# Banff International Research Station
## for Mathematical Innovation and Discovery

# 2010 Scientific Report

NSERC CRSNG

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Alberta Innovates

# 5-Day Workshops 2010

| | | |
|---|---|---|
| Jan 10 | Jan 15 | Mathematics and Physics of Polymer Entanglement |
| Jan 17 | Jan 22 | Multi-Scale Stochastic Modeling of Cell Dynamics |
| Jan 24 | Jan 29 | Sparse Random Structures: Analysis and Computation |
| Jan 31 | Feb 5 | Theory and Applications of Matrices Described by Patterns |
| Jan 31 | Feb 5 | Branching Random Walks and Searching in Trees |
| Feb 7 | Feb 12 | Small-scale Hydrodynamics: Microfluidics and Thin Films |
| Feb 14 | Feb 19 | Convex Algebraic Geometry |
| Feb 21 | Feb 26 | Some Mathematical Problems of Material Science |
| Feb 28 | Mar 5 | Randomization, Relaxation and Complexity |
| Mar 7 | Mar 12 | Quasi-Isometric Rigidity in Low-Dimensional Topology |
| Mar 7 | Mar 12 | (0,2) Mirror Symmetry and Heterotic Gromov-Witten Invariants |
| Mar 14 | Mar 19 | Geometric Scattering Theory and Applications |
| Mar 21 | Mar 26 | Deterministic and Stochastic Front Propagation |
| Mar 28 | Apr 2 | Volume Inequalities |
| Apr 4 | Apr 9 | Coordinated Mathematical Modeling of Internal Waves |
| Apr 11 | Apr 16 | Generalized Complex and Holomorphic Poisson Geometry |
| Apr 18 | Apr 23 | Optimal Transportation and Applications |
| Apr 25 | Apr 30 | Character Varieties in the Geometry and Topology of Low-Dimensional Manifolds |
| May 2 | May 7 | Functional Data Analysis: Future Directions |
| May 2 | May 7 | Creative Writing in Mathematics and Science |
| May 9 | May 14 | Nonlinear Diffusions and Entropy Dissipation: From Geometry to Biology |
| May 16 | May 21 | Inverse Transport Theory and Tomography |
| May 23 | May 28 | Self-assembly of Block Copolymers: Theoretical Models and Mathematical Challenges |
| May 30 | Jun 4 | Diophantine Approximation and Analytic Number Theory |
| Jun 6 | Jun 11 | Whittaker Functions, Crystal Bases and Quantum Groups |
| Jun 13 | Jun 18 | Inclusive Fitness in Evolutionary Modeling |
| Jun 13 | Jun 18 | Evolutionary Games |
| Jun 20 | Jun 25 | Geometric Analysis and General Relativity |
| Jun 27 | Jul 2 | Noncommutative Lp spaces, Operator Spaces and Applications |
| Jul 4 | Jul 9 | Structure and Representations of Exceptional Groups |
| Jul 11 | Jul 16 | Statistical Issues Relevant to Significance of Discovery Claims |
| Jul 18 | Jul 23 | Statistical Genomics in Biomedical Research |
| Jul 25 | Jul 30 | Analysis and Boundary Value Problems on Real and Complex Domains |
| Aug 1 | Aug 6 | Computational Complexity |
| Aug 8 | Aug 13 | Recent Advances on de Giorgi's Conjecture and the Study of Entire Solutions of Nonlinear Scalar Equations |
| Aug 15 | Aug 20 | Multivariate Operator Theory |
| Aug 22 | Aug 27 | Extreme Events in Climate and Weather - an Interdisciplinary Workshop |
| Sep 5 | Sep 10 | New Trends in Structural Graph Theory |
| Sep 12 | Sep 17 | Test Problems for the Theory of Finite Dimensional Algebras |
| Sep 19 | Sep 24 | Classification of Amenable C*-Algebras |
| Sep 26 | Oct 1 | Mathematical Foundations of Mechanical Biology |
| Oct 3 | Oct 8 | Linking Neural Dynamics and Coding: Correlations, Synchrony, and Information |
| Oct 10 | Oct 15 | New Perspectives in Univariate and Multivariate Orthogonal Polynomials |
| Oct 17 | Oct 22 | Front Propagation in Heterogeneous Media: Mathematical, Numerical, and Statistical Issues in Modelling a Forest Fire Front |
| Oct 24 | Oct 29 | Control and Optimization with Differential-Algebraic Constraints |
| Oct 31 | Nov 5 | Integrable and Stochastic Laplacian Growth in Modern Mathematical Physics |
| Nov 7 | Nov 12 | Topological Methods in Toric Geometry, Symplectic Geometry and Combinatorics |
| Nov 14 | Nov 19 | Quasisymmetric Functions |
| Nov 21 | Nov 26 | Nonstandard Discretizations for Fluid Flows |
| Nov 28 | Dec 3 | Sampling and Reconstruction: Applications and Advances |
| Dec 5 | Dec 10 | Teachers as Stakeholders in Mathematics Education Research (MER) |

