



**Banff International Research Station  
for Mathematical Research and Discovery**

**2011 Scientific Report**



**NSERC  
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## 5-Day Workshops 2011

Jan 9	Jan 14	Combinatorial Game Theory
Jan 16	Jan 21	Sparse Statistics, Optimization and Machine Learning
Jan 23	Jan 28	Density Functional Theory: Fundamentals and Applications in Condensed Matter Physics
Jan 30	Feb 5	Linear Algebraic Techniques in Combinatorics/Graph Theory
Jan 6	Feb 11	Ergodic Optimization
Feb 6	Feb 11	Topological Insulators and Superconductors
Feb 13	Feb 18	Advancing Numerical Methods for Viscosity Solutions and Applications
Feb 20	Feb 25	Frontiers in Complex Dynamics (Celebrating John Milnor's 80th birthday)
Feb 27	Mar 4	Modelling and Analysis of Options for Controlling Persistent Infectious Diseases
Mar 6	Mar 11	Sparse and Low Rank Approximation
Mar 13	Mar 18	Global/Local Conjectures in Representation Theory of Finite Groups
Mar 13	Mar 18	Functor Calculus and Operads
Mar 20	Mar 25	Interactions Between Contact Symplectic Topology and Gauge Theory in Dimensions 3 & 4
Mar 27	Apr 1	Stochastic Multiscale Methods: Bridging the Gap Between Mathematical Analysis and Scientific and Engineering Applications
Apr 3	Apr 8	Quantum Control
Apr 10	Apr 15	Imaging, Interpretation and Modeling in Modern Immunology
Apr 17	Apr 22	Geometric Flows in Mathematics and Physics
Apr 24	Apr 29	Algebraic Graph Theory
May 1	May 6	Organized Tropical Convection and Large-Scale Circulation: Theory, Modeling, and Observations
May 8	May 13	Number Theory and Physics at the Crossroads
May 15	May 20	Harmonic Analysis in Convex Geometry
May 22	May 27	Algebraic Combinatorixx
May 29	Jun 3	Gradient Random Fields
Jun 5	Jun 10	KAM Theory and Geometric Integration
Jun 12	Jun 17	Triangulated Categories and Applications
Jun 19	Jun 24	Groups, Graphs and Stochastic Processes
Jun 26	Jul 1	L-Packets
Jul 3	Jul 8	Emerging Challenges at the Interface of Mathematics, Environmental Science and Spatial Eco
Jul 17	Jul 22	Geometric Properties of Solutions of Nonlinear PDEs and their Applications
Jul 24	Jul 29	Localized Multi-Dimensional Patterns in Dissipative Systems: Theory, Modeling, and Experiments
Jul 31	Aug 5	Mathematical Biology of the Cell: Cytoskeleton and Motility
Aug 7	Aug 12	Twenty-five Years of Representation Theory of Quantum Groups
Aug 14	Aug 19	Algebraic Structure in Network Information Theory
Aug 21	Aug 26	Crossing Numbers Turn Useful
Aug 21	Aug 26	Self Adjoint Extensions and Singularity Resolution in String Theory and Quantum Gravity
Aug 28	Sep 2	Geometry for Anatomy
Sep 4	Sep 9	Cluster Algebras, Representation Theory, and Poisson geometry
Sep 11	Sep 16	Stochasticity in Biochemical Reaction Networks
Sep 18	Sep 23	Foundations of Stochastic Analysis
Sep 25	Sep 30	Almost Periodic Order: Spectral, Dynamical, and Stochastic Approaches
Oct 2	Oct 7	Proof Complexity
Oct 9	Oct 14	High Dimensional Probability
Oct 16	Oct 21	New Recursion Formulae and Integrability for Calabi-Yau Spaces
Oct 23	Oct 28	Information Theory and Statistics for Large Alphabets
Oct 30	Nov 4	Cycles on Modular Varieties
Nov 6	Nov 11	WIN2: Women in Numbers 2
Nov 13	Nov 18	Diophantine Methods, Lattices, and Arithmetic Theory of Quadratic Forms
Nov 20	Nov 25	Black Holes: New Horizons
Nov 27	Dec 2	Approximation Algorithms and the Hardness of Approximation
Dec 4	Dec 9	Mathematics: Muse, Maker, and Measure of the Arts
Dec 4	Dec 9	Hodge Theory and String Duality
Dec 11	Dec 16	Current Challenges in Statistical Learning

## 2-Day Workshops 2011

Mar 11	Mar 13	High-performance Numerical Methods Supporting Radiation Therapy Treatment Planning
Apr 15	Apr 17	Ted Lewis Workshop on SNAP Math Fairs 2011
May 27	May 29	Data Analytics Research Workshop
Jun 17	Jun 19	Alberta Number Theory Days
Jun 24	Jun 26	Automated Deduction and its Application to Mathematics
Aug 26	Aug 28	CanQueue 2011: 13th Annual Conference for Canadian Queuing Theorists and Practitioners
Sep 2	Sep 4	Modeling and Simulation
Nov 4	Nov 6	Enacting Enactivism: Exploring the Potential for a Theory of Mathematical Cognition to Enhance Classroom Practice
Nov 11	Nov 13	Calculus 11x11x11

## Summer Schools

Jul 3	Jul 15	Summer IMO Training Camp
Jul 10	Jul 15	Advanced Mathematical Methods to Study Atmospheric Dynamical Processes and Predictability

## Research In Teams

Mar 6	Mar 13	Heights on Moduli Space for Post-Critically Finite Dynamical Systems
May 1	May 8	Vector-Valued Modular Forms and Cohomology
May 29	Jun 5	Problems in Pluripotential Theory
Jun 19	Jun 26	The $SU(3)$ Casson Invariant for Spliced Sums
Jun 26	Jul 3	Universal Higher Extensions
Jul 17	Jul 24	Approximation Theory and Harmonic Analysis on Spheres and Related Domains
Sep 4	Sep 11	Probabilistic and Statistical Properties of Stochastic Volatility Models
Sep 18	Sep 25	Canonical Forms of Two-Person Zero-Sum Limit Average Payoff Stochastic Games

## Focused Research Groups

May 15	May 22	Eventually Nonnegative Matrices and their Sign Patterns
Jun 5	Jun 12	Quantum Information for Quantum Chemistry
Jun 12	Jun 19	Mixed Boundary Value Problems in Nonsmooth Domains
Jul 31	Aug 7	Extending Properties of Tournaments to $k$ -Traceable Oriented Graphs
Oct 23	Oct 30	New methods for Analysing Metastable Structures in Closed, Open or Non-Autonomous Dynamical Systems

# **Banff International Research Station**

**2011**

**5-Day Workshops**



# Combinatorial Game Theory

## January 9-14, 2011

### Organizers:

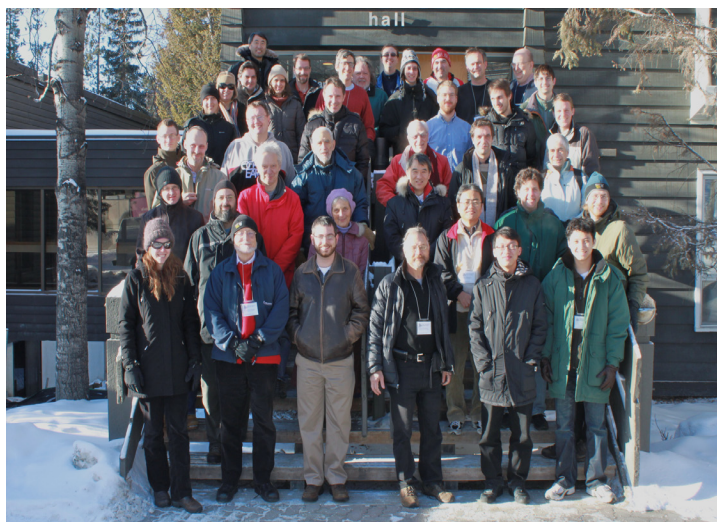
**Tristan Cazenave** (Paris-Dauphine University)

**Aviezri Fraenkel** (Weizmann Institute)

**Martin Mueller** (University of Alberta)

**Richard Nowakowski** (Dalhousie University)

**Elwyn Berlekamp** (University of California, Berkeley)



A “Games of No Chance” workshop was a welcome opportunity to host special sessions on temperature theory, misere-play games, and complexity of impartial games. There have been recent strides forward in all three areas of the subject, many directly attributable to collaborations started in previous “Games of No Chance” workshops at MSRI and BIRS, and this workshop proved a valuable chance to continue progress in these fields.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5073>

### Participants:

**Berlekamp, Elwyn** (University of California, Berkeley)

**Burke, Kyle** (Wittenberg University)

**Carvalho, Alda** (CEMAPRE/ISEG, Technical University of Lisbon)

**Cazenave, Tristan** (Paris-Dauphine University)

**Demaine, Erik** (Massachusetts Institute of Technology)

**Demaine, Martin** (Massachusetts Institute of Technology)

**Dias, Catia** (ISEL)

**Dorbec, Paul** (Universite Bordeaux 1)

**Duchene, Eric** (University Lyon 1)

**Elkies, Noam** (Harvard University)

**Fraenkel, Aviezri** (Weizmann Institute)

**Grossman, J.P.** (D. E. Shaw)

**Guo, Alan** (Duke University)

**Guy, Richard** (University of Calgary)

**Hayward, Ryan** (University of Alberta)

**Hearn, Robert** (Dartmouth College)

**Hegarty, Peter** (Chalmers University, University of Gothenburg)

**Larsson, Urban** (Chalmers & University of Gothenburg)

**McKay, Neil** (Dalhousie University)

**Mehat, Jean** (University of Paris)

**Mueller, Martin** (University of Alberta)

**Nakamura, Teigo** (Kyushu Institute of Technology)

**Nowakowski, Richard** (Dalhousie University)

**Ottaway, Paul** (University of British Columbia)

**Oudalov, Vladimir** (Rutgers University)

**Plambeck, Thane** (Counterwave)

**Santos, Carlos** (FCUL)

**Siegel, Aaron** (Berkeley Quantitative)

**Siegel, Angela** (Dalhousie University)

**Sopena, Eric** (Universite Bordeaux)

**Spight, Bill** (WLS)

**Takizawa, Takenobu** (Waseda University)

**Teytaud, Olivier** (Université Paris-Sud)

**Van Eyck, Gabe** (University of Alberta)

**Vinagre, Sandra** (University of Évora/CIMA)

**Weimerskirch, Mike** (Macalaster College)

**Wolfe, David** (SheepDogInc.ca)

**Xie, Fan** (University of Alberta)

**Zhujiu, Jiang** (Hanguk Kiwon)

# Sparse Statistics, Optimization and Machine Learning

## January 16-21, 2011

### Organizers:

**Francis Bach** (INRIA - Ecole Normale Superieure)  
**Alexandre d'Aspremont** (Princeton University)

**Martin Wainwright** (UC Berkeley)



A small revolution has recently started brewing in statistics and information theory, with a stream of consistency or “truth-discovery” results on sparse model identification and decoding being produced in the last few years, together with efficient large-scale numerical algorithms to identify these models. Many intensely active research topics such as sparse recovery in coding theory, compressed sensing and basis pursuit in signal processing, lasso and covariance selection in statistics, feature selection in machine learning, all revolve around the core idea that seeking sparse models is a meaningful way of simultaneously stabilizing inference procedures, and highlighting structure in the underlying data. These results have immediate applications in signal or image processing among other fields. Some have already yielded spectacular improvements, e.g. a tenfold speedup of MRI scanners or a cheap 1 pixel infrared camera. Sparse models show up everywhere in nature (as power laws) and we can expect the range of such applications to expand considerably. The goal of this workshop was to study the performance and numerical cost of sparse statistical methods in depth.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5012>

### Participants:

**Agarwal, Alekh** (University of California Berkeley)  
**Ahipasaoglu, Selin** (Princeton University)  
**Andersen, Martin** (UCLA)  
**Bach, Francis** (INRIA - Ecole Normale Superieure)  
**Baraniuk, Richard** (Rice University)  
**Becker, Stephen** (California Institute of Technology)  
**Buhlmann, Peter** (ETH Zurich)  
**Caramanis, Constantine** (U. Texas at Austin)  
**Chandrasekaran, Venkat** (MIT)  
**Cuturi, Marco** (Princeton University)  
**d'Aspremont, Alexandre** (Princeton University)  
**Dhillon, Inderjit** (U. Texas at Austin)  
**El Karoui, Noureddine** (University of California Berkeley)  
**Goldfarb, Donald** (Columbia University)  
**Ma, Shiqian** (Columbia University)  
**Mairal, Julien** (University of California Berkeley)  
**Negahban, Sahand** (U.C. Berkeley)  
**Nowak, Robert** (University of Wisconsin-Madison)  
**Obozinski, Guillaume** (INRIA)

**Parrilo, Pablo** (Massachusetts Institute of Technology)  
**Rakhlin, Alexander** (University of Pennsylvania)  
**Ravikumar, Pradeep** (U. Texas at Austin)  
**Recht, Ben** (University of Wisconsin)  
**Rigollet, Philippe** (Princeton University)  
**Rish, Irina** (IBM T.J. Watson)  
**Scheinberg, Katya** (Columbia University)  
**Srebro, Nathan** (Toyota Technological Institute at Chicago)  
**Todd, Michael** (Cornell University)  
**Tropp, Joel** (California Institute of Technology)  
**Tulabandhula, Theja** (MIT)  
**van de Geer, Sara** (Eidgenössische Technische Hochschule Zürich)  
**Vandenberghe, Lieven** (ULCA)  
**Wainwright, Martin** (UC Berkeley)  
**Wegkamp, Marten** (Florida State University)  
**Zhang, Tong** (Rutgers University)  
**Zhang, Cun-Hui** (Rutgers University)



# Density Functional Theory: Fundamentals and Applications in Condensed Matter Physics

## January 23-28, 2011

### Organizers:

**Eric Cancès** (ENPC and INRIA)  
**Carlos Garcia-Cervera** (University of California, Santa Barbara)

**Yan Alexander Wang** (University of British Columbia)



The properties of a material can be understood in terms of the interactions between its constituent atoms. This interaction is described by Quantum Mechanics. However, the equations describing this interaction are too complex. For this reason, Density Functional Theory, developed by Walter Kohn and collaborators, is an attractive alternative. Its impact was so large that Walter Kohn received the Nobel prize for it in 1998. To make this theory a practical computational tool, much needs to be done, and that was the main topic of the workshop, by bringing together a group of applied mathematicians with training in analysis, nonlinear PDEs, and scientific computing, with physicists and chemists with expertise in quantum-mechanical systems and multiscale modeling.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5121>

### Participants:

**Burke, Kieron** (UC Irvine)  
**Cancès, Eric** (ENPC/INRIA)  
**Car, Roberto** (Princeton University)  
**Chen, Jingrun** (University of California, Santa Barbara)  
**Chen, Yakun** (University of British Columbia)  
**Ehrlacher, Virginie** (Ecole des Ponts - ParisTech/INRIA)  
**Ernzerhof, Matthias** (University of Montreal)  
**Esteban, Maria J.** (CNRS/Université de Paris-Dauphine)  
**Friesecke, Gero** (Technische Universität München)  
**Gao, Weiguo** (Fudan University)  
**Garcia-Cervera, Carlos** (University of California, Santa Barbara)  
**Gavini, Vikram** (University of Michigan)  
**Krasny, Robert** (University of Michigan)  
**Lahbabi, Salma** (Université de Cergy)  
**Lewin, Mathieu** (CNRS/University of Cergy Pontoise)  
**Lin, Lin** (Princeton University)  
**Lopata, Kenneth** (Pacific Northwest National Laboratory)

**Lu, Jianfeng** (Courant Institute of Mathematical Sciences)  
**Lu, Gang** (California State University Northridge)  
**Maday, Yvon** (University Paris 6)  
**Meza, Juan** (Lawrence Berkeley National Laboratory)  
**Ortner, Christoph** (University of Warwick/University of Oxford)  
**Pask, John** (Lawrence Livermore National Laboratory)  
**Prodan, Emil V.** (Yeshiva University)  
**Romaniello, Pina** (Ecole Polytechnique)  
**Salahub, Dennis** (University of Calgary)  
**Schneider, Reinhold** (Technische Universität Berlin)  
**Scuseria, Gustavo** (Rice University)  
**Solovej, Jan Phillip** (University of Copenhagen)  
**Staroverov, Viktor** (University of Western Ontario)  
**Wagner, Lucas** (UC Irvine)  
**Wang, Yan** (University of British Columbia)  
**Zhou, Aihui** (University of Chinese Academy of Sciences)

# Linear Algebraic in Combinatorics/Game Theory

## January 30 - February 4, 2011

### Organizers:

**Saieed Akbari** (Sharif University of Technology & Institute for Research in Fundamental Sciences)  
**Richard Brualdi** (University of Wisconsin-Madison)  
**William Haemers** (Tillburg University)

**Hadi Kharaghani** (University of Lethbridge)  
**Behruz Tayfeh-Rezaie** (Institute for Research in Fundamental Sciences - IPM)  
**Qing Xiang** (University of Delaware)



Our main aim in organizing this workshop was to bring together the large and diverse collection of researchers who have made substantial contributions using linear algebra techniques in combinatorics and graph theory, or using combinatorial and graph-theoretic ideas to investigate matrices. There has been considerable cross-fertilization of ideas leading to people learning new problems and new applications of linear algebra techniques, which has led to new and innovative collaborations and breakthroughs. Recent successes in collaborations of this kind encouraged us in the belief that such a meeting would bring new perspectives on old problems and open up many channels of communication for future collaborative research, and for young researchers in particular, it was an excellent opportunity to see the full scope of the subject and the many interesting directions they can explore.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5033>

### Participants:

**Akbari, Saieed** (Sharif University of Technology/ Institute for Research Fundamental Sciences, IPM)  
**Akelbek, Mahmud** (Weber State University)  
**Bang, Sejeong** (Pusan National University)  
**Blokhuis, Aart** (Technical University Eindhoven)  
**Brualdi, Richard** (University of Wisconsin-Madison)  
**Butler, Steve** (UCLA)  
**Colbourn, Charles** (Arizona State University)  
**Craigen, Robert** (University of Manitoba)  
**Da Fonseca, Carlos** (Universidade da Coimbra)  
**De Bruyn, Bart** (Ghent University)  
**Friedland, Shmuel** (University of Illinois at Chicago)  
**Haemers, Willem** (Tilburg University)  
**Holzmann, Wolfgang** (University of Lethbridge)  
**Kharaghani, Hadi** (University of Lethbridge)  
**Khosrovshahi, Gholamreza B.** (Institute for Research in Fundamental Sciences(IPM))  
**Kirkland, Stephen** (National University of Ireland Maynooth)  
**Koolen, Jack** (POSTECH)  
**Krattenthaler, Christian** (University of Vienna)  
**Lamken, Esther** (Independent)  
**Lazebnik, Felix** (University of Delaware)

**Martin, William** (Worcester Polytechnic Institute)  
**Meyer, Seth** (University of Wisconsin-Madison)  
**Mitjana, Margarida** (University of Poly. Catalunya)  
**Mohammadian, Ali** (IPM)  
**Mohar, Bojan** (Simon Fraser University)  
**Nikiforov, Vladimir** (University of Memphis)  
**Rada, Juan** (University of Simon Bolivar)  
**Schroeder, Michael** (University of Wisconsin-Madison)  
**Shader, Bryan** (University of Wyoming)  
**Sheikh Ahmady, Azhvan** (Simon Fraser University)  
**Stinson, Douglas** (University of Waterloo)  
**Tanaka, Hajime** (Tohoku University)  
**Tayfeh-Rezaie, Behruz** (Institute for Research in Fundamental Sciences (IPM))  
**Terwilliger, Paul** (University of Wisconsin)  
**Wang, Wei** (Xi'an Jiaotong University)  
**Wang, Steven** (Carleton University)  
**Wanless, Ian** (Monash University)  
**Wilson, Richard** (California Institute of Technology)  
**Wu, Yaokun** (Shanghai Jiao Tong University)  
**Xiang, Qing** (University of Delaware)  
**Yamada, Mieko** (Kanazawa University)

# Ergodic Optimization

## February 6-11, 2011

### Organizers:

**James Campbell** (University of Memphis)

**Anthony Quas** (University of Victoria)



Physical processes (for example resonances of sound waves in a confined space) often can be supported in a number of different modes. It is frequently desirable to find a mode for which some quantity is minimized or maximized (for example in satellite phone technology one is interested in energy transmission using minimal energy). The study of such modes is known as ergodic optimization. It is frequently found that the optimizing modes have a very simple periodic behaviour (like that of a pendulum). The goal of the workshop was to bring together researchers working on different approaches to this family of problems to narrow the agenda, as well as to promote a fertile and accessible area of ergodic theory to students and post-doctoral fellows.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5039>

### Participants:

**Allahbakhshi, Mahsa** (University of Victoria)  
**Anagnostopoulou, Vasso** (TU Dresden)  
**Campbell, James** (University of Memphis)  
**Contreras, Gonzalo** (CIMAT)  
**González Tokman, Cecilia** (University of Victoria)  
**Iturriaga, Renato** (CIMAT)  
**Jenkinson, Oliver** (Queen Mary University of London)  
**Morris, Ian** (University of Rome Tor Vergata)

**Pavlov, Ronnie** (University of Denver)  
**Pollicott, Mark** (University of Warwick)  
**Quas, Anthony** (University of Victoria)  
**Reeve-Black, Heather** (Queen Mary, University of London)  
**Siefken, Jason** (University of Victoria)  
**Thieullen, Philippe** (Université Bordeaux 1)  
**Vivaldi, Franco** (Queen Mary University of London)

# Topological Insulators and Superconductors

## February 6-11, 2011

### Organizers:

**Marcel Franz** (University of British Columbia)  
**Zahid Hasan** (Princeton University)

**Joel Moore** (University of California - Berkeley)  
**Shoucheng Zhang** (Stanford University)



This workshop brought together top researchers in theoretical and experimental physics, mathematics and quantum information, interested in topological insulators and superconductors. The objectives of the proposed workshop were first of all, to provide a platform for the exchange of ideas and studies of the physical nature of the topological phases of matter recently discovered. The participants addressed the most important theoretical and experimental issues connected with the underlying physical models, real materials, as well as their potential practical applications. The workshop also presented an opportunity for the participants to reflect upon other condensed matter systems where a unique combination of physical insights and ideas from topology, homotopy theory, and other areas of mathematics could lead to discoveries of new forms of quantum matter.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5053>

### Participants:

**Alicea, Jason** (UC Irvine)  
**Beenakker, Carlo** (Leiden University)  
**Chung, Suk-Bum** (Stanford University)  
**Du, Rui-Rui** (Rice University)  
**Fiete, Gregory** (University of Texas at Austin)  
**Franz, Marcel** (University of British Columbia)  
**Haldane, F Duncan M** (Princeton University)  
**Hasan, Zahid** (Princeton University)  
**Kim, Yong-Baek** (University of Toronto)

**Ludwig, Andreas** (UC Santa Barbara)  
**Molenkamp, Laurens** (Wuerzburg University)  
**Moore, Joel** (University of California - Berkeley)  
**Ong, N. Phuan** (Princeton University)  
**Qi, Xiao-Liang** (Stanford University)  
**Refael, Gil** (California Institute of Technology)  
**Weeks, Conan** (University of British Columbia)  
**Xue, Qi-Kun** (Tsinghua University)  
**Zhang, Shoucheng** (Stanford University)

# Advancing Numerical Methods for Viscosity Solutions and Applications February 13-18, 2011

## Organizers:

**Maurizio Falcone** (Universita di Roma - La Sapienza)  
**Roberto Ferretti** (Universita di Roma Tre)

**Ian Mitchell** (University of British Columbia)  
**Hongkai Zhao** (University of University of California, Irvine)



A number of differential models of great importance for applications fall within the theory of Viscosity Solutions, which provide a powerful analytical tool for their analysis. On the other hand, the development of accurate and efficient algorithms for the numerical solution has raised a growing interest in last years, and has proved crucial to transfer the mathematical knowledge to the field of applications, which typically include optimal control, image processing, material science, and front propagation. In this workshop, we gathered experts of Viscosity Solutions, with an emphasis on numerical approximation, but with a significant presence of both mathematical analysis and applications, in order to support an interchange between the various aspects of this challenging field.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5086>

