Souplet, Philippe** (Université Paris 13)  
**Taniguchi, Masaharu** (Okayama University)  
**Terracini, Susanna** (Università di Torino)  
**Valdinoci, Enrico** (Weierstrass Institute for Applied Analysis and Stochastics)  
**Wang, Kelei** (Wuhan Institute of Physics and Mathematics)  
**Wang, Zhi-Qiang** (Utah State University)  
**Wei, Jun Cheng** (University of British Columbia)  
**Winkler, Michael** (University of Paderborn)  
**Yan, Shusen** (University of New England)  
**Yanagida, Eiji** (Tokyo Institute of Technology)  
**Yang, Wen** (University of British Columbia)



# The Future of Trace Formulas

## June 1-6, 2014

### Organizers:

**Wee Teck Gan** (National University of Singapore)  
**Chung Pang Mok** (McMaster University)

**Yiannis Sakellaridis** (Rutgers University)  
**Shuichiro Takeda** (University of Missouri)



Automorphic functions are special functions that possess rich symmetries. The theory of automorphic functions, and more generally the theory of automorphic representations, has always been a central part of mathematics, with the trace formula being one of the most powerful tools in their study. This workshop is took advantage of a number of significant recent developments in the subject to bring together researchers and new PhDs in the area of automorphic representations and trace formula, both to review the current state of the art and to set stage for the future direction of the subject.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5001>

### Participants:

**Arthur, James** (University of Toronto)  
**Bernstein, Joseph** (Tel Aviv University)  
**Beuzart-Plessis, Raphael** (Institut Mathématique de Jussieu)  
**Casselman, William** (University of British Columbia)  
**Châu, Ngô Bảo** (University of Chicago)  
**Chaudouard, Pierre-Henri** (IMJ-PRG Université Paris 7-Denis Diderot)  
**Cheng, Shuyang** (University of Chicago)  
**Cunningham, Clifton** (University of Calgary)  
**Feigon, Brooke** (City College of New York)  
**Filip, Ioan** (Columbia University)  
**Furusawa, Masaaki** (Osaka City University)  
**Gan, Wee Teck** (National University of Singapore)  
**Ganapathy, Radhika** (University of British Columbia)  
**Gordon, Julia** (University of British Columbia)  
**He, Xuhua** (University of Science and Technology of Hong Kong)  
**Heiermann, Volker** (Université d'Aix-Marseille)  
**Herman, P. Edward** (University of Chicago)  
**Ichino, Atsushi** (Kyoto University)  
**Jiang, Dihua** (University of Minnesota)  
**Johnstone, Daniel** (University of Chicago)  
**Kaletha, Tasho** (Princeton University)  
**Krishna, Rahul** (Columbia University)  
**Labesse, Jean-Pierre** (Aix-Marseille Université)  
**Lapid, Erez** (Weizmann Institute of Science)

**Li, Wen-Wei** (Academy of Mathematics, Chinese Academy of Sciences)  
**Liu, Yifeng** (Massachusetts Institute of Technology)  
**Martin, Kimball** (University of Oklahoma)  
**Mezo, Paul** (Carleton University)  
**Moeglin, Colette** (Institut de Mathématiques de Jussieu)  
**Mok, Chung Pang** (McMaster University)  
**Morimoto, Kazuki** (Kyoto University)  
**Murnaghan, Fiona** (University of Toronto)  
**Nadler, David** (University of California, Berkeley)  
**Offen, Omer** (Technion)  
**Prasad, Dipendra** (Tata Institute of Fundamental Research)  
**Sakellaridis, Yiannis** (Rutgers University)  
**Shahidi, Freydoon** (Purdue University)  
**Shin, Sug Woo** (Massachusetts Institute of Technology)  
**Sugiyama, Shingo** (Osaka University)  
**Takeda, Shuichiro** (University of Missouri)  
**Tam, Kam Fai** (McMaster University)  
**Waldspurger, Jean-Loup** (Institut de Mathématiques de Jussieu)  
**Walls, Patrick** (McMaster University)  
**Xu, Bin** (University of Toronto)  
**Yamana, Shunsuke** (Kyushu University)  
**Yun, Zhiwei** (Stanford University)  
**Zhang, Lei** (Boston College)  
**Zhang, Wei** (Columbia University)  
**Zhu, Xinwen** (Northwestern University)

# Integrability in Holography

## June 8-13, 2014

### Organizers:

**Nikolay Gromov** (King's College London)

**Amit Sever** (Institute for Advanced Study, Princeton)

**Pedro Vieira** (Perimeter Institute for Theoretical Physics)



This workshop explored the interplay between physics and mathematics in the context of holography. Under the holographic principle, problems in four dimensional gauge theory are mapped to two dimension. These are then solved exactly using techniques from integrable models. This new idea allows calculations that are impossible with standard approaches and hopefully would lead to a complete solution of a theory similar to Quantum chromodynamics. Archiving that very ambitious goal require the development of new mathematical tools in algebraic geometry, Yangians, quantum groups, combinatorics and Grassmanians. The workshop brought together people working on these subjects and holography.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5070>

### Participants:

**Caetano, João** (Perimeter Institute)

**Gómez Córdoba, Lucía** (Perimeter Institute)

**Gromov, Nikolay** (King's College London)

**Kazakov, Vladimir** (École Normale Supérieure, Paris)

**Komatsu, Shota** (University of Tokyo)

**Kruczenski, Martin** (Purdue University)

**Sever, Amit** (Institute for Advanced Study, Princeton)

**Simmons-Duffin, David** (Institute for Advanced Study)

**Sizov, Grigory** (King's College London)

**Toledo, Jon** (Perimeter Institute)

**Vieira, Pedro** (Perimeter Institute for Theoretical Physics)

**West, Peter** (King's College London)

**Zhiboedov, Alexander** (Princeton University)



# Programming with Chemical Reaction Networks: Mathematical Foundations

## June 8-13, 2014

### Organizers:

**Anne Condon** (University of British Columbia)  
**David Doty** (California Institute of Technology)

**Chris Thachuk** (University of Oxford)



This workshop brought together mathematicians, computer scientists, physicists and chemists to advance the mathematical foundations of molecular programming. The focus of the workshop was on understanding the capabilities of programs that can be described abstractly as chemical reactions. What could such programs do? How energy efficient can they be? How would we verify that such programs are correct?

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5167>

### Participants:

**Anderson, David** (University of Wisconsin at Madison)  
**Baez, John** (University of California, Riverside)  
**Brijder, Robert** (Hasselt University)  
**Cardelli, Luca** (Microsoft Research)  
**Chen, Yuan-Jyue** (University of Washington)  
**Condon, Anne** (University of British Columbia)  
**Doty, David** (California Institute of Technology)  
**Enciso, German** (University of California, Irvine)  
**Hajiaghayi, Monir** (University of British Columbia)  
**Johnson, Robert** (California Institute of Technology)  
**Manuch, Jan** (University of British Columbia)  
**Phillips, Andrew** (Microsoft Research)  
**Qian, Lulu** (California Institute of Technology)  
**Shin, Seung Woo** (University of California, Berkeley)  
**Soloveichik, David** (University of California, San Francisco)  
**Srinivas, Niranjan** (California Institute of Technology)  
**Thachuk, Chris** (University of Oxford)  
**Winfree, Erik** (California Institute of Technology)  
**Woods, Damien** (California Institute of Technology)

# Quantum Curves and Quantum Knot Invariants

## June 15-20, 2014

### Organizers:

**Vincent Bouchard** (University of Alberta)  
**Mikhail Khovanov** (Columbia University)  
**Motohico Mulase** (University of California, Davis)

**Alexei Oblomkov** (University of Massachusetts)  
**Marko Stošić** (Instituto Superior Técnico, Portugal)  
**Piotr Sułkowski** (University of Warsaw and Caltech)



The goal of this workshop was to explore the mystery surrounding mirror symmetry of quantum knot invariants. More specifically, at building a concrete mathematical understanding of the quantization process, given by the topological recursion of Eynard and Orantin, which is expected to construct quantum knot invariants from the classical knot  $A$ -polynomials.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5073>

### Participants:

**Anajao, Rosa** (University of Alberta)  
**Awata, Hidetoshi** (Nagoya University)  
**Basor, Estelle** (American Institute of Mathematics)  
**Borot, Gaëtan** (Max Planck Institut fuer Mathematik)  
**Bouchard, Vincent** (University of Alberta)  
**Cooper, Benjamin** (University of Zurich)  
**Cornwell, Chris** (Duke University)  
**Dimofte, Tudor** (Institute for Advanced Study)  
**Do, Norman** (Monash University)  
**Dumitrescu, Olivia** (University of Leibniz, Hannover)  
**Etingof, Pavel** (Massachusetts Institute of Technology)  
**Fuji, Hiroyuki** (Tsinghua University)  
**Garoufalidis, Stavros** (Georgia Institute of Technology)  
**Ginzburg, Victor** (University of Chicago)  
**Harnad, John** (Centre de recherches mathématiques, Université de Montréal and Concordia University)  
**Hogancamp, Matt** (Indiana University Bloomington)  
**Hollands, Lotte** (University of Oxford)  
**Holman, Brett** (University of Alberta)  
**Kim, Hoil** (Kyungbook National University)  
**Kucharski, Piotr** (University of Warsaw)  
**Liu, Chiu-Chu Melissa** (Columbia University)

**Manabe, Masahide** (University of Warsaw)  
**Moran, Logan** (University of Alberta)  
**Mulase, Motohico** (University of California, Davis)  
**Murakami, Jun** (Waseda University)  
**Nawata, Satoshi** (NIKHEF, Amsterdam)  
**Ng, Lenny** (Duke University)  
**Norbury, Paul** (University of Melbourne)  
**Oblomkov, Alexei** (University of Massachusetts)  
**Penkava, Michael** (University of Wisconsin-Eau Claire)  
**Rayyan, Ahmed** (University of Alberta)  
**Saenz, Axel** (University of California, Davis)  
**Samperton, Eric** (University of California, Davis)  
**Schilling, Anne** (University of California, Davis)  
**Selmani, Sam** (McGill University)  
**Shirokova, Nadya** (Santa Clara University)  
**Stošić, Marko** (Instituto Superior Técnico, Portugal)  
**Sułkowski, Piotr** (University of Warsaw and Caltech)  
**Vazirani, Monica** (University of California, Davis)  
**Wedrich, Paul** (University of Cambridge)  
**Wendland, Katrin** (Albert-Ludwigs-Universität Freiburg)



# Emerging Statistical Challenges and Methods For Analysis of Massive Genomic Data in Complex Human Disease Studies

## June 22-27, 2014

### Organizers:

**Shelley Bull** (University of Toronto)  
**Michael Epstein** (Emory University)  
**Xihong Lin** (Harvard University)

**Lei Sun** (University of Toronto)  
**Michael Wu** (University of North Carolina)



Many complex human diseases, such as autism and type 2 diabetes, originate in part from the complicated effects of multiple genetic variants found throughout the human genome. Given the enormous impact of such diseases on public health, it is imperative to map relevant genetic variants to improve our understanding of the molecular basis of these diseases, as well as improve screening techniques for disease prevention. To this end, successful human gene mapping of complex traits requires the development and application of powerful statistical methods that fully utilize existing resources such as the Human Genome Project as well as cutting-edge resources like next-generation sequencing technology. This workshop focused on methods to address emerging challenges in the analysis of such data. Topics included the analysis of rare variation, testing of gene-gene/gene-environment interactions, integrative genomics and risk-prediction modeling. This workshop will bring together international experts in this important field of research to advance our understanding of the methods and tools which can be effectively applied to address common issues that arise in the analysis of large-scale genetic and genomic data.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5011>

### Participants:

**Allen, Andrew** (Duke University)  
**Amos, Christopher** (Dartmouth College)  
**Barnett, Ian** (Harvard University)  
**Briollais, Laurent** (Samuel Lunenfeld Research Institute)  
**Bull, Shelley** (University of Toronto)  
**Chatterjee, Nilanjan** (National Cancer Institute)  
**Chen, Jiahua** (University of British Columbia)  
**Conneely, Karen** (Emory University)  
**Cordell, Heather** (Newcastle University)  
**Cox, Nancy** (University of Chicago)  
**Epstein, Michael** (Emory University)  
**Eskin, Eleazar** (University of California, Los Angeles)  
**Graham, Jinko** (Simon Fraser University)  
**Horvath, Steve** (University of California, Los Angeles)  
**Ionita-Laza, Iuliana** (Columbia University)  
**Larribe, Fabrice** (Université du Québec à Montréal)  
**Li, Yun** (University of North Carolina)  
**Liang, Liming** (Harvard University)

**Lin, Xihong** (Harvard University)  
**Minnier, Jessica** (Oregon Health and Science University)  
**Mukherjee, Bhramar** (University of Michigan)  
**Nicolae, Dan** (University of Chicago)  
**Satten, Glen** (Centers for Disease Control and Prevention)  
**Schaid, Dan** (Mayo Clinic)  
**Sinsheimer, Janet** (University of California, Los Angeles)  
**Strug, Lisa** (Hospital for Sick Children, Toronto)  
**Thomas, Duncan** (University of Southern California)  
**Thornton, Timothy** (University of Washington)  
**Tzeng, Jung-Ying** (North Carolina State University)  
**Wang, Kai** (University of Southern California)  
**Wijsman, Ellen** (University of Washington)  
**Witte, John** (University of California, San Francisco)  
**Wu, Michael** (University of North Carolina)  
**Zhao, Hongyu** (Yale University)  
**Zöllner, Sebastian** (University of Michigan)



# Entropy Methods, PDEs, Functional Inequalities, and Applications

## June 29 - July 4, 2014

### Organizers:

**Eric Carlen** (Rutgers University)  
**Jean Dolbeault** (Université Paris Dauphine)

**Daniel Matthes** (Technische Universität München)  
**Dejan Slepcev** (Carnegie Mellon University)



Entropies are a key tool from this point of view: they measure, in a sense, how far the system is from its equilibrium configuration, and they never increase as time goes by, which means that they also capture the system's trend towards equilibrium. In this spirit, entropy methods provide guiding lines both for the modeling and for the analysis of complex systems. This workshop brought together pure and applied mathematicians in order to discuss how to identify an entropy for a given complex system, how to analyze the temporal properties of that entropy mathematically and to draw conclusions on the original problem, which is related, e.g., to fluid dynamics, material sciences or biology.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5109>

### Participants:

**Arnold, Anton** (Technische Universität Wien)  
**Balague, Daniel** (North Carolina State University)  
**Bertozzi, Andrea** (University of California, Los Angeles)  
**Blanchet, Adrien** (Université de Toulouse)  
**Bolley, Francois** (Université Paris-Dauphine)  
**Cañizo, José** (University of Birmingham)  
**Carrillo, Jose Antonio** (Imperial College London)  
**Chen, Li** (Universität Mannheim)  
**Chugunova, Marina** (Claremont Graduate University)  
**Craig, Katy** (Rutgers University)  
**Degond, Pierre** (Imperial College London)  
**Desvillettes, Laurent** (École Normale Supérieure de Cachan)  
**Dolbeault, Jean** (Université Paris Dauphine)  
**Fellner, Klemens** (University of Graz)  
**Francis, Filbet** (University Claude Bernard)  
**Gentil, Ivan** (Université Lyon 1)  
**Ghoussoub, Nassif** (University of British Columbia)  
**Huang, Yanghong** (Imperial College London)  
**Jankowiak, Gaspard** (Université de Paris IX)  
**Kim, Inwon** (University of California, Los Angeles)