## 2-Day Workshops 2010

| | | |
|---|---|---|
| Apr 9 | Apr 11 | Cascades Topology |
| Apr 23 | Apr 25 | Ted Lewis Workshop on SNAP Math Fairs |
| Apr 30 | May 2 | Alberta Number Theory Days - L-functions |
| May 7 | May 9 | Western Canada Linear Algebra Meeting |
| May 21 | May 23 | PIMS Mathematical and Statistical Graduate Education Roundtable |
| Aug 13 | Aug 15 | New Geometric and Numeric Tools for the Analysis of Differential Equations |
| Aug 27 | Aug 29 | Information Processing, Rational Beliefs and Social Interaction |
| Sep 10 | Sep 12 | Hierarchical Bayesian Methods in Ecology |
| Oct 1 | Oct 13 | Prediction and Control of Pandemic Outbreak |
| Oct 8 | Oct 10 | Operator Algebras and Representation Theory: Frames, Wavelets and Fractals |
| Nov 26 | Nov 28 | Canadian Math Kangaroo Contest Workshop |

## Research In Teams

| | | |
|---|---|---|
| Jan 17 | Jan 24 | Convergence of Loop-Erased Random Walk to SLE(2) in the Natural Parametrization |
| Feb 21 | Feb 28 | Theory of Functions of Noncommuting Variables and Its Applications |
| Mar 7 | Mar 14 | Local-Global Principles for Etale Cohomology |
| Apr 4 | Apr 18 | H-holomorphic Maps in Symplectic Manifolds |
| Apr 18 | Apr 25 | Boundary Problems for the Second Order Elliptic Equations with Rough Coefficients |
| May 5 | May 9 | Alexandrov Geometry |
| May 30 | Jun 6 | Pentagram Map, Complete Integrability and Cluster Manifolds |
| Jul 4 | Jul 11 | Borel Measurable Functionals on Measure Algebras |
| Jul 25 | Aug 1 | Analytic Index Theory |
| Aug 15 | Aug 22 | Subordination Problems Related to Free Probability |
| Sep 9 | Sep 19 | Research in Photonics: Modeling, Analysis, and Optimization |
| Oct 31 | Nov 7 | Derived Category Methods in Commutative Algebra II |

## Focused Research Groups

| | | |
|---|---|---|
| Mar 28 | Apr 4 | Hyperbolicity in the Symplectic Category |
| May 9 | May 16 | Theory of Rotating Machines |
| May 23 | May 30 | Sparse Pseudorandom Objects |
| Jun 6 | Jun 6 | The Mathematical Genesis of the Phenomenon Called 1/f Noise |
| Jun 13 | Jun 27 | Discrete Probability |
| Jul 18 | Jul 25 | Nonlinear Discrete Optimization |
| Aug 1 | Aug 8 | Cortical Spreading Depression and Related Phenomena |

# Banff International Research Station

**2010**

**5-Day Workshops**

# Mathematics and Physics of Polymer Entanglement: Emerging Concepts and Biomedical Applications
# January 10 - 15, 2010

## Organizers:

**Eric Rawdon** (University of Saint Thomas)
**Christine Soteros** (University of Saskatchewan)
**Hue Sun Chan** (University of Toronto)
**Lynn Zechiedrich** (Baylor College of Medicine)