## Participants:

**Akian, Marianne** (INRIA Saclay-Ile-de-France/CMAP)

**Benamou, Jean-David** (INRIA Rocquencourt)

**Cacace, Simone** (Sapienza - Università di Roma)

**Camilli, Fabio** (Sapienza - Università di Roma)

**Carlini, Elisabetta** (Sapienza - Università di Roma)

**Cristiani, Emiliano** (Sapienza - Università di Roma)

**da Silva, Jorge Estrela** (Instituto Superior de Engenharia do Porto)

**Falcone, Maurizio** (Sapienza - Università di Roma)

**Ferretti, Roberto** (Universita di Roma Tre)

**Festa, Adriano** (Sapienza - Università di Roma)

**Forcadel, Nicolas** (CEREMADE Université Paris-Dauphine)

**Giorgi, Tiziana** (New Mexico State University)

**Gomes, Diogo** (Instituto Superior Tecnico)

**Guigue, Alexis** (University of British Columbia)

**Kao, Chiuyen** (Ohio State University)

**Klomp maker, Irene** (TU Berlin)

**Li, Fengyan** (Rensselaer Polytechnic Institute)

**Maurice-Bokanowski, Olivier** (University Paris-Diderot)

**Mecca, Roberto** (Sapienza - Università di Roma)

**Mitchell, Ian** (University of British Columbia)

**Nave, Jean-Christophe** (McGill University)

**Oberman, Adam** (Simon Fraser University)

**Rao, Zhiping** (ENSTA ParisTech)

**Serna, Susana** (Universitat Autònoma de Barcelona)

**Sethian, James** (University of California, Berkeley)

**Smits, Robert** (New Mexico State University)

**Tasso de Figueiredo Borges de Sousa, Joao** (Universidade do Porto - Robotics and Systems Institute)

**Vladimirsky, Alexander** (Cornell University)

**Yu, Yifeng** (University of California Irvine)

**Zhao, Hongkai** (University of California Irvine)

**Zidani, Hasnaa** (ENSTA ParisTech & Inria Saclay)

# Frontiers in Complex Dynamics

## February 20-25, 2011

### Organizers:

**Araceli Bonifant** (University of Rhode Island)

**Mikhail Lyubich** (Stony Brook University)



“Frontiers in Complex Dynamics” brought together leading experts in the field, along with many young researchers from all over the world, to discuss the latest trends and ideas in holomorphic dynamical systems. The field of complex dynamics, founded in the early 20th century by Fatou and Julia, experienced explosive development in the last two decades of the century, followed with deep breakthroughs in several long-standing problems. This workshop sought to set the ground for future developments of the field. Interactions with other fields such as Teichmüller theory, hyperbolic and complex geometry, arithmetic dynamics, statistical physics and numerical analysis were strongly emphasized. The workshop was also held in celebration of John Milnor’s 80th birthday.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5076>

### Participants:

**Bedford, Eric** (Indiana University)  
**Binder, Ilia** (University of Toronto)  
**Bonifant, Araceli** (University of Rhode Island)  
**Buff, Xavier** (Université de Toulouse)  
**Cheritat, Arnaud** (Institut de Mathématiques de Toulouse)  
**de Carvalho, Andre** (Universidade de São Paulo)  
**Devaney, Robert** (Boston University)  
**Dujardin, Romain** (Ecole Polytechnique)  
**Epstein, Adam** (University of Warwick)  
**Flexor, Marguerite** (Université Paris Sud)  
**Goldman, William** (University of Maryland)  
**Grigorchuk, Rostislav** (Texas A&M University)  
**Hubbard, John** (Cornell University)  
**Inou, Hiroyuki** (Kyoto University)  
**Kahn, Jeremy** (University of Stony Brook)  
**Kaloshin, Vadim** (Penn State University)  
**Keen, Linda** (CUNY Lehman College and Graduate Center)  
**Kiwi, Jan** (Pontificia Universidad Católica de Chile)  
**Lei, Tan** (Université d’Angers)  
**Levin, Genadi** (Hebrew University)

**Lyubich, Mikhail** (Stony Brook University)  
**Mayer, John** (University of Alabama at Birmingham)  
**McDuff, Dusa** (Barnard College)  
**McMullen, Curtis** (Harvard University)  
**Milnor, John** (SUNY at Stony Brook University)  
**Nekrashevych, Volodymyr** (Texas A&M University)  
**Perez-Marco, Ricardo** (Université Paris XIII)  
**Petersen, Carsten Lunde** (Roskilde University)  
**Rees, Mary** (University of Liverpool)  
**Roesch, Pascale** (Université Paul Sabatier Toulouse, Institut de Mathématiques de Toulouse)  
**Schleicher, Dierk** (Jacobs University Bremen)  
**Shishikura, Mitsuhiro** (Kyoto University)  
**Sibony, Nessim** (Université Paris-Sud-Bat 425)  
**Smillie, John** (Cornell University)  
**Smirnov, Stanislav** (University of Geneva)  
**Sullivan, Dennis** (CUNY, Stony Brook University)  
**Sutherland, Scott** (Stony Brook University)  
**Timorin, Vladlen** (Higher School of Economics)  
**Van Strien, Sebastian** (University of Warwick)  
**Verjovsky, Alberto** (UNAM Mexico)  
**Yampolsky, Michael** (University of Toronto)

# Modelling and Analysis of Options for Controlling Persistent Infectious Disease February 27 - March 4, 2011

## Organizers:

**Jonathan Dushoff** (McMaster University)  
**David Earn** (McMaster University)

**David Fisman** (University of Toronto)



Much attention today is directed to the scourges of newly emerging pathogens, and methods for their control. There remain, however, a resilient set of agents that have managed to cause high levels of mortality and morbidity in human populations for centuries. The only such “endemic” pathogen to have been eliminated by human efforts is smallpox, and the eradication of smallpox was a major achievement of the 20th century. For this workshop, we gathered a group of mathematicians and public health researchers to discuss and share ideas about a variety of endemic diseases (such as polio, measles, influenza, malaria, HIV, and West Nile Virus), with the aim of developing improved control strategies for these extremely important infections.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5133>

## Participants:

**Blumberg, Seth** (NIH Fogarty, UCLA)  
**Bolker, Ben** (McMaster University)  
**Boni, Maciej** (Oxford University)  
**Brown, Kevin** (University of Toronto)  
**Chan, Christina** (University of Toronto)  
**Day, Troy** (Queens University)  
**Dushoff, Jonathan** (McMaster University)  
**Earn, David** (McMaster University)  
**Eichner, Martin** (University of Tübingen)  
**Eisenberg, Marisa** (Ohio State University)  
**Feng, Zhilan** (Purdue University)  
**Fisman, David** (University of Toronto)  
**Funk, Sebastian** (Zoological Society of London)  
**Glasser, John** (US Centers for Disease Control and Prevention)  
**Greer, Amy** (Public Health Agency of Canada)  
**He, DaiHai** (McMaster University)  
**Hempel, Karsten** (McMaster University)  
**Hill, Andrew** (Self)  
**Huppert, Amit** (Gertner Institute for Epidemiology, Health Policy Research Sheba Medical Center)  
**Hurford, Amy** (York University/University of Toronto)  
**Ke, Ruian** (University of California, Los Angeles)  
**Keegan, Lindsay** (McMaster University)  
**Krylova, Olga** (McMaster University)  
**Lindquist, Jennifer** (University of Victoria)  
**Loeb, Mark** (McMaster University)  
**Ma, Junling** (University of Victoria)  
**Mishra, Sharmistha** (Imperial College)  
**Moghadas, Seyed** (Centre for Disease Modelling)  
**Ng, Vicky** (Centre for Public Health and Zoonoses)  
**Patocs, Audrey** (McMaster University)  
**Price, David** (Debategraph)  
**Sander, Beate** (Ontario Agency for Health Protection and Promotion)  
**Tien, Joe** (Ohio State University)  
**Tuite, Ashleigh** (University of Toronto)  
**van den Driessche, Pauline** (University of Victoria)  
**Worden, Lee** (McMaster University)  
**Yaari, Rami** (Tel Aviv University)  
**Yan, Ping** (Public Health Agency of Canada)

# Sparse and Low Rank Approximation

## March 6-11, 2011

### Organizers:

**Gitta Kutyniok** (Technische Universität Berlin)  
**Holger Rauhut** (University of Bonn)

**Joel Tropp** (California Institute of Technology)  
**Ozgur Yilmaz** (University of British Columbia)



This workshop provided a unique opportunity to discuss the most recent results, stimulate new research in the interplay between sparse approximation, compressed sensing and low rank matrix recovery problems, and, in particular, to formulate open questions, and thereby significantly influence the research in this field in the future. We focussed on the following applications of sparse approximation: astronomical image and signal processing, radar imaging, wireless communication, and seismology, with experts from each of these application fields in order to stimulate discussions between practitioners and mathematicians, and thereby initiate new research directions and new research collaborations.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5036>

### Participants:

**Agarwal, Alekh** (University of California Berkeley)  
**Ayaz, Ulas** (University of Bonn)  
**Baraniuk, Richard** (Rice University)  
**Bodmann, Bernhard** (University of Houston)  
**Boufounos, Petros** (Mitsubishi Electric Research Laboratories)  
**Calderbank, Robert** (Duke University)  
**Casazza, Peter** (University of Missouri)  
**Cohen, Albert** (Université Pierre et Marie Curie)  
**Daubechies, Ingrid** (Duke University)  
**Eldar, Yonina** (Technion - Israel Institute of Technology)  
**Fazel, Maryam** (University of Washington)  
**Fornasier, Massimo** (Austrian Academy of Sciences)  
**Foucart, Simon** (Université Pierre et Marie Curie)  
**Goyal, Vivek** (Massachusetts Institute of Technology)  
**Herman, Matthew** (UCLA)  
**Herrmann, Felix** (University of British Columbia)  
**Huegel, Max** (University of Bonn)  
**Iwen, Mark** (Duke University)  
**Krahmer, Felix** (University of Bonn)

**Kunis, Stefan** (University of Osnabrueck)  
**Kutyniok, Gitta** (Technische Universität Berlin)  
**Maleki, Arian** (Stanford University)  
**Mansour, Hassan** (University of British Columbia)  
**Montanari, Andrea** (Stanford University)  
**Needell, Deanna** (Stanford University)  
**Pezeshki, Ali** (Colorado State University)  
**Pfander, Goetz** (Jacobs University)  
**Rauhut, Holger** (University of Bonn)  
**Recht, Ben** (University of Wisconsin)  
**Romberg, Justin** (Georgia Tech University)  
**Saab, Rayan** (University of British Columbia)  
**Sacchi, Mauricio** (University of Alberta)  
**Srebro, Nathan** (Toyota Technological Institute)  
**Starck, Jean Luc** (Service d'Astrophysique CEA/Saclay)  
**Strohmer, Thomas** (University of California, Davis)  
**Temlyakov, Vladimir** (University of South Carolina)  
**Tropp, Joel** (California Institute of Technology)  
**van den Berg, Ewout** (Stanford University)  
**Vybiral, Jan** (RICAM Linz)  
**Ward, Rachel** (Courant Institute)  
**Yilmaz, Ozgur** (University of British Columbia)



# Global/Local Conjectures in Representation Theory of Finite Groups

## March 13-18, 2011

### Organizers:

**Gunter Malle** (Universitaet Kaiserslautern)  
**Gabriel Navarro** (University of Valencia)

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



The aim of this meeting was to bring together the leading experts on modular representation theory of finite groups to exploit the substantial recent advances on some of these fundamental conjectures, including the McKay conjecture and its refinements, the Alperin Weight Conjecture, the Brauer Height Zero Conjecture, and the Broue' conjecture. This also provided a unique opportunity for young mathematicians to learn about these exciting developments and become directly involved in this fascinating area of research. Overall, this meeting strengthened existing collaborations and fostered new ones, and facilitated significant progress along the lines of all these important conjectures.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5008>

### Participants:

**Broué, Michel** (Université Paris 7 Paris-Diderot)  
**Brunat, Olivier** (Ruhr-Universitaet Bochum)  
**Cabanes, Marc** (Université Paris 7 Paris-Diderot)  
**Dade, Everett** (University of Illinois at Urbana-Champaign)  
**Eaton, Charles** (University of Manchester)  
**Evseev, Anton** (Queen Mary, University of London)  
**Fong, Paul** (University of Illinois at Chicago)  
**Geck, Meinolf** (Aberdeen University)

**Gluck, David** (Wayne State University)  
**Hiss, Gerhard** (RWTH Aachen University)  
**Koshitani, Shigeo** (Chiba University)  
**Kunugi, Naoko** (Tokyo University of Science)  
**Malle, Gunter** (Universitaet Kaiserslautern)  
**Navarro, Gabriel** (University of Valencia)  
**Spaeth, Britta** (University of Paris Diderot)  
**Srinivasan, Bham** (University of Illinois at Chicago)  
**Tiep, Pham Huu** (University of Arizona)

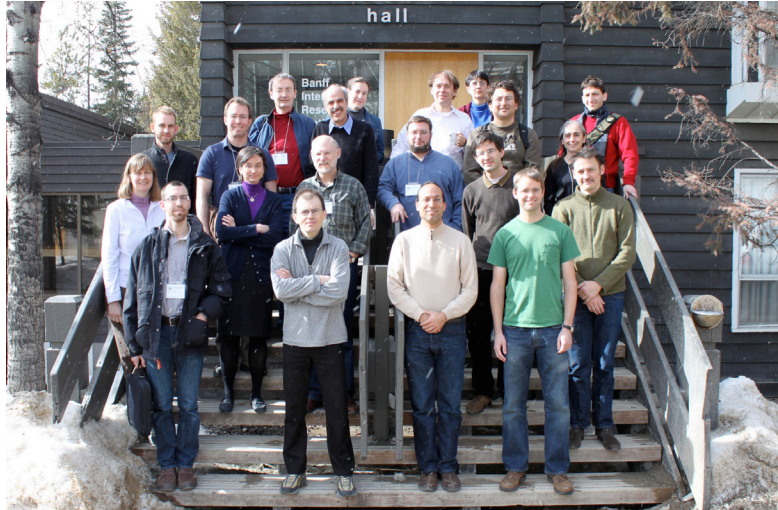
# Functor Calculus and Operads

## March 13-18, 2011

### Organizers:

**Michael Ching** (University of Georgia)  
**Nick Kuhn** (University of Virginia)

**Victor Turchin** (Kansas State University)



In topology, one is studying geometric objects by means of algebraic invariants, with the goal of using these to classify fundamental types of geometric structure such as knots and higher dimensional surfaces. Such invariants need to be computable, which in practice means that if a 'global' object is built out of "local" pieces, there is some process that allows one to attempt to calculate the global invariant from the local invariants. Often these invariants are left unchanged by "homotopies" i.e. deformations. The Calculus of Functors is a relatively new systematic method of stratifying such invariants by a hierarchy of invariants that satisfy certain 'polynomial' local-to-global behavior. This has some compelling similarity to how polynomials are used in ordinary calculus to approximate functions. The workshop focused on the emerging perspective that Functor Calculus has deep connections with other, more studied parts of homotopy theory and related parts of algebra. Featured was the Theory of Operads, the study of deformations of algebraic operations like multiplication.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5058>

### Participants:

**Arone, Greg** (University of Virginia)  
**Basterra, Maria** (University of New Hampshire)  
**Bauer, Kristine** (University of Calgary)  
**Behrens, Mark** (Massachusetts Institute of Technology)  
**Budney, Ryan** (University of Victoria)  
**Ching, Michael** (University of Georgia)  
**Dwyer, William** (Notre Dame University)  
**Finster, Eric** (Ecole Polytechnique Fédérale de Lausanne)  
**Fresse, Benoit** (Université Lille 1 - Sciences et Technologies)  
**Harper, John** (Ecole Polytechnique Fédérale de Lausanne)

**Hess, Kathryn** (Ecole Polytechnique Fédérale de Lausanne)  
**Johnson, Brenda** (Union College)  
**Kuhn, Nick** (University of Virginia)  
**Lambrechts, Pascal** (Université de Louvain)  
**Lesh, Kathryn** (Union College)  
**Mandell, Michael A.** (Indiana University)  
**Miller, Haynes** (Massachusetts Institute of Technology)  
**Salvatore, Paolo** (University of Rome Tor Vergata)  
**Sinha, Dev** (University of Oregon)  
**Turchin, Victor** (Kansas State University)  
**Weiss, Michael** (University of Aberdeen)

# Interactions Between Compact Symplectic Topology and Gauge Theory Between Dimensions 3 and 4

## March 20-25, 2011

### Organizers:

**Denis Auroux** (University of California, Berkeley)  
**Hans U. Boden** (McMaster University)

**Olivier Collin** (Université du Québec à Montréal)  
**John Etnyre** (Georgia Institute of Technology)



This workshop is a follow-up event to the well-received BIRS workshops organized in 2007 and 2009. For topologists, any space with four or fewer dimensions is considered to be low-dimensional. Because high-dimensional space has lots of “room to move,” algebraic techniques can be used to effectively answer many of the fundamental questions in dimensions five and higher. In low dimensions, these techniques break down and many fundamental questions remain unanswered. One interesting feature of dimension four is the plethora of “exotic” smooth structures. The workshop focused on new discoveries about the shape of space and knotted objects embedded in space, and featured several talks about new exotic smooth structures on 4-manifolds and slicing knots. Inspiration for many of these results came in large part from ideas in mathematical physics (gauge theory, symplectic and contact geometry).

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5085>

### Participants:

**Auroux, Denis** (University of California, Berkeley)  
**Baker, Ken** (University of Miami)  
**Baldwin, John** (Princeton University)  
**Boden, Hans U.** (McMaster University)  
**Collin, Olivier** (Université du Québec à Montréal)  
**Etnyre, John** (Georgia Institute of Technology)  
**Friedl, Stefan** (University of Cologne)  
**Ghiggini, Paolo** (CNRS - Laboratoire Jean Leray)  
**Grigsby, Julia Elisenda** (Boston College)  
**Hedden, Matthew** (Michigan State University)  
**Hom, Jen** (University of Pennsylvania)  
**Honda, Ko** (University of Southern California)  
**Kutluhan, Cagatay** (Columbia University)  
**Lee, Yi-Jen** (Purdue University)  
**Lekili, Yanki** (University of Cambridge)  
**Licata, Joan** (Stanford University)  
**Lidman, Tye** (UCLA)  
**Lisca, Paolo** (University of Pisa)  
**Ma'u, Sikimeti** (MSRI/Barnard)  
**Manolescu, Ciprian** (UCLA)  
**Margalit, Dan** (Georgia Institute of Technology)  
**Matic, Gordana** (University of Georgia)

**Mrowka, Tom** (MIT)  
**Ng, Lenny** (Duke University)  
**Owens, Brendan** (University of Glasgow)  
**Park, Jongil** (Seoul National University)  
**Perutz, Tim** (University of Texas-Austin)  
**Plamenevskaya, Olga** (State University of New York at Stony Brook)  
**Saveliev, Nikolai** (University of Miami)  
**Sivek, Steven** (MIT)  
**Stern, Ronald** (University of California, Irvine)  
**Thurston, Dylan** (Columbia University)  
**Torres, Rafael** (Oxford University)  
**Van Horn-Morris, Jeremy** (AIM)  
**Vela-Vick, David Shea** (Columbia University)  
**Vertesi, Vera** (MIT)  
**Vidussi, Stefano** (University of California Riverside)  
**Watson, Liam** (UCLA)  
**Wehrheim, Katrin** (MIT)  
**Williams, Jonathan** (University of California Berkeley)  
**Yazinski, Jonathan** (McMaster University)  
**Zarev, Rumen** (Columbia University)

# Stochastic Multiscale Methods: Bridging the Gap between Mathematical Analysis and Scientific and Engineering Applications

## March 27 - April 1, 2011

### Organizers:

**Guillaume Bal** (Columbia University)

**Roger Ghanem** (University of Southern California)

**Wing Liu** (Northwestern University)

**George Papanicolaou** (Stanford University)

**Boris Rozovsky** (Brown University)



The communities of stochastic analysis and computational science have evolved essentially along separate paths. The path forward, however, in the direction of disruptive scientific impact, requires significant exchange and collaboration. The intent of this workshop was to bring together leading researchers in these two fields with view to delineate new horizons and forge new synergies that will accelerate the evolution of multi-scale capabilities to become an enabler of scientific and economic progress. The workshop brought together researchers from academia, government labs, and industry in an effort to identify technical challenges and research opportunities in the treatment of multiscale problems, and had participation from computational science, mechanics and mathematics. We aimed to provide the scientific community at large with an expert summary in which we delineated the current challenges and opportunities associated with a very rapidly growing scientific area.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5120>

### Participants:

**Arendt, Paul** (Northwestern University)

**Arnst, Maarten** (University of Southern California)

**Bal, Guillaume** (Columbia University)

**Bellis, Cedric** (Columbia University)

**Chen, Wei** (Northwestern)

**Comboul, Maud** (University of Southern California)

**Das, Sonjoy** (SUNY - Buffalo)

**Doostan, Alireza** (University of Colorado)

**Ghanem, Roger** (University of Southern California)

**Greene, Steven** (Northwestern)

**Guilleminot, Johann** (Universite Paris-Est)

**Jing, Wenjia** (Columbia University)

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

**Legoll, Frederic** (Ecole Nationale des Ponts et Chaussees LAMI)

**Liu, Wing** (Northwestern University)

**Lototsky, Sergey** (University of Southern California)

**Marzouk, Youssef** (Massachusetts Institute of Technology)

**Mehrez, Loujaine** (Katholieke Universiteit Leuven)

**Mitran, Sorin** (University of North Carolina)

**Monard, Francois** (Columbia University)

**Najm, Habib** (Sandia National Laboratories)

**Newton, Paul** (University of Southern California)

**Nolen, James** (Duke University)

**Owhadi, Houman** (California Institute of Technology)

**Phipps, Eric** (Sandia National Laboratories)

**Pinaud, Olivier** (Columbia University/Université

Lyon 1)

**Prudhomme, Serge** (UT Austin)

**Red-Horse, John** (Sandia National Laboratories)

**Stargel, David** (AFOSR)

**Stuart, Andrew** (Warwick University)

**Tempone, Raul** (KAUST)

**von Schwerin, Erik** (KAUST)

# Quantum Control

## April 3-8, 2011

### Organizers:

**Herschel Rabitz** (Princeton University)  
**Chitra Rangan** (University of Windsor)  
**Holger Teismann** (Acadia University)

**Enrique Zuazua Iriondo** (BCAM - Basque Center for Applied Mathematics)



The emergence of nanotechnology, quantum information, and the ever-increasing miniaturization of electronic devices has led to a scientific and technological regime where the control of quantum systems are of paramount importance. In this area of quantum control, research has been progressing largely along two parallel streams - the development of specific control schemes by physicists, chemists and engineers, and the development of a mathematical theory by mathematicians. This 5-day workshop on Quantum Control aimed to take advantage of newly emerging links between these two diverse communities in order to develop much-needed synergies within this rapidly moving field.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5030>

### Participants:

**Bandrauk, André D** (Université de Sherbrooke)  
**Brif, Constantin** (Princeton University)  
**Brown, Alex** (University of Alberta)  
**Castro, Alberto** (University of Zaragoza)  
**Cazacu, Cristian** (Basque Center for Applied Mathematics)  
**Chakrabarti, Raj** (Purdue University)  
**Chambrion, Thomas** (Nancy University)  
**Chittaro, Francesca** (L2S-Supélec)  
**Cong, Shuang** (University of Science and Technology of China)  
**Coron, Jean-Michel** (Laboratoire Jacques-Louis Lions)  
**Ervedoza, Sylvain** (Institut de Mathématiques de Toulouse - CNRS)  
**Grace, Matthew** (Sandia National Laboratories)  
**Grigoriu Lachapelle, Andreea** (Princeton University)  
**Jacob, Andreas** (Max Planck Institute for the Physics of Complex Systems)  
**Koch, Christiane** (Freie Universitaet Berlin)  
**Kosut, Robert** (SC Solutions)

**Lange, Horst** (University of Cologne)  
**Marica, Aurora-Mihaela** (BCAM)  
**Melnik, Roderick** (Wilfrid Laurier University)  
**Mirahimi, Mazyar** (INRIA Paris-Rocquencourt)  
**Moore, Katharine** (Princeton University)  
**Morris, Kirsten** (University of Waterloo)  
**Nersesyan, Vahagn** (Université de Versailles)  
**Platzer, Felix** (MPI Dresden)  
**Prabhakar, Sanjay** (Wilfrid Laurier University)  
**Privat, Yannick** (Ecole Normale Supérieure de Cachan)  
**Puel, Jean-Pierre** (Université de Versailles)  
**Rabitz, Herschel** (Princeton University)  
**Rangan, Chitra** (University of Windsor)  
**Schirmer, Sophie (Sonia)** (Swansea University)  
**Tannor, David** (Weizmann Institute)  
**Teismann, Holger** (Acadia University)  
**Turinici, Gabriel** (Université Paris Dauphine)  
**Wu, Re-Bing** (Tsinghua University)  
**Young, Kevin** (Sandia National Laboratories)  
**Zuazua Iriondo, Enrique** (BCAM)

# Imaging, Interpretation and Modeling in Modern Immunology

## April 10-15, 2011

### Organizers:

**Daniel Coombs** (University of British Columbia)

**Rob De Boer** (Utrecht University)

**Rajat Varma** (NIH - NIAID)



Advances in microscopic imaging techniques have revolutionized our knowledge of biological cellular and subcellular dynamics *in vitro* and *in vivo*. Nowhere are these advances clearer than in modern immunology, where we have newfound abilities to chart cellular interactions in living tissues, and to identify and track individual molecular players at dynamic intercellular interfaces. The objective of this workshop was to allow for substantial and detailed interactions between experimental and mathematical scientists working in cellular immunology. This allowed the experimental scientists to develop an understanding of existing computational tools for data analysis, and equally, led the mathematical scientists to learn where their expertise can most fruitfully be directed in order to impact the field.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5045>