**Laurençot, Philippe** (Institut de Mathématiques de Toulouse)  
**Laurent, Thomas Boris** (Loyola Marymount University)  
**Léonard, Christian** (Université Paris Ouest)  
**Liero, Matthias** (Weierstrass Institute Berlin)  
**Maas, Jan** (University of Bonn)  
**Matthes, Daniel** (Technische Universität München)  
**Nazaret, Bruno** (SAMM, Université Paris 1)  
**Savaré, Giuseppe** (University of Pavia)  
**Schmeiser, Christian** (University of Vienna)  
**Slepcev, Dejan** (Carnegie Mellon University)  
**Stanczy, Robert** (Uniwersytet Wrocławski)  
**Stefanelli, Ulisse** (University of Vienna)  
**Stevens, Angela** (Universität Münster)  
**Sturm, Karl-Theodor** (University of Bonn)  
**Tudorascu, Adrian** (West Virginia University)  
**Wolfram, Marie-Therese** (Austrian Academy of Sciences)  
**Wu, Lijiang** (Carnegie Mellon University)  
**Yao, Yao** (University of Wisconsin Madison)  
**Zimmer, Johannes** (University of Bath)

# New Directions in Financial Mathematics and Mathematical Economics

## July 6-11, 2014

### Organizers:

**Ulrich Horst** (Humboldt University)  
**Sebastian Jaimungal** (University of Toronto)

**Ronnie Sircar** (Princeton University)  
**Thaleia Zariphopoulou** (University of Texas at Austin)



This workshop was motivated by the importance of energy markets, the development of natural resources and understanding the modern structure of equity markets that have changed dramatically in recent years with faster electronic transactions. It brought together mathematicians, economists and experts in the applications to develop the common tools underlying the analysis of these issues: dynamic game theory, equilibrium analysis and optimization under uncertainty. With active participation from young researchers, the workshop encouraged students and postdocs in mathematics and economics to focus future research on these important and real-world problems.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5168>

### Participants:

**Bayraktar, Erhan** (University of Michigan)  
**Bichuch, Maxim** (Worcester Polytechnic Institute)  
**Capponi, Agostino** (Johns Hopkins University)  
**Carmona, Rene** (Princeton University)  
**Cartea, Alvaro** (University College London)  
**Cebiroglu, Goekhan** (University of Vienna)  
**Cont, Rama** (Imperial College London and Centre national de la recherche scientifique)  
**Donnelly, Ryan** (University of Toronto)  
**Ewald, Christian** (University of Glasgow)  
**Frei, Christoph** (University of Alberta)  
**Grasselli, Matheus** (Fields Institute)  
**Guasoni, Paolo** (Boston University and Dublin City University)  
**Hernández-Hernández, Daniel** (Centro de Investigacion en Matematicas Guanajuato)  
**Horst, Ulrich** (Humboldt University)  
**Huang, Minyi** (Carleton University)  
**Hyndman, Cody** (Concordia University)  
**Jaimungal, Sebastian** (University of Toronto)

**Kallblad, Sigrid** (University of Oxford)  
**Kinzebulatov, Damir** (Fields Institute)  
**Larsson, Martin** (École Polytechnique Fédérale de Lausanne)  
**Leung, Tim** (Columbia University)  
**Lorig, Matt** (Princeton University)  
**Ludkovski, Michael** (University of California, Santa Barbara)  
**Moallemi, Ciamac** (Columbia University)  
**Muhle-Karbe, Johannes** (ETH Zürich)  
**Papanicolaou, Andrew** (University of Sydney)  
**Papantoleon, Antonis** (Technical University Berlin)  
**Praz, Remy** (École Polytechnique Fédérale de Lausanne)  
**Qiu, Jinniao** (Humboldt University)  
**Robertson, Scott** (Carnegie Mellon University)  
**Rockafellar, R.Terry** (University of Washington)  
**Sircar, Ronnie** (Princeton University)  
**Sturm, Stephan** (Worcester Polytechnic Institute)  
**Ware, Tony** (University of Calgary)  
**Zariphopoulou, Thaleia** (University of Texas at Austin)



# Stochastic Network Models of Neocortex (a Festschrift for Jack Cowan) July 13-18, 2014

## Organizers:

**Paul Bressloff** (University of Utah)

**Carson Chow** (National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health)

**Bard Ermentrout** (University of Pittsburgh)

**Stuart Kauffmann** (University of Vermont)

**Peter Thomas** (Case Western Reserve University)

**Hugh Wilson** (York University)



In the 1950s, during development of the first computers, the renowned mathematician John von Neumann posed a challenge: is it possible to build a reliable computing machine out of unreliable individual components?

Jack Cowan, then a precocious student, solved von Neumann's problem in 1961. This workshop celebrated the past and present contributions of Cowan and his many students and protégés, and explored new directions in the development of brain theories incorporating the intrinsically unreliable behaviour of individual nerve cells as part of a reliably functioning nervous system.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5138>

## Participants:

**Arbib, Michael** (University of Southern California)

**Bertalmío, Marcelo** (Universitat Pompeu Fabra)

**Chow, Carson** (National Institute of Diabetes and Digestive and Kidney Diseases and National Institutes of Health)

**Cowan, Jack** (University of Chicago)

**Cowan, Jeremy** (Independent Web Designer)

**Dimitrov, Alexander** (Washington State University)

**Ermentrout, Bard** (University of Pittsburgh)

**Faugeras, Olivier** (INRIA Sophia Antipolis-Méditerranée research centre)

**Feldman, Jack** (University of California, Los Angeles)

**Glass, Leon** (McGill University)

**Golubitsky, Martin** (Ohio State University)

**Greenwood, Cindy** (University of British Columbia)

**Josić, Krešimir** (University of Houston)

**Kauffmann, Stuart** (University of Vermont)

**Milton, John** (Claremont Colleges)

**Neuman, Jeremy** (University of Chicago)

**Obermayer, Klaus** (Technical University of Berlin)

**Ohira, Toru** (Nagoya University)

**Priesemann, Viola** (Max Planck Institute for Dynamics and Self-Organization)

**Rotter, Stefan** (University of Freiburg)

**Schiff, Steve** (Pennsylvania State University)

**Spire, Jean-Paul** (University of Chicago)

**Stannat, Wilhelm** (Technical University Berlin)

**Thomas, Peter** (Case Western Reserve University)

**Troy, Bill** (University of Pittsburgh)

**van Drongelen, Wim** (University of Chicago)

**Wallace, Edward** (University of Chicago)

**Wilkinson, Fran** (York University)

**Wilson, Hugh** (York University)

**Wolf, Fred** (Max Planck Institute for Dynamics and Self-Organization)

# Spin Glasses and Related Topics

## July 20-25, 2014

### Organizers:

**Erwin Bolthausen** (Universität Zürich)  
**Michael Cranston** (University of California, Irvine)

**Dmitry Panchenko** (Texas A&M University)



This conference brought together researchers from a broad spectrum, all of whom share a common interest in the general area of spin glasses. The field has witnessed some rapid and profound progress in recent years, which made this a propitious time for researchers in this area to come together to share their results and exchange new ideas. Organisers made a special attempt to bring young researchers to the conference, since it has become a fertile area of investigation.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5082>

### Participants:

**Arguin, Louis-Pierre** (University of Montreal)  
**Auffinger, Antonio** (University of Chicago)  
**Belius, David** (ETH Zurich)  
**Ben Arous, Gerard** (New York University)  
**Berestycki, Nathanael** (University of Cambridge)  
**Bolthausen, Erwin** (Universität Zürich)  
**Bovier, Anton** (Rheinische Friedrich-Wilhelms-Universität Bonn)  
**Chen, Wei-Kuo** (University of Chicago)  
**Comets, Francis** (University of Paris Diderot - Paris 7)  
**Cranston, Michael** (University of California, Irvine)  
**Dembo, Amir** (Stanford University)  
**Franz, Silvio** (Université Paris-Sud 11)  
**Fyodorov, Yan** (QMU of London)  
**Gamarnik, David** (Massachusetts Institute of Technology)  
**Gayard, Véronique** (Aix-Marseille Université and Centre national de la recherche scientifique)  
**Genovese, Giuseppe** (Universität Zürich)

**Giardina, Cristian** (University of Modena, Reggio Emilia)  
**Götze, Friedrich** (University of Bielefeld)  
**Hu, Wan-Ching** (National Chiao Tung University)  
**Jagannath, Aukosh** (New York University)  
**Kirkpatrick, Kay** (University of Illinois)  
**Mingione, Emanuele** (University of Bologna)  
**Newman, Charles** (New York University)  
**Panchenko, Dmitry** (Texas A&M University)  
**Parisi, Giorgio** (University of Roma La sapienza)  
**Read, Nicholas** (Yale University)  
**Schweinsberg, Jason** (University of California, San Diego)  
**Sly, Allan** (University of California, Berkeley)  
**Starr, Shannon** (University of Alabama, Birmingham)  
**Stein, Daniel** (New York University)  
**Sun, Nike** (Stanford University)  
**Tantari, Daniele** (La Sapienza Università di Roma)  
**Zindy, Olivier** (Université Pierre et Marie Curie)



# Statistics and Nonlinear Dynamics in Biology and Medicine

## July 27 - August 1, 2014

### Organizers:

**Jiguo Cao** (Simon Fraser University)  
**David Earn** (McMaster University)  
**Giles Hooker** (Cornell University)

**Edward Ionides** (University of Michigan)  
**Darren Wilkinson** (Newcastle University)



The past decade has seen a massive increase in data recorded from environmental and public health monitoring, medical equipment and scientific experiments. These data allow scientists, doctors and public health professionals to examine in detail the way systems change over time in response to their own state and the environment around them. While there are many mathematical models that purport to describe the systems that are now being monitored, attempts to reconcile these models with data have only recently been undertaken in earnest. This workshop brought together statisticians, mathematicians, ecologists and biologists to develop new methods to understand how this new wealth of data can inform and improve mathematical models in these fields and how these models, in turn, can affect how the data is collected and measured.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5079>

### Participants:

**Bellan, Steve** (University of Texas at Austin)  
**Bolker, Benjamin** (McMaster University)  
**Bouchard, Alexandre** (University of British Columbia)  
**Cao, Jiguo** (Simon Fraser University)  
**Carey, Michelle** (University of Rochester)  
**Chkrebtii, Oksana** (Simon Fraser University)  
**Dattner, Itai** (University of Haifa)  
**de Valpine, Perry** (University of California, Berkeley)  
**Ditlevsen, Susanne** (University of Copenhagen, Denmark)  
**Dowd, Mike** (Dalhousie University)  
**Dukic, Vanja** (University of Colorado at Boulder)  
**Dushoff, Jonathan** (McMaster University)  
**Dwyer, Greg** (University of Chicago)  
**Ellner, Stephen** (Cornell University)  
**Fasiolo, Matteo** (University of Bath)  
**Greenwood, Cindy** (University of British Columbia)  
**Gugushvili, Shota** (Leiden University)  
**Herrera, Alejandra** (University of British Columbia)  
**Higgs, Paul** (McMaster University)

**Hooker, Giles** (Cornell University)  
**Ionides, Edward** (University of Michigan)  
**King, Aaron** (University of Michigan)  
**Lele, Subhash** (University of Alberta)  
**Ma, Junling** (University of Victoria)  
**McKinley, Scott** (University of Florida)  
**Nie, Yunlong** (Simon Fraser University)  
**Park, Joon Ha** (University of Michigan)  
**Popovic, Lea** (Concordia University)  
**Preston, Simon** (University of Nottingham)  
**Ramsay, James** (McGill University)  
**Sang, Peijun** (Simon Fraser University)  
**Timmer, Jens** (University of Freiburg)  
**Voit, Eberhard** (Georgia Institute of Technology)  
**Wang, Liangliang** (Simon Fraser University)  
**Weiss, Howie** (Georgia Institute of Technology)  
**Wilkinson, Darren** (Newcastle University)  
**Wood, Simon** (University of Bath)  
**Wu, Hulin** (University of Rochester)

# Approximation Algorithms and the Hardness of Approximation

## August 3-8, 2014

### Organizers:

**Chandra Chekuri** (University of Illinois, Urbana-Champaign)  
**Joseph Cheriyan** (University of Waterloo)

**Ryan O'Donnell** (Carnegie Mellon University)  
**Mohammad Salavatipour** (University of Alberta)  
**David Williamson** (Cornell University)



This workshop focused on a few key topics that could lead to deep new results in the areas of approximation algorithms, combinatorial optimization, hardness of approximation and proof complexity. Some of the focus topics are: the Traveling Salesman Problem (TSP); the Disjoint Paths Problem and the Unique Games Conjecture.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5051>

### Participants:

**Ahmadian, Sara** (University of Waterloo)  
**An, Hyung-Chan** (École polytechnique fédérale de Lausanne)  
**Austrin, Per** (KTH Royal Institute of Technology)  
**Beame, Paul** (University of Washington)  
**Chan, Siu On** (Microsoft Research New England)  
**Charikar, Moses** (Princeton University)  
**Chekuri, Chandra** (University of Illinois, Urbana-Champaign)  
**Cheriyan, Joseph** (University of Waterloo)  
**Dinur, Irit** (Weizmann Institute)  
**Ene, Alina** (Princeton University)  
**Friggstad, Zachary** (University of Alberta)  
**Gupta, Anupam** (Carnegie Mellon University)  
**Hastad, Johan** (Royal Institute of Technology, Stockholm)  
**Huang, Sangxia** (KTH Royal Institute of Technology)  
**Khanna, Sanjeev** (University of Pennsylvania)  
**Lee, James** (University of Washington)  
**Linhares, Andre** (University of Waterloo)  
**Makarychev, Konstantin** (Microsoft Research)  
**Makarychev, Yuri** (Toyota Technological Institute at Chicago)  
**Oveis Gharan, Shayan** (University of California, Berkeley)

**Pitassi, Toni** (University of Toronto)  
**Poloczek, Matthias** (Cornell University)  
**Raghavendra, Prasad** (University of California, Berkeley)  
**Rao, Satish** (University of California, Berkeley)  
**Ravi, R.** (Carnegie Mellon University)  
**Rothvoss, Thomas** (University of Washington)  
**Salavatipour, Mohammad** (University of Alberta)  
**Shepherd, Bruce** (McGill University)  
**Shmoys, David** (Cornell University)  
**Sidiropoulos, Anastasios** (Ohio State University)  
**Singh, Mohit** (Microsoft Research, Redmond)  
**Sivakumar, Rohit** (University of Alberta)  
**Steurer, David** (Cornell University)  
**Svensson, Ola** (École polytechnique fédérale de Lausanne)  
**Swamy, Chaitanya** (University of Waterloo)  
**van Zuylen, Anke** (College of William and Mary)  
**Vishnoi, Nisheeth** (Microsoft Research India)  
**Vondrak, Jan** (IBM Almaden Research Center)  
**Vygen, Jens** (University of Bonn)  
**Wiese, Andreas** (Max-Planck-Institut für Informatik)  
**Williamson, David** (Cornell University)  
**Wright, John** (Carnegie Mellon University)



# Recent Progress in Dynamical Systems and Related Topics

## August 10-15, 2014

### Organizers:

**Boris Hasselblatt** (Tufts University)  
**Yakov Pesin** (Pennsylvania State University)

**Federico Rodriguez Hertz** (Universidad de la República)  
**Klaus Schmidt** (University of Vienna)



This workshop attracted participants from Europe, Asia and the Americas. The discipline of dynamical systems has many applications, some of which are known by the popular name of chaos theory, and it studies systems that evolve in time, often in ways so complicated that statistical methods are needed for a useful description. The subjects of this workshop were related to particle motion in curved spaces (geodesic flows) and enclosures (billiards), both of which are related to celestial mechanics, to evolutions of spaces themselves (Teichmüller flow flow), to evolutions with respect to multidimensional time, and to the question of whether essentially all such systems can be described in terms of a very few main categories (the Palis Conjecture).