Over the last decade, tremendous advances have been made in understanding the structure of DNA. On the small scale, twisting, electrostatic charge, and the DNA sequence all contribute to the structure of DNA. But there are also larger scale effects: polymers are often long strands confined in small spaces, essentially forcing complicated entanglement. How do we model DNA taking into account all of these, and many more, factors? Theoretical, numerical, and experimental advancements are needed, combining the efforts of top researchers working at the interface of mathematics, biology, chemistry, and physics. This workshop bridged these fields, inspiring cutting-edge interdisciplinary collaborations, and defining the key problems for the next decade.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5100*

## Participants:

**Arsuaga, Javier** (San Francisco State University)
**Atapour, Mahshid** (York University)
**Buck, Dorothy** (Imperial College)
**Cantarella, Jason** (University of Georgia)
**Chan, Hue Sun** (University of Toronto)
**Darcy, Isabel** (University of Iowa)
**Deguchi, Tetsuo** (Ochanomizu University)
**Diao, Yuanan** (University of North Carolina)
**Duplantier, Bertrand** (Centre d'énergie atomique)
**Ernst, Claus** (Western Kentucky University)
**Fogg, Jonathan** (Baylor College of Medicine)
**Grosberg, Alexander** (New York University)
**Harris, Sarah** (University of Leeds)
**Hughes, Tim** (University of Toronto)
**Janse van Rensburg, Esaias J** (York University)
**Levene, Stephen** (University of Texas at Dallas)
**Levens, David** (Center for Cancer Research NIH)
**Mastin, Matt** (University of Georgia)
**Micheletti, Cristian** (International School for Advanced Studies)
**Muskhelishivili, Georgi** (Jacobs University)
**Olson, Wilma** (Rutgers University)
**Rabin, Yitzhak** (Bar-Ilan University)
**Ramirez-Rosas, Teresita** (University of California)
**Rawdon, Eric** (University of Saint Thomas)
**Rechnitzer, Andrew** (University of British Columbia)
**Rice, Phoebe** (University of Chicago)
**Scharein, Rob** (Hypnagogic Software)
**Schmid, Michael** (Baylor College of Medicine)
**Simon, Jonathan** (University of Iowa)
**Soteros, Christine** (University of Saskatchewan)
**Szafron, Michael** (University of Saskatchewan)
**Wang, Jade** (Baylor College of Medicine)
**Whittington, Stuart** (University of Toronto)
**Yang, Wei** (National Institute of Health)
**Zechiedrich, Lynn** (Baylor College of Medicine)

# Multi-scale Stochastic Modeling of Cell Dynamics
# January 17 - 22, 2010

## Organizers:

**Lea Popovic** (Concordia University)
**Jonathan Mattingly** (Duke University)
**Peter Swain** (University of Edinburgh)
**Brian Ingalls** (University of Waterloo)

The past decade has been marked by an increasing focus on systematic studies of complex interactions in biological systems. Accordingly there is a need for new quantitative approaches that can improve our understanding of how complex pathway hierarchies and their components interact to define various functional networks within cells. Cells are inherently “noisy” systems, and identifying how these complex pathways respond to intrinsic and extrinsic stochastic conditions is an additional challenge requiring new stochastic results. Cellular networks involve many different molecular species, interconnected by an even larger number of chemical reactions, which poses a complex analytical problem. For prediction and simulation purposes, it is essential to reduce both the modeling and the computational complexity of the problem, while still capturing all the essential characteristics and behavior of such a network. This has recently stimulated the development and analysis of stochastic models for biochemical networks and dynamics with multiple scales. This workshop focused on elucidating the mathematical and statistical approaches which can directly contribute to solving some of these problems.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5058*