### Participants:

**Ariotti, Silvia** (Netherlands Cancer Institute)

**Batista, Facundo** (Cancer Research UK London Research Institute)

**Beltman, Joost** (Utrecht University)

**Burroughs, Nigel** (University of Warwick)

**Cairo, Christopher** (University of Alberta)

**Carneiro, Jorge** (Instituto Gulbenkian de Ciencia)

**Coombs, Daniel** (University of British Columbia)

**Das, Jayajit** (Research Institute at the Nationwide Childrens Hospital/Ohio State University)

**Das, Raibatak** (University of British Columbia)

**Davis, Daniel** (Imperial College London)

**De Boer, Rob** (Utrecht University)

**de Vries, Gerda** (University of Alberta)

**Delgado-Carrillo, Monica** (UBC)

**Destainville, Nicholas** (Universite Paul Sabatier)

**Dushek, Omer** (Oxford University)

**Dustin, Michael** (NY University School of Medicine)

**Faeder, James** (University of Pittsburgh)

**Freeman, Spencer** (University of British Columbia)

**Gold, Michael** (University of British Columbia)

**Goldstein, Byron** (Los Alamos National Laboratory)

**Graw, Frederik** (Los Alamos National Laboratory)

**Jacobson, Ken** (University of North Carolina Chapel Hill)

**Kepler, Thomas** (Duke University Medical Center)

**Kleinstejn, Steven** (Yale University)

**Li, Caishun** (University of Alberta)

**Lythe, Grant** (University of Leeds)

**Meier-Schellersheim, Martin** (NIH - NIAID)

**Meyer-Hermann, Michael** (HZI)

**Molina-Paris, Carmen** (University of Leeds)

**Olivieri, David** (University of Vigo)

**Perelson, Alan** (Los Alamos National Laboratory)

**Raychaudhuri, Subhadip** (UC Davis)

**Saxton, Michael** (UC Davis)

**Schumacher, Ton** (Netherlands Cancer Institute)

**Textor, Johannes** (Universitaet zu Luebeck)

**Valitutti, Salvatore** (INSERM Toulouse)

**van der Merwe, Anton** (Oxford University)

**Varma, Rajat** (NIH - NIAID)

**Yaari, Gur** (Yale University)

**Zarnitsyna, Veronika** (Georgia Tech)

# Geometric Flows in Mathematics and Physics

## April 17-22, 2011

### Organizers:

**Mauro Carfora** (University of Pavia)  
**Zindine Djadli** (Institut Fourier Université Grenoble 1)  
**Gerhard Huisken** (Max-Planck-Institute for Gravitational Physics)

**Lei Ni** (University of California, San Diego)  
**Eric Woolgar** (University of Alberta)



This workshop sought to continue the recent explorations of connections between geometric flows and other areas of mathematics and physics. Geometric flows refer to various controlled ways in which geometry can be made to change smoothly with time, rather analogous to the way in which the geometry of the surface of a balloon becomes smooth and round as it is inflated with air. Over the last few years, this field has seen amazing mathematical progress, and the number of applications outside mathematics has increased dramatically as well. In this workshop, we invited a wide spectrum of mathematical workers in the field, but we will also invited a similar number of physicists working on applications of geometric flows in physics. Our goal was to bring these communities together in an ongoing dialogue, to facilitate the transfer of the most recent mathematical knowledge to those working on physical problems, while exposing mathematicians to physics problems to encourage and motivate further mathematical advances.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5010>

### Participants:

**Arnold, Joakim** (Albert-Einstein-Institut)  
**Bahuaud, Eric** (Stanford University)  
**Bessières, Laurent** (Université de Grenoble I)  
**Besson, Gérard** (Université Grenoble, CNRS)  
**Buzano, Maria** (University of Oxford)  
**Carfora, Mauro** (University of Pavia)  
**Chen, Jingyi** (University of British Columbia)  
**Dixon, Kael** (McGill University)  
**Djadli, Zindine** (Institut Fourier Univ. Grenoble 1)  
**Dziuk, Gerhard** (University of Freiburg)  
**Fang, Fuquan** (Capital Normal University)  
**Guan, Pengfei** (McGill University)  
**Gulcev, Liljana** (University of Alberta)  
**Haslhofer, Robert** (ETH Zurich)  
**Hobill, David** (University of Calgary)  
**Holder, Cody** (University of Alberta)  
**Huisken, Gerhard** (Max-Planck-Institute for Gravitational Physics)

**Kotschwar, Brett** (Max-Planck-Institute for Gravitational Physics)  
**Lamm, Tobias** (Goethe-University Frankfurt)  
**LeFloch, Philippe G.** (Paris 6)  
**Maillot, Sylvain** (Montpellier)  
**McLellan, Brendan** (University of Alberta)  
**Müller, Reto** (Scuola Normale Superiore di Pisa)  
**Ni, Lei** (University of California, San Diego)  
**Oliylyk, Todd** (Monash University)  
**Pulemotov, Artem** (University of Chicago)  
**Pulwiski, Julia** (University of Calgary)  
**Schulze, Felix** (Freie Universität Berlin)  
**Shi, Yuguang** (Peking University)  
**Simon, Miles** (Albert-Ludwigs-Universität Freiburg)  
**Topping, Peter** (University of Warwick)  
**Wilkes, Jason** (University of Alberta)  
**Woolgar, Eric** (University of Alberta)

# Algebraic Graph Theory

## April 24-29, 2011

### Organizers:

**Chris Godsil** (University of Waterloo)

**Michael Newman** (University of Ottawa)



The primary objective of this workshop was to bring together researchers working in Algebraic Graph Theory to discuss current trends and future directions in this area. It is precisely the interaction between algebra and graph theory that we highlighted: in terms of tools and techniques on the one hand, and applications on the other. We aimed to foster an increase in collaboration and applications, and especially create more awareness among disparate groups of researchers. This also provided an ideal opportunity for younger researchers and students to participate in this area.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5119>

### Participants:

**Ahmadi, Bahman** (University of Regina)  
**Alinaghypour, Fatemeh** (University of Regina)  
**Ball, Simeon** (Universitat Politècnica de Catalunya)  
**Butler, Steve** (UCLA)  
**Chan, Ada** (York University)  
**Chowdhury, Ameera** (University of California San Diego)  
**Cioaba, Sebastian** (University of Delaware)  
**DeVos, Matt** (Simon Fraser University)  
**Farr, Graham** (Monash University)  
**Godsil, Chris** (University of Waterloo)  
**Gosselin, Shonda** (University of Winnipeg)  
**Gottshall, Alyssa** (Worcester Polytechnic Institute)  
**Greenfield, Kara** (Worcester Polytechnic Institute)  
**Guo, Krystal** (University of Waterloo)  
**Haemers, Willem** (Tilburg University)  
**Hobart, Sylvia** (University of Wyoming)  
**Kharaghani, Hadi** (University of Lethbridge)  
**Lee, Jae-Ho** (University of Wisconsin-Madison)  
**Mancinska, Laura** (University of Waterloo/Institute for Quantum Computing)  
**Martin, William** (Worcester Polytechnic Institute)

**Meagher, Karen** (University of Regina)  
**Moorhouse, Eric** (University of Wyoming)  
**Morgan, Kerri** (University of Melbourne)  
**Mullin, Natalie** (University of Waterloo)  
**Newman, Michael** (University of Ottawa)  
**Ozols, Maris** (Institute for Quantum Computing)  
**Purdy, Alison** (University of Regina)  
**Rahnamai Barghi, Amir** (K. N. Toosi University of Technology)  
**Roberson, David** (University of Waterloo)  
**Roetteler, Martin** (NEC Laboratories America)  
**Rooney, Brendan** (University of Waterloo)  
**Roy, Aidan** (University of Waterloo)  
**Sankey, Alyssa** (University of New Brunswick)  
**Severini, Simone** (University College London)  
**Szollosi, Ferenc** (Central European University)  
**Vanhove, Frederic** (Universiteit Gent)  
**Williford, Jason** (University of Wyoming)  
**Wilson, Richard** (California Institute of Technology)  
**Worwawannotai, Chalermpong** (University of Wisconsin)  
**Young, Michael** (Iowa State University)



# Organized Tropical Convection and Large-Scale Circulation: Theory, Modeling and Observations

## May 1-6, 2011

### Organizers:

**Boualem Khouider** (University of Victoria)  
**Andrew J. Majda** (New York University)

**Chidong Zhang** (University of Miami)



This workshop focused primarily on the following topics: vertical structure and self-similarity of large scale tropical convective systems, effects of the MJO on monsoon dynamics and rainfall, MJO initiation and tropical extra-tropical teleconnections, atmosphere-ocean coupling and the MJO, as well as climate predictability and data assimilation in the tropics. It brought together leading experts from around the world to discuss new insights in tropical convective systems, blending in theoreticians (mathematicians and physicists), observation experts, and operational modelers, together with junior researchers such as postdocs and students, to foster new and strengthen existing interactions between the three communities. This proved to be highly beneficial to everybody, and in particular for the areas of statistical predictions and data assimilations that are new to the tropics.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5047>

### Participants:

**Ajayamohan, R. S.** (Environment Canada)  
**Austin, Phillip** (UBC)  
**Biello, Joseph** (UC Davis)  
**Boos, William** (Yale)  
**De La Chevrotiere, Michele** (University of Victoria)  
**Dias, Juliana** (NOAA)  
**Frederiksen, Jorgen** (CSIRO)  
**Frenkel, Yevgeniy** (New York University)  
**Frierson, Dargan** (University of Washington)  
**Haertel, Patrick** (Yale University)  
**Harlim, John** (North Carolina State)  
**Jakob, Christian** (Monash University)  
**Johnson, Richard** (Colorado State University)  
**Khairoutdinov, Marat** (Stony Brook University)  
**Khouider, Boualem** (University of Victoria)  
**Kiladis, George** (National Atmospheric and Oceanic Administration)  
**Majda, Andrew J.** (New York University)

**Moncrieff, Mitchell** (NCAR)  
**Muraki, David** (Simon Fraser University)  
**Randall, David** (Colorado State University)  
**Rommel, Mark** (U.C. Davis)  
**Schubert, Wayne** (Colorado State University)  
**Schumacher, Courtney** (Texas A&M)  
**Sessions, Sharon** (New Mexico Tech.)  
**Smith, Leslie** (University of Wisconsin)  
**Stechmann, Samuel** (University of Wisconsin-Madison)  
**Straub, Katherine** (Susquehanna University)  
**Tulich, Stefan** (NOAA)  
**Tung, Wen-Wen** (Purdue University)  
**Waite, Michael** (University of Waterloo)  
**Wheeler, Matthew** (Centre for Australian Weather and Climate Research)  
**Zhang, Chidong** (University of Miami)  
**Zhang, Guang** (Scripps Institution of Oceanography)

# Number Theory and Physics at the Crossroads

## May 8-13, 2011

### Organizers:

**Victor Batyrev** (Universität Tübingen)  
**Charles Doran** (University of Alberta)  
**Sergei Gukov** (California Institute of Technology)

**Noriko Yui** (Queen's University)  
**Don Zagier** (Max Planck Institute Bonn)



There have been strong desires among mathematicians and physicists for more workshops directed to the areas of number theory and physics at the crossroads, and this workshop was initiated in response to this demand. The last workshop at BIRS in 2008 brought together researchers in number theory, algebraic geometry, and physics (string theory) whose common interests are centered around modular forms. We have felt that all things modular have come together at BIRS from both sides: number theory and physics (in particular, string theory). At the end of both our BIRS workshops to date, all participants felt that both camps have finally crossed boundaries and established relatively comfortable rapport. One of the principal goals of this workshop was to compare new developments since what was established three years ago, and give directions to future researchers in the interface of number theory and physics.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5001>

### Participants:

**Ballard, Matthew** (University of Wisconsin)  
**Batyrev, Victor** (Universität Tübingen)  
**Bogner, Micheal** (University of Mainz)  
**Bouchard, Vincent** (University of Alberta)  
**Brown, Francis** (CNRS, Institut Mathematiques de Jussieu)  
**Carnahan, Scott** (IPMU, University of Tokyo)  
**Clingher, Adrian** (University of Missouri-St.Louis)  
**Dimofte, Tudor** (Institute for Advanced Study)  
**Doran, Charles** (University of Alberta)  
**Friedrich, Roland** (Humboldt-Universität zu Berlin)  
**Galkin, Sergey** (University of Tokyo)  
**Gannon, Terry** (University of Alberta)  
**Gukov, Sergei** (California Institute of Technology)  
**Gunnells, Paul** (University of Massachusetts Amherst)  
**Harder, Andrew** (University of Alberta)  
**Hosono, Shinobu** (University of Tokyo)  
**Keller, Christoph** (California Institute of Technology)  
**Kerr, Matt** (Washington University in St. Louis)  
**Klemm, Albrecht** (University of Bonn)  
**Lewis, Jacob** (University of Vienna)  
**Maier, Robert** (University of Arizona)  
**Manschot, Jan** (CEA, Saclay)

**Morrison, David** (University of California Santa Barbara)  
**Movasati, Hossein** (IMPA - Instituto de Matematica Pura e Aplicada)  
**Mulase, Motohico** (University of California, Davis)  
**Neitzke, Andy** (University of Texas at Austin)  
**Novoseltsev, Andrey** (University of Alberta)  
**Pioline, Boris** (CNRS, Universite Pierre et Marie Curie - Paris 6)  
**Rodriguez Villegas, Fernando** (University of Texas at Austin)  
**Rohde, Jan Christian** (University Hamburg)  
**Sebbar, Abdellah** (University of Ottawa)  
**Shapiro, Ilya** (University of Waterloo)  
**Song, Ruifang** (Harvard University)  
**Stienstra, Jan** (Utrecht University)  
**Szendroi, Balazs** (Oxford University)  
**van Straten, Duco** (Johannes Gutenberg-Universitue)  
**Walcher, Johannes** (McGill University)  
**Whitcher, Ursula** (University of Wisconsin)  
**Yui, Noriko** (Queen's University)  
**Zagier, Don** (Max-Planck Institut Bonn)

# Harmonic Analysis in Convex Geometry

## May 15-20, 2011

### Organizers:

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

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



In recent years convex geometric analysis has experienced an extraordinarily high rate of growth and has been connected to new areas of mathematics and computer science. Tools from harmonic analysis have played a prominent role in convex geometry for a long time. The main goal of this workshop at BIRS was to invite the leading experts and young researchers in the area to coordinate the main applications of harmonic analysis to convex geometry, and to develop new Fourier analytic approaches to the main open problems in the area. Areas that were focused on include sections and projections of convex bodies, the Mahler conjecture and its functional versions, classes of convex and star bodies associated with projections and sections, as well as relations between various classes, among others.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5034>

### Participants:

**Abardia, Judit** (Frankfurt University)  
**Alfonseca-Cubero, Maria de los Angeles** (North Dakota State University)  
**Alonso-Gutierrez, David** (University of Alberta)  
**Berck, Gautier** (Polytechnic Institute of NYU)  
**Dann, Susanna** (Louisiana State University)  
**Fish, Alexander** (University of Wisconsin)  
**Goodey, Paul** (University of Oklahoma)  
**Gordon, Yehoram** (Technion)  
**Grinberg, Eric** (University of Massachusetts Boston)  
**Iosevich, Alex** (University of Rochester)  
**Kim, Jaegil** (Kent State University)  
**Koenig, Hermann** (Universitaet Kiel)  
**Latala, Rafal** (University of Warsaw)  
**Maresch, Gabriel** (Vienna University of Technology)  
**Meyer, Mathieu** (Université Paris-Est Marne-la-Vallée)  
**Pivovarov, Peter** (Fields Institute)  
**Reisner, Shlomo** (University of Haifa)  
**Reitzner, Matthias** (University of Osnabrueck)  
**Rivasplata, Omar** (University of Alberta)  
**Rivin, Igor** (Institute for Advanced Study)

**Rudelson, Mark** (University of Michigan, Ann Arbor)  
**Ryabogin, Dmitry** (Kent State University)  
**Schneider, Rolf** (University of Freiburg)  
**Schuett, Carsten** (Christian-Albrechts-Universitaet)  
**Schuster, Franz** (Vienna University of Technology)  
**Soprunov, Ivan** (Cleveland State University)  
**Stancu, Alina** (Concordia University)  
**Szarek, Stanislaw** (Case Western Reserve University)  
**Taschuk, Steven** (University of Alberta)  
**Vigh, Viktor** (University of Calgary)  
**Vitale, Rick** (University of Connecticut)  
**Wannerer, Thomas** (TU Wien)  
**Weberndorfer, Manuel** (Vienna University of Technology)  
**Weil, Wolfgang** (Universitaet Karlsruhe)  
**Werner, Elisabeth** (Case Western Reserve University)  
**Yaskin, Vladyslav** (University of Alberta)  
**Ye, Deping** (Carleton University)  
**Zvavitch, Artem** (Kent State University)

# Algebraic Combinatorixx

## May 22-27, 2011

### Organizers:

**Georgia Benkart** (University of Wisconsin-Madison)

**Stephanie van Willigenburg** (University of British Columbia)

**Monica Vazirani** (University of California, Davis)



Algebraic combinatorics is a broad area of research with substantial connections to representation theory, mathematical physics, algebraic geometry, number theory, knots and links, mathematical biology, statistical mechanics, symmetric functions, and invariant theory. The goal of this five-day workshop was to increase and strengthen the participation of women in algebraic combinatorics and related fields of research. The workshop paired senior and junior researchers, and had a major mentoring component. The organizers were inspired to propose this workshop after the highly successful “WIN” (Women in Numbers) workshop that took place at BIRS in November 2008.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5025>

### Participants:

**Barcelo, Helene** (MSRI)

**Bayer, Margaret** (University of Kansas, Lawrence)

**Beazley, Elizabeth** (Williams College)

**Beier, Julie** (Mercer University)

**Benkart, Georgia** (University of Wisconsin- Madison)

**Bertiger, Anna** (Cornell University)

**Bessenrodt, Christine** (Leibniz University Hannover)

**Chan, Melody** (UC Berkeley)

**Cho, Soojin** (Ajou University, South Korea)

**De Visscher, Maud** (City University of London)

**Dye, Heather** (McKendree University)

**Fishel, Susanna** (Arizona State University)

**Garrett, Kristina** (St. Olaf College)

**Hamel, Angèle** (Wilfrid Laurier University)

**Hersh, Patricia** (North Carolina State University)

**Karaali, Gizem** (Pomona College)

**Klivans, Caroline** (University of Chicago)

**Lemire, Nicole** (University of Western Ontario)

**Li, Huilan** (Drexel University)

**Mason, Sarah** (Wake Forest University)

**Meszaros, Karola** (MIT)

**Morier-Genoud, Sophie** (Universite Paris 6)

**Nyman, Kathryn** (Willamette University)

**Orellana, Rosa** (Dartmouth College)

**Owen, Megan** (University of California Berkeley)

**Parker, Alison** (University of Leeds)

**Readdy, Margaret** (Institute for Advanced Study)

**Schilling, Anne** (University of California Davis)

**Shepler, Anne** (University of North Texas)

**Smith Barnes, Camillia** (Sweet Briar College)

**Striker, Jessica** (Augsburg College)

**Talaska, Kelli** (University of California-Berkeley)

**Tenner, Bridget** (DePaul University)

**Tymoczko, Julianna** (University of Iowa)

**van Willigenburg, Stephanie** (University of British Columbia)

**Vazirani, Monica** (University of California, Davis)

**Venkateswaran, Vidya** (California Institute of Technology)

**Wachs, Michelle** (University of Miami)

**Williams, Lauren** (U.C. Berkeley)

**Yip, Martha** (University of California, San Diego)

**Yoo, Meesue** (Korea Institute for Advanced Study)

**Yu, Josephine** (Georgia Institute of Technology)

# Gradient Random Fields

## May 29 - June 3, 2011

### Organizers:

**Stefan Adams** (Warwick University)

**Roman Kotecky** (Charles University)

**Marek Biskup** (University of California at Los Angeles)



Gradient random fields are mathematical models arising in a variety of applied contexts. One is theoretical physics, where they are believed to capture the large-scale behavior of microscopic fluctuating interfaces or magnetic materials at the so-called Curie temperature point. Another use of these models comes from material science, where they describe the displacement of microscopic constituents of a piece of material that is deformed by stress/shear forces on its boundary. There are many important technical challenges and it is clear that their solution will only come from close collaboration between experts in these fields. The purpose of this meeting was to bring these experts together and facilitate the exchange of ideas and technical know-how among them. The topics we highlighted included: mathematics and physics underlying classical elasticity theory, statics and dynamics of gradient models with non-convex interactions, stochastic geometry associated with Gaussian Free Field and connections to the classical field theory.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5124>

### Participants:

**Abdesselam, Abdelmalek** (University of Virginia)

**Adams, Stefan** (Warwick University)

**Bauerschmidt, Roland** (University of British Columbia)

**Biskup, Marek** (University of California at Los Angeles)

**Braides, Andrea** (Universita degli studi di Roma Tor Vergata)

**Bru, Jean-Bernard** (Universidad del País Vasco-Ikerbasque Basque Foundation for Sciences)

**Conlon, Joseph** (University of Michigan)

**Cotar, Codina** (TU Munich)

**Crawford, Nicholas** (Technion)

**Disertori, Margherita** (Université de Rouen)

**Dondl, Patrick** (University of Heidelberg)

**Falco, Pierluigi** (IAS Princeton)

**Funaki, Tadahisa** (University of Tokyo)

**Giacomin, Giambattista** (Universite Paris Diderot)

**Kenyon, Richard** (Brown University)

**Kotecky, Roman** (Charles University)

**Kozma, Gady** (Weizmann Institute)

**Kuelske, Christof** (University Bochum)

**Kurt, Noemi** (TU-Berlin)

**Louidor, Oren** (UCLA)

**Luckhaus, Stephan** (University of Leipzig)

**Maguire, Shaun** (Caltech)

**Nishikawa, Takao** (Nihon University)

**Olla, Stefano** (CEREMADE - Université Paris Dauphine)

**Otto, Felix** (Max Planck Institute for Mathematics in the Sciences)

**Peled, Ron** (Tel Aviv University)

**Spencer, Tom** (Institute for Advanced Studies, USA)

**Theil, Florian** (University of Warwick)

**Zahradnik, Milos** (Charles University)

# KAM Theory and Geometric Integration

## June 5-10, 2011

### Organizers:

**Walter Craig** (McMaster University)

**Erwan Faou** (Ecole Normale Supérieure de Cachan Bretagne)

**Benoit Grebert** (Université de Nantes, France)



This workshop on KAM theory and geometric integration brought a number of world experts in Hamiltonian partial differential equations together with specialists in scientific computing, in a first of its kind meeting. Numerical simulations of the principal differential equations of mathematical physics play an increasingly important role in the modern physical sciences, and they have an impact on a wide variety of topics, including those as directly applicable as earthquake and tsunami wave prediction, as well as the somewhat less earthly sciences of galactic cluster formation or of general relativity and cosmology. Some of the most important topics for which solutions are sought include effective numerical methods for ocean wave simulations, for solutions of molecular dynamics equations, and for numerical general relativity. The workshop participants discussed both the current state of their respective disciplines, as well as the perspectives for collaboration on the future directions of their discipline.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5132>

### Participants:

**Bambusi, Dario** (University of Milano)

**Bao, Weizhu** (National University of Singapore)

**Calleja, Renato** (McGill University)

**Cohen, David** (University of Basel)

**Craig, Walter** (McMaster University)

**de la Llave, Rafael** (University of Texas at Austin)

**Dujardin, Guillaume** (INRIA Lille Nord-Europe)

**Faou, Erwan** (Ecole Normale Supérieure de Cachan Bretagne)

**Figueras, Jordi-Lluís** (Universitat de Barcelona)

**Grebert, Benoit** (Université de Nantes, France)

**Gustafson, Stephen** (University of British Columbia)

**Guyenne, Philippe** (University of Delaware)

**Hairer, Ernst** (University of Geneva)

**Imekraz, Rafik** (University Paris Dauphine)

**Kappeler, Thomas** (University of Zurich)

**Lemou, Mohammed** (CNRS, University of Rennes)

**Leok, Melvin** (University of California, San Diego)

**McDonald, Fleur** (Massey University Manawatu)

**Mehats, Florian** (Université Rennes)

**Ostermann, Alexander** (University of Innsbruck)

**Paturel, Eric** (University of Nantes)

**Penati, Tiziano** (University of Milan)

**Sanz-Serna, J M** (Universidad de Valladolid Spain)

**Shang, Zaijiu** (Chinese Academy of Sciences)

**Simo, Carles** (Universitat de Barcelona)

**Sire, Yannick** (Université Paul Cézanne)

**Thomann, Laurent** (University of Nantes)

**Vilmart, Gilles** (Ecole Polytechnique Fédérale de Lausanne)

# Triangulated Categories and Applications

## June 12-17, 2011

### Organizers:

**Paul Balmer** (University of California Los Angeles)  
**Dan Christensen** (University of Western Ontario)

**Amnon Neeman** (Australian National University)



Triangulated Categories offer a powerful set of techniques for mathematicians of very different horizons. Born independently in algebraic geometry and topology, triangulated categories were later “re-discovered” by people interested in the representation of finite groups, and by many mathematicians of more recent specialization, like in the theory of motives, in non-commutative topology or even in string theory, in physics. This highly interdisciplinary workshop offered the opportunity to specialists of different backgrounds, sharing an interest in triangulated categories, to meet and exchange ideas and techniques. It also offered the opportunity to train younger mathematicians and to open them to the broad potential and large spectrum of applications of triangulated categories.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5009>