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5058>

### Participants:

**Brown, Aaron** (Pennsylvania State University)  
**Burns, Keith** (Northwestern University)  
**Climenhaga, Vaughn** (University of Houston)  
**de la Llave, Rafael** (Georgia Institute of Technology)  
**Dolgopyat, Dmitry** (University of Maryland)  
**Eberlein, Patrick** (University of North Carolina at Chapel Hill)  
**Einsiedler, Manfred** (ETH Zuerich)  
**Feres, Renato** (Washington University)  
**Franks, John** (Northwestern University)  
**Gerber, Marlies** (Indiana University)  
**Gogolev, Andrey** (SUNY Binghamton)  
**Gorodnik, Alexander** (University of Bristol)  
**Guysinsky, Misha** (Pennsylvania State University)  
**Hasselblatt, Boris** (Tufts University)  
**Hu, Huyi** (Michigan State University)  
**Hurder, Steven** (University of Illinois Chicago)  
**Jakobson, Michael** (University of Maryland)  
**Kalinin, Boris** (Pennsylvania State University)

**Kaloshin, Vadim** (University of Maryland)  
**Katok, Anatole** (Pennsylvania State University)  
**Katok, Svetlana** (Pennsylvania State University)  
**Krikorian, Raphaël** (Université Pierre et Marie Curie)  
**Ledrappier, François** (University of Notre Dame)  
**Lemańczyk, Mariusz** (Nicolaus Copernicus University in Toruń)  
**Nițică, Viorel** (West Chester University)  
**Pesin, Yakov** (Pennsylvania State University)  
**Rodriguez Hertz, Federico** (Universidad de la República)  
**Sarig, Omri** (Weizmann Institute of Science)  
**Scheglov, Dmitry** (Federal Fluminense University)  
**Schmidt, Klaus** (University of Vienna)  
**Török, Andrew** (University of Houston)  
**Ugarcovici, Ilie** (DePaul University)  
**Vinhage, Kurt** (Pennsylvania State University)  
**Wang, Zhiren** (Pennsylvania State University)  
**Weiss, Benjamin** (Hebrew University of Jerusalem)  
**Windsor, Alistair** (University of Memphis)



# Mathematical Modelling of Particles in Fluid Flow

## August 17-22, 2014

### Organizers:

**Stuart Dalziel** (University of Cambridge)  
**Eckart Meiburg** (University of California, Santa Barbara)

**Bruce Sutherland** (University of Alberta)



The transport of particles in fluid flow has wide-ranging applications from examining the settling of particles in tailing ponds, the transport of ash in volcanic eruptions, and the delivery of drugs through respiration. Although computers have made great advances in speed and memory, they cannot simulate the details of fluid interacting with particles of various shapes, sizes and concentrations.

The study of these complex systems has mostly fallen under the purview of chemical engineering, focusing separately on mining engineering, environmental engineering and biomedical engineering. By bringing together a diverse group of mathematicians, physicists and engineers with backgrounds in theory, numerical modelling and laboratory experiments, this has challenged existing paradigms and developed new insights into the mathematical description of particle resuspension, transport and sedimentation.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5122>

### Participants:

**Bergmann, Michel** (INRIA Bordeaux sud ouest and IMB)  
**Blanchette, Francois** (University of California, Merced)  
**Chowdhury, Mijanur** (University of Toronto)  
**Climent, Eric** (Institut de Mécanique des Fluides de Toulouse)  
**Cottet, Georges-Henri** (Université Joseph Fourier)  
**Dalziel, Stuart** (University of Cambridge)  
**Derksen, Jos** (University of Aberdeen)  
**Frigaard, Ian** (University of British Columbia)  
**Govindarajan, Rama** (Tata Institute of Fundamental Research)  
**Hogg, Andrew** (University of Bristol)  
**Hu, Howard** (University of Pennsylvania)  
**Iollo, Angelo** (University of Bordeaux and Inria Bordeaux - Sud Ouest)  
**McElwaine, Jim** (Durham University)  
**Meiburg, Eckart** (University of California, Santa Barbara)  
**Mingotti, Nicola** (BP Institute for Multiphase Flow, University of Cambridge)  
**Monaghan, Joe** (Monash)  
**Nandakumar, Krishnaswamy** (Louisiana State University and Agricultural and Mechanical College)  
**Peakall, Jeff** (University of Leeds)

**Rahmani, Mona** (IFP Energies nouvelles)  
**Rajagopal, Kumbakonam** (Texas A&M University)  
**Rival, David** (University of Calgary)  
**Rosi, Giuseppe** (University of Calgary)  
**Salsac, Anne-Virginie** (University of Technology of Compiègne)  
**Schneider, Kai** (Aix Marseille Université)  
**Shaqfeh, Eric** (Stanford)  
**Sivaramakrishnan, Ravichandran** (Tata Institute of Fundamental Research Centre for Interdisciplinary Sciences)  
**Sutherland, Bruce** (University of Alberta)  
**Turek, Stefan** (Technical University of Dortmund)  
**Turnbull, Barbara** (University of Nottingham)  
**Verhille, Gautier** (Institut de recherche sur les phénomènes hors équilibre, Aix-Marseille Université, Centrale Marseille and Centre national de la recherche scientifique)  
**Vriend, Nathalie** (University of Cambridge)  
**Wachs, Anthony** (IFP Energies nouvelles)  
**Weynans, Lisl** (University of Bordeaux and Inria Bordeaux Sud-Ouest)  
**Woods, Andrew** (Cambridge University)

# Communication Complexity and Applications

## August 24-29, 2014

### Organizers:

**Amit Chakrabarti** (Dartmouth College)  
**Funda Ergun** (Simon Fraser University)

**Andrew McGregor** (University of Massachusetts)  
**Anup Rao** (University of Washington)



A wide range of powerful combinatorial, linear algebraic, optimization, and information-theoretic techniques have been developed for proving communication lower bounds. Over the last couple of years, remarkable progress has been made towards extending and unifying these approaches. However, foundational questions such as the “direct-sum” problem and “log-rank” conjecture remain. Furthermore, new applications including analyzing massive graphs, sub-linear time algorithms, and quantum computation necessitate new communication models and techniques. This workshop brought together world experts in communication complexity and the relevant algorithmic topics with the goal of addressing these challenges and proposing new directions of research.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5164>

### Participants:

**Beame, Paul** (University of Washington)  
**Braverman, Mark** (Princeton University)  
**Brody, Joshua** (Swarthmore College)  
**Chakrabarti, Amit** (Dartmouth College)  
**Chattopadhyay, Arkadev** (Tata Institute of Fundamental Research)  
**Ergun, Funda** (Simon Fraser University)  
**Gal, Anna** (University of Texas at Austin)  
**Garg, Ankit** (Princeton University)  
**Guha, Sudipto** (University of Pennsylvania)  
**Guruswami, Venkatesan** (Carnegie Mellon University)  
**Jain, Rahul** (National University of Singapore)  
**Jayram Thathachar, T.S.** (IBM Almaden Research Center)  
**Klauck, Hartmut** (Centre for Quantum Technologies)  
**Kol, Gillat** (Institute for Advanced Study)  
**Kushilevitz, Eyal** (Technion)

**Larsen, Kasper Green** (Aarhus University)  
**Magniez, Frederic** (CNRS, Univ Paris Diderot)  
**McGregor, Andrew** (University of Massachusetts)  
**Nayak, Ashwin** (University of Waterloo)  
**Nelson, Jelani** (Harvard University)  
**Onak, Krzysztof** (IBM T.J. Watson Research Center)  
**Oshman, Rotem** (Princeton University)  
**Pankratov, Denis** (University of Chicago)  
**Pitassi, Toni** (University of Toronto)  
**Rao, Anup** (University of Washington)  
**Raz, Ran** (Weizmann Institute of Science)  
**Sinha, Makrand** (University of Washington)  
**Thaler, Justin** (Yahoo! Labs)  
**Viola, Emanuele** (Northeastern University)  
**Watson, Thomas** (University of Toronto)  
**Weinstein, Omri** (Princeton University)  
**Woodruff, David** (IBM)  
**Yehudayoff, Amir** (Technion-IIT)



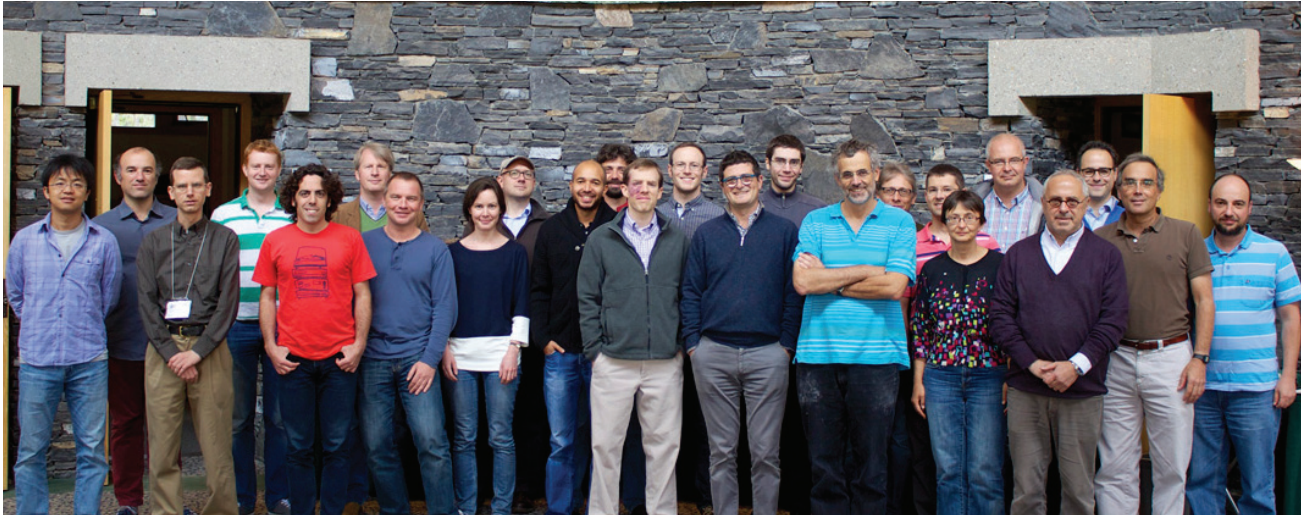
# Front Propagation and Particle Systems

## August 31 - September 5, 2014

### Organizers:

**Julien Berestycki** (Université UPMC - Paris VI)  
**Jeremy Quastel** (University of Toronto)

**Lenya Ryzhik** (Stanford University)



This workshop brought together specialists in probability and PDEs to study emergent ideas in the study of front propagation and branching particle systems. Loosely speaking, the workshop acted as a continuation of two previous workshops held at BIRS: *Reaction-diffusion and Free Boundary Problems* (March 2006) and *Deterministic and Stochastic Front Propagation* (March 2010).

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5055>

### Participants:

**Addario-Berry, Louigi** (McGill University)  
**Aidekon, Elie** (Université Paris 6)  
**Berestycki, Julien** (Université UPMC - Paris VI)  
**Berestycki, Nathanaël** (University of Cambridge)  
**Berestycki, Henri** (L'École des Hautes Etudes en Sciences Sociales Paris)  
**Brunet, Eric** (École Normale Supérieure Paris & UPMC)  
**Corre, Pierre Antoine** (Université Paris VI)  
**Gu, Yu** (Columbia University)  
**Hamel, Francois** (Université d'Aix-Marseille)  
**Harris, Simon** (University of Bath)  
**Henderson, Chris** (Stanford University)  
**Kosygina, Elena** (Baruch College and CUNY Graduate Center)  
**Kyprianou, Andreas** (University of Bath)  
**Madaule, Thomas** (Université Paris XIII)

**Mirrahimi, Sepideh** (Université Paul Sabatier)  
**Mytnik, Leonid** (Technion)  
**Nolen, James** (Duke University)  
**Novikov, Alexei** (Pennsylvania State University)  
**Penington, Sarah** (University of Oxford)  
**Pinsky, Ross** (Technion)  
**Roberts, Matthew** (University of Bath)  
**Roquejoffre, Jean-Michel** (Université Paul Sabatier Toulouse III)  
**Rossi, Luca** (Università di Padova)  
**Ryzhik, Lenya** (Stanford University)  
**Schweinsberg, Jason** (University of California, San Diego)  
**Zeitouni, Ofer** (Weizmann Institute of Science)  
**Zlotos, Andrej** (University of Wisconsin)



# Mathematics of the Cell: Integrating Genes, Biochemistry and Mechanics

## September 7-12, 2014

### Organizers:

**Eric Cytrynbaum** (University of British Columbia)  
**Adriana Dawes** (Ohio State University)

**Alex Mogilner** (University of California, Davis)  
**David Sept** (University of Michigan)



To take a more integrative view and combine models and information from genetic, mechanical and biochemical sources to better predict cellular behavior in physiological contexts, this workshop gathered researchers to discuss and map the current challenges and future directions in understanding function and organization at the single cell level. It was both horizontally and vertically integrated: researchers from a variety of fields, including biology, mathematics, physics and engineering participated in the workshop, representing educational levels from graduate students to senior academic faculty. The diversity in backgrounds and expertise led to vigorous discussion and a roadmap for the future of the field.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5075>

### Participants:

**Allard, Jun** (University of California, Irvine)  
**Bement, William** (University of Wisconsin Madison)  
**Bershadsky, Alexander** (Weizmann Institute)  
**Carlsson, Anders** (Washington University)  
**Castle, Brian** (University of Minnesota)  
**Cytrynbaum, Eric** (University of British Columbia)  
**Dawes, Adriana** (Ohio State University)  
**Diz Munoz, Alba** (University of California, San Francisco and Berkeley)  
**Edelstein-Keshet, Leah** (University of British Columbia)  
**Efimova, Nadia** (University of Pennsylvania)  
**Ermentrout, Bard** (University of Pittsburgh)  
**Fletcher, Dan** (University of California, Berkeley)  
**Fogelson, Ben** (University of California, Davis)  
**Gardner, Melissa** (University of Minnesota)  
**Goodson, Holly** (University of Notre Dame)  
**Grieneisen, Veronica** (John Innes Centre)  
**Holmes, Bill** (University of California, Irvine)  
**Janmey, Paul** (University of Pennsylvania)  
**Jilkine, Alexandra** (University of Notre Dame)  
**Keren, Kinneret** (Technion University)  
**Khismatullin, Damir** (Tulane University)  
**Levchenko, Andre** (Yale University)

**Losert, Wolfgang** (University of Maryland)  
**Luca, Magdalena** (Massachusetts College of Pharmacy and Health Sciences)  
**Maree, Stan** (John Innes Centre)  
**McCullough, Brannon** (University of Minnesota)  
**Mogilner, Alex** (University of California, Davis)  
**Mori, Yoichiro** (University of Minnesota)  
**Nathke, Inke** (University of Dundee)  
**Odde, David** (University of Minnesota)  
**Paluch, Ewa** (University College London)  
**Papoian, Garegin** (University of Maryland)  
**Pollard, Thomas D.** (Yale University)  
**Sept, David** (University of Michigan)  
**Sun, Sean** (John Hopkins)  
**Svitkina, Tatyana** (University of Pennsylvania)  
**Sykes, Cécile** (Institut Curie)  
**Upadhyaya, Arpita** (University of Maryland)  
**Verkhovskiy, Alexander** (École Polytechnique Fédérale de Lausanne)  
**Walcott, Sam** (University of California, Davis)  
**Weiner, Orion** (University of California, San Francisco)  
**White, Diana** (University of Alberta)

# Probability on Trees and Planar Graphs

## September 14-19, 2014

### Organizers:

**Louigi Addario-Berry** (McGill University)  
**Omer Angel** (University of British Columbia)

**Christina Goldschmidt** (University of Oxford)  
**Steffen Rohde** (University of Washington)



The study of random processes on trees and planar graphs is a well-established field of research at the core of probability theory, and one which has undergone tremendous growth in the past two decades. It is an extremely fertile subject area, with questions motivated by the most classical processes, such as random walks and percolation, on one hand, and by problems in statistical physics and computer science on the other. Much of the recent progress, including some substantial breakthroughs, derives from newly-discovered connections between probabilistic and geometric aspects of the objects studied. A key role is played by continuous and discrete conformal analysis, as well as related tools such as circle packings. Some of this work has been recognized by Fields medals in both 2006 (Werner) and 2010 (Smirnov), but the breakthroughs extend well beyond these works.