## Participants:

**Anderson, David** (University of Wisconsin Madison)
**Best, Katharina** (Freiburg University)
**Charlebois, Daniel** (University of Ottawa)
**Cottrell, David** (McGill University)
**Emberly, Eldon** (Simon Fraser University)
**Fricks, John** (Penn State University)
**Gedeon, Tomas** (Montana State University)
**Higham, Des** (University of Strathclyde)
**Kaern, Mads** (University of Ottowa)
**Kang, Hye-Won** (University of Minnesota)
**Kou, Samuel** (Harvard University)
**Kurtz, Thomas G.** (University of Wisconsin, Madison)
**Kuske, Rachel** (University of British Columbia)
**Li, Jiaxu** (University of Louisville)
**Liu, Di** (Michigan State University)
**Mattingly, Jonathan** (Duke University)
**McMillen, David** (University of Toronto, Mississauga)
**McSweeney, John** (SAMSI)
**Mischaikow, Konstantin** (Rutgers University)
**Mukherjee, Sayan** (Duke University)
**Othmer, Hans** (University of Minnesota)
**Perkins, Ted** (Ottawa Hospital Research Institute)
**Pfaffelhuber, Peter** (University of Freiburg)
**Popovic, Lea** (Concordia University)
**Qian, Hong** (University of Washington)
**Rempala, Greg** (Medical College of Georgia)
**Santillan, Moises** (Instituto Politécnico Nacional)
**Scott, Matthew** (University of Waterloo)
**Swain, Peter** (University of Edinburgh)
**Tsimring, Lev** (University of California, San Diego)
**Tupper, Paul** (Simon Fraser University)
**Wang, Jin** (SUNY Stony Brook)
**Wilkinson, Darren** (Newcastle University)
**Williams, Ruth** (University of California, San Diego)

# Sparse Random Structures: Analysis and Computation
# January 24 - 29, 2010

## Organizers:

**Raj Rao Nadakuditi** (University of Michigan)
**Alan Edelman** (Massachusetts Institute of Technology)
**Emmanuel Candes** (California Institute of Technology)
**Roland Speicher** (Queen's University)
**Balint Virag** (University of Toronto)
**John Gilbert** (University of California, Santa Barbara)

This interdisciplinary workshop brought together experts deemed likely to be able to combine the mathematical pieces necessary for understanding modern discrete structures such as the internet, social networks, physical networks, and compressible data. The motivation for workshop was to stimulate interaction between the research communities that have contributed to the body of literature associated with random matrix theory as well as all of the users of this theory represented by the applications above. The research communities actively developing random matrix theory include those in mathematical multivariate statistics,operator algebras, combinatorics, symmetric spaces, stochastic analysis , number theory, orthogonal polynomials, Riemann-Hilbert problems, random graphs, Painleve equations and special functions, random walks and growth processes, integrable systems, and many others. While work has been ongoing for decades, the interest in applying these techniques to discrete structures is only now blossoming.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5033*

## Participants:

**Arizmendi Echegaray, Octavio** (Queen´s University)
**Baryshnikov, Yuliy** (Bell Laboratories)
**Biane, Philippe** (Université de Marne la Vallée)
**Blake, Ian** (University of British Columbia)
**Blitvic, Natasa** (Massachusetts Institute of Technology)
**Bordenave, Charles** (CNRS & Université de Toulouse)
**Brannan, Michael** (Queen's University)
**Bryc, Wlodzimierz** (University of Cincinnati)
**Curran, Stephen** (University of California, Berkeley)
**Davis, Tim** (University of Florida)
**Djidjev, Hristo** (Los Alamos Nat.Lab)
**Dumitriu, Ioana** (University of Washington)
**Edelman, Alan** (Massachusetts Institute of Technology)
**Gilbert, John** (University of California, Santa Barbara)
**Harding, Matthew** (Stanford University)
**Hayden, Patrick** (McGill University)
**Hero, Alfred** (University of Michigan)
**Kolda, Tamara** (Sandia National Laboratories)
**Kritchevski, Eugene** (University of Toronto)
**Leskovec, Jure** (Stanford University)
**Litvak, Alexander** (University of Alberta)
**Loh, Po-Ru** (Massachusetts Institute of Technology)
**Mahoney, Michael** (Stanford University)
**Martinsson, Gunnar** (Colorado University, Boulder)
**McKay, Brendan** (Australian National University)
**Mingo, James A.** (Queen's University)
**Nadakuditi, Raj Rao** (University of Michigan)
**Novak, Jonathan** (University of Waterloo)
**Perry, Patrick** (Harvard University)
**Plan, Yaniv** (California Institute of Technology)
**Preciado, Victor M.** (University of Pennsylvania)
**Preisig, James** (Woods Hole Oceanographic Inst.)
**Redelmeier, Emily** (Queen's University)
**Rider, Brian** (Colorado University Boulder)
**Rogers, Tim** (King's College London)
**Rudelson, Mark** (University of Michigan, Ann Arbor)
**Sen, Arnab** (University of California, Berkeley)
**Speicher, Roland** (Queen's University)
**Vargas Obieta, Carlos** (Queen's University)
**Vavasis, Stephen** (University of Waterloo)
**Virag, Balint** (University of Toronto)
**Ward, Rachel** (Courant Institute)