### Participants:

**Balmer, Paul** (University of California Los Angeles)  
**Benson, David** (University of Aberdeen)  
**Carlson, Jon** (University of Georgia)  
**Casacuberta, Carles** (Universitat de Barcelona)  
**Cautis, Sabin** (Columbia University)  
**Christensen, Dan** (University of Western Ontario)  
**Dell’Ambrogio, Ivo** (Universität Bielefeld)  
**Dugger, Dan** (University of Oregon)  
**Friedlander, Eric** (University of Southern California)  
**Greenlees, John** (University of Sheffield)  
**Hovey, Mark** (Wesleyan University)  
**Iyengar, Srikanth** (University of Nebraska, Lincoln)  
**Kawamata, Yujiro** (University of Tokyo)  
**Klein, Sebastian** (Utrecht University)  
**Krause, Henning** (University of Bielefeld)  
**Licata, Anthony** (Institute for Advanced Study, Australian National University)  
**Lowen, Wendy** (Universiteit Antwerpen)  
**Lowrey, Parker** (University of Western Ontario)  
**Meyer, Ralf** (Universität Göttingen)  
**Murfet, Daniel** (University of California Los Angeles)  
**Muro, Fernando** (Universidad de Sevilla)

**Neeman, Amnon** (Australian National University)  
**Pauwels, Bregje** (University of California Los Angeles)  
**Pevtsova, Julia** (University of Washington)  
**Rickard, Jeremy** (University of Bristol)  
**Sanders, Beren** (University of California Los Angeles)  
**Shipley, Brooke** (University of Illinois, Chicago)  
**Smith, Paul** (University of Washington)  
**Smith, Jeffrey** (University of British Columbia)  
**Stanley, Don** (University of Regina)  
**Stevenson, Gregory** (ANU)  
**Stovicek, Jan** (Charles University in Prague)  
**Strickland, Neil** (University of Sheffield)  
**Tabuada, Goncalo** (Universidade Nova de Lisboa)  
**Takahashi, Ryo** (Shinshu University)  
**Wang, Gaohong** (University of Western Ontario)  
**Wolcott, Luke** (University of Washington)  
**Wu, Enxin** (University of Western Ontario)  
**Yekutieli, Amnon** (Ben Gurion University)  
**Zhang, James** (University of Washington)

# Groups, Graphs and Stochastic Processes

## June 19-24, 2011

### Organizers:

**Miklos Abert** (Renyi Institute of Mathematics)

**Balint Virag** (University of Toronto)



Studying the asymptotic behavior of large finite networks with few edges is important in many fields, including physics and computer science. The local theory seems to be connected to ergodic theory via group actions in manifold ways. Often, the methods employed are probabilistic in nature. In particular, percolation and random walks come into the game. This field is not yet established in a strong way, but there are already a number of exciting results by various people working in different areas of mathematics. This workshop aimed to bring together top experts and young researchers to boost further interaction and make a step towards building a general theory.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5141>

### Participants:

**Abert, Miklos** (Renyi Institute of Mathematics)

**Amir, Gidi** (Bar-Ilan University)

**Babai, Laszlo** (University of Chicago)

**Bowen, Lewis** (Texas A&M)

**Brieussel, Jeremie** (Neuchatel University)

**Candellero, Elisabetta** (Graz University of Technology)

**Csoka, Endre** (Eötvös Loránd University)

**Elek, Gabor** (Renyi Institute)

**Friedman, Joel** (University of British Columbia)

**Gilch, Lorenz** (Graz Technical University)

**Glasner, Yair** (Ben Gurion University of the Negev)

**Grabowski, Łukasz** (Goettingen University)

**Gurel-Gurevich, Ori** (University of British Columbia)

**Harangi, Viktor** (Renyi Institute)

**Hegedus, Pal** (Central European University)

**Kaimanovich, Vadim** (University of Ottawa)

**Karlssohn, Anders** (University of Geneva)

**Kassabov, Martin** (Cornell University)

**Lee, James** (University of Washington)

**Li, Xiang (Janet Lisha)** (University of Toronto)

**Lippner, Gabor** (Harvard University)

**Lyons, Russell** (Indiana University)

**Matter, Michel** (University of Geneva)

**Mineyev, Igor** (University of Illinois at Urbana-Champaign)

**Nachmias, Asaf** (MIT)

**Navas, Andres** (Universidad de Santiago de Chile)

**Peres, Yuval** (Microsoft Research)

**Pete, Gabor** (University of Toronto)

**Saloff-Coste, Laurent** (Cornell University)

**Smirnova-Nagnibeda, Tatiana** (University of Geneva)

**Stewart, Andrew** (University of Toronto)

**Szegedy, Balazs** (University of Toronto)

**Thompson, Russ** (Cornell University)

**Timar, Adam** (Hausdorff Center for Mathematics, Bonn University)

**Virag, Balint** (University of Toronto)

**Weinberger, Shmuel** (University of Chicago)

**Woess, Wolfgang** (Technische Universität Graz)

**Young, Robert** (University of Toronto)



# L-Packets

## June 26 - July 1, 2011

### Organizers:

**Clifton Cunningham** (University of Calgary)  
**Colette Moeglin** (Institut de Mathématiques de Jussieu)

**Vinayak Vatsal** (University of British Columbia)



The objectives of this workshop were to review the current status of Arthur's conjectures as they pertain to the structure, stability and parametrization of L-packets both global and local, Archimedean and non-Archimedean; to carefully examine examples to gather evidence to support (or refute) the conjectures; to think about arithmetic implications; and to develop strategies that might lead to progress on the conjectures. This workshop, which was timed to follow on the heels of the release of Jim Arthur's book on automorphic representations, built on work facilitated by the 2008 BIRS workshops on the stable trace formula, automorphic forms, and Galois representations. By gathering together the experts in this field, this workshop represented the state of the art of the subject, both from the representation, theoretic, and arithmetic perspectives.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5100>

### Participants:

**Achter, Jeff** (Colorado State University)  
**Arthur, James** (University of Toronto)  
**Asgari, Mahdi** (Oklahoma State University)  
**Bauer, Mark** (University of Calgary)  
**Chaudouard, Pierre-Henri** (Université Paris-Sud)  
**Choi, Kwangho** (Purdue University)  
**Christie, Aaron** (University of Calgary)  
**Clozel, Laurent** (Université Paris-Sud)  
**Cornut, Christophe** (CNRS)  
**Cunningham, Clifton** (University of Calgary)  
**Gordon, Julia** (University of British Columbia)  
**Haines, Thomas** (University of Maryland)  
**Ichino, Atsushi** (Osaka City University)  
**Jiang, Dihua** (University of Minnesota)  
**Kaletha, Tasho** (Princeton University)  
**Kamgarpour, Masoud** (University of British Columbia)  
**Lapid, Erez** (Hebrew University)  
**Li, Wen-Wei** (Institut de Mathématiques de Jussieu)  
**Mezo, Paul** (Carleton University)  
**Minguez, Alberto** (Institut de Mathématiques de Jussieu)  
**Moeglin, Colette** (Institut de Mathématiques de Jussieu)  
**Morel, Sophie** (Harvard University)  
**Morimoto, Kazuki** (Osaka City University)  
**Prasad, Dipendra** (Tata Institute of Fundamental Research)  
**Roe, David** (University of Calgary)  
**Sakellaridis, Yiannis** (Rutgers University)  
**Sandeep Varma, Vadakkumkoor** (University of Chicago)  
**Savin, Gordan** (Utah University)  
**Shelstad, Diana** (Rutgers University)  
**Shin, Sug Woo** (Massachusetts Institute of Technology)  
**Smithling, Brian** (University of Toronto)  
**Spice, Loren** (Texas Christian University)  
**Stroh, Benoit** (Institut Galilée - Université Paris 13)  
**Templier, Nicolas** (Princeton University)  
**Urban, Eric** (Institut Mathématique de Jussieu)  
**Vatsal, Vinayak** (University of British Columbia)  
**Waldspurger, Jean-Loup** (Institut de Mathématiques de Jussieu)  
**White, Paul-James** (IHES)  
**Xu, Bin** (University of Toronto)  
**Yamana, Shunsuke** (Osaka City University)

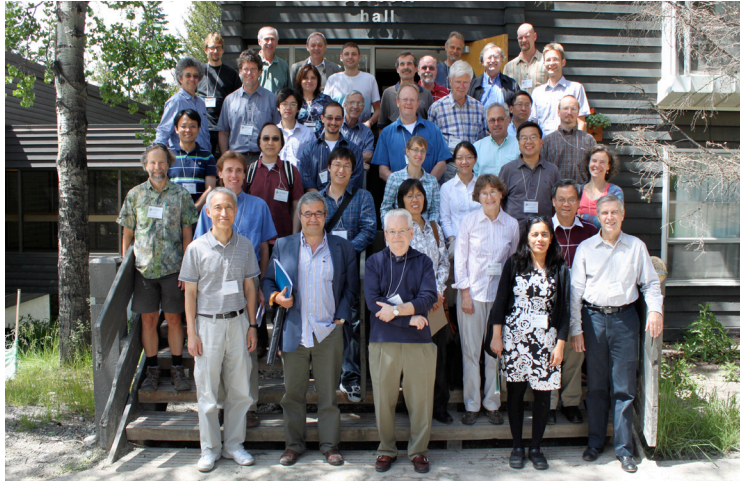
# Emerging Challenges at the Interface of Mathematics, Environmental Science and Spatial Eco

## July 3-8, 2011

### Organizers:

**Steve Cantrell** (University of Miami)  
**Robert Holt** (University of Florida)

**Mark Lewis** (University of Alberta)



Traditional mathematical models in ecology, epidemiology, evolution, and related areas typically assume that the environment is uniform in time and space and that the transport of organisms, chemicals, genes, and pathogens through the environment is random. In reality, many environments are heterogeneous in time and/or space and many physical processes and behavioral responses involve nonrandom transport. The proposed workshop investigated the impact of spatial and temporal heterogeneity on biological populations. This work posed important intellectual challenges in applied mathematics and theoretical biology. It also represented a crucial, necessary ingredient in understanding, predicting, and, hopefully, mitigating the impacts of global environmental change. This workshop was therefore timely and critical both in terms of basic understanding, and for developing tools that are important in applied arenas.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5106>

### Participants:

**Abrams, Peter** (University of Toronto)  
**Allen, Linda** (Texas Tech University)  
**Berestycki, Henri** (L'Ecole des Hautes Etudes en Sciences Sociales Paris)  
**Bokil, Vrushali** (Oregon State University)  
**Cantrell, Steve** (University of Miami)  
**Cosner, Chris** (University of Miami)  
**Cressman, Ross** (Wilfrid Laurier University)  
**DeAngelis, Don** (University of Miami)  
**Diekmann, Odo** (Universiteit Utrecht)  
**Fagan, William** (University of Maryland)  
**Gutierrez, Juan B.** (Ohio State University)  
**Hadeler, Karl** (University of Tuebingen)  
**Hastings, Alan** (University of California Davis)  
**Hilker, Frank** (University of Bath)  
**Hillen, Thomas** (University of Alberta)  
**Holt, Robert** (University of Florida)  
**Hsu, S.B.** (National Tsing-Hua University)  
**Jin, Yu** (University of Alberta)  
**Krivan, Vlastimil** (Biological Research Center)  
**Lewis, Mark** (University of Alberta)  
**Lin, Xihui** (University of Alberta)

**Lopez-Gomez, Julian** (Universidad Complutense de Madrid)  
**Lou, Yuan** (Ohio State University)  
**Lutscher, Frithjof** (University of Ottawa)  
**Martinez, Salome** (Universidad de Chile)  
**Ni, Wei-Ming** (University of Minnesota)  
**Nisbet, Roger** (UC Santa Barbara)  
**Ovaskainen, Otso** (University of Helsinki)  
**Pang, Peter** (National University of Singapore)  
**Petrovskii, Sergei** (University of Leicester)  
**Powell, Jim** (Utah State University)  
**Ruan, Shigui** (University of Miami)  
**Ryan, Daniel** (University of Miami)  
**Schlaegel, Ulrike** (University of Alberta)  
**Shen, Wenxian** (Auburn University)  
**Shi, Junping** (College of William and Mary)  
**Smith, Hal** (Arizona State University)  
**Tyson, Rebecca** (University of British Columbia Okanagan)  
**Wang, Hao** (University of Alberta)  
**Zhao, Xiao-Qiang** (Memorial University)

# Geometric Properties of Solutions of Nonlinear PDEs and their Applications

## July 17-22, 2011

### Organizers:

**Andrea Colesanti** (University of Florence)  
**Vincenzo Ferone** (Università di Napoli Federico II)

**Pengfei Guan** (McGill University)  
**Paolo Salani** (Università degli Studi di Firenze)



This workshop focused primarily on the study of qualitative properties of solutions of nonlinear elliptic and parabolic partial differential equations. This workshop brought together researchers working in this area to intensify interaction between the different groups. The study of qualitative properties of solutions is one of the most important areas in the field of partial differential equations. Several directions of research can be included in this area and this workshop covered in various ways most of them. Among these different directions, the aim of the workshop was to focus on convexity type properties of solutions to boundary value problems for elliptic and parabolic operators. This remains a very active field and recent developments gave new impulse to this topic in the last few years. The main target here was to determine structure conditions on the differential operator which allows to deduce convexity, or power convexity, or log-convexity, or quasi-convexity of the solution.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5019>

### Participants:

**Bian, Baojun** (Tongji University)  
**Brandolini, Barbara** (Università degli Studi di Napoli Federico II)  
**Brasco, Lorenzo** (Università degli Studi di Napoli Federico II)  
**Cabre, Xavier** (ICREA and Universitat Politècnica de Catalunya)  
**Cianchi, Andrea** (Università di Firenze)  
**Colesanti, Andrea** (University of Florence)  
**Dolbeault, Jean** (University of Paris Dauphine)  
**Enache, Cristian** (Ovidius University of Constanta)  
**Ferone, Vincenzo** (Università di Napoli Federico II)  
**Gazzola, Filippo** (Politecnico di Milano)  
**Guan, Pengfei** (McGill University)  
**Gutierrez, Cristian** (Temple University)  
**Henrot, Antoine** (Institut Elie Cartan)  
**Hurri-Syrjanen, Ritva** (University of Helsinki)  
**Ishige, Kazuhiro** (Tohoku University)  
**Kawohl, Bernd** (University of Koeln)

**Li, Qun** (Wright State University)  
**Lin, Chang-Shou** (National Taiwan University)  
**Ma, Xinan** (University of Science and Technology of China)  
**Magnanini, Rolando** (University of Florence)  
**Nguyen, Phuc** (Louisiana State University)  
**Ni, Lei** (University of California, San Diego)  
**Nitsch, Carlo** (Università di Napoli Federico II)  
**Philippin, Gerard A.** (Laval University)  
**Prajapat, Jyotshana V.** (The Petroleum Institute)  
**Reichel, Wolfgang** (Karlsruhe Institute of Technology)  
**Sakaguchi, Shigeru** (Hiroshima University)  
**Salani, Paolo** (Università degli Studi di Firenze)  
**Spruck, Joel** (Johns Hopkins University)  
**Stanczy, Robert** (Uniwersytet Wrocławski)  
**Trombetti, Cristina** (Federico II University)  
**Xiao, Jie** (Memorial University of Newfoundland)  
**Yang, Deane** (Polytechnic Institute of NYU)

# Localized Multi-Dimensional Patterns in Dissipative Systems: Theory, Modeling, and Experiments

## July 24-29, 2011

### Organizers:

**Bernard Deconinck** (University of Washington)  
**Arjen Doelman** (Leiden University)  
**Edgar Knobloch** (University of California Berkeley)

**Yasumasa Nishiura** (Hokkaido University)  
**Bjorn Sandstede** (Brown University)  
**Michael Ward** (University of British Columbia)



This five-day workshop provided a forum for the dissemination of current advances in the mathematical analysis, computational modeling, and experimental realizations of localized patterns and coherent structures arising in fluids, nonlinear optics, chemistry, and materials science. The aim was to bring together theoreticians and experimentalists working on localized pattern formation problems in diverse applications and from different viewpoints to uncover common analytical or modeling approaches that either advanced our mathematical understanding or helped explain key experimental results relating to localized pattern formation. A key feature of this workshop was the goal to invite some noted experimentalists who have observed and characterized localized patterns in diverse real-world laboratory experiments. Our aim was to bring to the forefront the sub-discipline of “localized pattern formation” as an emerging and highly-active interdisciplinary area of pattern formation with many challenging and interesting open directions.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5091>

### Participants:

**Ackemann, Thorsten** (Strathclyde University)  
**Beck, Margaret** (Boston University)  
**Budd, Chris** (University of Bath)  
**Burke, John** (Boston University)  
**Champneys, Alan** (University of Bristol)  
**Chen, Wan** (Oxford University)  
**Curtis, Chris** (University Colorado at Boulder)  
**Dawes, Jonathan** (University of Bath)  
**Deconinck, Bernard** (University of Washington)  
**Doelman, Arjen** (Leiden University)  
**Ei, Shin-ichiro** (Institute of Mathematics for Industry, Kyushu University)  
**Epstein, Irving** (Brandeis University)  
**Gavish, Nir** (Michigan State University)  
**Ghazaryan, Anna** (Miami University)  
**Haragus, Mariana** (Université de Franche-Comté)  
**Iima, Makoto** (Hokkaido University)  
**Iron, David** (Dalhousie University)  
**Johnson, Mat** (Indiana University)  
**Kaper, Tasso** (Boston University)  
**Knobloch, Edgar** (University of California Berkeley)  
**Kokolnikov, Theodore** (Dalhousie University)

**Kondo, Shigeru** (Osaka University)  
**Kozyreff, Gregory** (Université Libre de Bruxelles)  
**Lloyd, David** (University of Surrey)  
**McCalla, Scott** (Brown University)  
**Nec, Yana** (University of British Columbia)  
**Nishiura, Yasumasa** (Hokkaido University)  
**Promislow, Keith** (Michigan State University)  
**Purwins, H.G.** (University of Münster)  
**Rademacher, Jens** (Centrum Wiskunde & Informatica)  
**Ren, Xiaofeng** (George Washington University)  
**Richter, Reinhard** (University of Bayreuth)  
**Sandstede, Bjorn** (Brown University)  
**Scheel, Arnd** (University of Minnesota)  
**Schneider, Tobias** (Harvard University)  
**Showalter, Ken** (West Virginia University)  
**Teramoto, Takashi** (Chitose Institute of Science and Technology)  
**van Heijster, Peter** (Brown University)  
**Ward, Michael** (University of British Columbia)  
**Wei, Jun Cheng** (Chinese University of Hong Kong)  
**Weinstein, Michael** (Columbia University)  
**Yamaguchi, Tomohiko** (AIST Japan)

# Mathematical Biology of the Cell: Cytoskeleton and Motility

## July 31 - August 5, 2011

### Organizers:

**Anders Carlsson** (Washington University)  
**Adriana Dawes** (University of Alberta)  
**David Sept** (University of Michigan)

**Leah Edelstein-Keshet** (University of British Columbia)



Underlying the process of cell motility are complex biochemical and biophysical mechanisms that enable cells to detect chemical signals, rearrange their internal structure (“cytoskeleton”), exert forces on their surroundings and move towards their targets. Understanding such phenomena mandates close cooperation between scientists who produce experimental data, and those quantitative scientists who can help to decipher it using tools of mathematics and physics. Discussions aimed at fostering such collaboration formed the major theme of this workshop. This workshop brought together top experts from biology and from theoretical quantitative sciences for an intensive discussion of science at the leading edge of cell motility and the cytoskeleton. We explored the details of the molecular machinery (actin, myosin, microtubules, and proteins that affect these), how these are assembled in the moving cell, and their role in cell motility. We additionally compared normal and abnormal motility across many cell types and conditions, and discussed promising avenues for modeling and theoretical-experimental collaborations.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5050>

### Participants:

**Allard, Jun** (UC Davis)  
**Carlsson, Anders** (Washington University)  
**Condeelis, John** (Albert Einstein College of Medicine)  
**Cooper, John** (Washington University School of Medicine)  
**Danuser, Gaudenz** (Harvard Medical School)  
**Dawes, Adriana** (University of Alberta)  
**Edelstein-Keshet, Leah** (University of British Columbia)  
**Falcke, Martin** (Max Delbrück Center Berlin)  
**Fletcher, Dan** (University of California Berkeley)  
**Gardel, Margaret** (University of Chicago)  
**Gardner, Melissa** (University of Minnesota)  
**Goodson, Holly** (University of Notre Dame)  
**Holmes, Bill** (University of British Columbia)  
**Janmey, Paul** (University of Pennsylvania)  
**Kasza, Karen** (Sloan-Kettering Institute)  
**Keren, Kinneret** (Technion University)  
**Kozlov, Michael** (Tel Aviv University)  
**Levine, Herbert** (University of California San Diego)  
**Loew, Leslie** (University of Connecticut)  
**MacKintosh, Fred** (Vrije Universiteit)  
**Mogilner, Alex** (University of California, Davis)  
**Nathke, Inke** (University of Dundee)  
**Odde, David** (University of Minnesota)  
**Oegema, Karen** (Ludwig Institute for Cancer Research)  
**Paluch, Ewa** (Max Planck Institute of Molecular Cell Biology and Genetics)  
**Pollard, Thomas D.** (Yale University)  
**Rodewald, Richard** (National Science Foundation)  
**Ross, Jennifer** (University of Massachusetts Amherst)  
**Sept, David** (University of Michigan)  
**Sun, Sean** (John Hopkins)  
**Svitkina, Tatyana** (University of Pennsylvania)  
**Sykes, Cécile** (Institut Curie)  
**Tang, Jay** (Brown University)  
**Tania, Nissy** (University of British Columbia)  
**Upadhyaya, Arpita** (University of Maryland)  
**Vavylonis, Dimitrios** (Lehigh University)  
**Verkhovsky, Alexander** (EPFL Lausanne)  
**Weiner, Orion** (University of California San Francisco)  
**White, Diana** (University of Alberta)  
**Wirtz, Denis** (Johns Hopkins University)  
**Zallen, Jennifer** (Sloan-Kettering Institute)

# Twenty-five Years of Representation Theory of Quantum Groups August 7-12, 2011

## Organizers:

**Pavel Etingof** (Massachusetts Institute of Technology)  
**Victor Ginzburg** (University of Chicago)

**Nicolas Guay** (University of Alberta)  
**David Hernandez** (Université Paris 7)  
**Alistair Savage** (University of Ottawa)



The objective of this workshop was to bring together experienced mathematicians, many of whom have contributed to some of the main advances in the theory of quantum groups, and younger researchers with a special interest in this topic. This workshop gave these mathematicians an opportunity to survey the important open conjectures from the past which are still relevant today and pave the way for future research on quantum groups in light of the recent advances on this subject.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5096>

## Participants:

**Benkart, Georgia** (University of Wisconsin - Madison)  
**Brundan, Jonathan** (University of Oregon)  
**Cliff, Gerald** (University of Alberta)  
**Enriquez, Benjamin** (Université de Strasbourg)  
**Frenkel, Igor** (Yale University)  
**Gautam, Sachin** (Northeastern University)  
**Ginzburg, Victor** (University of Chicago)  
**Greenstein, Jacob** (University of California Riverside)  
**Guay, Nicolas** (University of Alberta)  
**Hernandez, David** (Université Paris 7)  
**Jordan, David** (Massachusetts Institute of Technology)  
**Kamnitzer, Joel** (University of Toronto)  
**Kim, Jeong-Ah** (University of Seoul)  
**Licata, Anthony** (Institute for Advanced Study, Australian National University)  
**Molev, Alexander** (University of Sydney)  
**Moura, Adriano** (Universidade Estadual de Campinas)  
**Mukhin, Evgeny** (University-Purdue University Indianapolis)

**Nakanishi, Tomoki** (Nagoya University)  
**Nazarov, Maxim** (University of York)  
**Okado, Masato** (Osaka University)  
**Savage, Alistair** (University of Ottawa)  
**Schilling, Anne** (University of California Davis)  
**Shin, Dong-Uy** (Hanyang University)  
**Soergel, Wolfgang** (University of Freiburg)  
**Stroppel, Catharina** (Universität Bonn)  
**Tingley, Peter** (Massachusetts Institute of Technology)  
**Toledano Laredo, Valerio** (Northeastern University)  
**Varagnolo, Michela** (Université de Cergy-Pontoise)  
**Vasserot, Eric** (University Paris 7)  
**Wang, Weiqiang** (University of Virginia)  
**Webster, Ben** (University of Oregon)  
**Wilcox, Stewart** (University of Alberta)  
**Yakimov, Milen** (Louisiana State University)  
**Young, Charles** (University of York)

# Algebraic Structure in Network Information Theory

## August 14-19, 2011

### Organizers:

**Michael Gastpar** (University of California, Berkeley)    **Frank Kschischang** (University of Toronto)



This workshop brought together experts from pure and applied mathematics, computer science, and electrical engineering to tackle problems of central importance in digital communications and information theory. The problems that this workshop focused on were not only of theoretical interest, but also of great practical significance, as they are directly motivated by the need to find increasingly efficient and robust coding schemes for error-free transmission and storage of data. The current grand challenge is to devise strategies and architectures to optimally exploit communication networks. An emerging insight is that a key role in the development of the next generation of network protocols will go to Algebra. The aim of the workshop was to provide an environment within which mathematicians and computer scientists with expertise in algebraic structure could interact and exchange ideas with experts from digital communications and information theory.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5074>