It is evident that geometric and analytic insights have a vital role to play in the study of random combinatorial structures, and that many fascinating conjectures and problems may now be within reach. The goal of this workshop was to connect researchers with backgrounds in probability, combinatorics, analysis and geometry in order to deepen our understanding of the interplay between these fields, and to explore the implications of geometric methods in probability.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5159>

### Participants:

**Addario-Berry, Louigi** (McGill University)  
**Albenque, Marie** (École polytechnique and Centre national de la recherche scientifique)  
**Angel, Omer** (University of British Columbia)  
**Barlow, Martin** (University of British Columbia)  
**Berestycki, Nathanael** (University of Cambridge)  
**Bhamidi, Shankar** (University of North Carolina)  
**Bouttier, Jérémie** (CEA Saclay)  
**Budd, Timothy** (Niels Bohr Institute, University of Copenhagen)  
**Cerny, Jiri** (University of Vienna)  
**Chelkak, Dmitry** (Steklov Institute)  
**Curien, Nicolas** (CNRS and Université Paris 6)  
**Ding, Jian** (University of Chicago)  
**Duplantier, Bertrand** (CEA Saclay)  
**Evans, Steve** (University of California, Berkeley)  
**Georgakopoulos, Agelos** (University of Warwick)  
**Goldschmidt, Christina** (University of Oxford)  
**Gurel-Gurevich, Ori** (Hebrew University of Jerusalem)  
**Haas, Bénédicte** (Université Paris-Dauphine)  
**Hutchcroft, Tom** (University of British Columbia)

**Kolesnik, Brett** (University of British Columbia)  
**Kortchemski, Igor** (École Normale Supérieure)  
**Kumagai, Takashi** (RIMS Kyoto)  
**Lawler, Greg** (University of Chicago)  
**Le Gall, Jean-Francois** (Université Paris-Sud, Orsay)  
**Lind, Joan** (University of Tennessee)  
**Miermont, Grégory** (École Normale Supérieure de Lyon)  
**Miller, Jason** (Massachusetts Institute of Technology)  
**Nachmias, Asaf** (University of British Columbia)  
**Peres, Yuval** (Microsoft Research)  
**Ray, Gourab** (University of Cambridge)  
**Rizzolo, Douglas** (University of Washington)  
**Rohde, Steffen** (University of Washington)  
**Sheffield, Scott** (Massachusetts Institute of Technology)  
**Sousi, Perla** (University of Cambridge)  
**Stephenson, Ken** (University of Tennessee)  
**Tassion, Vincent** (École Normale Supérieure de Lyon)  
**van der Hofstad, Remco** (Eindhoven University of Technology)  
**Wen, Yuting** (McGill University)  
**Werness, Brent** (University of Washington)



# Multiscale Models of Crystal Defects

## September 21-26, 2014

### Organizers:

**Mitchell Luskin** (University of Minnesota)  
**Christoph Ortner** (University of Warwick)

**Florian Theil** (University of Warwick)



The quest for better and cheaper materials is a part of human history since the stone ages. The most spectacular advancements (semiconductors, liquid crystals...) in the 20th century have been a result of atomic theories. A limiting factor for further progress is the lack of mathematical understanding of the corresponding discrete systems. Building on recent progress in multiscale analysis this workshop fostered exchange between mathematicians and material scientists, to seek mathematical answers for longstanding fundamental questions such as: Why do minimizers of the free energy form crystals? and What is the effect of crystal defects such as dislocations and grain boundaries on the macroscopic material behavior?

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5069>

### Participants:

**Binder, Andrew** (University of Minnesota)  
**Blanc, Xavier** (Université Paris Diderot)  
**Cances, Eric** (École des Ponts and INRIA)  
**Csanyi, Gabor** (Cambridge)  
**Ehrlacher, Virginie** (École des Ponts ParisTech and Institut national de recherche en informatique et en automatique)  
**Garroni, Adriana** (Università di Roma La Sapienza)  
**Hall, Cameron** (Oxford University)  
**Legoll, Frédéric** (École Nationale des Ponts et Chaussées)  
**Luskin, Mitchell** (University of Minnesota)  
**Minvielle, William** (Centre d'Enseignement et de Recherche en Mathématiques et Calcul Scientifique, École des Ponts ParisTech)

**Nazar, Faizan** (University of Warwick)  
**Ortner, Christoph** (University of Warwick)  
**Perez, Danny** (Los Alamos National Laboratory)  
**Reina, Celia** (University of Pennsylvania)  
**Schmidt, Bernd** (Augsburg University)  
**Shapeev, Alexander** (University of Minnesota)  
**Simpson, Gideon** (Drexel University)  
**Theil, Florian** (University of Warwick)  
**Trinkle, Dallas** (University of Illinois)  
**Van Koten, Brian** (University of Chicago)  
**Voorhees, Peter** (Northwestern University)



# Rigorously Verified Computing for Infinite Dimensional Nonlinear Dynamics September 21-26, 2014

## Organizers:

**Jean-Philippe Lessard** (Université Laval)  
**Konstantin Mischaikow** (Rutgers University)  
**Siegfried Rump** (Hamburg University of Technology)

**Jan Bouwe van den Berg** (VU University Amsterdam)  
**JF Williams** (Simon Fraser University)



Nonlinear dynamics shape the world around us, from the complicated biochemistry in the living cell, via the swirling motions in fluid flows, to the spiraling waves in contracting heart muscles. Mathematically these phenomena are described by partial differential equations and dynamical systems in infinite dimensions. This workshop focused on tightly integrating abstract mathematics with computer simulations to improve our fundamental understanding of the complex nonlinear phenomena displayed by these mathematical models.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5098>

## Participants:

**Breden, Maxime** (ENS Cachan)  
**Cyranka, Jacek** (University of Warsaw)  
**Czechowski, Aleksander** (Jagiellonian University)  
**Day, Sarah** (College of William and Mary)  
**Deschênes, Andréa** (Université Laval)  
**Gameiro, Marcio** (University of São Paulo at São Carlos)  
**Groothedde, Chris** (VU University Amsterdam)  
**Jaquette, Jonathan** (Rutgers University)  
**Lessard, Jean-Philippe** (Université Laval)  
**Mireles-James, Jay** (Rutgers University)  
**Mischaikow, Konstantin** (Rutgers University)

**Murray, Maxime** (Université Laval)  
**Neumaier, Arnold** (Universität Wien)  
**Plum, Michael** (Karlsruhe Institute of Technology)  
**Reinhardt, Christian** (VU University Amsterdam)  
**Rump, Siegfried** (Hamburg University of Technology)  
**Sheombarsing, Ray** (VU University Amsterdam)  
**van den Berg, Jan Bouwe** (VU University Amsterdam)  
**Wanner, Thomas** (George Mason University)  
**Williams, JF** (Simon Fraser University)  
**Zgliczynski, Piotr** (Jagiellonian University)

# Vojta's Conjectures

## September 28 - October 3, 2014

### Organizers:

**Aaron Levin** (Michigan State University)  
**David McKinnon** (University of Waterloo)

**Paul Vojta** (University of California, Berkeley)  
**Umberto Zannier** (Scuola Normale Superiore)



In the last few years, interest in Vojta's conjectures has exploded, with exciting new developments arriving every year. This first ever workshop dedicated to the exploration of Vojta's conjectures and their consequences brought together experts in wide-ranging areas of number theory and Nevanlinna theory to concentrate on this fast-moving area of mathematics.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5129>

### Participants:

**Akhtari, Shabnam** (University of Oregon)  
**Amerik, Ekaterina** (Higher School of Economics)  
**Bugeaud, Yann** (Université de Strasbourg)  
**Campana, Frédéric** (Université de Lorraine)  
**Canci, Jung Kyu** (Universität Basel)  
**Chen, Xi** (University of Alberta)  
**Cherry, William** (University of North Texas)  
**Corvaja, Pietro** (Università di Udine)  
**Dutter, Seth** (University of Wisconsin Stout)  
**Elkies, Noam** (Harvard University)  
**Evertse, Jan-Hendrik** (Universiteit Leiden)  
**Györy, Kálmán** (University of Debrecen)  
**Heier, Gordon** (University of Houston)  
**Ih, Su-ion** (University of Colorado at Boulder)  
**Ingram, Patrick** (Colorado State University)  
**Krieger, Holly** (Massachusetts Institute of Technology)  
**Kuehne, Lars** (Scuola Normale Superiore Pisa)  
**Levin, Aaron** (Michigan State University)  
**Lu, Steven** (Université du Québec à Montréal)  
**McKinnon, David** (University of Waterloo)

**Nguyen, Khoa** (University of California, Berkeley)  
**Noguchi, Junjiro** (University of Tokyo)  
**Pasten, Hector** (Harvard University)  
**Poonen, Bjorn** (Massachusetts Institute of Technology)  
**Rémond, Gaël** (Institut Math Bordeaux)  
**Ru, Min** (University of Houston)  
**Tucker, Tom** (University of Rochester)  
**Turchet, Amos** (Chalmers University of Technology and University of Gothenburg)  
**van Frankenhuijsen, Machiel** (Utah Valley University)  
**Veneziano, Francesco** (Graz University of Technology)  
**Vojta, Paul** (University of California, Berkeley)  
**Voloch, Jose Felipe** (University of Texas at Austin)  
**Wakabayashi, Isao** (Senkei University)  
**Wang, Julie Tzu-Yueh** (Academia Sinica)  
**Winkelmann, Jörg** (Mathematisches Institut, Bayreuth)  
**Yasufuku, Yu** (Nihon University)  
**Zhao, Yongqiang** (University of Waterloo)  
**Zhu, Huilin** (University of British Columbia)  
**Zorin, Evgeniy** (University of York)



# Sparse Representations, Numerical Linear Algebra, and Optimization

## October 5-10, 2014

### Organizers:

**Gitta Kutyniok** (Technische Universität Berlin)  
**Michael Saunders** (Stanford University)

**Stephen Wright** (University of Wisconsin, Madison)  
**Ozgun Yilmaz** (University of British Columbia)



Compressed sensing studies efficient data acquisition schemes; frame theory develops suitable representation systems; and optimization and numerical linear algebra deliver efficient and stable algorithms that use acquired data and representation systems to recover vital information about the system being observed. Until now, these four areas have interacted only in ad hoc ways in the service of data analysis. This workshop brought together experts from all these areas to initiate close and concerted interactions, to advance research on the use of sparse representations in data processing and analysis.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5003>

### Participants:

**Aravkin, Aleksandr** (IBM T.J. Watson Research Center)  
**Arioli, Mario** (Rutherford Appleton Labs)  
**Balzano, Laura** (University of Michigan)  
**Cartis, Coralia** (University of Oxford)  
**Casazza, Pete** (University of Missouri)  
**Chadrasekaran, Venkat** (California Institute of Technology)  
**Elad, Michael** (Technion)  
**Friedlander, Michael** (University of British Columbia)  
**Greif, Chen** (University of British Columbia)  
**Herrmann, Felix** (University of British Columbia)  
**Krahmer, Felix** (University of Göttingen)  
**Kressner, Daniel** (École Polytechnique Fédérale de Lausanne)  
**Kutyniok, Gitta** (Technische Universität Berlin)  
**Liesen, Joerg** (Technical University of Berlin)  
**Mehrmann, Volker** (Technische Universität Berlin)  
**Mixon, Dustin** (Air Force Institute of Technology)  
**Orban, Dominique** (École Polytechnique de Montréal)  
**Roosta, Fred** (University of British Columbia)

**Saab, Rayan** (Duke University)  
**Saunders, Michael** (Stanford University)  
**Schmidt, Mark** (University of British Columbia)  
**Simoncini, Valeria** (Università di Bologna)  
**Stoll, Martin** (Max Planck Institute Magdeburg)  
**Strakoš, Zdeněk** (Charles University in Prague)  
**Strohmer, Thomas** (University of California, Davis)  
**Szlam, Arthur** (City College of New York)  
**Tanner, Jared** (University of Oxford)  
**Temlyakov, Vladimir** (University of South Carolina)  
**Tremain, Janet C.** (University of Missouri)  
**Turkiyyah, George** (American University of Beirut)  
**van den Berg, Ewout** (IBM T.J. Watson Research Center)  
**Vert, Jean-Philippe** (Mines ParisTech)  
**Wang, Rongrong** (University of British Columbia)  
**Ward, Rachel** (University of Texas at Austin)  
**Willett, Rebecca** (University of Wisconsin, Madison)  
**Wright, Stephen** (University of Wisconsin, Madison)  
**Yilmaz, Ozgur** (University of British Columbia)

# Optimal Cooperation, Communication, and Learning in Decentralized Systems October 12-17, 2014

## Organizers:

**Aditya Mahajan** (McGill University)  
**Maxim Raginsky** (University of Illinois, Urbana  
Champaign)

**Demosthenis Teneketzis** (University of Michigan, Ann  
Arbor)  
**Serdar Yüksel** (Queen's University)



Decentralized decision-making is a unifying theme of a very diverse set of problems and applications of current interest both to researchers and to practitioners. These include: collective decision-making and problem-solving via crowdsourcing and social networks; design and implementation of economic mechanisms and control policies for smart grids, health care, and other large-scale socioeconomic infrastructures; parallel and distributed computing for large-scale machine learning problems; cybersecurity; etc. It is becoming increasingly apparent that one can distill a common set of core features shared by these heterogeneous problem domains, and to identify a common list of core questions that need urgent attention. By bringing together researchers from separate communities (including stochastic control, economics, machine learning, and information theory) that do not normally interact, and by highlighting the common threads and methodological approaches underlying much of the research into large-scale decentralized systems, this workshop led to cross-fertilization of ideas and mutually beneficial exchange of perspectives.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5077>