# Theory and Applications of Matrices Described by Patterns Half Workshop
# January 31 - February 5, 2010

## Organizers:

**Pauline van den Driessche** (University of Victoria)
**Richard Brualdi** ( University of Wisconsin Madison)
**Shaun Fallat** (Universit of Regina)
**Leslie Hogben** (Iowa State University)
**Bryan Shader** (University of Whyoming)


Solving systems of equations is at the heart of many mathematical endeavors. For equations that describe lines, planes and so on (linear equations), the fundamental object is an array of numbers (representing the coefficients of the equations), which is known as a matrix. The solvability of these equations often relies on the amount of information that can be retrieved from the relevant data. For example, if the actual coefficients are unknown, but the positions of the nonzero coefficients (or the signs of the coefficients) are known, this information can be used to deduce properties about the system of equations. The purpose of this workshop was to investigate properties of the corresponding matrices when only combinatorial (position or sign) data is used. For example, it asked questions about minimum rank (and other important properties) when the pattern of nonzero entries is given, and asked the same questions assuming a knowledge of where the zero, positive and negative entries were specified.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5024*

## Participants:

**Brualdi, Richard** (University of Wisconsin-Madison)
**Cavers, Michael** (University of Regina)
**Cioaba, Sebastian** (University of Delaware)
**Deaett, Louis** (University of Victoria)
**Fallat, Shaun** (University of Regina)
**Forster, Juergen** (ITS Informationstechnik Service)
**Gregory, David** (Queens University)
**Grout, Jason** (Iowa State University)
**Haemers, Willem** (Tilburg University)
**Hogben, Leslie** (Iowa State University)
**Kim, In-Jae** (Minnesota State University)
**Kirkland, Steve** (National Uni. of Ireland Maynooth)
**Martin, Ryan** (Iowa State University)
**McDonald, Judi** (Washington State University)
**Nikiforov, Vladimir** (University of Memphis)
**Olesky, Dale** (University of Victoria)
**Shader, Bryan** (University of Wyoming)
**Sherstov, Alexander** (Microsoft Research)
**Srinivasan, Venkatesh** (University of Victoria)
**Tsatsomeros, Michael** (Washington State University)
**van den Driessche, Pauline** (University of Victoria)
**Vander Meulen, Kevin** (Redeemer University College)

# Branching Random Walks and Searching in Trees
# Half Workshop
# January 31 - February 5, 2010

## Organizers:

**Louigi Addario-Berry** (Université de Montréal )
**Colin McDiarmid** (Oxford University)
**Luc Devroye** (McGill University)
**Nicolas Broutin** (INRIA Rocquencourt)

The use of tree-based data structures in algorithm design dates back to at least the 1940s. To this day, many of the fastest and easiest-to-implement algorithms have at their root a tree of one kind or another. (In math lingo, a tree is an object that is "branching" and where, once branches diverge, they never meet again.) The behavior of these data structures turns out to be intimately linked to the study of a probabilistic object known as a branching random walks. The purpose of this workshop was to explore the connections between branching random walks and tree-based data structures. Recent developments from both the probability and the theoretical computer science communities suggest that now may be the time to glean a deeper understanding of both the data structures commonly used in practice, and the probabilistic objects underlying them.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5085*

## Participants:

**Addario-Berry, Louigi** (Université de Montréal)
**Aidekon, Elie** (Eurandom - Technische Universiteit Eindhoven)
**Alsmeyer, Gerold** (University of Münster)
**Biggins, John** (University of Sheffield)
**Broutin, Nicolas** (INRIA Rocquencourt)
**Devroye, Luc** (McGill University)
**Drmota, Michael** (TU Vienna)
**Gantert, Nina** (University of Muenster)
**Goldschmidt, Christina** (University of Warwick)
**Haas, Bénédicte** (Université Paris-Dauphine)
**Hu, Yueyun** (Université Paris 13)
**Kyprianou, Andreas** (University of Bath)
**McDiarmid, Colin** (Oxford University)
**Meiners, Matthias** (Uppsala University)
**Müller, Sebastian** (Technische Universtät Graz)
**Neininger, Ralph** (J.W. Goethe-Universität)
**Popov, Serguei** (IMECC-UNICAMP)
**Reed, Bruce** (McGill University)
**Winkel, Matthias** (University of Oxford)