### Participants:

**Boston, Nigel** (University of Wisconsin)  
**Bresler, Guy** (University of California at Berkeley)  
**Cadambe, Viveck** (University of California at Irvine)  
**Chung, Sae-Young** (Korea Advanced Institute of Science and Technology)  
**Devroye, Natasha** (University of Illinois at Chicago)  
**Dimakis, Alex** (University of Southern California)  
**Erez, Uri** (Tel Aviv University)  
**Feng, Chen** (University of Toronto)  
**Gastpar, Michael** (University of California, Berkeley)  
**Hassibi, Babak** (California Institute of Technology)  
**Ho, Tracey** (California Institute of Technology)  
**Ishwar, Prakash** (Boston University)  
**Khisti, Ashish** (University of Toronto)  
**Kramer, Gerhard** (Technical University Munich)  
**Kschischang, Frank** (University of Toronto)  
**Maddah-Ali, Mohammad Ali** (Alcatel-Lucent Bell Laboratories)  
**Morrison, Katie** (University of Nebraska - Lincoln)  
**Narayanan, Krishna** (Texas A&M University)  
**Nazer, Bobak** (Boston University)  
**Niesen, Urs** (Alcatel-Lucent Bell Laboratories)  
**Nokleby, Matthew** (Rice University)  
**Oggier, Frederique** (Nanyang Technological University)  
**Pradhan, Sandeep** (University of Michigan at Ann Arbor)  
**Rosenthal, Joachim** (University of Zurich)  
**Shamai, Shlomo** (Technion Israel Institute of Technology)  
**Silva, Danilo** (Federal University of Santa Catarina)  
**Song, Yiwei** (University of Illinois at Chicago)  
**Stanczak, Slawomir** (Fraunhofer Heinrich-Hertz-Institute, Technical University of Berlin)  
**Trautmann, Anna-Lena** (University of Zurich)  
**Vardy, Alexander** (University of California San Diego)  
**Vishwanath, Sriram** (University of Texas at Austin)  
**Viterbo, Emanuele** (Monash University Melbourne)  
**Wagner, Aaron** (Cornell University)  
**Xie, Liang-Liang** (University of Waterloo)  
**Yener, Aylin** (Pennsylvania State University)  
**Zamir, Ram** (Tel Aviv University)  
**Zhan, Jiening** (University of California at Berkeley)

# Crossing Numbers Turn Useful

## August 21-26, 2011

### Organizers:

**Dan Archdeacon** (University of Vermont)

**Gelasio Salazar** (Universidad Autonoma de San Luis Potosi)

**Laszlo Szekely** (University of South Carolina)



The objective of this workshop was to bring together people who arrived at crossing numbers from different directions: topological graph theorists who want to prove general theorems of a structural character; computer scientists who are interested in asymptotic results or estimates on crossing numbers of very large graphs; other computer scientists who are interested in several variants of the crossing number problem to model chip-design problems and want algorithms; network scientists, who look for graph theoretic concepts potentially useful at grasping the complexity of networks; and discrete geometers who use crossing numbers as a proof technique. This workshop effectively brought together experts from around the world who study such lay-out problems from both their theoretical side and from their practical applications, allowing issues important to each perspective to be enhanced by those studied by the other.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5144>

### Participants:

**Aichholzer, Oswin** (TU Graz)

**Archdeacon, Dan** (University of Vermont)

**Balogh, Jozsef** (University of Illinois at Urbana)

**Bokal, Drago** (University of Maribor)

**Cabello, Sergio** (University of Ljubljana)

**Chimani, Markus** (Friedrich-Schiller-University Jena)

**Cranston, Dan** (Virginia Commonwealth University)

**Czabarka, Eva** (University of South Carolina)

**Duncan, Christian** (Louisiana Tech University)

**Dvorak, Zdenek** (Charles University, Prague)

**Fernandez-Merchant, Silvia** (California State University, Northridge)

**Hlineny, Petr** (Masaryk University)

**Leanos, Jesus** (Universidad Autonoma de Zacatecas)

**Mohar, Bojan** (Simon Fraser University)

**Mutzel, Petra** (Technische Universität Dortmund)

**Ramos, Pedro** (Universidad de Alcala)

**Richter, Bruce** (University of Waterloo)

**Salazar, Gelasio** (Universidad Autonoma de San Luis Potosi)

**Szekely, Laszlo** (University of South Carolina)

**Toth, Csaba** (University of Calgary)



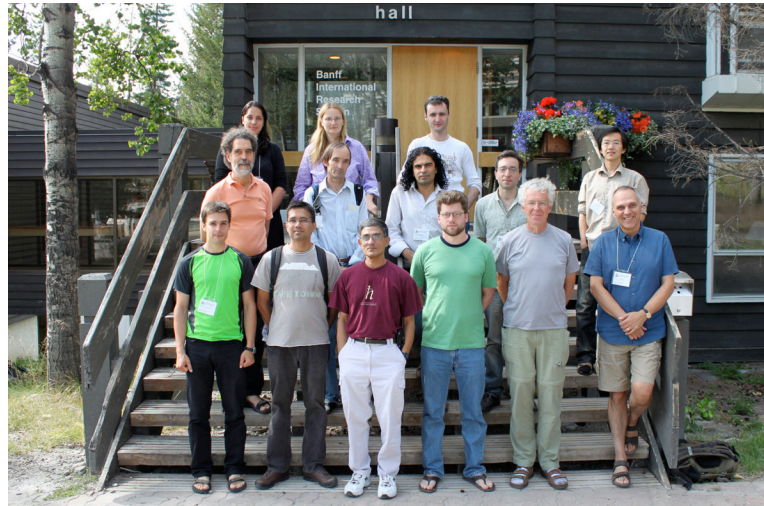
# Self Adjoint Extensions and Singularity Resolution in String Theory and Quantum Gravity

## August 21-26, 2011

### Organizers:

**Robert Brandenberger** (McGill University)  
**Walter Craig** (McMaster University)  
**Thomas Thiemann** (Albert Einstein Institute, Golm)

**Neil Turok** (Perimeter Institute)  
**Mark Van Raamsdonk** (University of British Columbia)



Recently there have been several proposals for how singularities in this field might be overcome by making use of ideas from superstring theory and quantum gravity. However, these approaches have not been sufficiently developed from the mathematical point of view. The objective of this workshop was to bring together physicists and mathematicians who are interested in problems of physical importance in quantum mechanics, quantum field theories, and general relativity, and in particular experts in the problem of self-adjoint extensions in operator theory, to promote discussions and stimulate novel collaborations. Physicists involved included string theorists, loop quantum gravity experts and cosmologists. A secondary goal of this workshop was to encourage more collaborations and discussions between the relevant research communities in theoretical physics, namely string theorists and loop gravity experts.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5080>

### Participants:

**Bojowald, Martin** (The Pennsylvania State University)  
**Brandenberger, Robert** (McGill University)  
**Craig, Walter** (McMaster University)  
**Das, Sumit** (University of Kentucky)  
**Dittrich, Bianca** (Albert Einstein Institute)  
**Ferreira, Elisa** (University of Sao Paulo, McGill University)  
**Kaminski, Wojciech** (Albert Einstein Institute in Golm, Max Planck)  
**Kamran, Niky** (McGill University)

**Lowe, David** (Brown University)  
**Pawlowski, Tomasz H** (University of New Brunswick)  
**Saremi, Omid** (University of California Berkeley)  
**Smolkin, Misha** (Perimeter Institute)  
**Vaidya, Sachindeo** (Indian Institute of Science, McGill University)  
**Wang, Yi** (McGill University)  
**Wunsch, Jared** (Northwestern University)  
**Yngvason, Jakob** (Universität Wien)

# Geometry for Anatomy

## August 28 - September 2, 2011

### Organizers:

**Ghassan Hamarneh** (Simon Fraser University)

**Hao (Richard) Zhang** (Simon Fraser University)

**Stephen Pizer** (University of North Carolina, Chapel Hill)



Medical Imaging is providing clinicians and scientists exceptional views of internal anatomy. In order to take a full advantage of the information provided in the images, first the surfaces of these intricate and complex anatomical structures must be extracted from these images by experienced doctors or by highly-automated computer algorithms to improve efficiency and robustness. The shape and variability of anatomical structures must also be encoded in robust and expressive ways allowing for qualitative and quantitative information extraction. The focus of this workshop was the study of mathematical and computational geometric representations, processing, analysis, and visualization techniques of internal anatomical structures.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5018>

### Participants:

**Abugarbieh, Rafeef** (University of British Columbia)

**Amenta, Nina** (University of California)

**Andrews, Shawn** (Simon Fraser University)

**Booth, Brian** (Simon Fraser University)

**Damon, James** (University of North Carolina)

**Deng, Zhigang** (University of Houston)

**Dryden, Ian** (University of South Carolina)

**Fletcher, Tom** (University of Utah)

**Florack, Luc** (Eindhoven University of Technology)

**Giblin, Peter** (University of Liverpool)

**Grady, Leo** (Siemens Corporate Research)

**Grimm, Cindy** (Washington University)

**Groeller, M. Eduard** (Vienna University of Technology)

**Hamarneh, Ghassan** (Simon Fraser University)

**Huckemann, Stephan** (University of Goettingen)

**Jacob, Christian** (University of Calgary)

**Joshi, Sarang** (University of Utah)

**Jung, Sungkyu** (University of Pittsburgh)

**Kazhdan, Michael** (Johns Hopkins University)

**Kim, Peter** (University of Guelph)

**Kindlmann, Gordon** (University of Chicago)

**Kurtek, Sebastian** (Florida State University)

**Marron, J. S.** (University of North Carolina)

**Moeller, Torsten** (Simon Fraser University)

**Nielsen, Mads** (University of Copenhagen)

**Penec, Xavier** (INRIA-France)

**Pierrynowski, Michael** (McMaster University)

**Pizer, Stephen** (University of North Carolina, Chapel Hill)

**Pottmann, Helmut** (King Abdullah University of Science and Technology)

**Saad, Ahmed** (Simon Fraser University)

**Sheffer, Alla** (University of British Columbia)

**Siddiqi, Kaleem** (McGill University)

**Sommer, Stefan** (University of Copenhagen)

**Srivastava, Anuj** (Florida State University)

**Sundaramoorthi, Ganesh** (King Abdullah University of Science and Technology)

**Tagliasacchi, Andrea** (Simon Fraser University)

**Taylor, Chris** (University of Manchester)

**van Kaick, Oliver** (Simon Fraser University)

**Whitaker, Ross T.** (University of Utah)

**Yezzi, Anthony** (Georgia Tech)

**Zhang, Hao (Richard)** (Simon Fraser University)

**Zhou, Kevin** (Siemens Corporate Research)

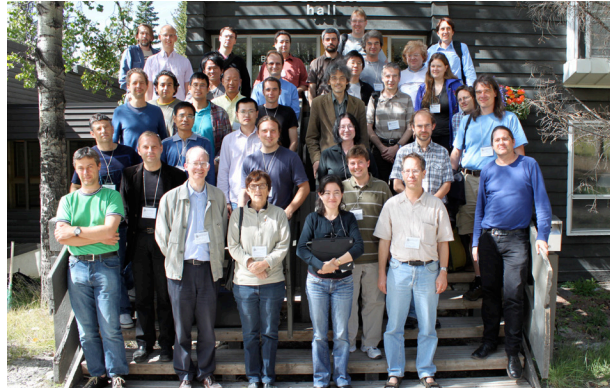
# Cluster Algebras, Representation Theory, and Poisson Geometry

## September 4-9, 2011

### Organizers:

**Thomas Brüstle** (Universite de Sherbrooke,  
Bishop's University)  
**Hugh Thomas** (University of New Brunswick)

**Michael Shapiro** (Michigan State University)  
**Christof Geiss** (Universidad Nacional Autónoma de México)



Suppose you have a blown-up balloon, with a lot of dots marked on it, and you measure the distance between each pair of dots. That collection of information is what mathematicians would call a “metric” for the balloon. If you blew more air into the balloon, or if you squashed it or stretched it, those distances would change. This shows that there are lots of different metrics which could exist for the same balloon. Teichmueller theory is concerned with studying the collection of all the different metrics that could exist for the same surface. Cluster algebras were invented less than ten years ago by Sergei Fomin and Andrei Zelevinsky, and since then have appeared in a wide variety of contexts in mathematics and physics, including Teichmueller theory. It turns out that any surface has a cluster algebra associated to it, and the cluster algebra encodes all possible coordinate systems of the space of metrics for the surface. These cluster algebras were a particular focus of this meeting.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5137>

### Participants:

**Barot, Michael** (Universidad Nacional Autonoma de Mexico)  
**Berenstein, Arkady** (University of Oregon)  
**Brüstle, Thomas** (Universite de Sherbrooke, Bishop's University)  
**Buan, Aslak** (The Norwegian University of Science and Technology (NTNU) in Trondheim)  
**Chapoton, Frédéric** (Université Claude Bernard Lyon 1)  
**Demonet, Laurent** (University of Nagoya Japan)  
**Di Francesco, Philippe** (Institut de Physique Theorique du Commissariat a l'Energie Atomique)  
**Early, Nick** (The Pennsylvania State University)  
**Geiss, Christof** (Universidad Nacional Autónoma de México)  
**Gekhtman, Misha** (University of Notre Dame)  
**Hernandez, David** (Université Paris 7)  
**Iyama, Osamu** (Nagoya University)  
**Kedem, Rinat** (University of Illinois)  
**Keller, Bernhard** (University Paris Diderot - Paris 7)  
**Knutson, Allen** (Cornell University)  
**Labardini, Daniel** (Universität Bonn)  
**Lampe, Philipp** (University of Bielefeld)  
**Le, Ian** (Northwestern University)  
**Leclerc, Bernard** (Universite de Caen)

**Muller, Greg** (Louisiana State University)  
**Musiker, Gregg** (University of Minnesota)  
**Nagao, Kentaro** (Nagoya University)  
**Nakajima, Hiraku** (Kyoto University)  
**Nakanishi, Tomoki** (Nagoya University)  
**Palu, Yann** (Leeds University)  
**Plamondon, Pierre-Guy** (Universite Paris 7)  
**Qin, Fan** (Université Paris 7)  
**Reiten, Idun** (Norwegian University of Science and Technology)  
**Rupel, Dylan** (University of Oregon)  
**Schiffler, Ralf** (University of Connecticut)  
**Schroer, Jan** (University of Bonn)  
**Shapiro, Michael** (Michigan State University)  
**Talaska, Kelli** (University of California-Berkeley)  
**Thomas, Hugh** (University of New Brunswick)  
**Todorov, Gordana** (Northeastern University)  
**Tumarkin, Pavel** (Jacobs University Bremen)  
**Williams, Lauren** (U.C. Berkeley)  
**Yakimov, Milen** (Louisiana State University)  
**Zhang, Jie** (Universite de Sherbrooke)  
**Zhu, Bin** (Tsinghua University)  
**Zwickenagl, Sebastian** (Mathematisches Institut der Universität Bonn Germany)

# Stochasticity in Biochemical Reaction Networks

## September 11-16, 2011

### Organizers:

**Sotiria Lampoudi** (University of California Santa Barbara)  
**Brian Munsky** (Los Alamos National Laboratory)

**David Thorsley** (Biotechnology HPC Software Applications Institute)  
**Aleksandra Walczak** (Ecole Normale Superieure)



Living cells function in a random evolving environment - molecules diffuse in random directions and chemical reactions occur at random times. Robust, reliable cellular processes have evolved from noisy parts living in a noisy environment by developing methods to either reject or exploit randomness. Understanding how cells function in their “stochastic” environments will allow researchers to make advances in areas as diverse as medicine, molecular computing and nanotechnology. This workshop united researchers working on different aspects of the problem of understanding the role of stochasticity in biochemical systems. Experts in developing mathematical methods to describe cellular behavior, experimentally analyzing biochemical processes, performing advanced computations of stochastic behavior, and designing novel biological devices worked together to share the latest results in this exciting area of research and define new research directions for future study.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5140>

### Participants:

**Allen, Rosalind** (University of Edinburgh)  
**Balazsi, Gabor** (The University of Texas MD Anderson Cancer Center)  
**Becker, Nils** (AMOLF)  
**Becskei, Attila** (University of Zurich)  
**Boettiger, Alistair** (University of California at Berkeley)  
**Burger, Anat** (University of California at San Diego)  
**Cox, Daniel** (University of California at Davis)  
**Daigle, Bernie** (University of California at Santa Barbara)  
**Dunlop, Mary** (University of Vermont)  
**Egbert, Robert** (University of Washington)  
**Emberly, Eldon** (Simon Fraser University)  
**Estevez-Torres, Andre** (Centre national de la Recherche Scientifique)  
**Ferreiro, Diego** (Universidad de Buenos Aires)  
**Franco, Elisa** (University of California at Riverside)  
**Francois, Paul** (McGill University)  
**Hellander, Andreas** (University of California at Santa Barbara)  
**Hilfinger, Andreas** (Harvard Medical School)  
**Joo, Jaewook** (University of Tennessee- Knoxville)  
**Lampoudi, Sotiria** (University of California Santa Barbara)  
**Lillacci, Gabriele** (University of California at Santa Barbara)

**Maheshri, Narendra** (Massachusetts Institute of Technology)  
**Meyer-Rojas, Pablo** (IBM research)  
**Molina, Nacho** (Ecole Polytechnique Federale de Lausanne)  
**Mora, Thierry** (Ecole Normale Superieure)  
**Mulger, Andrew** (Fundamental Research on Matter Institute, Amsterdam)  
**Munsky, Brian** (Los Alamos National Laboratory)  
**Nemenman, Ilya** (Emory University)  
**Neuert, Gregor** (Massachusetts Institute of Technology)  
**Payne, Stephen** (Duke University)  
**Rondelez, Yannick** (The University of Tokyo)  
**Scott, Matthew** (University of Waterloo)  
**Shimizu, Tom** (AMOLF)  
**Singh, Abhyudai** (University of Delaware)  
**Suel, Gurol** (University of Texas Southwestern Medical Center)  
**Swain, Peter S.** (Centre for Systems Biology at Edinburgh, University of Edinburgh)  
**Thorsley, David** (Biotechnology HPC Software Applications Institute)  
**Venturelli, Ophelia** (Caltech)  
**Walczak, Aleksandra** (Ecole Normale Superieure)  
**Werner, James** (Los Alamos National Laboratory)  
**You, Lingchong** (Duke University)  
**Zilman, Anton** (University of Toronto)

# Foundations of Stochastic Analysis

## September 18-23, 2011

### Organizers:

Zhen-Qing Chen (University of Washington)

Takashi Kumagai (RIMS Kyoto)



Stochastic Analysis takes a central place in modern probability theory, and has numerous interactions with other areas of mathematics and sciences. Over the years, the foundations of stochastic analysis included various specific topics, such as the general theory of Markov processes, the general theory of stochastic integration, the theory of martingales, Malliavin calculus, the martingale-problem approach to Markov processes, and the Dirichlet form approach to Markov processes. The scientific goal of this workshop was to bring together top experts in stochastic analysis representing its various branches, with the common theme of developing new foundational methods and their applications to specific areas of probability. We stressed the geographic diversity of the participants to create new links across the field, and also to invited some of the most promising junior mathematicians.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5077>

### Participants:

**Banuelos, Rodrigo** (Purdue University)  
**Barlow, Martin** (University of British Columbia)  
**Bass, Richard** (University of Connecticut)  
**Bogdan, Krzysztof** (Wroclaw University of Technology)  
**Burdzy, Krzysztof** (University of Washington)  
**Chen, Zhen-Qing** (University of Washington)  
**Croydon, David** (University of Warwick)  
**Deuschel, Jean-Dominique** (Technische Universität Berlin)  
**Eisenbaum, Nathalie** (CNRS - University of Paris VI)  
**Evans, Steve** (University of California, Berkeley)  
**Feng, Shui** (McMaster University)  
**Fitzsimmons, P. J.** (UC San Diego)  
**Fukushima, Masatoshi** (Osaka University)  
**Gordina, Masha** (University of Connecticut)  
**Hairer, Martin** (University of Warwick)  
**Hambly, Ben** (University of Oxford)  
**Hsu, Elton** (Northwestern University)  
**Kajino, Naotaka** (University of Bielefeld)  
**Kassmann, Moritz** (Bielefeld University)  
**Khoshnevisan, Davar** (University of Utah)  
**Kigami, Jun** (Kyoto University)

**Kim, Panki** (Seoul National University)  
**Kulczycki, Tadeusz** (Polish Academy of Sciences)  
**Kumagai, Takashi** (RIMS Kyoto)  
**Kwasnicki, Mateusz** (Polish Academy of Sciences)  
**Le Jan, Yves** (Université Paris Sud)  
**Li, Xuemei** (University of Warwick)  
**Pal, Soumik** (University of Washington)  
**Perkins, Ed** (University of British Columbia)  
**Ren, Yanxia** (Peking University)  
**Röckner, Michael** (Universität Bielefeld)  
**Schilling, Rene** (TU Dresden)  
**Song, Renming** (University of Illinois)  
**Sturm, Karl-Theodor** (University of Bonn)  
**Swanson, Jason** (University of Central Florida)  
**Takeda, Masayoshi** (Tohoku University)  
**Uemura, Toshihiro** (Kansai University)  
**Vondracek, Zoran** (University of Zagreb)  
**Winter, Anita** (Universität Duisburg-Essen)  
**Xiang, Kainan** (Nankai University)  
**Xiong, Jie** (University of Tennessee)

# Almost Periodic Order: Spectral, Dynamical, and Stochastic Approaches September 25-30, 2011

## Organizers:

**Michael Baake** (University of Bielefeld)

**David Damanik** (Rice University)

**Daniel Lenz** (Friedrich-Schiller-Universität Jena)



The theory of Aperiodic Order considers systems without periodicity yet with long-range positional order, often of high symmetry. It draws from deep connections between seemingly disjoint mathematical disciplines as well as from the existence of such structures in the real world, for instance in the form of quasicrystals. The field has been shaped considerably by the continuous effort of Robert V. Moody since the early 1990s, and this meeting focused on the recent developments by methods from dynamical systems, spectral theory and stochastics. At the same time, we celebrated Robert Moody's 70th birthday.