## Participants:

**Anantharam, Venkat** (University of California, Berkeley)  
**Arabneydi, Jalal** (McGill University)  
**Arslan, Gürdal** (University of Hawaii)  
**Basar, Tamer** (University of Illinois at Urbana Champaign)  
**Belabbas, Ali** (University of Illinois Urbana Champaign)  
**Borkar, Vivek** (Indian Institute of Technology Bombay)  
**De Lara, Michel** (École des Ponts ParisTech)  
**Ghahesifard, Bahman** (Queen's University)  
**György, András** (University of Alberta)  
**Hörner, Johannes** (Yale University)  
**Jain, Rahul** (University of Southern California)  
**Javidi, Tara** (University of California, San Diego)  
**Jovanovic, Mihailo** (University of Minnesota)  
**Krishnamurthy, Vikram** (University of British Columbia)  
**Lall, Sanjay** (Stanford University)  
**Langbort, Cédric** (University of Illinois, Urbana-Champaign)  
**Leslie, David** (Lancaster University)  
**Linder, Tamas** (Queen's University)  
**Lugosi, Gabor** (Institució Catalana de Recerca i  
Estudis Avançats Pompeu Fabra University)  
**Mahajan, Aditya** (McGill University)  
**Malhamé, Roland** (École Polytechnique de Montreal)

**Marden, Jason** (University of Colorado)  
**Martins, Nuno** (University of Maryland)  
**Meyn, Sean** (University of Florida)  
**Narayan, Prakash** (University of Maryland)  
**Oliehoek, Frans** (University of Amsterdam)  
**Olshevsky, Alex** (University of Illinois at Urbana  
Champaign)  
**Ouyang, Yi** (University of Michigan)  
**Perchet, Vianney** (Université Paris Diderot)  
**Raginsky, Maxim** (University of Illinois, Urbana  
Champaign)  
**Sahai, Anant** (University of California, Berkeley)  
**Saldi, Naci** (Queen's University)  
**Sandholm, Bill** (University of Wisconsin)  
**Shamir, Ohad** (Weizmann Institute of Science)  
**Spaan, Matthijs** (Delft University of Technology)  
**Sundaram, Shreyas** (University of Waterloo)  
**Szepesvari, Csaba** (University of Alberta)  
**Touri, Behrouz** (University of Colorado)  
**Wong, Wing Shing** (Chinese University of Hong Kong)  
**Yüksel, Serdar** (Queen's University)  
**Zilberstein, Shlomo** (University of Massachusetts Amherst)



# Dynamics and $C^*$ -Algebras: Amenability and Soficity

## October 19-24, 2014

### Organizers:

George Elliott (University of Toronto)  
Thierry Giordano (University of Ottawa)

David Kerr (Texas A&M University)  
Andrew Toms (Purdue University)



The workshop pursued lines of investigation in a way that integrates the expertise of specialists in dynamical systems who may not be versed in  $C^*$ -classification theory. This is especially timely as recent developments in  $C^*$ -classification have honed on issues that have long been central in dynamics, such as the tension between additive and multiplicative structure that is characteristic of amenability and the distinction between internal and external approximation that figures prominently in the currently very active study of sofic groups.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5161>

### Participants:

**Brenken, Berndt** (University of Calgary)  
**Dadarlat, Marius** (Purdue University)  
**Deeley, Robin** (Université Blaise Pascal)  
**Eckhardt, Caleb** (Miami University)  
**Elliott, George** (University of Toronto)  
**Exel, Ruy** (Universidade Federal de Santa Catarina)  
**Gardella, Eusebio** (University of Oregon)  
**Georgescu, Magdalena** (University of Victoria)  
**Giordano, Thierry** (University of Ottawa)  
**Hirshberg, Ilan** (Ben Gurion University of the Negev)  
**Itza-Ortiz, Benjamin Alfonso** (Universidad Autónoma del Estado de Hidalgo)  
**Kennedy, Matthew** (Carleton University)  
**Kerr, David** (Texas A&M University)  
**Li, Hanfeng** (SUNY at Buffalo)  
**Li, Xin** (Queen Mary University of London)  
**Lin, Huaxin** (University of Oregon)  
**Lupini, Martino** (York University)  
**Lutley, James** (University of Toronto)  
**Musat, Magdalena** (University of Copenhagen)  
**Ng, Ping Wong** (University of Louisiana at Lafayette)  
**Niu, Zhuang** (University of Wyoming)

**Phillips, N. Christopher** (University of Oregon)  
**Putnam, Ian** (University of Victoria)  
**Rainone, Timothy** (Texas A&M University)  
**Renault, Jean** (Université d'Orléans)  
**Robert, Leonel** (University of Louisiana at Lafayette)  
**Rordam, Mikael** (University of Copenhagen)  
**Sato, Yasuhiko** (Kyoto University)  
**Sierakowski, Adam** (University of Wollongong)  
**Skau, Christian** (Norwegian University of Science and Technology)  
**Strung, Karen** (Institute of Mathematics, Polish Academy of Sciences)  
**Szabo, Gabor** (University of Münster)  
**Tikuisis, Aaron** (University of Aberdeen)  
**Toms, Andrew** (Purdue University)  
**Vignati, Alessandro** (York University)  
**Wang, Qingyun** (University of Toronto)  
**Wang, Kun** (University of Toronto)  
**White, Stuart** (University of Glasgow)  
**Winter, Wilhelm** (University of Muenster)  
**Zacharias, Joachim** (University of Glasgow)

# Biological and Bio-Inspired Information Theory

## October 26-31, 2014

### Organizers:

**Toby Berger** (University of Virginia)  
**Andrew Eckford** (York University)

**Peter Thomas** (Case Western Reserve University)



The trillions of individual cells in the human body need to stay in constant contact to keep the heart pumping, the muscles moving, and the brain thinking. But cells can't call or text each other -- they need to keep in touch by using chemical or electrical signals. This week, scientists at the Banff International Research Station are talking about biological communication -- not just how cells chat, but how information is processed in the brain, how data is stored in DNA, and how biological systems organize themselves into networks.

The key to understanding these processes is information theory, the mathematical study of reliability and efficiency in communication.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5170>

### Participants:

**Aazhang, Behnaam** (Rice University)  
**Adami, Christoph** (Michigan State University)  
**Baez, John** (University of California, Riverside)  
**Berger, Toby** (University of Virginia)  
**Bogdan, Paul** (University of Southern California)  
**Chae, Chan-Byoung** (Yonsei University)  
**Dimitrov, Alexander** (Washington State University)  
**Eckford, Andrew** (York University)  
**Emad, Amin** (University of Illinois, Urbana-Champaign)  
**Fekri, Faramarz** (Georgia Institute of Technology)  
**Guo, Weisi** (University of Warwick)  
**Kostal, Lubomir** (Institute of Physiology, Academy of Sciences of the Czech Republic)  
**Levchenko, Andre** (Yale University, Systems Biology Institute)  
**Michelusi, Nicolo** (University of Southern California)  
**Moser, Stefan** (ETH Zurich)

**Nemenman, Ilya** (Emory University)  
**Paluh, Janet** (SUNY College of Nanoscale Science and Engineering)  
**Polani, Daniel** (University of Hertfordshire)  
**Pollard, Blake** (University of California, Riverside)  
**Rabenstein, Rudolf** (Friedrich-Alexander-Universitat Erlangen-Nurnberg)  
**Rose, Chris** (Rutgers University)  
**Schneider, Tom** (National Institutes of Health)  
**Schober, Robert** (Universitat Erlangen-Nurnberg)  
**Shaw, Robert** (ProtoLife Inc.)  
**Soltani, Nima** (Stanford University)  
**Still, Susanne** (University of Hawaii)  
**Thomas, Peter** (Case Western Reserve University)  
**Tishby, Naftali** (Hebrew University of Jerusalem)  
**Zylberberg, Joel** (University of Washington)



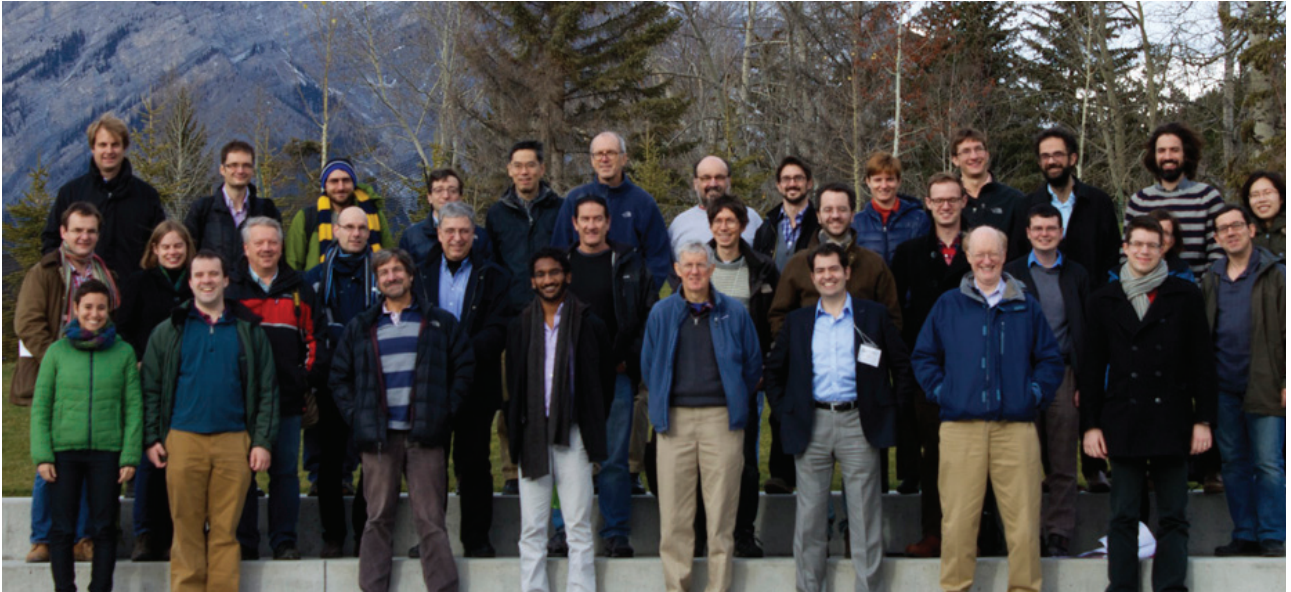
# Geometric Scattering Theory and Applications

## November 2-7, 2014

### Organizers:

**Richard Froese** (University of British Columbia)  
**Peter Hislop** (University of Kentucky)

**Rafe Mazzeo** (Stanford University)  
**Peter Perry** (University of Kentucky)



This workshop brought together researchers in scattering theory and geometry to make further progress in geometric scattering theory, which studies scattering in the mathematical setting of Riemannian manifolds. Riemannian manifolds are mathematical models for spaces which occur naturally such as in general relativity and string theory. The main goal was to relate the behavior of the scattered waves to the geometry of the spaces.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5105>

### Participants:

**Albin, Pierre** (University of Illinois, Urbana-Champaign)  
**Alexakis, Spyros** (University of Toronto)  
**Baskin, Dean** (Northwestern University)  
**Borthwick, David** (Emory University)  
**Canzani, Yaiza** (Institute for Advanced Study and Harvard University)  
**Christiansen, Tanya** (University of Missouri)  
**Datchev, Kiril** (Massachusetts Institute of Technology)  
**Degeratu, Anda** (University of Freiburg)  
**Dyatlov, Semyon** (Massachusetts Institute of Technology)  
**Eswarathasan, Suresh** (McGill University)  
**Ford, Austin** (Stanford University)  
**Froese, Richard** (University of British Columbia)  
**Galkowski, Jeffrey** (University of California, Berkeley)  
**Gell-Redman, Jesse** (Johns Hopkins University)  
**Gover, A. Rod** (University of Auckland)  
**Graham, Robin** (University of Washington)  
**Häfner, Dietrich** (University of Grenoble)  
**Hassell, Andrew** (Australian National University)  
**Hislop, Peter** (University of Kentucky)  
**Hunsicker, Eugenie** (Loughborough University)

**Ingremeau, Maxime** (CEA-Saclay)  
**Jakobson, Dmitry** (McGill University)  
**Kottke, Chris** (Northeastern University)  
**Lassas, Matti** (University of Helsinki)  
**Marzuola, Jeremy** (University of North Carolina, Chapel Hill)  
**Mazzeo, Rafe** (Stanford University)  
**Mendoza, Gerardo** (Temple University)  
**Müller, Werner** (Universität Bonn)  
**Nakamura, Shu** (University of Tokyo)  
**Naud, Frederic** (Université d'Avignon)  
**Nonnenmacher, Stephane** (Commissariat à l'énergie atomique Saclay)  
**Perry, Peter** (University of Kentucky)  
**Rochon, Frederic** (Université du Québec à Montréal)  
**Sa Barreto, Antonio** (Purdue University)  
**Sher, David** (University of Michigan)  
**Strohmaier, Alex** (University of Loughborough)  
**Tacy, Melissa** (University of Adelaide)  
**Vasy, Andrés** (Stanford University)  
**Wunsch, Jared** (Northwestern University)  
**Zhu, Xuwen** (Massachusetts Institute of Technology)

# Particle-Based Stochastic Reaction-Diffusion Models in Biology

## November 9-14, 2014

### Organizers:

**Daniel Coombs** (University of British Columbia)  
**Mark Flegg** (Monash University)  
**Samuel Isaacson** (Boston University)

**Per Lötstedt** (Uppsala University)  
**Linda Petzold** (University of California, Santa Barbara)



This workshop was designed to bring together international leaders and up-and-coming academics researching particle-based reaction-diffusion simulation techniques in biology. Some of the aims of this workshop included; developing new innovative techniques which increase the efficiency and accuracy of simulation outcomes, facilitating international collaboration between mathematical modellers applying existing methods to biological problems, discussing sources of error associated with different simulation techniques, introducing new hybrid methods of simulation and introducing early-career researchers to world leaders in the field and some of the existing mathematical problems associated with efficient and accurate simulation.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5103>

### Participants:

**Agbanusi, Ikemefuna** (University of Illinois at Urbana-Champaign)  
**Allard, Jun** (University of California, Irvine)  
**Andrews, Steve** (Fred Hutchinson Cancer Research Center)  
**Baker, Ruth** (University of Oxford)  
**Becskei, Attila** (University of Basel)  
**Blackwell, Avrama Kim** (George Mason University - Krasnow Institute for Advanced Study)  
**Cao, Yang** (Virginia Tech)  
**Coombs, Daniel** (University of British Columbia)  
**De Schutter, Erik** (Okinawa Institute of Science and Technology)  
**Del Razo Sarmina, Mauricio** (University of Washington)  
**Engblom, Stefan** (Uppsala University)  
**Erbán, Radek** (University of Oxford)  
**Flegg, Mark** (Monash University)  
**Gillespie, Dan** (Dan T. Gillespie Consulting)  
**Harris, Leonard** (Vanderbilt University)  
**Hellander, Stefan** (University of California, Santa Barbara)  
**Hellander, Andreas** (Uppsala University)  
**Isaacson, Samuel** (Boston University)  
**Jędrzejewski-Szmek, Zbigniew** (George Mason University - Krasnow Institute for Advanced Study)

**Johnson, Margaret** (Johns Hopkins University)  
**Kaizu, Kazunari** (RIKEN Quantitative Biology Center)  
**Kang, Hye-Won** (University of Maryland, Baltimore County)  
**Lopez, Carlos** (Vanderbilt)  
**MacNamara, Shev** (Massachusetts Institute of Technology)  
**Matzavinos, Anastasios** (Brown University)  
**Mauro, Ava** (Boston University)  
**Meier-Schellersheim, Martin** (National Institutes of Health - National Institute of Allergy and Infectious Diseases)  
**Newby, Jay** (Ohio State University - Mathematical Biosciences Institute)  
**Noe, Frank** (Freie Universitaet Berlin)  
**Petzold, Linda** (University of California, Santa Barbara)  
**Prüstel, Thorsten** (National Institutes of Health - Laboratory of Systems Biology)  
**Sanft, Kevin** (University of Minnesota)  
**Shahrezaei, Vahid** (Imperial College London)  
**Sokolowski, Thomas** (Institute of Science and Technology Austria)  
**Thomas, Peter** (Case Western Reserve University)  
**Yates, Christian** (University of Oxford - Centre for Mathematical Biology)