For details, please refer to the workshop webpage

<http://www.birs.ca/events/2011/5-day-workshops/11w5062>

## Participants:

**Akiyama, Shigeki** (Niigata University)

**Aliste Prieto, Jose** (Universidad de Chile)

**Baake, Michael** (University of Bielefeld)

**Barge, Marcy** (Montana State University)

**Bellissard, Jean** (Georgia Institute of Technology)

**Berman, Stephan** (University of Saskatchewan)

**Birkner, Matthias** (Universitaet Mainz)

**Boshernitzan, Michael** (Rice University)

**Breuer, Jonathan** (Hebrew University of Jerusalem)

**Cortez, Maria Isabel** (Universidad de Santiago de Chile)

**Damanik, David** (Rice University)

**Frank, Natalie Priebe** (Vassar College)

**Gähler, Franz** (Universität Bielefeld)

**Gambaudo, Jean-Marc** (Universite de Nice - Sophia Antipolis)

**Gorodetski, Anton** (UC Irvine)

**Grimm, Uwe** (The Open University)

**Julien, Antoine** (University of Victoria)

**Kellendonk, Johannes** (Institut Camille Jordan, University of Lyon)

**Lee, Jeong-Yup** (Kwandong University)

**Lenz, Daniel** (Friedrich-Schiller-Universität Jena)

**Maloney, Gregory** (University of Massachusetts)

**Mei, May** (UC Irvine)

**Miekisz, Jacek** (Warsaw University)

**Moody, Robert** (University of Victoria)

**Morita, Jun** (University of Tsukuba)

**Munger, Paul** (Rice University)

**Patera, Jiri** (Universite de Montreal)

**Petite, Samuel** (University of Picardie)

**Putnam, Ian** (University of Victoria)

**Richard, Christoph** (Department fuer Mathematik)

**Ringel, Claus Michael** (Universitaet Bielefeld)

**Sadun, Lorenzo** (University of Texas at Austin)

**Savinien, Jean** (Université Claude Bernard Lyon 1)

**Sing, Bernd** (University of the West Indies)

**Starling, Charles** (University of Ottawa)

**Stollmann, Peter** (TU Chemnitz)

**Strungaru, Nicolae** (Grant MacEwan University)

**Suto, Andras** (Hungarian Academy of Sciences)

**van Enter, Aernout** (University of Groningen)

**White, Tyler** (George Washington University)

**Yessen, William** (UC Irvine)

# Proof Complexity

## October 2-7, 2011

### Organizers:

**Samuel Buss** (University of California, San Diego)  
**Toni Pitassi** (University of Toronto)  
**Pavel Pudlak** (Institute of Mathematics, Prague)

**Stephen Cook** (University of Toronto)  
**Antonina Kolokolova** (Memorial University of Newfoundland)



Given a theorem, how short is its shortest proof? Is it possible to find a short proof efficiently? How complex are the concepts necessary to prove this theorem? These are just some of the questions studied in the field of proof complexity. One of the motivating questions is whether there is a formal system in which every propositional tautology has a proof of length polynomial in length of the tautology. At this workshop we brought together researchers in proof complexity and related areas and created an environment that facilitated the exchange and cross-fertilization of ideas. This helped to consolidate knowledge in proof complexity, bounded arithmetic, logical approaches to complexity theory and other related subjects, with a hope of making progress in this rich and exciting field.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5103>

### Participants:

**Aehlig, Klaus** (Universität München)  
**Atserias, Albert** (Universitat Politècnica de Catalunya)  
**Beame, Paul** (University of Washington)  
**Beck, Chris** (Princeton University)  
**Beyersdorff, Olaf** (Leibniz University Hannover)  
**Buss, Samuel** (University of California, San Diego)  
**Cook, Stephen** (University of Toronto)  
**Edmonds, Jeff** (York University)  
**Galesi, Nicola** (Università degli Studi di Roma La Sapienza)  
**Gallagher, Jonathan** (University of Calgary)  
**Georgiou, Konstantinos** (University of Waterloo)  
**Ghasemloo, Kaveh** (University of Toronto)  
**Hirsch, Edward** (Steklov Institute of Mathematics at St. Petersburg)  
**Hrubes, Pavel** (University of Calgary)  
**Impagliazzo, Russell** (University of California, San Diego)  
**Jerabek, Emil** (Mathematical Institute AS CZ)  
**Johannsen, Jan** (LMU Munich)  
**Kabanets, Valentine** (Simon Fraser University)  
**Kolodziejczyk, Leszek** (University of Warsaw)

**Kolokolova, Antonina** (Memorial University of Newfoundland)  
**Kullmann, Oliver** (Swansea University)  
**Kuroda, Satoru** (Gunma Prefectural Women's University)  
**Lauria, Massimo** (Institute of Mathematics AS CR)  
**Maciel, Alexis** (Clarkson University)  
**Mueller, Moritz** (CRM Centre de Recerca Matemàtica)  
**Muller, Sebastian** (Charles University)  
**Nguyen, Phuong** (McGill University)  
**Nordstrom, Jakob** (KTH Royal Institute of Technology)  
**Pankratov, Denis** (University of Chicago)  
**Pich, Jan** (Charles University)  
**Pitassi, Toni** (University of Toronto)  
**Pollett, Chris** (San Jose State University)  
**Pudlak, Pavel** (Institute of Mathematics, Prague)  
**Razborov, Alexander** (Institute for Advanced Study)  
**Robere, Robert** (Memorial University of Newfoundland)  
**Soltys, Michael** (McMasters University)  
**Thapen, Neil** (Mathematical Institute AS CR)  
**Tzameret, Iddo** (Tsinghua University)  
**Urquhart, Alasdair** (University of Toronto)  
**Wang, Zi Chao** (Charles University in Prague)

# High Dimensional Probability

## October 9-14, 2011

### Organizers:

**Christian Houdré** (Georgia Institute of Technology)  
**Jan Rosinski** (University of Tennessee)  
**Jon Wellner** (University of Washington)

**David M. Mason** (University of Delaware)  
**Richard M. Dudley** (Massachusetts Institute of Technology)



Problems in probability theory increasingly involve high dimensions either in the basic sample spaces or in the dimensionality of the classes of functions or sets involved. In statistical problems, this occurs via the vast and fast data collection made possible by new generations of instrumentation in areas as diverse as microarray data in genetics, cosmic background microwave radiation measurements in astronomy, and new imaging methods in medicine and biophysics. Similarly, real world problems of interest in combinatorial optimization are high-dimensional in nature. The primary objectives of this workshop were to bring together experts in high dimensional probability and those in a number of the “areas of strong interaction” to discuss some of the major problems in this area and report on progress towards their solution, and to facilitate interactions and communications between the experts actively involved in the development of new theory in high dimensional probability, and leading researchers in statistics, machine learning, and computer science.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5122>

### Participants:

**Adamczak, Radoslaw** (University of Warsaw)  
**Aurzada, Frank** (Technische Universitat Berlin)  
**Basse-O'Connor, Andreas** (University of Tennessee, University of Aarhus)  
**Bryc, Wlodzimierz** (University of Cincinnati)  
**Chen, Xia** (University of Tennessee)  
**de La Pena, Victor** (Columbia University)  
**Dedecker, Jerome** (University Paris-Descartes)  
**Deheuvels, Paul** (UPMC - LSTA)  
**Dudley, Richard M.** (Massachusetts Institute of Technology)  
**Eichelsbacher, Peter** (Ruhr-Universitaet Bochum)  
**Figueroa-Lopez, Jose Enrique** (Purdue University)  
**Gao, Fuchang** (University of Idaho)  
**Giné, Evarist** (University of Connecticut)  
**Goetze, Friedrich** (University of Bielefeld)  
**Gozlan, Nathael** (Universite Paris-Est Marne-la-Vallée)  
**Hitczenko, Pawel** (Drexel University)  
**Hoffmann-Jorgensen, Jorgen** (University of Aarhus)  
**Houdré, Christian** (Georgia Institute of Technology)  
**Kevei, Peter** (Szeged University)  
**Koldobsky, Alexander** (University of Missouri)

**Koltchinskii, Vladimir** (Georgia Institute of Technology)  
**Kuelbs, James** (University of Wisconsin-Madison)  
**Latala, Rafal** (University of Warsaw)  
**Li, Wenbo** (University of Delaware)  
**Lifshits, Mikhail** (St-Petersburg State University)  
**Linde, Werner** (FSU-Jena)  
**Lounici, Karim** (Georgia Institute of Technology)  
**Marchal, Philippe** (Universite Paris 13)  
**Marcus, Michael** (CUNY)  
**Mason, David M.** (University of Delaware)  
**Meckes, Elizabeth** (Case Western Reserve University)  
**Meckes, Mark** (Case Western Reserve University)  
**Merlevede, Florence** (University Paris Est)  
**Panchenko, Dmitriy** (Texas A&M University)  
**Peligrad, Magda** (University of Cincinnati)  
**Radulovic, Dragan** (Florida Atlantic University)  
**Reynaud-Bouret, Patricia** (CNRS - Universite de Nice Sophia Antipolis)  
**Rosinski, Jan** (University of Tennessee)  
**Shao, Qi-Man** (Hong Kong University of Science and Technology)  
**Wolff, Pawel** (University of Warsaw)  
**Yukich, Joe** (Lehigh University)



# New Recursion Formulae and Integrability for Calabi-Yau Spaces

## October 16-21, 2011

### Organizers:

**Vincent Bouchard** (University of Alberta)  
**Tom Coates** (University of Imperial College)  
**Motohico Mulase** (University of California, Davis)

**Emma Previato** (Boston University)  
**Jian Zhou** (Tsinghua University)



Calabi-Yau spaces play a fundamental role in String Theory. String Theory makes a number of surprising predictions, among them that the Universe that we live in may have to be ten-dimensional. We are familiar with four of these dimensions (three space dimensions and one time dimension); string theorists propose that the other six dimensions are curled up into an extremely small shape called a Calabi-Yau space. It turns out that by studying the physics of string theory, we can extract many new and unexpected mathematical properties of Calabi-Yau spaces. This workshop brought together many mathematicians - both leading experts and young researchers - from around the world to investigate the consequences of the Eynard-Orantin theory. This joint effort opened the way to solving several long-standing problems in both pure mathematics and String Theory, and to a better understanding of how the world works at very small scales.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5114>

### Participants:

**Alim, Murad** (Harvard University)  
**Borot, Gaëtan** (University of Geneva)  
**Bouchard, Vincent** (University of Alberta)  
**Brini, Andrea** (University of Geneva)  
**Bryan, Jim** (University of British Columbia)  
**Cavalieri, Renzo** (Colorado State University)  
**Chiodo, Alessandro** (Fourier Institute Grenoble)  
**Coates, Tom** (Imperial College)  
**Do, Norman** (The University of Melbourne)  
**Doran, Charles** (University of Alberta)  
**Dumitrescu, Olivia** (University of California Davis)  
**Eynard, Bertrand** (IPhT CEA Saclay)  
**Fang, Bohan** (Columbia University)  
**Fuji, Hiroyuki** (Nagoya University)  
**Hernandez Serrano, Daniel** (University of Salamanca)  
**Hurtubise, Jacques** (McGill University)  
**Kashani-Poor, Amir-Kian** (École Normale Supérieure)  
**Kimura, Takashi** (Boston University)  
**Klemm, Albrecht** (University of Bonn)  
**Kroll, Jeffrey** (University of Alberta)  
**Lin, Yuncheng** (Stanford University)  
**Liu, Chiu-Chu Melissa** (Columbia University)  
**Manabe, Masahide** (Harish-Chandra Institute)  
**Marchal, Olivier** (University of Alberta)  
**Mariño, Marcos** (Université de Genève)  
**Marks, Christopher** (University of Alberta)  
**Mulase, Motohico** (University of California, Davis)  
**Norbury, Paul** (University of Melbourne)  
**Orantin, Nicolas** (IST)  
**Penkava, Michael** (University of Wisconsin-Eau Claire)  
**Plaza Martin, Francisco** (University of Salamanca)  
**Previato, Emma** (Boston University)  
**Ross, Dusty** (Colorado State University)  
**Rossi, Paolo** (Institut de Mathématiques de Jussieu, Paris 6)  
**Safnuk, Brad** (Central Michigan University)  
**Shadrin, Sergey** (University of Amsterdam)  
**Sorkin, Adam** (University of California Davis)  
**Sułkowski, Piotr** (California Institute of Technology)  
**Xu, Hao** (Harvard University)  
**Yamazaki, Masahito** (Princeton University)

# Information Theory and Statistics for Large Alphabets

## October 23-28, 2011

### Organizers:

**Mokshay Madiman** (Yale University)

**Alon Orlitsky** (University of California, San Diego)

**Narayana Prasad Santhanam** (University of Hawaii, Manoa)

**Balazs Szegedy** (University of Toronto)

**Krishnamurthy Viswanathan** (HP Labs)

**Aaron Wagner** (Cornell University)



How likely is the sun to not rise tomorrow? What is the probability of a nuclear armageddon? These questions are difficult to answer as they ask about events so rare, they are seldom observed. This workshop focused on the general question of how to make predictions using small amounts of data. The participants represented a diverse set of mathematical backgrounds, and explored recently-uncovered connections between this problem, data compression, and certain problems in probability theory. Fostering these kinds of connections could lead to new mathematical analysis tools for problems such as web search and even deciphering how information is encoded in the human brain.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5127>

### Participants:

**Anantharam, Venkatachalam** (University of California, Berkeley)

**Andoni, Alexandr** (Microsoft Research)

**Batu, Tugkan** (London School of Economics)

**Dudik, Miroslav** (Yahoo! Research)

**Foster, Dean** (University of Pennsylvania)

**Grassberger, Peter** (University of Calgary)

**Haxell, Penny** (University of Waterloo)

**Hero, Alfred** (University of Michigan)

**Huang, Dayu** (UIUC)

**Jaggi, Sidharth** (Chinese University of Hong Kong)

**Lee, Jaeyong** (Seoul National University)

**Madiman, Mokshay** (Yale University)

**Mahoney, Michael** (Stanford University)

**McAllester, David** (Toyota Technological Institute at Chicago)

**Ohannessian, Mesrob** (MIT)

**Orbanz, Peter** (University of Cambridge)

**Orlitsky, Alon** (University of California, San Diego)

**Petrone, Sonia** (Università Bocconi)

**Rubinfeld, Ronitt** (MIT)

**Saligrama, Venkatesh** (Boston University)

**Sanghavi, Sujay** (University of Texas at Austin)

**Santhanam, Narayana Prasad** (University of Hawaii, Manoa)

**Sarwate, Anand** (Toyota Technological Institute at Chicago)

**Sharma, Ankur** (Yale University)

**Suresh, Ananda Theertha** (UCSD)

**Szegedy, Balazs** (University of Toronto)

**Towsley, Don** (University of Massachusetts)

**Valiant, Gregory** (UC Berkeley)

**Valiant, Paul** (UC Berkeley)

**van Handel, Ramon** (Princeton University)

**Viswanathan, Krishnamurthy** (HP Labs)

**Vontobel, Pascal** (Hewlett-Packard Laboratories)

**Wagner, Aaron** (Cornell University)

**Weinberger, Marcelo** (HP Labs)

**Woodruff, David** (IBM)

**Yang, En-hui** (University of Waterloo)

**Yuksel, Serdar** (Queen's University)

# Cycles on Modular Varieties

## October 30 - November 4, 2011

### Organizers:

**Pierre Charollois** (Institut de Mathématiques de Jussieu)  
**Matthew Greenberg** (University of Calgary)

**Benedict Gross** (Harvard University)  
**Samit Dasgupta** (University of California, Santa Cruz)



Finding solutions of polynomial equations using analytic and geometric methods is a classical and highly developed subject. On the other hand, methods for solving Diophantine equations, i.e., finding integer solutions of integral polynomial equations, are usually of an algebraic nature. Hinted at by Dirichlet's famous "class number formula", analytic methods for solving important mathematical equations, like those defining elliptic curves, have seen significant development in the second half of the twentieth century. The major tool allowing for this development is the theory of modularity, which connects the worlds of analysis, geometry and arithmetic. In this workshop, we sought to explore and develop a family of state-of-the art modularity-based techniques for solving Diophantine equations.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5125>

### Participants:

**Agashe, Amod** (Florida State University)  
**Agboola, Adebisi** (University of California Santa Barbara)  
**Benois, Denis** (Universite Bordeaux I,)  
**Berger, Laurent** (Ecole Normale Supérieure de Lyon)  
**Bertolini, Massimo** (Università degli Studi di Milano)  
**Brakocovic, Miljan** (McGill University)  
**Bruinier, Jan** (TU Darmstadt)  
**Brunault, François** (ENS-Lyon (France))  
**Castella, Francesc** (McGill University)  
**Chapdelaine, Hugo** (Laval)  
**Charollois, Pierre** (Institut de Mathématiques de Jussieu)  
**Ciperiani, Mirela** (The University of Texas at Austin)  
**Colmez, Pierre** (Institut de Mathématiques de Jussieu)  
**Cornut, Christophe** (CNRS)  
**Darmon, Henri** (McGill University)  
**Dasgupta, Samit** (University of California, Santa Cruz)  
**de Shalit, Ehud** (Hebrew University of Jerusalem)  
**Ellenberg, Jordan** (University of Wisconsin)  
**Franc, Cameron** (McGill University)  
**Goren, Eyal** (McGill University)  
**Greenberg, Matthew** (University of Calgary)

**Howard, Benjamin** (Boston College)  
**Johnson-Leung, Jennifer** (University of Idaho)  
**Kudla, Stephen** (University of Toronto)  
**Kuehn, Ulf** (Universitaet Hamburg)  
**Longo, Matteo** (Università di Padova)  
**Masdeu, Marc** (Columbia University)  
**Mok, Chung Pang** (McMaster University)  
**Niziol, Wieslawa** (University of Utah)  
**Park, Jeehoon** (POSTECH)  
**Prasanna, Kartik** (University of Michigan)  
**Rapoport, Michael** (Universität Bonn)  
**Rotger, Victor** (Universitat Politècnica de Catalunya)  
**Seveso, Marco Adamo** (Università di Milano)  
**Sharifi, Romyar** (University of Arizona)  
**Spiess, Michael** (University of Bielefeld)  
**Stevens, Glenn** (Boston University)  
**Trifkovic, Mak** (University of Victoria)  
**Vigni, Stefano** (King's College London)  
**Voight, John** (University of Vermont)  
**Yang, Tonghai** (University of Wisconsin)  
**Zhang, Wei** (Columbia University)  
**Zhang, Shou-Wu** (Columbia University)

# WIN2: Women in Numbers 2

## November 6-11, 2011

### Organizers:

**Chantal David** (Concordia University)  
**Matilde Lalin** (Universite de Montreal)

**Michelle Manes** (University of Hawaii)



The workshop was designed to facilitate the growth of the female number theory community by bringing together researchers at various stages of their careers (from graduate students to senior mathematicians) in order to create a fertile ground for research collaboration and mentorship. The specific goals were to highlight research activities of women in number theory; to increase the participation of women in research activities in number theory; to train female graduate students in number theory and related fields; to strengthen the research network of potential collaborators in number theory and related fields started by the WIN 2008 conference; to enable female faculty at small colleges to participate actively with research activities including the training of graduate students; and to provide information on women in number theory with an inclusive approach.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5075>

### Participants:

**Akhtari, Shabnam** (CRM)  
**Anderson, Jackie** (Brown University)  
**Balakrishnan, Jennifer** (Harvard University)  
**Bellovin, Rebecca** (Stanford University)  
**Bertin, Marie Jose** (Universite Paris 6)  
**Bucur, Alina** (UC San Diego)  
**Chisholm, Sarah** (University of Calgary)  
**Cojocaru, Alina Carmen** (University of Illinois at Chicago)  
**David, Chantal** (Concordia University)  
**Davis, Rachel** (University of Wisconsin)  
**Deines, Alyson** (University of Washington)  
**Ertl, Veronika** (University of Utah)  
**Feaver, Amy** (University of Colorado Boulder)  
**Fuselier, Jenny** (High Point University)  
**Garthwaite, Sharon** (Bucknell University)  
**Hahn, Heekyoung** (McGill University)  
**Hoelscher, Jing** (University of Illinois at Chicago)  
**Lalin, Matilde** (Universite de Montreal)  
**Lauter, Kristin** (Microsoft Research)  
**Lee, Min** (Columbia University)  
**Long, Ling** (Iowa State University)  
**Manes, Michelle** (University of Hawaii)

**Nebe, Gabriele** (RWTH Aachen University)  
**Niziol, Wieslawa** (University of Utah)  
**Ozman, Ekin** (University of Texas-Austin)  
**Park, Jennifer** (Massachusetts Institute of Technology)  
**Pauwels, Bregje** (UCLA)  
**Perucca, Antonella** (University of Leuven)  
**Pries, Rachel** (Colorado State University)  
**Ramdorai, Sujatha** (University of British Columbia)  
**Scheidler, Renate** (University of Calgary)  
**Silverberg, Alice** (University of California at Irvine)  
**Stange, Katherine** (Stanford University)  
**Swisher, Holly** (Oregon State University)  
**Thompson, Lola** (Dartmouth College)  
**Varma, Ila** (Princeton University)  
**Viray, Bianca** (Brown University)  
**Williams, Cassie** (Colorado State University)  
**Wood, Melanie Matchett** (American Institute of Mathematics and University of Wisconsin-Madison)  
**Yap, Diane** (University of Hawaii)  
**Zhu, Hui June** (State University New York at Buffalo)

# Diophantine Methods, Lattices, and Arithmetic Theory of Quadratic Forms November 13-18, 2011

## Organizers:

**Wai Kiu Chan** (Wesleyan University)  
**Lenny Fukshansky** (Claremont McKenna College)

**Rainer Schulze-Pillot** (Universitaet des Saarlandes)  
**Jeff Vaaler** (University of Texas, Austin)



In Diophantine geometry mathematicians investigate, following Diophantos of Alexandria from ancient Greece, the solutions to equations in several variables in integers and their analogues in other arithmetic situations using geometric methods; height functions are used to measure the size of solutions, and the theory of heights is an important branch of Diophantine geometry. The arithmetic theory of quadratic forms originated as another branch of Diophantine geometry (the investigation of those equations which are quadratic in the variables), but over the last century evolved into an independent subject with its own problems and methods. These two lively areas of number theory have seen rapid development and spectacular successes over the recent years. The goal of this workshop was to bring together leading experts and younger researchers working in these two fields to emphasize the unification and interplay of these topics, and to promote interaction and exchange of ideas among researchers coming from North and South America, Europe, and Asia.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5011>

## Participants:

**Baeza, Ricardo** (University of Talca)  
**Bayer-Fluckiger, Eva** (Ecole Polytechnique Federale de Lausanne)  
**Browning, Tim** (Bristol University)  
**Cervino, Juan Marcos** (Universitat Heidelberg)  
**Chan, Wai Kiu** (Wesleyan University)  
**Choi, Stephen** (Simon Fraser University)  
**Christensen, Christian** (Universitat Tübingen)  
**Colliot-Thélène, Jean-Louis** (Universite Paris-Sud)  
**Coulangeon, Renaud** (University of Bordeaux)  
**David, Sinnou** (Marie Curie Paris)  
**Dietmann, Rainer** (Royal Holloway, University of London)  
**Earnest, Andrew** (Southern Illinois University)  
**Fukshansky, Lenny** (Claremont McKenna College)  
**Haensch, Anna** (Wesleyan University)  
**Hanke, Jonathan** (University of Georgia)  
**Heath-Brown, Roger** (Oxford University)  
**Kane, Ben** (University of Cologne)  
**Kim, Ji Young** (Seoul National University)  
**Kim, Myung-Hwan** (Seoul National University)  
**Kirschmer, Markus** (RWTH Aachen University)  
**Kumar, Abhinav** (Massachusetts Institute of Technology)

**Leep, David** (University of Kentucky)  
**Luca, Florian** (Universidad Nacional Autonoma de Mexico)  
**Mantilla-Soler, Guillermo** (University of British Columbia)  
**Meyer, Bertrand** (Ecole Polytechnique Federale de Lausanne)  
**Minton, Gregory** (Massachusetts Institute of Technology)  
**Nebe, Gabriele** (RWTH Aachen University)  
**Oh, Byeong-Kweon** (Seoul National University)  
**Petersen, Kathleen** (Florida State University)  
**Reznick, Bruce** (University of Illinois)  
**Roy, Damien** (University of Ottawa)  
**Scharlau, Rudolf** (Universitat Dortmund)  
**Schuermann, Achill** (University of Rostock)  
**Schulze-Pillot, Rainer** (Universitaet des Saarlandes)  
**Stewart, Cameron** (University of Waterloo)  
**Thunder, Jeff** (Northern Illinois University)  
**Vaaler, Jeff** (University of Texas, Austin)  
**Walling, Lynne** (Bristol University)  
**Watanabe, Takao** (Osaka University)  
**Watkins, Mark** (University of Sydney)  
**Widmer, Martin** (Graz University of Technology)

# Black Holes: New Horizons

## November 20-25, 2011

### Organizers:

**Valeri Frolov** (University of Alberta)  
**Sang Pyo Kim** (Kunsan National University)

**Don Page** (University of Alberta)  
**Misao Sasaki** (Kyoto University)



Exciting problems of black hole physics, such as a collision of astrophysical black holes and possible mini-black creation in colliders, require for their study development of new mathematical tools. This workshop focused on these problems and discussed different aspects of the gravitational physics in the strong field limit and in the presence of extra dimensions. This workshop was a joint activity of three institutions: Institute of Theoretical Physics of the University of Alberta (Edmonton, Canada), Asia Pacific Center for Theoretical Physics (Seoul, Korea), and Yukawa Institute for Theoretical Physics of Kyoto University.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5099>

### Participants:

**Abdolrahimi, Shohreh** (University of Alberta)  
**Al Zahrani, Abdallah M.** (University of Alberta)  
**Cai, Rong-Gen** (Institute of Theoretical Physics, Chinese Academy of Sciences)  
**Carlip, Steve** (UC Davis)  
**Choptuik, Matthew** (University of British Columbia)  
**Coley, Alan** (Dalhousie University)  
**Empanan, Roberto** (Universitat de Barcelona)  
**Frolov, Valeri** (University of Alberta)  
**Gregory, Ruth** (University of Durham)  
**Ishibashi, Akihiro** (Kinki University)  
**Kang, Gungwon** (KISTI (Korea Institute of Science and Technology Information))  
**Kim, Sang Pyo** (Kunsan National University)  
**Kim, Sungwon** (Ewha Womans University)  
**Kimura, Masashi** (Kyoto University)  
**Kol, Barak** (Hebrew University)  
**Krtous, Pavel** (Charles University)  
**Kubiznak, David** (University of Cambridge)  
**Kunstatter, Gabor** (University of Winnipeg)  
**Kunz, Jutta** (University of Oldenburg)  
**Kwon, Yongjoon** (Kyung Hee University)  
**Lake, Kayll** (Queen's University)  
**Lee, Hyun Kyu** (Hanyang University)  
**Lehner, Luis** (University of Guelph)

**Maeda, Kei-ichi** (Waseda University)  
**Mann, Robert** (University of Waterloo)  
**Mukohyama, Shinji** (IPMU)  
**Nozawa, Masato** (KEK)  
**Page, Don** (Institute of Theoretical Physics, University of Alberta)  
**Park, Mu-In** (Kunsan National University)  
**Poisson, Eric** (University of Guelph)  
**Sahlmann, Hanno** (Asia Pacific Center for Theoretical Physics, and Pohang University of Science and Technology)  
**Sekiguchi, Yuichiro** (YITP)  
**Shibata, Masaru** (Kyoto University)  
**Shoom, Andrey** (University of Alberta)  
**Solodukhin, Sergey** (University of Tours)  
**Tanaka, Takahiro** (Kyoto University)  
**Unruh, Bill** (University of British Columbia)  
**Volkov, Michael** (University of Tours)  
**Warnick, Claude** (University of Alberta)  
**Wu, Xing** (University of Alberta)  
**Yaghoobpour Tari, Shima** (University of Alberta)  
**Yoo, Chul-Moon** (YITP)  
**Yoshino, Hirotaka** (KEK (High Energy Accelerator Research Organization))  
**Zelnikov, Andrei** (University of Alberta)