# Algorithms for Linear Groups

## November 16-21, 2014

### Organizers:

**Jon Carlson** (University of Georgia)

**Bettina Eick** (Technische Universität Braunschweig)

**Alexander Hulpke** (Colorado State University)

**Eamonn O'Brien** (University of Auckland)



Since its birth, Computational Group Theory has proved to be a fertile area for the development of effective computational techniques, which have been applied in diverse areas of mathematics, science and engineering; these include coding theory, design theory, integer programming, crystallography, algebraic number theory, and topology. It provides an important bridge between abstract algebra and other sciences and engineering. The aim of this meeting is to bring together a combination of leading and young researchers on computations with linear groups, for the purpose of exploring new directions for research in the light of significant recent advances.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5031>

### Participants:

**Brooksbank, Peter** (Bucknell University)

**Carlson, Jon** (University of Georgia)

**Cohen, Arjeh** (Technische Universiteit Eindhoven)

**Corr, Brian** (University of Western Australia)

**de Graaf, Willem** (University of Trento)

**Dekimpe, Karel** (Katholieke Universiteit Leuven Kulak)

**Detinko, Alla** (National University of Ireland, Galway)

**Dietrich, Heiko** (Monash University)

**Dixon, John D.** (Carleton University)

**Eick, Bettina** (Technische Universität Braunschweig)

**Flannery, Dane** (National University of Ireland, Galway)

**Hiss, Gerhard** (Rheinisch-Westfälische Technische Hochschule Aachen University)

**Horn, Max** (Justus-Liebig-Universität Gießen)

**Hulpke, Alexander** (Colorado State University)

**Jespers, Eric** (Vrije Universiteit Brussel)

**Kantor, William** (Brookline, MA)

**Kassabov, Martin** (Cornell University)

**Kirschmer, Markus** (Rheinisch-Westfälische Technische Hochschule Aachen University)

**Leedham-Green, Charles** (Queen Mary College London)

**Litterick, Alastair** (University of Auckland)

**Lübeck, Frank** (Rheinisch-Westfälische Technische Hochschule Aachen University)

**Lux, Klaus** (University of Arizona)

**Magaard, Kay** (University Birmingham)

**Maglione, Josh** (Colorado State University)

**Malle, Gunter** (Technische Universität Kaiserslautern)

**Moede, Tobias** (Technische Universität Braunschweig)

**Nebe, Gabriele** (Rheinisch-Westfälische Technische Hochschule Aachen University)

**Niemeyer, Alice** (University of Western Australia)

**O'Brien, Eamonn** (University of Auckland)

**Ostheimer, Gretchen** (Hofstra University)

**Pfeiffer, Markus** (University of St Andrews)

**Praeger, Cheryl** (University of Western Australia)

**Roney-Dougal, Colva** (University of St Andrews)

**Rossmann, Tobias** (Universität Bielefeld)

**Ryba, Alex** (Queens College New York)

**Schillewaert, Jeroen** (Imperial College London)

**Schneider, Csaba** (Universidade Federal de Minas Gerais)

**Taylor, Don** (University of Sydney)

**Waldecker, Rebecca** (Martin Luther University of Halle-Wittenberg)

**Wilson, James** (Colorado State University)

**Wilson, Robert** (Queen Mary London)

# Algebraic and Model Theoretical Methods in Constraint Satisfaction

## November 23-28, 2014

### Organizers:

**Manuel Bodirsky** (École Polytechnique)  
**Andrei Bulatov** (Simon Fraser University)

**Dugald MacPherson** (University of Leeds)  
**Jaroslav Nesetril** (Charles University)



The aim in a constraint satisfaction problem (CSP) is to find an assignment of values to a given set of variables, subject to constraints on the values which can be assigned simultaneously to certain specified subsets of variables. CSPs are used to model a wide variety of computational problems in computer science, discrete mathematics, artificial intelligence, and elsewhere, and they have found numerous applications in those areas. Several very successful approaches to study the complexity and algorithms for constraint satisfaction problems have been developed over the last decade. One of the most fruitful uses universal algebra. So far the bulk of research on the CSP has been done assuming the variables can take only a finite number of values. The infinite CSP, in which this restriction is removed, has much stronger expressive power, but is also much harder to study. Two recent discoveries made it possible to transfer some techniques, in particular the algebraic approach, from the finite to some classes of the infinite CSP. The goal of this workshop was, for the first time, to bring together researchers from model theory, topological dynamics, combinatorics, universal algebra and computer science to explore the implications of this new connection between these three fields.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5136>

### Participants:

**Ahlman, Ove** (Uppsala University)  
**Aranda, Andrés** (University of Calgary)  
**Barto, Libor** (Charles University in Prague)  
**Bodirsky, Manuel** (École Polytechnique)  
**Bulatov, Andrei** (Simon Fraser University)  
**Cameron, Peter** (Queen Mary University of London)  
**Carvalho, Catarina** (University of Hertfordshire)  
**Chen, Hubie** (Universidad del País Vasco and Ikerbasque)  
**Cherlin, Gregory** (Rutgers University)  
**Dalmau, Victor** (University Pompeu Fabra)  
**Dvorak, Zdenek** (Charles University in Prague)  
**Dyer, Martin** (University of Leeds)  
**Egri, Laszlo** (Concordia University)  
**Goldstern, Martin** (Wien University of Technology)  
**Gray, Robert** (University of East Anglia)  
**Hartman, David** (Charles University in Prague)  
**Hubicka, Jan** (University of Calgary)  
**Jonsson, Peter** (Linköping University)  
**Kazda, Alexandr** (Vanderbilt University)  
**Kearnes, Keith** (University of Colorado, Boulder)  
**Kolmogorov, Vladimir** (Institute of Science and Technology Austria)  
**Koponen, Vera** (Uppsala University)

**Kozik, Marcin** (Jagiellonian University)  
**Krokhin, Andrei** (Durham University)  
**Larose, Benoit** (Concordia University)  
**Liman, Julie** (University of Colorado)  
**Liprandi, Max** (University of Calgary)  
**MacPherson, Dugald** (University of Leeds)  
**Madelaine, Florent** (Université d'Auvergne)  
**Maroti, Miklos** (University of Szeged)  
**Martin, Barnaby** (Middlesex University)  
**Mayr, Peter** (University of Linz)  
**McKenzie, Ralph** (Vanderbilt University)  
**Moore, Matthew** (Vanderbilt University)  
**Nesetril, Jaroslav** (Charles University)  
**Ossona de Mendez, Patrice** (École des Hautes Etudes en Sciences Sociales)  
**Pinsker, Michael** (Technische Universität Wien)  
**Pongracz, Andras** (École Polytechnique)  
**Szendrei, Agnes** (University of Colorado, Boulder)  
**Thapper, Johan** (Université Paris-Est Marne-la-Vallée)  
**Valeriote, Matthew** (McMaster University)  
**Willard, Ross** (University of Waterloo)  
**Wrona, Michal** (Linköping University)  
**Zivny, Stanislav** (University of Oxford)



# Families of Automorphic Forms and the Trace Formula

## November 30 - December 5, 2014

### Organizers:

**Werner Müller** (Universität Bonn)

**Sug-Woo Shin** (Massachusetts Institute of Technology)

**Nicolas Templier** (Princeton University)



This workshop focused on the equidistribution of local invariants in the families of automorphic representations. There are numerous instances of such equidistribution including Weyl's law, limit multiplicity and Plancherel density with application to a Sato-Tate type equidistribution for families and confirmed the Katz-Sarnak heuristics explaining the connection between the statistics of low-lying zeros in a family of automorphic L-functions and random matrix models. By bringing together different groups of researchers with no past collaboration and distant locations, a synergetic effect is expected in generalizing previous results on equidistribution while building a unifying framework and finding more applications to automorphic L-functions.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5120>

### Participants:

**Andrade, Julio** (Mathematical Institute at University of Oxford)

**Asgari, Mahdi** (Oklahoma State University)

**Entin, Alexei** (Institute for Advanced Study)

**Finis, Tobias** (Freie Universität Berlin)

**Kala, Vitezslav** (Purdue University)

**Kim, Julee** (Massachusetts Institute of Technology)

**Knightly, Andrew** (University of Maine)

**Lapid, Erez** (Weizmann Institute of Science)

**Lee, Min** (Brown University)

**Li, Wen-Wei** (Academy of Mathematics, Chinese Academy of Sciences)

**Lipnowski, Michael** (Duke University)

**Matz, Jasmine** (Bonn University)

**Miller, S. J.** (Williams College)

**Müller, Werner** (Universität Bonn)

**Pfaff, Jonathan** (Universität Bonn)

**Rubinstein, Michael** (University of Waterloo)

**Shankar, Arul** (Harvard University)

**Shin, Sug-Woo** (Massachusetts Institute of Technology)

**Templier, Nicolas** (Princeton University)

**Young, Matthew** (Texas A&M University)

**Zhang, Ruixiang** (Princeton University)

# Motivic Integration, Orbital Integrals, and Zeta-Functions

## November 30 - December 5, 2014

### Organizers:

**William Casselman** (University of British Columbia)  
**Julia Gordon** (University of British Columbia)

**Francois Loeser** (Institut Mathematique de Jussieu)



This workshop will explore the connections between two areas of mathematics which until 10 years ago appeared completely unrelated. The first area is model theory -- a modern branch of mathematical logic, which lead to the transfer principle by Ax and Kochen in the 70s. The second area is harmonic analysis on p-adic groups, a field that plays a major role in number theory, for example, in the proof of Fermat's last theorem. In recent years it has turned out that some methods of model theory, by expanding our notions of integration, apply to the problems in harmonic analysis on p-adic groups.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5155>

### Participants:

**Bouthier, Alexis** (Université Paris-Sud)  
**Casselmann, William** (University of British Columbia)  
**Cluckers, Raf** (Univ. Lille 1 and Univ. Leuven)  
**Cunningham, Clifton** (University of Calgary)  
**Ganapathy, Radhika** (University of British Columbia)  
**Gordon, Julia** (University of British Columbia)  
**Gourevitch, Dmitry** (Weizmann Institute of Science)  
**Hales, Thomas C.** (University of Pittsburgh)  
**Litt, Daniel** (Stanford University)  
**Loeser, Francois** (Institut Mathematique de Jussieu)  
**Murnaghan, Fiona** (University of Toronto)

**Nguyen, Athena** (University of British Columbia)  
**Nicaise, Johannes** (University of Leuven)  
**Oliver, Thomas** (University of Bristol)  
**Raibaut, Michel** (Université de Savoie)  
**Roe, David** (University of British Columbia)  
**Sakellaridis, Yiannis** (Rutgers University)  
**Spice, Loren** (Texas Christian University)  
**Takloo-Bighash, Ramin** (University of Illinois at Chicago)  
**Tsai, Cheng-Chiang** (Harvard University)  
**Wyss, Dimitri** (École Polytechnique Fédérale de Lausanne)



# Cohomological Realizations of Motives

## December 7-12, 2014

### Organizers:

**Rob de Jeu** (VU University Amsterdam)

**Pedro Luis del Angel** (Center of Investigations in Mathematics)

**E. Javier Elizondo** (Universidad Nacional Autonoma de Mexico, Ciudad Universitaria)

**James Lewis** (University of Alberta)

**Paulo Lima-Filho** (Texas A&M University)

**Deepam Patel** (Institut des Hautes Études Scientifiques)



The subject of motives was invented by A. Grothendieck as a way of unifying all of the deepest ideas in mathematics relating to algebra and geometry. The workshop is intended to cover recent developments in the study of motives and their realizations with an emphasis to the connections to physics, arithmetic and algebraic cycles.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/5-day-workshops/14w5074>

### Participants:

**Agarwala, Susama** (Oxford University)

**Asakura, Masanori** (Hokkaido University)

**Brosnan, Patrick** (University of Maryland)

**Burgos Gil, Jose Ignacio** (The Instituto de Ciencias Matemáticas)

**Chen, Xi** (University of Alberta)

**Chernousov, Vladimir** (University of Alberta)

**de Jeu, Rob** (VU University Amsterdam)

**Doran, Charles** (University of Alberta)

**Dos Santos, Pedro** (Instituto Superior Técnico Lisbon)

**Elizondo, E. Javier** (Universidad Nacional Autónoma de México, Ciudad Universitaria)

**Gangl, Herbert** (Durham University)

**Gille, Stefan** (University of Alberta)

**Gille, Philippe** (Université Claude Bernard Lyon 1)

**Girivaru, Ravindra** (University of Missouri St. Louis)

**Goswami, Souvik** (University of Alberta)

**Iyer, Jaya** (Institute of Mathematical Sciences, India)

**Joshua, Roy** (Ohio State University)

**Kahn, Bruno** (Centre national de la recherche scientifique)

**Karpenko, Nikita** (University of Alberta)

**Kerr, Matt** (Washington University in St. Louis)

**Kimura, Shun-ichi** (Hiroshima University)

**Lalin, Matilde** (Université de Montréal)

**Lewis, James** (University of Alberta)

**Lima-Filho, Paulo** (Texas A&M University)

**Mendez, Hector** (University of Alberta)

**Nagel, Jan** (Université de Bourgogne)

**Pal, Suchandan** (University of Michigan)

**Patel, Deepam** (Institut des Hautes Études Scientifiques)

**Pearlstein, Gregory** (Texas A&M)

**Pelaez, Pablo** (Universidad Nacional Autónoma de México)

**Raskind, Wayne** (Wayne State University)

**Rivera Arredondo, Carolina** (Università degli Studi di Milano)

**Sheng, Mao** (University of Science and Technology of China)

**Tabuada, Gonçalo** (Massachusetts Institute of Technology)

**Tong, Zhang** (University of Alberta)

**Weibel, Chuck** (Rutgers University)

**Wilson, Glen** (Rutgers University)

**Zhong, Changlong** (University of Alberta)

# **Banff International Research Station**

**2014**

**2-Day Workshops**





# Alberta Number Theory Days VI

## April 18-20, 2014

### Organizers:

**Clifton Cunningham** (University of Calgary)  
**Habiba Kadiri** (University of Lethbridge)

**Soroosh Yazdani** (University of Lethbridge)



Number theory is a broad and central area of research with many connections and applications to other areas of mathematics and science. The subject may be divided into several sub-disciplines that range from pure mathematics, such as algebraic number theory, arithmetic geometry, analytic number theory, and representation theory, to more applied areas such as computational number theory and cryptography. All these fields are represented among the Alberta number theorists from Calgary, Edmonton, or Lethbridge. In the past couple of years, there have been many exciting breakthroughs in the field of number theory. For instance the long lasting ternary Goldbach conjecture has been resolved by Helfgott. Currently, after Zhang's amazing result, the mathematics community is actively working towards proving the twin primes conjecture. The annual Alberta Number Theory Days provide a unique venue for these researchers, their students, and their visitors for face to face discussion of ideas and for facilitating collaborations. New connections are made and old associations are renewed. The workshop also allows for the exchange of knowledge, which will improve the progress of current projects.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/2-day-workshops/14w2192>