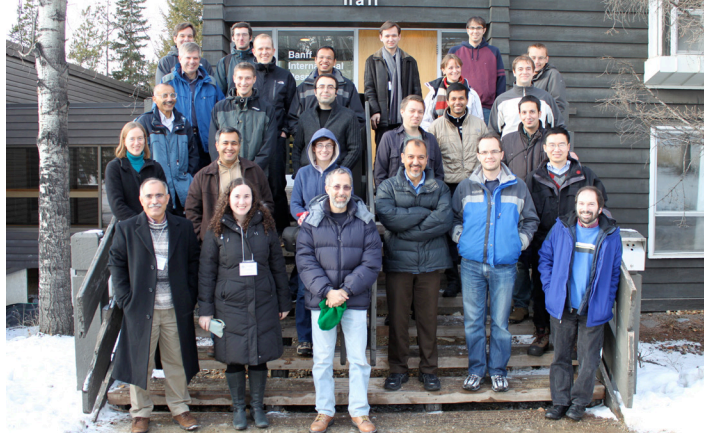
# Approximation Algorithms and the Hardness of Approximation

## November 27 - December 2, 2011

### Organizers:

**Chandra Chekuri** (University of Illinois Urbana-Champaign)  
**Joseph Cheriyan** (University of Waterloo)  
**Ryan O'Donnell** (Carnegie Mellon University)

**Mohammad R. Salavatipour** (University of Alberta)  
**David Williamson** (Cornell University)



The goals of the workshop were to bring together researchers in the fields of approximation algorithms (who work on finding algorithms with good approximation guarantees) and complexity theory (who work on finding hardness thresholds), and to stimulate the exchange of ideas and techniques between these two groups. We also wanted to highlight some of the new technical and mathematical directions in approximation guarantees (hierarchies of linear programming and semidefinite programming relaxations, uses of convex programming) and hardness thresholds (boolean functions, noise stability). We also examined some of the key problems in the area, even those beyond the reach of current techniques.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5117>

### Participants:

**Andrews, Matthew** (Bell Laboratories Alcatel-Lucent USA)  
**Austrin, Per** (University of Toronto)  
**Bansal, Nikhil** (Eindhoven University of Technology)  
**Behsaz, Babak** (University of Alberta)  
**Borradaile, Glencora** (Oregon State University)  
**Byrka, Jaroslaw** (University of Wroclaw)  
**Cheriyan, Joseph** (University of Waterloo)  
**Cheung, Kevin** (Carleton University)  
**Chuzhoy, Julia** (Toyota Technological Institute at Chicago)  
**Feige, Uriel** (Weizmann Institute)  
**Fleischer, Lisa** (Dartmouth College)  
**Friggstad, Zachary** (University of Waterloo)  
**Fung, Wai Shing (Issac)** (University of Waterloo)  
**Georgiou, Konstantinos** (University of Waterloo)  
**Gupta, Anupam** (Computer Science Carnegie Mellon University)  
**Harsha, Prahladh** (Tata Institute of Fundamental Research, Mumbai)  
**Harvey, Nick** (University of British Columbia)  
**Khandekar, Rohit** (IBM Research)  
**Khanna, Sanjeev** (University of Pennsylvania)  
**Khuller, Samir** (University of Maryland)  
**Konemann, Jochen** (University of Waterloo)  
**Lee, James** (University of Washington)

**Makarychev, Yury** (Toyota Technological Institute at Chicago)  
**Makarychev, Konstantin** (IBM Watson Research Center USA)  
**Moshkovitz, Dana** (Massachusetts Institute of Technology)  
**Naves, Guylain** (McGill University)  
**Newman, Alantha** (DIMACS)  
**Rothvoss, Thomas** (MIT)  
**Saberi, Amin** (Management Sci. and Eng. Stanford University)  
**Salavatipour, Mohammad R.** (University of Alberta)  
**Shepherd, Bruce** (McGill University)  
**Shmoys, David B.** (Cornell University)  
**Singh, Mohit** (Computer Science McGill University)  
**Steurer, David** (Microsoft Research New England)  
**Svensson, Ola** (EPFL)  
**Swamy, Chaitanya** (University of Waterloo)  
**Talwar, Kunal** (Microsoft Research SVC)  
**van Zuylen, Anke** (Max Planck Institute for Informatics)  
**Vetta, Adrian** (McGill University)  
**Vishnoi, Nisheeth** (Microsoft Research India)  
**Williamson, David** (Cornell University)  
**Wu, Yi** (IBM Almaden Research Center USA)

# Mathematics: Muse, Maker, and Measure of the Arts

## December 4-9, 2011

### Organizers:

**Ingrid Daubechies** (Duke University)

**Shannon Hughes** (University of Colorado at Boulder)

**Robert Moody** (University of Victoria)

**Daniel Rockmore** (Dartmouth College)

**Yang Wang** (Michigan State University)



The processing power of modern computers allows mathematicians and non-mathematicians to visualize complex and often visually stunning mathematical objects such as the Mandelbrot set and other fractal sets. The study of dynamical systems, information theory and other areas of mathematics has opened up the field of generative arts as well as other mathematical aided art making such as origami. Stylometry analysis now employs sophisticated mathematical and statistical techniques to determine the authenticity of art. Increasingly, advanced techniques in differential equations and optimization are being used to enhance and restore old work of art. The goal of this workshop was to bring together mathematicians and people in the art communities who are otherwise less likely to interact due to the distances in their respective fields of expertise. Only by regularly interacting with the art community can mathematics find its vitality in and become an important and lasting component of the study of arts.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5070>

### Participants:

**Abry, Patrice** (ENS Lyon - CNRS)

**Brown, Jason** (Dalhousie University)

**Coddington, Jim** (Museum of Modern Art)

**Daubechies, Ingrid** (Duke University)

**Hart, George W.** (Museum of Mathematics)

**Hughes, Shannon** (University of Colorado at Boulder)

**Hughes, James** (Dartmouth College)

**Jaffard, Stephane** (Université Paris est Créteil)

**Kaplan, Craig** (University of Waterloo)

**Major, Alice** (Independent)

**Moody, Robert** (University of Victoria)

**Mumford, David** (Brown University)

**Sarhangi, Reza** (Towson University)

**Schneider, Robert** (University of Kentucky)

**Wang, Yang** (Michigan State University)

**Wang, James** (Penn State University, NSF)

**Wolcott, Luke** (University of Washington)



# Hodge Theory and String Duality

## December 4-9, 2011

### Organizers:

**Adrian Clingher** (University of Missouri-St.Louis)  
**Charles Doran** (University of Alberta)

**Matt Kerr** (Washington University in St. Louis)  
**Johannes Walcher** (McGill University)



The mathematical theory that describes how integrals and differential equations control the shape of algebraic spaces in various dimensions is known as Hodge theory. One of the million-dollar prize Clay Millennium Problems, the most important conjecture in algebraic geometry -- the Hodge Conjecture -- can be thought of as “a metaphor for transforming transcendental computations into algebraic ones.” The physical theory able to describe the universe at both micro- (quantum mechanics) and macro- (general relativity) scales, and at the same time thought to be a suitable candidate for unifying all known forces of nature, is string theory. There are several variants of this “theory of everything,” linked by dualities which can radically alter mathematical formulations while preserving physical predictions. String dualities thus imply conjectures: seemingly unrelated pieces of mathematics must be related since they offer different descriptions of the same physical world. Although a role for Hodge theory in string theory has been hinted at for some time, only very recently has the depth and precision of this relationship begun to emerge. Cutting edge results suggest that a mathematical “grand unification” relating arithmetic geometry and symplectic geometry is taking shape. This workshop brought together at BIRS experts in both the mathematics of Hodge theory and the physics of string dualities. Their goal in Banff: to find the common key linking the abstract machinery of Hodge theory with uncharted sectors of string theory.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5090>

### Participants:

**Ballard, Matthew** (University of Wisconsin)  
**Bouchard, Vincent** (University of Alberta)  
**Clingher, Adrian** (University of Missouri-St.Louis)  
**Donagi, Ron** (University of Pennsylvania)  
**Doran, Charles** (University of Alberta)  
**Garavuso, Richard** (University of Alberta)  
**Harder, Andrew** (University of Alberta)  
**Hosono, Shinobu** (University of Tokyo, Graduate School of Mathematical Sciences)  
**Jockers, Hans** (Stanford University)  
**Kerr, Matt** (Washington University in St. Louis)

**Lapan, Josh** (McGill University)  
**Lewis, James D.** (University of Alberta)  
**Malmendier, Andreas** (Colby College)  
**Mendez-Diez, Stefan** (University of Alberta)  
**Morrison, David** (University of California Santa Barbara)  
**Novoseltsev, Andrey** (University of Alberta)  
**Pearlstein, Gregory** (Michigan State University)  
**Thompson, Alan** (University of Alberta)  
**Usui, Sampei** (Osaka University)  
**Walcher, Johannes** (McGill University)

# Current Challenges in Statistical Learning

## December 11-16, 2011

### Organizers:

**Hugh Chipman** (Acadia University)  
**Xiaotong Shen** (University of Minnesota)  
**Robert Tibshirani** (Stanford University)

**Joseph Verducci** (Ohio State University)  
**Mu Zhu** (University of Waterloo)  
**Ji Zhu** (University of Michigan)



This workshop brought together researchers in statistics to discuss ideas for automated learning and data mining that enhance the discovery process throughout the sciences. Recent developments in machine learning, and the widespread need for knowledge discovery, provided an excellent opportunity to bring researchers together to address important issues of the analysis of high-dimensional data as well as the data of complex structures, which arise in information technology and biomedical sciences, as well as in many other fields. The workshop covered a range of topics, including support vector machines, boosting, the self-organization maps, structured learning, unsupervised and semisupervised learning and other nonlinear classification methods, as well as application areas of microarrays, bio/chemo informatics, and text mining. We enjoyed lively exchanges among senior and junior researchers, which should lead to productive collaborations, especially among young researchers.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/5-day-workshops/11w5051>

### Participants:

**Ahmed, S. Ejaz** (U. of Windsor)  
**Banks, David** (Duke University)  
**Bondell, Howard** (North Carolina State University)  
**Chen, Jiahua** (University of British Columbia)  
**Chipman, Hugh** (Acadia University)  
**Ciampi, Antonio** (McGill University)  
**Clarke, Bertrand** (University of Miami)  
**Cutler, Adele** (Utah State University)  
**Eckles, Dean** (Stanford University)  
**Huo, Xiaoming** (Georgia Institute of Technology)  
**Jeon, Jong-June** (Seoul National University)  
**Kim, Yongdai** (Seoul National University)  
**Kondo, Yumi** (University of British Columbia)  
**Li, Hongzhe** (University of Pennsylvania)  
**Li, Wenbo** (University of Delaware)  
**Liu, Yufeng** (The University of North Carolina at Chapel Hill)  
**Michailidis, George** (University of Michigan)  
**Murdoch, Duncan** (University of Western Ontario)  
**Murua, Alejandro** (Universite de Montreal)  
**Owen, Art** (Stanford University)

**Peng, Wang** (Bowling Green State University)  
**Qin, Steve** (Emory University)  
**Qu, Annie** (University of Illinois at Urbana Champaign)  
**Salibian-Barrera, Matias** (University of British Columbia)  
**Shen, Xiaotong** (University of Minnesota)  
**Stenning, David** (University of California at Irvine)  
**Thierry, Chekouo Tekougang** (University of Montreal)  
**van Dyk, David** (Imperial College London)  
**Vannucci, Marina** (Rice University)  
**Verducci, Joseph** (The Ohio State University)  
**Wang, Junhui** (University of Illinois at Chicago)  
**Wang, Steven** (York University)  
**Wonyul, Lee** (The University of North Carolina at Chapel Hill)  
**Wu, Yichao** (North Carolina State University)  
**Young, Stanley** (National Institute of Statistical Sciences)  
**Zamar, Ruben** (University of British Columbia)  
**Zhang, Helen** (University of Arizona)  
**Zhu, Mu** (University of Waterloo)  
**Zhu, Ji** (University of Michigan)

# **Banff International Research Station**

**2011**

**2-Day Workshops**

# High-Performance Numerical Methods Supporting Radiation Therapy Treatment Planning March 11-13, 2011

## Organizers:

**Yuriy Zinchenko** (University of Calgary)

Radiation therapy is a dominant modality for treating various cancers. Motion-induced, structural and biological uncertainties in radiation therapy severely limit the efficacy of the treatment. We target minimizing adverse effects of uncertainties in high-precision therapy using a combination of novel image processing algorithms, image guidance, and large-scale numerical and robust optimization techniques. The workshop brought together a unique team of applied mathematicians, medical physicists and radiation oncologists, and targeted the development of a set of integrated strategic directions for collaboration in high-performance numerical methods and models that support optimal radiation therapy treatment planning and related applications.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/2-day-workshops/11w2035>

## Participants:

**Aleman, Dionne** (University of Toronto)  
**Apte, Aditya** (Memorial Sloan Kettering Cancer Center)  
**Chan, Timothy** (University of Toronto)  
**Deasy, Joseph** (Memorial Sloan-Kettering Cancer Center)  
**Eskicioglu, Murat** (University of British Columbia Okanagan)  
**Ferris, Michael C.** (University of Wisconsin)  
**Ghobadi, Kimia** (University of Toronto)  
**Goez, Julio** (Lehigh University)  
**Hare, Warren** (UBC Okanagan)  
**Hope, Andrew** (Princess Margaret Hospital / University of Toronto)  
**Jiang, Steve B.** (University of California, San Diego)

**Lee, Taewoo** (University of Toronto)  
**Li, Yuying** (University of Waterloo)  
**Long, Troy** (University of Michigan)  
**Lucet, Yves** (University of British Columbia Okanagan)  
**Men, Chunhua** (Elekta)  
**Milette, Marie-Pierre** (BC Cancer Agency-Centre for the Southern Interior)  
**Ramakrishnan, Jagdish** (MIT)  
**Romeijn, Edwin** (University of Michigan)  
**Shirvani Ghomi, Pooyan** (University of Calgary)  
**Terlaky, Tamas** (Lehigh University)  
**Unkelbach, Jan H.** (Massachusetts General Hospital )  
**Wright, Stephen** (University of Wisconsin)  
**Zinchenko, Yuriy** (University of Calgary)

# Ted Lewis Workshop on SNAP Math Fairs 2011

## April 15-17, 2011

### Organizers:

**Tiina Hohn** (Grant MacEwan University)  
**Ted Lewis** (SNAP Mathematics Foundation)

**Andy Liu** (University of Alberta)

This workshop was extremely popular with teachers in elementary and secondary schools, because it provided them with resources for their lesson plans, and has helped to reshape the way mathematics is being approached in the schools. Problem solving and puzzles in the classroom is now a specific area of the new curriculum and in service teachers have had very little training in using these tools effectively. This is not limited to Alberta Schools and the snap math fair idea is now spreading around the world. This type of workshop is considered front line approach in the collaborative effort between mathematicians, more experienced teachers and all teachers interested in professional development to improve the mathematics teaching in the elementary level and beyond. To have teachers share their valuable experiences with math fair in their own schools was the best and most useful information to others.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/2-day-workshops/11w2164>

### Participants:

**Barrett, Nicole** (Calgary Schools)  
**Benassi, Melissa** (St. Mary's University College)  
**Francis-Poscente, Krista** (St. Mary's University College)  
**Hildebrandt, Maxine** (University of Alberta)  
**Hoffman, Janice** (Edmonton Public Schools)  
**Hohn, Tiina** (Grant MacEwan University)  
**Kraft, Nicole** (St. Mary's University College)  
**Leal, Jaclyn** (St. Mary's University College)  
**Lewis, Ted** (SNAP Mathematics Foundation)

**Liu, Andy** (University of Alberta)  
**Meliefste, Andrea** (Edmonton Schools)  
**Moser, Leah** (St. Mary's University College)  
**Nichols, Ryan** (Edmonton Schools)  
**Pasanen, Trevor** (University of Alberta)  
**Rice, William** (Edmonton schools)  
**Shaw, Dolph** (Edmonton Public Schools)  
**Thompson, Tanya** (ThinkFun, Inc)

# Data Analytics Research Workshop

## May 27-29, 2011

### Organizers:

**Denilson Barbosa** (University of Alberta)  
**Leslie Dolman** (NSERC BIN/University of Toronto)

**Annette Mayer** (University of Toronto)

The Data Analytics Workshop brought together researchers and students from seven Canadian universities to further research in four key areas: strategy and policy management, capitalizing on document assets, adaptive data cleaning and data integration. The workshop provided an in-depth review of the research underway in the NSERC Business Intelligence Network, a national network currently completing two of a five year research program. The goal of the workshop was to ensure that all researchers are aware of the results obtained to date, and to identify challenges and potential new directions for the remaining three years of the network. The goal of NSERC BIN is to create an innovation platform for pre-competitive research in Business Intelligence in Canada, and to enhance Canadian business competitiveness through the development of intelligent data management and decision-making solutions.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/2-day-workshops/11w2167>

### Participants:

**Abounaga, Ashraf** (University of Waterloo)  
**Bahmani, Zeinab** (Carleton University)  
**Barbosa, Denilson** (University of Alberta)  
**Bertossi, Leo** (Carleton University)  
**Binnie, Adam** (SAP)  
**Campbell, Don** (IBM)  
**Carenini, Giuseppe** (University of British Columbia)  
**Dayal, Umeshwar** (HP Labs)  
**Dolman, Leslie** (NSERC BIN/University of Toronto)  
**Gardezi, Jaffer** (University of Ottawa)  
**Grosset, Robin** (IBM)  
**Guo, Zhaochen** (University of Alberta)  
**Holmberg, Greg** (SAP)  
**Jou, Stephan** (IBM)  
**Kiringa, Iluju** (University of Ottawa)  
**Lakshmanan, Laks** (University of British Columbia)  
**Latzel, Markus** (Palomino System Innovations Inc.)  
**McIlraith, Sheila** (University of Toronto)

**Mesquita, Filipe** (University of Alberta)  
**Milios, Evangelos** (Dalhousie University)  
**Miller, Renée** (University of Toronto)  
**Mireku Kwakye, Michael** (University of Ottawa)  
**Ng, Raymond** (University of British Columbia)  
**Özsu, M. Tamer** (University of Waterloo)  
**Pottinger, Rachel** (University of British Columbia)  
**Senneville, Guillaume** (IBM)  
**Shamsaei, Azalia** (University of Ottawa)  
**Soto, Axel** (Dalhousie University)  
**Statchuk, Craig** (IBM)  
**Suciu, Dan** (University of Washington)  
**Tajer, Mohammad** (University of British Columbia)  
**Tompa, Frank** (University of Waterloo)  
**Topaloglou, Thodoros** (University of Toronto)  
**Viktor, Herna** (University of Ottawa)  
**Yu, Eric** (University of Toronto)

# Alberta Number Theory Days

## June 17-19, 2011

### Organizers:

**Amir Akbary** (University of Lethbridge)

**Brandon Fodden** (University of Lethbridge)

Number Theory was coined the “Queen of Mathematics” by Gauss. It is one of the oldest branches of mathematics. Over the years, it has extended its roots into a variety of other domains such as probability, combinatorics, analysis, algebra, and geometry. This conference gave a glimpse into the diverse aspects of modern Number Theory. Several experts from Western Canada gave talks on recent research developments in the field. The conference also actively included early career researchers and postdoctoral fellows. Alberta is home to a number of very active groups of number theorists, but with hours of driving times separating them - Edmonton, Calgary, Lethbridge - it can sometimes be hard to discuss ideas. This is why organized this conference to come together for a weekend in Banff, to increase our ability to exchange thoughts, plan projects, and forge links to ensure that Alberta continues to be a leading contributor to number theory.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/2-day-workshops/11w2169>

### Participants:

**Akbary, Amir** (University of Lethbridge)

**Bauer, Mark** (University of Calgary)

**Biasse, Jean-Francois** (University of Calgary)

**Buckingham, Paul** (University of Alberta)

**Caranay, Perlas** (University of Calgary)

**Chisholm, Sarah** (University of Calgary)

**Christie, Aaron** (University of Calgary)

**Cunningham, Clifton** (University of Calgary)

**Esteki, Fataneh** (University of Lethbridge)

**Fodden, Brandon** (University of Lethbridge)

**Guy, Richard** (University of Calgary)

**Jacobson, Michael** (University of Calgary)

**Kadiri, Habiba** (University of Lethbridge)

**Kamgarpour, Masoud** (University of British Columbia)

**Kostiuk, Jordan** (University of Alberta)

**Lavasani, Seyed** (University of Calgary)

**Musson, Matthew** (University of Calgary)

**Ng, Nathan** (University of Lethbridge)

**Quan, Diane** (University of Calgary)

**Rezaei Rad, Monireh** (University of Calgary)

**Sabeti, Milad** (University of Calgary)

**Scheidler, Renate** (University of Calgary)

**Shahabi, Majid** (University of Lethbridge)

**Stein, Andreas** (Carl von Ossietzky Universitat Oldenburg)

**Stein, Sandra** (University of Oldenburg)

**Sylvestre, Jeremy** (Augustana Campus - University of Alberta)

**Trudgian, Timothy** (University of Lethbridge)

**Weir, Colin** (University of Calgary)

**Weiss, Al** (University of Alberta)

# Automated Deduction and its Application to Mathematics

## June 24-26, 2011

### Organizer:

**R. Padmanabhan** (University of Manitoba)

**Robert Veroff** (University of New Mexico)

Can computers do mathematics? If so, what kind of mathematics? Prover9 (developed by William McCune, University of New Mexico) is a first-order theorem prover. It employs, among other algorithms, the famous Knuth-Bendix algorithm, to decide whether or not two words composed of variables and operators can be proved equal as a consequence of a given set of identities or implications satisfied by the operators. Although the general word problem is well known to be unsolvable, this algorithm provides results in many interesting cases. MACE (models and counterexamples) is a companion program - also developed by McCune, that searches for small finite models and counterexamples. As mathematicians, we make conjectures, prove theorems and give counter-examples. During the past 10 years, the ADAM workshops have shown the huge success made by Prover9-MACE combination in the use of computers to gather evidence in support of proving or disproving specific mathematical assertions. Throughout this workshop, we demonstrated that computers can be a useful, even essential, tools to mathematical research in the areas of algebra (semigroups, groups and rings) and geometry.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/2-day-workshops/11w2170>

### Participants:

**Churchill, Richard** (Hunter College, CUNY, University of Calgary)

**Ens, Eric** (University of Manitoba)

**Ernst, Zac** (University of Missouri-Columbia)

**Padmanabhan, R.** (University of Manitoba)

**Phillips, J.D.** (Northern Michigan University)

**Sutcliffe, Geoff** (University of Miami)

**Veroff, Robert** (University of New Mexico)

**Vojtechovsky, Petr** (University of Denver)

**Yang, Qiduan** (University of British Columbia)

**Zhang, Yang** (University of Manitoba)



# CanQueue 2011: 13th Annual Conference for Canadian Queueing Theorists and Practitioners August 26-28, 2011

## Organizer:

**Winfried Grassmann** (University of Saskatchewan)      **Javad Tavakoli** (University of British Columbia, Okanagan)

The objectives of the CanQueue workshops, held annually since 1999, are to promote research and application of queueing theory. This workshops emphasized a discussion of research projects in their early stages to facilitate feedback and collaboration between colleagues while the direction of the project could still be influenced. Other objectives included providing a venue for graduate students to present their work (in process or completed) in a supportive environment, strengthening the community of researchers in queueing theory in Canada, introducing interesting application areas, and presenting relevant and emerging fields of mathematics to the community.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/2-day-workshops/11w2154>

## Participants:

**Alfa, Attahiru** (University of Manitoba)  
**Alvarenga, Sofia** (University of Manitoba)  
**Badescu, Andrei** (University of Toronto)  
**Brill, Percy** (University of Windsor)  
**Campello de Souza, Fernanda** (University of Alberta)  
**Delasay, Mohammad** (University of Alberta)  
**Devanarayana, Chamara** (University of Manitoba)  
**Drekic, Steve** (University of Waterloo)  
**Grassmann, Winfried** (University of Saskatchewan)  
**Gunasekara, Charith** (University of Manitoba)  
**Ingolfsson, Armann** (University of Alberta)  
**Kolfal, Bora** (University of Alberta)  
**Landriault, David** (University of Waterloo)  
**Li, Hui** (Mount Saint Vincent University)  
**Margolius, Barbara** (Cleveland State University)  
**Ngatched Nkouatchah, Telex Magloire** (University of Manitoba)

**Rastpour, Amir** (University of Alberta)  
**Stanford, David** (University of Western Ontario)  
**Tavakoli, Javad** (University of British Columbia Okanagan)  
**Terekhov, Daria** (University of Toronto)  
**Tirdad, Ali** (University of British Columbia Okanagan)  
**Tran, Tony** (University of Toronto)  
**Willmot, Gordon E** (University of Waterloo)  
**Withthige, Samitha** (University of Manitoba)  
**Ye, Wenzhe** (Carleton University)  
**Zafari, Zafar** (University of British Columbia Okanagan)  
**Zhang, George** (Simon Fraser University and Western Washington University in Bellingham)