### Participants:

**Amir, Akbary** (University of Lethbridge)  
**Aryan, Farzad** (University of Lethbridge)  
**Balakrishnan, Jennifer** (University of Oxford)  
**Bauer, Mark** (University of Calgary)  
**Bedard, Robert** (University of Lethbridge)  
**Biasse, Jean-Francois** (University of Calgary)  
**Bleaney, Jeff** (University of Lethbridge)  
**Bruin, Nils** (Simon Fraser University)  
**Cunningham, Clifton** (University of Calgary)  
**DeQuehen, Victoria** (McGill University)  
**Felix, Adam** (University of Lethbridge)  
**Fenton, Diane** (University of Calgary)  
**Gherga, Adela** (University of Lethbridge)  
**Guy, Richard** (University of Calgary)  
**Kadiri, Habiba** (University of Lethbridge)

**Kumar, Manoj** (University of Lethbridge)  
**Labrande, Hugo** (University of Calgary/ISPIA, INRIA Nancy)  
**Langlois, Marie-Andree** (University of Calgary)  
**Lindner, Sebastian** (University of Calgary)  
**Lumley, Allysa** (University of Lethbridge)  
**Ng, Nathan** (University of Lethbridge)  
**Parks, James** (University of Lethbridge)  
**Patnaik, Manish** (University of Alberta)  
**Roe, David** (University of British Columbia)  
**Scheidler, Renate** (University of Calgary)  
**Stange, Katherine** (University of Colorado, Boulder)  
**Steele, Ander** (University of Calgary)  
**Varma, Ila** (Princeton University)  
**Yazdani, Soroosh** (University of Lethbridge)



# Ted Lewis Workshop on SNAP Math Fairs 2014

## April 25-27, 2014

### Organizers:

**Sean Graves** (University of Alberta)  
**Tiina Hohn** (MacEwan University)

**Ted Lewis** (SNAP Mathematics Foundation)

SNAP math fairs are non-competitive events that give teachers an opportunity to have their students do problem solving with a particular goal in mind. The Ted Lewis SNAP Math Fair Workshop was a gathering of teachers and educators who had a common interest in promoting and learning about hosting SNAP Math Fairs. The experienced teachers shared their success stories in hopes to motivate others to adopt SNAP Math Fairs into their classrooms.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/2-day-workshops/14w2197>

### Participants:

**Akinwumi, Michael** (University of Alberta)  
**Alcock, Jazz** (St Gerard Elementary)  
**Alfano, Dan** (Telus World of Science Edmonton)  
**Brogly, Katherine** (St Gerard Elementary)  
**Campbell, Cathy** (Bessie Nichols School, Edmonton Public Schools)  
**Froese, Heidi** (Allendale School)  
**Gagnon, Lynn** (St Martha School)  
**Graves, Sean** (University of Alberta)  
**Hoffman, Janice** (Edmonton Public Schools)  
**Hohn, Tiina** (MacEwan University)  
**Ikari, Cindy** (Rutland Middle School)  
**Isaac, Vince** (St Teresa)  
**Jones, Carolyn** (Dr. Donald Massey School)  
**Korah, Lyn** (Edmonton Public Schools)

**Kotyk, Nicole** (Evergreen Elementary School)  
**Kristiansen, Joel** (St Gerard School)  
**Lewis, Ted** (SNAP Mathematics Foundation)  
**Marion, Sam** (TELUS World of Science - Edmonton)  
**McLellan, Brandy** (Calgary Catholic School District)  
**Morin, Matthew** (Keyano College)  
**Morrill, Ryan** (University of Alberta)  
**Myers, Lisa** (Calgary Catholic School Board)  
**Nastos, James** (University of British Columbia Okanagan)  
**Naturkach, Christine** (St Gerard Elementary)  
**Pasanen, Trevor** (University of Alberta)  
**Sartorelli, Toni** (Johnny Bright School)  
**Truong, Richard** (Edmonton Public Schools)

# Algebraic Design Theory with Hadamard Matrices: Applications, Current Trends and Future Directions July 11-13, 2014

## Organizers:

**Robert Craigen** (University of Manitoba)  
**Dane Flannery** (National University of Ireland, Galway)

**Hadi Kharaghani** (University of Lethbridge)

This workshop brought together internationally renowned mathematicians to discuss recent advances, challenges, and possible future strategies in algebraic design theory, with a special focus on Hadamard matrices and their generalizations. The subject of intense research interest due to their optimal nature and innate mathematical beauty, these matrices have applications in quantum information theory, coding theory and other areas related to communications. Participants developed effective methods of attack on a range of outstanding problems; this includes a famous unresolved conjecture first stated more than a century ago.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/2-day-workshops/14w2199>

## Participants:

**Alvarez, Victor** (Universidad de Sevilla)  
**Andrés Armario, José** (Universidad de Sevilla)  
**Best, Darcy** (Monash University)  
**Colbourn, Charles** (Arizona State University)  
**Craigen, Robert** (University of Manitoba)  
**Crnković, Dean** (University of Rijeka)  
**Egan, Ronan** (National University of Ireland)  
**Erickson, Jacob** (Wright State University)  
**Flannery, Dane** (National University of Ireland, Galway)  
**Frau, Maria** (Universidad de Sevilla)  
**Fujiwara, Yuichiro** (California Institute of Technology)  
**Holzmann, Wolfgang** (University of Lethbridge)  
**Jedwab, Jonathan** (Simon Fraser University)  
**Kharaghani, Hadi** (University of Lethbridge)  
**Lam, Clement** (Concordia University)  
**Martin, William** (Worcester Polytechnic Institute)  
**Matolcsi, Mate** (Rényi Institute)

**Munemasa, Akihiro** (Tohoku University)  
**Ó Catháin, Pádraig** (The University of Queensland)  
**Olmez, Oktay** (Ankara University)  
**Orrick, William** (Indiana University)  
**Ramp, Hugh** (University of Alberta)  
**Rao, Asha** (RMIT University)  
**Schmidt, Bernhard** (Nanyang Technological University)  
**Suda, Sho** (Aichi University of Education)  
**Szöllősi, Ferenc** (Tohoku University)  
**Taghikhani, Rahim** (University of Manitoba)  
**Tan, Ming Ming** (Nanyang Technological University)  
**Tayfeh-Rezaie, Behruz** (Institute for Research in Fundamental Sciences)  
**Tonchev, Vladimir** (Michigan Technological University)  
**Xiang, Qing** (University of Delaware)  
**Zyckowski, Karol** (Jagiellonian University)



# Recent Advances in Survey Sampling Techniques

## July 25-27, 2014

### Organizers:

**Keumhee Carriere** (University of Alberta)

It is well known that surveys provide a means of measuring a population's characteristics. Repeating surveys at regular intervals can assist in the measurement of changes over time. Through surveys, we obtain invaluable data on self-reported and observed behaviour, awareness of programs, attitudes or opinions, and needs, to name just a few. This information is invaluable in planning and evaluating government policies and programs. Unlike a population census, where all members of a population are studied, sample surveys gather information from only a fraction of a population of interest. For the survey to be valid, the sample has to be objectively chosen so that each member of the population will have an equal chance of selection. Otherwise, the results may not be reliably projected from the sample to the population. Suitable choice of a sample size, the manner of how the samples are chosen, the method of estimation and its inference are all important to deliberate carefully so that investigators can aid in planning and evaluating government policies and various programs effectively and unbiasedly. This workshop showcased important advances in survey method and small area estimation techniques developed in the last three decades and highlighted major challenges for the future for further development.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/2-day-workshops/14w2202>

### Participants:

**Carriere, Keumhee** (University of Alberta)  
**Cribben, Ivor** (Alberta School of Business)  
**Datta, Gauri** (University of Georgia)  
**Deng, Bo** (University of Alberta)  
**Fuller, Wayne** (Iowa State University)  
**Gombay, Edit** (University of Alberta)  
**Heo, Giseon** (University of Alberta)  
**Hooper, Peter** (University of Alberta)  
**Hu, Rui** (University of Alberta)  
**Karunamuni, Rohan** (University of Alberta)  
**Kim, Jae-Kwang** (Iowa State University)  
**Kong, Linglong** (University of Alberta)  
**Lahiri, Partha** (Maryland Population Research Center)  
**Lele, Subhash** (University of Alberta)  
**Li, Yin** (University of Alberta)

**Liu, Box** (University of Alberta)  
**Mizera, Ivan** (University of Alberta)  
**Mohammadi, Farhood** (University of Alberta)  
**Petrov, Pavel** (University of Alberta)  
**Pianzola, Arturo** (University of Alberta)  
**Prasad, NGN** (University of Alberta)  
**Rao, J. N. K.** (Carleton University)  
**Rosychuk, Rhonda** (University of Alberta)  
**Sinha, Sanjoy** (Carleton University)  
**Torabi, Mahmoud** (University of Manitoba)  
**Wiens, Doug** (University of Alberta)  
**Wong, Weng Kee** (University of California, Los Angeles)

# The Fourth International Workshop on the Perspectives on High-dimensional Data Analysis

## August 8-10, 2014

### Organizers:

**Ejaz Ahmed** (Brock University)  
**Timothy D. Johnson** (University of Michigan)

**Xuewen Lu** (University of Calgary)  
**Andrei Volodin** (University of Regina)



The goals of this workshop were to improve the understanding of high dimensional modeling and to bridge the gap among statisticians, computer scientists and mathematicians in understanding each other's tools. Objectives included: (1) highlight and expand the breadth of existing methods in high-dimensional data analysis and their potential for the advance of both mathematical and statistical sciences; (2) identify important directions for future research in the theory of regularization methods, algorithmic development, and methodology for different application areas; (3) facilitate collaboration between theoretical and subject-area researchers and (4) provide opportunities for highly qualified personnel to interact with leading international researchers.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/2-day-workshops/14w2178>

### Participants:

**Adraghi, Kofi** (University of Maryland Baltimore County)  
**Ahmed, Ejaz** (Brock University)  
**Amezziane, Mohamed** (Central Michigan University)  
**Daniels, Michael J.** (University of Texas, Austin)  
**Diao, Guoqing** (George Mason University)  
**Feng, Yang** (Columbia University)  
**Hossain, Shakhawat** (University of Winnipeg)  
**Johnson, Timothy D.** (University of Michigan)  
**Kafadar, Karen** (Indiana University)  
**Khalili, Abbas** (McGill University)  
**Li, James** (VisuMap Technologies Inc)  
**Lu, Xuewen** (University of Calgary)  
**Ma, Shuangge** (Yale University)  
**Michailidis, George** (University of Michigan)  
**Muñoz, Maria Pilar** (Universitat Politècnica de Catalunya)

**Nan, Bin** (University of Michigan)  
**Nathoo, Farouk** (University of Victoria)  
**Raheem, Enayetur** (University of Northern Colorado)  
**Ramirez-Ramirez, Lilia Leticia** (Mexico Autonomous Institute of Technology)  
**Shojaie, Ali** (University of Washington)  
**Singh, Radhey S** (University of Waterloo)  
**Song, Peter** (University of Michigan)  
**Stephens, David A.** (McGill University)  
**Taddy, Matt** (University of Chicago Booth School of Business)  
**Verducci, Joseph S.** (Ohio State University)  
**Vidyashankar, Anand** (George Mason University)  
**Volodin, Andrei** (University of Regina)  
**Xin, Jack** (University of California, Irvine)  
**Yi, Grace** (University of Waterloo)



# Canadian Abstract Harmonic Analysis Symposium

## August 29-31, 2014

### Organizers:

**Anthony Lau** (University of Alberta)

**Volker Runde** (University of Alberta)

Abstract harmonic analysis has evolved out of classical Fourier analysis; it deals with locally compact groups, their representations and the Banach algebras associated with them. Abstract harmonic analysis has had a strong presence in Canada's mathematical community for several decades. Since 1997, the Canadian Abstract Harmonic Analysis Symposium has been successful in bringing together researchers, from Canada and abroad, in abstract harmonic analysis and related areas, such as Banach algebras, operator algebras, and operator spaces. This meeting will continue this tradition and provide a forum for researchers in the area – many of whom are at the junior level – for fruitful interaction.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/2-day-workshops/14w2200>

### Participants:

**Alaghmandan, Mahmood** (Fields Institute)  
**ALDabbas, Eman** (University of Alberta)  
**Bandyopadhyay, Choiti** (University of Alberta)  
**Elgun, Elcim** (Lakehead University)  
**Forrest, Brian** (University of Waterloo)  
**Ghandehari, Mahya** (Fields Institute)  
**Huang, Qianhong** (University of Alberta)  
**Iverson, Joseph** (University of Oregon)  
**Lau, Anthony** (University of Alberta)  
**Loliencar, Prachi** (University of Alberta)  
**Mazowita, Matthew** (Fields Institute)  
**Neufang, Matthias** (Carleton University)  
**Runde, Volker** (University of Alberta)

**Salame, Khadime** (University of Alberta)  
**Schlitt, Kyle** (University of Alberta)  
**Shepelska, Varvara** (University of Manitoba)  
**Spronk, Nico** (University of Waterloo)  
**Stokke, Ross** (University of Winnipeg)  
**Tahmasebi, Nazanin** (University of Alberta)  
**Tanko, Zsolt** (University of Alberta)  
**Wang, Ya Shu** (National Chung Hsing University)  
**Wiersma, Matthew** (University of Waterloo)  
**Yasin, Omar** (University of Alberta)  
**Zadeh, Safoura** (University of Manitoba)  
**Zhang, Yong** (University of Manitoba)

# Connecting Women in Mathematics Across Canada

## October 3-5, 2014

### Organizers:

**Galia Dafni** (Concordia University)

**Sara Faridi** (Dalhousie University)

**Shannon Fitzpatrick** (University of Prince Edward Island)

**Megumi Harada** (McMaster University)

**Malabika Pramanik** (University of British Columbia)

The Canadian Mathematical Society's Women in Math Committee aims to "monitor the status of women within the Canadian Mathematical community and the CMS, recommend actions to the Board which will assure equitable treatment of women, and encourage the participation of women at all levels of mathematics." We try to achieve these goals by organizing short events during the biannual meetings of the Canadian Mathematical Society. The many topics of discussion that arise during these meetings have made us realize that in-depth analysis of issues are needed in order to offer proper guidance to young mathematicians entering the profession. The BIRS workshop intended to serve as a career starter retreat for young female mathematicians. It sought to strengthen networks and mentor graduate students and postdocs entering the job market, as well as to start a conversation that will continue in the following years. Another aim is to make these meetings a reliable forum that concentrates on issues arising for women pursuing academic careers and one that young mathematicians can use to build support networks that can last through their careers.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/2-day-workshops/14w2196>