# Modeling and Simulation

## September 2-4, 2011

### Organizer:

**Zhangxin John Chen** (University of Calgary)  
**Dong Liang** (York University)

**Yanping Lin** (University of Alberta)

This BIRS workshop focused on several important topics that have fundamental scientific merits and significant application values. Energy and environmental modeling and simulation require the observation of natural scientists, the technical expertise of engineers, the modeling and numerical skills of mathematicians, and the modern techniques of computer scientists. The engineering and science problems in these areas tend to culminate in coupled systems of nonlinear, time-dependent partial differential equations (PDEs). Numerical solutions of these PDEs are very challenging due to the multiple temporal and spatial scales presented, the nonlinear effects, and the large scale and unusually long duration simulations required. This workshop promoted, enhanced, and stimulated cross-continental research interactions and collaborations in mathematical sciences, and shaped changes in the research work completed with modeling and simulation. The objective of this workshop was to bring together the world's top active researchers (and their more junior counterparts) who study energy and environmental modeling and simulation to discuss past, recent, and prospective advances in this area. The ultimate goal was to expose workshop participants (in particular, junior researchers) to the latest developments in the field of modeling and simulation, while emphasizing the impact of this field on science, engineering, and industry.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/2-day-workshops/11w2017>

### Participants:

**Arbogast, Todd** (University of Texas at Austin)  
**Chen, Zhangxin John** (University of Calgary)  
**Deng, Jack** (University of Calgary)  
**Díaz Viera, Martín A.** (Instituto Mexicano del Petróleo)  
**Dong, Chao** (University of Calgary)  
**Douglas, Jim** (Purdue University)  
**Herrera, Ismael** (National University of Mexico)  
**Li, Qing** (Shanghai University)  
**Liang, Dong** (York University)  
**Lin, Yanping** (University of Alberta)  
**Lin, Fengyue** (University of Calgary)  
**Liu, Hui** (University of Calgary)  
**McInnis, Jamie** (University of Calgary)

**Minev, Peter** (University of Alberta)  
**Moreles, Miguel Angel** (CIMAT)  
**Ortiz-Tapia, Arturo** (Mexican Petroleum Institute)  
**Park, Eun-Jae** (Yonsei University)  
**Seifi, Mojtaba** (University of Calgary)  
**Shen, Lihua** (Capital Normal University)  
**Xie, Jiang** (Shanghai University)  
**Yu, Xijun** (Institute of Applied Physics and Computational Mathematics)  
**Yu, Song** (University of Calgary)  
**Zavala Yoé, Ricardo** (Instituto Tecnológico Autónomo de México (ITAM))  
**Zhang, Wu** (Shanghai University)

# Enacting Enactivism: Exploring the Potential for a Theory of Mathematical Cognition to Enhance Classroom Practice

## November 4-6, 2011

### Organizer:

**Lyndon Martin** (York University)  
**Lynn McGarvey** (University of Alberta)

**Jo Towers** (University of Calgary)

Constructivism (however defined) has undoubtedly become a major theoretical influence in contemporary mathematics education. Although constructivism began as a theory of learning, it has progressively expanded its influence, in particular becoming what might be seen as a theory of teaching. However, in recent years a new (and renewed) theoretical way of thinking about knowing has emerged. Broadly termed 'enactivism,' this framing prompts a reorientation to the collective body, both in terms of what is known and of who is doing the knowing. Within enactivism then, the teacher is not seen as a facilitator or a guide but as being 'structurally coupled' with the learners, and hence an authentic, full, and genuine participant in students' learning. Questions remain about what enactivism means concretely in practice for both mathematical teaching and learning. We need to know more about what such 'authentic participation' might mean for the classroom teacher of mathematics and what the implications for such a view of learning might be for his or her classroom practices. This workshop provided the first systematic step towards such a research agenda.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/2-day-workshops/11w2177>

### Participants:

**Babb, Paulino** (University of Calgary)  
**Davis, Brent** (University of Calgary)  
**Kieren, Thomas** (University of Alberta)  
**Martin, Lyndon** (York University)  
**McGarvey, Lynn** (University of Alberta)

**Mgombelo, Joyce** (Brock University)  
**Proulx, Jerome** (Université du Québec à Montréal)  
**Rapke, Tina** (University of Calgary)  
**Simmt, Elaine** (University of Alberta)  
**Towers, Jo** (University of Calgary)

# Calculus 11x11x11

## November 11-13, 2011

### Organizer:

**Manny Estabrooks** (Red Deer College)

**Pamini Thangarajah** (Mount Royal University)

Introductory calculus has proven to be a challenge not only to the students who take the course but also to the instructors who teach it. At this workshop, we considered common issues faced by all Alberta post secondary institutions with respect to introductory Calculus, and sought common solutions that could be applied in a multitude of situations. Moreover, the British Columbia Committee on the Undergraduate Programme in Mathematics has created a document called First year Core Calculus to promote common curriculum and assessment criteria in the province of British Columbia. This workshop provided the post secondary institutions of Alberta a platform through which to consider if they too should develop and implement such a document as well.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/2-day-workshops/11w2178>

### Participants:

**Aiffa, Mohammed** (University of Calgary)  
**Chanasyk, Donna** (Edmonton Highschools - Paul Kane High School)  
**Chisholm, Sarah** (University of Calgary)  
**Connolly, Dennis** (University of Lethbridge)  
**Davis, Tyler** (University of Calgary)  
**de Vries, Gerda** (University of Alberta)  
**Estabrooks, Manny** (Red Deer College)  
**Freed, Bill** (Concordia University College)  
**Gale, Susan** (Memorial Composite High School)  
**Hackborn, Bill** (University of Alberta, Augustana Campus)  
**Henzel, Christine** (Alberta Education)

**Hlede, Tony** (Alberta Education)  
**Hohn, Tiina** (Grant MacEwan University)  
**Kooistra, Remkes** (The Kings University College)  
**Martinig, April** (University of Calgary)  
**McNeilly, David** (University of Alberta)  
**Nosal, Eva** (PIMS, University of Calgary)  
**Peschke, Julie** (University of Athabasca)  
**Roettger, Eric** (Mount Royal University)  
**Sullivan, Cathleen** (Pearsons)  
**Thangarajah, Pamini** (Mount Royal University)  
**Tomoda, Satoshi** (Okanagan College)  
**Torres, Maria** (University of Athabasca)  
**Zvengrowski, Peter** (University of Calgary)

# **Banff International Research Station**

**2011**

**Summer Schools  
Research in Teams  
Focused Research Groups**

## Summer Schools

# Summer IMO Training Camp July 3-15, 2011

### Organizers:

**Dorette Pronk** (Dalhousie University)

**Christopher Small** (University of Waterloo)

The 2011 IMO Summer Training Camp was the final stage of training for the six preselected high school students who represented Canada at the 2011 International Mathematical Olympiad held in Holland. The students were assisted by seven adult trainers who helped them prepare for the IMO through lectures, problem solving sessions and mock competitions. The 2003, 2005, 2007 and 2009 IMO Summer Training Camps were all held at BIRS, and were a great success. Training at BIRS has many advantages. The IMO trainers and team can avoid many of the distracting influences which are features of camps held in large cities, and are better able to focus on mathematics training. The occasional hiking excursion for the students provides them an opportunity to bond together as a team so as to be mutually supporting of each other during the IMO.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/focussed-research-groups/11ss002>

### Participants:

**Arthur, David** (Google)

**Barekat, Farzin** (UCLA)

**Brennan, Matthew** (Upper Canada College)

**Demasi, Lino** (Simon Fraser University)

**Fink, Alex** (North Carolina State University)

**Jiang, Heinrich** (IMO 2011)

**Morewood, Robert** (International Mathematical Olympiad Committee)

**Morewood, Robert** (International Mathematical Olympiad Committee)

**Pronk, Dorette** (Dalhousie University)

**Rickards, James** (Colonel By Secondary School Ottawa)

**Sardarli, Mariya** (IMO 2011)

**Song, Alex** (Phillips Exeter Academy Waterloo)

**Spink, Hunter** (Western Canada H.S. Calgary)

**Tsimerman, Jacob** (Princeton)

# Advanced Mathematical Methods to Study Atmospheric Dynamical Processes and Predictability

## July 10-15, 2011

### Organizers:

**Craig Bishop** (Navy Research Laboratory Monterey)  
**Sarah Jones** (University of Karlsruhe)  
**Thomas Jung** (European Centre for Medium-Range Weather Forecasts)

**Istvan Szunyogh** (Texas A & M University)  
**Olivier Talagrand** (Laboratoire de Meteorologie Dynamique/Ecole Normale Supérieure)  
**Heini Wernli** (ETH Zurich)

The main objective of this summer school was to expose young talents to a variety of advanced mathematical techniques that play an important role in the investigation of atmospheric dynamical processes and atmospheric predictability. Great emphasis was placed on challenging open problems of the subject area. The program targeted applied mathematics and atmospheric sciences graduate students. The expected outcomes were the emergence of (i) young mathematicians who can take advantage of the broader funding opportunities available to those who conduct interdisciplinary research, (ii) young atmospheric scientists who are aware of the advanced mathematical techniques that are available to study atmospheric dynamical processes and predictability and, in general, (iii) future experts to design mathematical algorithms to address complex problems related to weather and climate.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/focussed-research-groups/11ss065>

### Participants:

**Ades, Melanie** (University of Reading)  
**Atkins, Ethan** (University of California Berkeley)  
**Bishop, Craig** (Navy Research Laboratory Monterey)  
**Blazica, Vanja** (University of Ljubljana)  
**Cook, David** (State University of New York at Albany)  
**Deshaies-Jacques, Martin** (Universite du Quebec a Montreal)  
**Dong, Jili** (University of Oklahoma)  
**Dunstone, Nick** (UK Met Office)  
**Durran, Dale** (University of Washington)  
**Fang, Wan** (Nanyang Technological University)  
**Gauthier, Pierre** (Université de Québec à Montréal)  
**Herbert, Corentin** (Laboratoire des Sciences du Climat et de l'Environnement)  
**Hoover, Brett** (University of Wisconsin)  
**Igri, Moudi Pascal** (University of Yaounde I)  
**Islam, Siraj Ul** (University of Northern British Columbia)  
**Kober, Kirstin** (Ludwig-Maximilians-University Munich)  
**Larios, Adam** (University of California Irvine)  
**Lynch, Peter** (University College Dublin)  
**Mattos, Rafael** (National Laboratory for Scientific Computing)  
**Methven, John** (University of Reading)  
**Michel, Clio** (Meteo-France)

**Mitchell, Lewis** (University of Sydney)  
**Nelson, Ethan** (Texas A&M University)  
**Ott, Edward** (University of Maryland)  
**Poterjoy, Jonathan** (Pennsylvania State University)  
**Pring, Stephen** (UK Met Office)  
**Rainwater, Sabrina** (University of Maryland)  
**Rasmijn, Lucinda** (Royal Dutch Meteorological Institute)  
**Roepnack, Andreas** (Deutscher Wetterdienst)  
**Saucedo, Marcos** (Universidad de Buenos Aires)  
**Scheuerer, Michael** (University of Heidelberg)  
**Solonen, Antti** (Lappeenranta University of Technology)  
**Szunyogh, Istvan** (Texas A & M University)  
**Talagrand, Olivier** (Laboratoire de Meteorologie Dynamique/Ecole Normale Supérieure)  
**Van Schaeybroeck, Bert** (Koninklijk Meteorologisch Instituut)  
**Vie, Benoit** (Meteo-France-CNRM)  
**Vollmer, Sebastian** (University of Warwick)  
**Wernli, Heini** (ETH Zurich)  
**Wu, Ting-Chi** (University of Miami)  
**Zhang, Yunji** (Peking University)

## Research in Teams

# Heights on Moduli Space for Post-Critically Finite Dynamical Systems March 6-13, 2011

### Organizers/Participants:

**Matthew Baker** (Georgia Institute of Technology)  
**Patrick Ingram** (Colorado State University)

**Rafe Jones** (College of the Holy Cross)  
**Joseph Silverman** (Brown University)

The purpose of this meeting was to pursue a problem in dynamical systems, using tools from number theory. In particular, post-critically finite maps are a special type of recursive system of interest to dynamicists. Results in that field indicate that these objects are amenable to study via number theory, a connection which has not been previously explored. We made some progress on the classification of post-critically finite dynamical systems using tools from number theory, and the direct collaboration afforded by the BIRS "Research in Teams" program will greatly accelerate this research.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/research-in-teams/11rit155>

# Vector-valued Modular Forms and Cohomology May 1-8, 2011

### Organizers/Participants:

**Peter Bantay** (Eötvös Loránd University)  
**Terry Gannon** (University of Alberta)  
**Christopher Marks** (University of Alberta)

**Geoffrey Mason** (University of California at Santa Cruz)

Modular forms are one of the oldest and best appreciated areas of number theory, with connections all over mathematics and mathematical physics. Surfaces like spheres and tori can be thought of as curves over the complex numbers, usually in many different ways, and modular forms are functions (differential forms) living on those curves. Because of their profound importance, many generalisations have been studied over the years. Perhaps the most natural is to make them vector-valued. Only in the last couple decades (largely due to the work of Fields' medalist Borcherds) has the significance of this generalisation become clear. This Research-in-Teams brought together the two main groups of researchers developing this theory to promote collaboration and progress in this field.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/research-in-teams/11rit175>



# Problems in Pluripotential Theory

## May 29 - June 5, 2011

### Organizers/Participants:

**John Anderson** (College of the Holy Cross)  
**Joseph Cima** (University of North Carolina)

**Norm Levenberg** (Indiana University)  
**Thomas Ransford** (Laval University)

The subject of potential theory has a long history with important applications in physics and other areas, and remains an active area of mathematical research. Throughout this workshop, three key problems that have arisen following recent developments in pluripotential theory were investigated. The four participants brought together different areas of expertise in potential theory, function theory and functional analysis, while BIRS provided us an opportunity to focus our attention and share ideas on these key problems. We also note that one of us (Levenberg) was introduced to the new variational approach of cite from Boucksom and Guedj at a BIRS workshop.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/research-in-teams/11rit157>

# The $SU(3)$ Casson Invariant for Spliced Sums

## June 19-26, 2011

### Organizers/Participants:

**Hans U. Boden** (McMaster University)  
**Chris Herald** (University of Nevada - Reno)

**Benjamin Himpel** (Aarhus University)

One of the most pressing questions regarding the  $SU(3)$  Casson invariant is whether there is a surgery formula for it, or at least a spliced sum formula like there is for the  $SU(2)$  Casson invariant. Given knots  $K_1 \subset M_1$  and  $K_2 \subset M_2$  in homology 3-spheres  $M_1$  and  $M_2$ , their spliced sum is defined by identifying complements of tubular neighborhoods of  $K_1$  and  $K_2$  so that the longitude of one gets identified with the meridian of the other. The  $SU(3)$  Casson invariant had been calculated for certain surgeries on torus knots and for Brieskorn spheres. Hans Boden and Benjamin Himpel recently computed the  $SU(3)$  Casson invariant for spliced sums of  $(2,q)$ -torus knot complements. Together with Chris Herald, we investigated the behavior of the  $SU(3)$  Casson invariant for spliced sums along  $(p,q)$ -torus knots. This provided useful clues about the general formula for spliced sums and understanding surgery issues. In the previous paper, we were able to perform computations directly on the  $SU(3)$  character variety, and in this more general situation, one must first perform a perturbation of the flat moduli space. The goal of our work was therefore to develop the necessary machinery for perturbations for spliced sums and to use it to calculate the  $SU(3)$  Casson invariant.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/research-in-teams/11rit159>

## **Universal Higher Extensions June 26 - July 3, 2011**

### **Organizers/Participants:**

**George Peschke** (University of Alberta)

**Tim Van der Linden** (Université Catholique de Louvain)

Throughout this workshop, we endeavored to forge a confluence of two developments presented in the most recent work of the participants. While these developments are quite different in nature, they complement each other with a promise of broad applications. We found this workshop to be both opportunistic and timely, as both participants had reached their respective insights very recently, and had worked up to then unaware of each other's existence. To combine these insights and carry them further, we met in person in a setting which enabled us to fully devote ourselves to the task at hand. For this, the "Research in Teams" program at BIRS proved to be an ideal venue.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/research-in-teams/11rit174>

## **Approximation Theory and Harmonic Analysis on Spheres and Related Domains July 17-24, 2011**

### **Organizers/Participants:**

**Feng Dai** (University of Alberta)  
**Yuan Xu** (University of Oregon)

**Heping Wang** (Capital Normal University)

This research group collaborated on a book on orthogonal polynomial expansions (OPEs) on the unit sphere and related domains, which includes the most recent research advances, and is written with the aim of becoming a standard reference for analysis on the unit sphere and related domains. This research-intensive collaboration at BIRS provided us with a unique opportunity of working intensively together, and came at a critical junction for the completion of our project.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/research-in-teams/11rit156>

# Probabilistic and Statistical Properties of Stochastic Volatility Models September 4-11, 2011

## Organizers/Participants:

**Rafal Kulik** (University of Ottawa)

**Philippe Soulier** (Université Paris Ouest)

Financial data has features which cannot be captured by classical time series. One such feature is so-called heteroskedasticity. To model this phenomena, Robert Engle introduced ARCH models. His work was rewarded with the Nobel Prize in Economics (2003). The model has been well understood. However, recently many other complicated models have been proposed. The goal of this research was to understand probabilistic structure of these models and provide practitioners guidelines how to use them.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/research-in-teams/11rit160>

# Canonical Forms of Two-Person Zero-Sum Limit Average Payoff Stochastic Games September 18-25, 2011

## Organizers/Participants:

**Endre Boros** (Rutgers University)

**Vladimir Gurvich** (Rutgers University)

**Khaled Elbassioni** (Max-Planck-Institute for Informatics)

**Kazuhisa Makino** (University of Tokyo)

Finding the value and optimal strategies for stochastic games, even in very special cases, remains a challenging open problem. A mathematically justified first step would be to show that such games can be brought to an equivalent “canonical” form, in which the locally best strategies are in fact globally optimal, too. Our aim was to characterize the family of stochastic games for which such a canonical form exists. We also found a new family of algorithms that directly aim at finding such a canonical form of games. One of our latest result indicates that this new type of algorithm provides a (first) finite procedure to determine the value and optimal strategies, when the game is ergodic, and also provides in guaranteed finite time epsilon-optimal strategies or proofs for non-ergodicity. Based on this new type of algorithmic approach, we plan to develop polynomial time approximations for the most important special cases, such as cyclic-games, parity-games, and more generally BRW-games.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/research-in-teams/11rit176>

## Focused Research Groups

### Eventually Nonnegative Matrices and their Sign Patterns

May 15-22, 2011

#### Organizers:

**Minerva Catral** (Xavier University)  
**Craig Erickson** (Iowa State University)  
**Leslie Hogben** (Iowa State University)

**Dale Olesky** (University of Victoria)  
**Pauline van den Driessche** (University of Victoria)

Linear algebra is a subject of central importance in both mathematics and a variety of other disciplines. It is used by virtually all mathematicians and by statisticians, physicists, biologists, computer scientists, engineers, and social scientists. The process of linearization often allows difficult problems to be approximated by more manageable linear ones. This can provide insight into and approximate local solutions of the original problem. Nonnegative matrices and their generalizations such as eventually nonnegative matrices have particularly nice properties and arise in many important applications. In some situations, the signs of the matrix entries are known from the nature of the problem, but the actual values of the data may be unreliable, and it is helpful to know whether the sign pattern requires or allows the desired type of matrix. This Focused Research Group investigated strongly nonnegative matrices and their sign patterns.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/focussed-research-groups/11frg149>

### Quantum Information for Quantum Chemistry

June 5-12, 2011

#### Organizers:

**Alan Aspuru-Guzik** (Harvard University)

**Sabre Kais** (Purdue University)

The development and use of quantum computers for chemical applications has potentially revolutionary impact opportunities to change the way computing is done in future generations. This workshop brought together leading scientists from the fields of quantum information, quantum computing and quantum chemistry to exchange ideas and discuss ways to develop quantum algorithms and experimental realization and to push forward the quantum information revolution in the field of chemistry.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/focussed-research-groups/11frg014>

#### Participants:

**Gildert, Suzanne** (D-Wave Systems Inc)  
**Kyriakidis, Jordan** (Dalhousie University)  
**Love, Peter** (Haverford)

**Papageorgiou, Anargyros** (Columbia University)  
**Rose, Geordie** (D-Wave Systems Inc.)  
**Walther, Philip** (University of Vienna)

# Mixed Boundary Value Problems in Nonsmooth Domains

## June 12-19, 2011

### Organizers:

**Irina Mitrea** (University of Minnesota)

**Katharine Ott** (University of Kentucky)

The purpose of this Focused Research Group was to study elliptic boundary value problems with mixed Dirichlet and Neumann type boundary conditions in nonsmooth domains. These include the class of domains with finitely many/isolated singularities (such as corners or edges) in two and three dimensions and the class of Lipschitz domains in arbitrary dimensions (which typically exhibit infinitely many singular boundary points, some of which may be accumulating). Being at BIRS provided a valuable opportunity to combine our various perspectives on this topic.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/focussed-research-groups/11frg158>

### Participants:

**Brown, Russell** (University of Kentucky)  
**Kim, Seick** (Yonsei University)

**Reitich, Fernando** (University of Minnesota)  
**Wright, Matthew** (Missouri State University)

# Extending Properties of Tournaments to $k$ -Traceable Oriented Graphs

## July 31 - August 7, 2011

### Organizers:

**Ortrud Oellermann** (University of Winnipeg)

Tournaments form a class of directed graphs. These digraphs represent the structures of round-robin tournaments in which players or teams participate in a game that cannot end in a tie and where every two players compete in a game exactly once. We propose to study generalizations of tournaments called  $k$ -traceable oriented graphs. The 2-traceable oriented graphs are precisely the tournaments. In particular we focused on determining which structural properties of tournaments hold for  $k$ -traceable oriented graphs.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/focussed-research-groups/11frg171>

### Participants:

**Dunbar, Jean** (Converse College, South Carolina)  
**Frick, Marietjie** (University of South Africa)  
**Nielsen, Morten** (Thompson Rivers University)

**van Aardt, Susan** (University of South Africa)

# **New Methods for Analysing Metastable Structures in Closed, Open or Non-autonomous Dynamical Systems**

## **October 23-30, 2011**

### **Organizers:**

**Wael Bahsoun** (Loughborough University)  
**Arno Berger** (University of Alberta)  
**Chris Bose** (University of Victoria)

**Gary Froyland** (University of New South Wales)  
**Cecilia González Tokman** (University of Victoria)  
**Rua Murray** (University of Canterbury)

Mathematical models play an increasing important role in research and development in diverse areas such as engineering, physics, the earth sciences, medical science, business and the social sciences. When the model represents time evolution of a physical system, the mathematical model is called a dynamical system. In addition to dynamical systems designed to study physical processes in other areas of science, there are dynamical systems arising naturally within mathematics itself. Given a dynamical system, equilibrium structures are perhaps the first important feature to understand; they identify the long-term behavior(s) for the system. Next, the stability (or lack of stability) of equilibria play a critical role in the global behavior of a dynamical system. For systems out of equilibrium, the typical case, understanding the mechanism of transition to equilibrium is a natural feature to investigate. More recently, attention has been focussed on non-equilibrium structures which none-the-less persist over long periods of time and play an important role in the structural evolution of the system. Various terms are used for these features: persistent structures, meta-stable states or quasi-invariant structures. The understanding of these objects for physically motivated dynamical systems is in its infancy, and the mathematical tools to analyze their behavior are just now being developed. Our proposal brought together researchers with diverse but related background suitable to study these questions.

For details, please refer to the workshop webpage  
<http://www.birs.ca/events/2011/focussed-research-groups/11frg168>

Front: Photo kindly provided by The Banff Centre  
Back: Photo kindly provided by Gordon Weber



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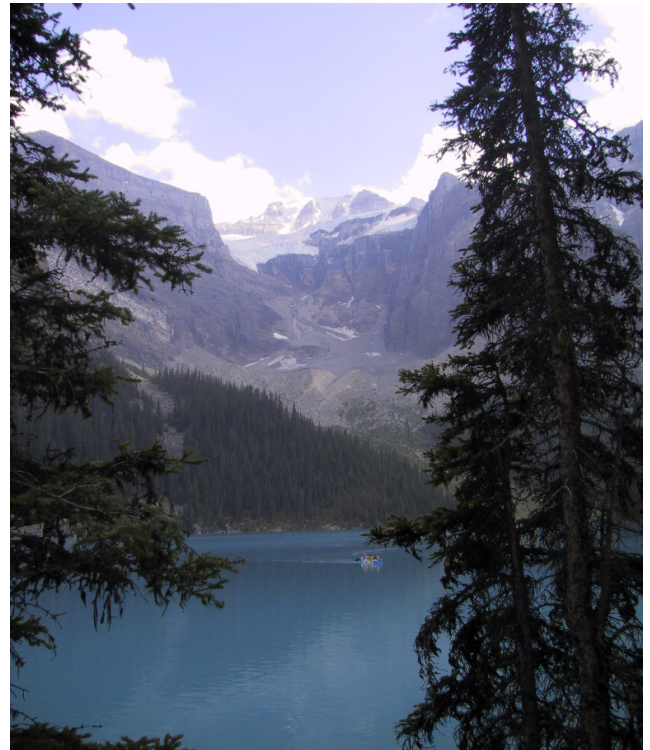
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