### Participants:

**Chow, Amenda** (University of Waterloo)

**DeDieu, Lauren** (McMaster University)

**Erey, Aysel** (Dalhousie University)

**Erey, Nursel** (Dalhousie University)

**Faridi, Sara** (Dalhousie University)

**Fitzpatrick, Shannon** (University of Prince Edward Island)

**Ghazzali, Nadia** (Université du Québec à Trois-Rivières)

**Huntemann, Svenja** (Dalhousie University)

**Hyndman, Jennifer** (University of Northern British Columbia)

**Junkins, Caroline** (University of Western Ontario)

**Karimianpour, Camelia** (University of Ottawa)

**Kasirzadeh, Atoosa** (École Polytechnique de Montreal)

**Kuske, Rachel** (University of British Columbia)

**Matthews, Asia R** (Queen's University)

**Mynhardt, Kieka** (University of Victoria)

**Pramanik, Malabika** (University of British Columbia)

**Puskás, Anna** (University of Alberta)

**Tahmasebi, Nazanin** (University of Alberta)

**Teshima, Laura** (University of Victoria)

**Varughese, Marie Betsy** (University of Alberta)

**Wang, Shuxin** (University of Alberta)

**Wodlinger, Jane** (University of Victoria)

**Yang, Jihyeon Jessie** (McMaster University)

**Zadeh, Safoura** (University of Manitoba)

**Zhang, Jing** (Concordia University)



# 53rd Cascade Topology Seminar

## November 7-9, 2014

### Organizers:

**Kristine Bauer** (University of Calgary)

Topology is the field associated with the study of shapes and surfaces which are flexible, and not subject to the rigid analysis of geometry. In recent years, topology has been used to analyze large data sets, which are ever-present in the age of technology. Topology has also been used to reinvent type theory, which is being used to try to develop a way that a computer could “check” a mathematical proof. This, plus the relationship of type theory to the foundations of mathematics, has the potential to revolutionize mathematics as we know it. Because of these and other advances in knowledge, it is very important for researchers in topology to reach across the boundaries of their particular sub-disciplines. The goal of the Cascade Topology Seminar was to promote discourse between topologists in different areas, which promotes progress and understanding in mathematical research.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/2-day-workshops/14w2209>

### Participants:

**Bauer, Kristine** (University of Calgary)  
**Bleiler, Steven** (Portland State University)  
**Budney, Ryan** (University of Victoria)  
**Cockett, Robin** (University of Calgary)  
**Cunningham, Clifton** (University of Calgary)  
**Gerlings, Adam** (University of Calgary)  
**Jardine, Rick** (University of Western Ontario)  
**Kooistra, Remkes** (Kings University)  
**Koytcheff, Robin** (University of Victoria)

**Lesnick, Michael** (University of Minnesota)  
**Luna Pattiarroy, German** (University of Calgary)  
**Morava, Jack** (Johns Hopkins University)  
**Peschke, George** (University of Alberta)  
**Rolfsen, Dale** (University of British Columbia)  
**Rueping, Henrik** (University of British Columbia)  
**Stanley, Don** (University of Regina)  
**Tran, TriThang** (University of Oregon)  
**Zvengrowski, Peter** (University of Calgary)

# **Banff International Research Station**

**2014**

**Summer Schools  
Research in Teams  
Focussed Research Groups**





# Summer Schools

## 2014 Summer IMO Training Camp June 22 - July 5, 2014

### Organizers:

Robert Morewood (YWorld.com)

Bill Sands (University of Calgary)



The International Mathematical Olympiad (IMO) is the “world championship” of high school math contests. It is held every year somewhere in the world, with Canada and up to 100 other countries each sending up to six high school students to compete. The contest lasts two days, and on each day the students are given three very tough math problems to solve within 4 1/2 hours. The IMO Training Camp is an intensive two-week preparation for the six Canadian students attending the upcoming International Mathematical Olympiad, plus several adult trainers. Once again this year, the camp took place at BIRS. Here, our six-student team received intensive training in the form of practice contests and lectures.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/summer-schools/14ss172>

### Participants:

**Arthur, David** (Google)

**Brennan, Matthew** (Massachusetts Institute of Technology)

**Cavers, Mike** (University of Calgary)

**Chow, Michael** (IMO)

**Du, Richard** (IMO)

**Furmaniak, Ralph** (Stanford University)

**Ji, Caleb** (IMO)

**Molina, Antonio** (IMO)

**Morewood, Robert** (YWorld.com)

**Pronk, Dorette** (Dalhousie University)

**Song, Zhuo Qun (Alex)** (IMO)

**Sun, Nicholas** (IMO)

**Sun, Kevin** (Kennedy Jr. High)

**Whatley, Alexander** (IMO)

**Zhou, Yang Rui** (IMO)



# Research in Teams

## Operator Limits of Random Matrices March 2-9, 2014

### Organizers:

**Benedek Valko** (University of Wisconsin - Madison)      **Balint Virag** (University of Toronto)

The emergence of random matrix theory in the 1950s was motivated by nuclear physics, the goal was to model the eigenvalues of large complicated operators. This initiated the study of large random hermitian or symmetric matrices. The study of the asymptotic behavior of the spectrum of such matrices has received another boost in the 1970s when it was discovered (by a chance encounter by Dyson and Montgomery) that the critical zeros of the Riemann zeta-function behave similarly to the point process limit of the eigenvalues of a large Gaussian hermitian matrix. A conjecture attributed to Hilbert and Polya states that the Riemann hypothesis is true because the imaginary parts of the critical zeros of the zeta-function correspond to the spectrum of a certain unbounded self-adjoint operator. In view of the Dyson-Montgomery connection between the critical zeros of the zeta-function and random matrices it is natural to ask if one can find an unbounded self-adjoint operator whose spectrum is exactly the point process limit of large random matrices. The goal of this research team was to complete a long-standing project related to this and related questions and to provide a better understanding of the limiting objects arising from various random matrix models.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/research-in-teams/14rit187>

## On a System of Hyperbolic Balance Laws Arising from Chemotaxis March 30 - April 6, 2014

### Organizers:

**Dong Li** (University of British Columbia)

This workshop investigates several open problems in the mathematical analysis of a system of hyperbolic balance laws derived from biology.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/research-in-teams/14rit198>

### Participants:

**Li, Dong** (University of British Columbia)  
**Zhao, Kun** (Tulane University)



# Subfactors, Twisted Equivariant K-theory and Conformal Field Theory

## April 6-13, 2014

### Organizers:

**David Evans** (Cardiff University)

**Gannon Terry** (University of Alberta)

Conformal field theory can be analysed from a number of mathematical viewpoints namely nets of subfactors, vertex operator algebras and twisted equivariant K-theory. It is a challenge to find subfactors, vertex operator algebras which are truly beyond those provided by finite groups and the loop groups of compact Lie groups. This team studied the modular tensor category of the double of the Haagerup subfactor or systems through twisted equivariant K-theory with the aim of deciding whether this can be achieved by combining the double of the symmetric or dihedral group  $S_3$  and the loop group of  $SO(13)$  - having already shown that the modular data can be built up from these components. There are natural problems associated to generalisations to quadratic systems of near groups (which encompass the Haagerup as well as the Asaeda-Haagerup subfactor, recently shown by Grossman to be related to a near group system), which potentially generate infinite families of subfactors and conformal field theories.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/research-in-teams/14rit179>

# Effective Field Theory Outside the Horizon

## April 27 - May 4, 2014

### Organizers:

**Cliff Burgess** (Perimeter Institute)

**Gianmassimo Tasinato** (Institute for Cosmology and Gravitation)

**Richard Holman** (Carnegie Mellon University) **Matthew Williams** (McMaster University)

Nature comes to us with a variety of scales, ranging from elementary particles up through atoms and molecules and on to the planets, stars, galaxies and the observable universe as a whole. It is a basic fact of Nature that we need not try to understand everything at once, since each of these scales can be understood largely on their own terms. For instance, it wasn't necessary to understand nuclei in detail to understand atoms, or to understand atoms to learn the laws of motion of macroscopic objects. It is largely because of this that science progresses at all. The mathematics we use to describe Nature, Quantum field theory, has a similar property in that it shows why very small (or very energetic) objects are largely irrelevant for describing the properties of much larger (or lower energy) things. This property is called 'decoupling', and is exploited by a mathematical technique called 'effective field theory' to simplify the description of complicated systems having many scales. It is not known how to apply this technique to a class of systems of great interest, such as to the properties of physical processes taking place over the largest distances in the universe; processes are relevant to cosmology (the science of the universe as a whole). This team aimed to develop these tools and apply them to some of the unsolved problems of current cosmological interest.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/research-in-teams/14rit184>

# Alexandrov Geometry

## May 4-11, 2014

### Organizers:

**Stephanie Alexander** (University of Illinois at Urbana-Champaign)    **Vitali Kapovitch** (University of Toronto)  
**Anton Petrunin** (Pennsylvania State University)

Alexandrov geometry has had noteworthy recent success stories. It was used in the solution of the famous Poincaré conjecture by Grigoriy Perelman (who in 2010 refused the associated million-dollar prize). In 2008, in work by Burago, Ferleger, and Kononenko, Alexandrov geometry solved a long-standing and celebrated open problem on collisions of gas molecules.

The team visited BIRS in 2010. The working conditions were perfect and it was extremely helpful. This session provided an intense in-person focus period such as BIRS provided in 2010, to work on their research project, a book entitled "Alexandrov Geometry". This is an ambitious project that has already taken a huge effort. The book will contain a lot of new material. In addition, almost every theorem will appear in an improved form and in the correct generality.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/research-in-teams/14rit188>

# Dirichlet Spaces and de Branges-Rovnyak Spaces

## June 15-22, 2014

### Organizers:

**Thomas Ransford** (Université Laval)

This project brought together two of the cornerstones of mathematical analysis: complex analysis (calculus with complex numbers) and functional analysis (the analysis of infinite-dimensional spaces). Each of these contributes to the understanding of the other, and together they lead to numerous applications in science and engineering. There are many examples of infinite-dimensional spaces of functions, among them two very interesting families that have recently come to the fore, Dirichlet spaces and de Branges--Rovnyak spaces. The purpose of this project is to solve three specific problems concerning these families and the relationship between them. The ultimate aim is to improve our understanding of these spaces and to develop new techniques to analyze them.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/research-in-teams/14rit183>

### Participants:

**EI-Fallah, Omar** (Université Mohammed V - Agdal - Rabat)  
**Kellay, Karim** (Université de Bordeaux)  
**Mashreghi, Javad** (Université Laval)  
**Ransford, Thomas** (Université Laval)

# **Spectrum Asymptotics of Operator Pencils**

## **July 20-27, 2014**

### **Organizers:**

**Birgit Jacob** (University of Wuppertal)

**Kirsten Morris** (University of Waterloo)

This team has been working on this problem for a few years and have made some significant progress. However, the large distance from their respective universities and their other duties have made it difficult to obtain a length of uninterrupted time to work on the remaining, difficult, problems. Two weeks of uninterrupted, concentrated time at Banff enabled the team to make significant progress.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/research-in-teams/14rit182>

# **Statistical Predictions for Chain Ladder Data**

## **August 24-31, 2014**

### **Organizers:**

**Ivan Mizera** (University of Alberta)

The project concerns the analysis of so-called “chain ladder” data, the triangular form of the data arising in predicting the reserves that insurance companies are required to keep to comply with regulatory statutes. While several methods, even implementations in the statistical software environment R, already exist, we were able to propose a new approach that experimentally outperforms all of those. As there turned out to be similarities to the method developed for classification with censored data by Delaigle and Hall (2013), the paper that contains also a good deal of theory, we believe that we will be able to develop some more rigorous underpinning of our methodology - the first topic was worked on at BIRS. While all such problematic might be per se rather of interest of specialized actuarial literature (where practical experience is often valued over theoretical justification), an important aspect is that in our research on the triangular data, we found that almost isomorphic problems arise in the biometric theory of the so-called growth curves in Biology. Strengthening this tie, and at the same time understanding the similarities and differences is another objective of our investigation at BIRS.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/research-in-teams/14rit206>

### **Participants:**

**Maciak, Matúš** (Czech University of Life Sciences)

**Mizera, Ivan** (University of Alberta)

**Pešta, Michal** (Charles University in Prague)



# Focussed Research Groups

## Hyperplane Arrangements, Wonderful Compactifications, and Tropicalization

April 20-27, 2014

### Organizers:

**Graham Denham** (University of Western Ontario)  
**June Huh** (University of Michigan)

**Alexander Suci** (Northeastern University)



The participants of this focussed research group came from several mathematical subdisciplines. Their work and common interest was to investigate new interactions of combinatorics (discrete structures) with comparatively well-developed subjects such as algebraic geometry and topology. Some of the participants had collaborated before in smaller groups, and this meeting provided the opportunity to work together more intensively. Two of the participants recently solved a long-standing open problem in the theory of graphs and matroids. This breakthrough used a combination of new and surprising techniques which are expected to have many additional interesting applications.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/focussed-research-groups/14frg193>

### Participants:

**Denham, Graham** (University of Western Ontario)  
**Falk, Michael** (Northern Arizona University)  
**Feichtner, Eva-Maria** (University Bremen)  
**Fink, Alex** (Queen Mary University of London)

**Huh, June** (University of Michigan)  
**Katz, Eric** (University of Waterloo)  
**Schenck, Hal** (University of Illinois Urbana Champaign)  
**Suci, Alexander** (Northeastern University)

# Borel complexity and classification of operator systems

## August 10-17, 2014

### Organizers:

**Martin Argerami** (University of Regina)  
**Samuel Coskey** (Boise State University)

**Martino Lupini** (York University)  
**Marcin Sabok** (McGill University)



Operator systems have a beautiful and well-developed theory, with several applications to other areas of mathematics, such as to quantum information theory. Nonetheless to this day even 3-dimensional operator systems are commonly considered too complicated to be understood and classified in full generality. The goal of this research group was to shift this paradigm, and obtain a satisfactory classification of arbitrary finite-dimensional operator systems.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/focussed-research-groups/14frg204>

### Participants:

**Argerami, Martin** (University of Regina)  
**Coskey, Samuel** (Boise State University)  
**Kalantar, Mehrdad** (Carleton University)

**Kennedy, Matthew** (Carleton University)  
**Lupini, Martino** (York University)  
**Sabok, Marcin** (McGill University)

# Geometric Aspects of $p$ -adic Automorphic Forms

## October 26 - November 2, 2014

### Organizers:

**Ana Caraiani** (Princeton University)

**Elena Mantovan** (California Institute of Technology)

**Ellen Eischen** (University of North Carolina at Chapel Hill)

Over the past two decades, there has been a spectacular amount of progress in the Langlands program, leading to the resolution of major open questions such as Fermat's Last Theorem, the Sato-Tate conjecture and Serre's conjecture. In addition, there have been recent breakthroughs in the field, such as the work of Harris-Lan-Taylor-Thorne and Scholze associating Galois representations to classes in the cohomology of locally symmetric spaces for  $GL_n$ . All of these developments have depended crucially on being able to  $p$ -adically interpolate automorphic forms. Questions about  $p$ -adic automorphic forms are intertwined with questions about the geometry of Shimura varieties. As there has been a lot of recent progress in the field of  $p$ -adic geometry, we propose to investigate the possible consequences this may have for  $p$ -adic automorphic forms and for the classical and  $p$ -adic Langlands programs.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2014/focussed-research-groups/14frg207>

### Participants:

**Caraiani, Ana** (Princeton University)

**Fintzen, Jessica** (Harvard University)

**Eischen, Ellen** (University of North Carolina at Chapel Hill)

**Mantovan, Elena** (California Institute of Technology)

**Varma, Ila** (Princeton University)







*Photo credit: Brooke Hoyer, Flickr*

The **Banff International Research Station** for Mathematical Innovation and Discovery (BIRS) is a collaborative Canada-US-Mexico venture that provides an environment for creative interaction as well as the exchange of ideas, knowledge, and methods within the Mathematical Sciences, with related disciplines and with industry. The research station is located at The Banff Centre in Alberta and is supported by Canada's Natural Science and Engineering Research Council (NSERC), the US National Science Foundation (NSF), Alberta's Advanced Education and Technology, and Mexico's Consejo Nacional de Ciencia y Tecnología (CONACYT).

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Email: [birs-administrator@birs.ca](mailto:birs-administrator@birs.ca)

**Program Coordinator:** Chee Chow  
Phone: 604-822-1694 Fax: 604-822-0883  
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