# Small Scale Hydrodynamics: Microfluidics and Thin Films
# February 7 - 12, 2010

## Organizers:

**Richard Craster** (University of Alberta)
**Demetrios Papageorgiou** (Imperial College London)
**G. M. Homsy** (University of British Columbia)

A revolution is underway in how fluid mechanical devices can be miniaturized. Just as shrinking the scale of computers has led to complete changes in lifestyles, working practices and global economies within a human generation, developments are occurring in the realm of small scale devices that involve the flow of one or more fluids. Many of these developments are driven by applications in medical, biochemical, bioanalytical, nano-liter scale chemical reaction engineering, and in microfluidic “lab-on-a-chip” devices. These rapid and recent developments require advances in theory and in mathematical modeling that lead to improved predictions and to further physical understanding. This interdisciplinary workshop brought together scientists from diverse backgrounds who share a common interest in microfluidics and thin fluid films.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5035*

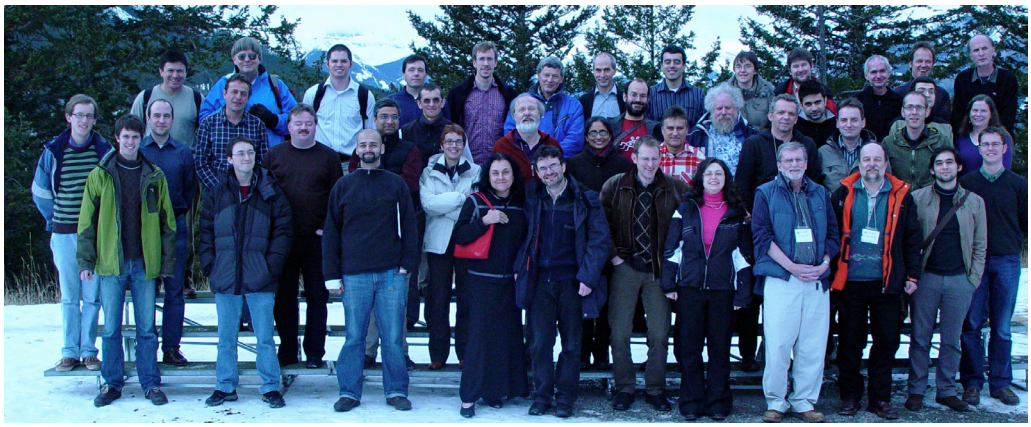
## Participants:

**Anna, Shelley** (Carnegie-Mellon University)
**Balmforth, Neil** (University of British Columbia)
**Booty, Michael** (New Jersey Institute of Technology)
**Braun, Richard** (University of Delaware)
**Breuer, Kenny** (Brown University)
**Cabral, Joao** (Imperial College London)
**Chang, Chia** (University of Notre Dame)
**Craster, Richard** (University of Alberta)
**Duffy, Brian** (University of Strathclyde)
**Eijkel, Jan** (University of Twente)
**Fried, Eliot** (McGill University)
**Graham, Michael** (University of Wisconsin-Madison)
**Gratton, Michael** (Northwestern University)
**Homsy, G. M.** (University of British Columbia)
**Hosoi, Anette** (Massachusetts Institute of Technology)
**Kalliadasis, Serafim** (Imperial College London)
**Krechetnikov, Rouslan** (UC, Santa Barbara)
**Kumar, Satish** (University of Minnesota)
**Lauga, Eric** (University of California at San Diego)
**Maki, Kara** (University of Minnesota)
**Maldarelli, Charles** (City University of New York)
**Matar, Omar K.** (Imperial College London)
**Mavromoustaki, Aliki** (Imperial College London)
**Miksis, Michael J.** (Northwestern University)
**Mitra, Sushanta** (University of Alberta)
**Muller, Susan** (University of California, Berkeley)
**Papageorgiou, Demetrios** (Imperial College London)
**Pascall, Andrew** (UC, Santa Barbara)
**Pennathur, Sumita** (UC, Santa Barbara)
**Savva, Nikos** (Imperial College London)
**Shaqfeh, Eric** (Stanford)
**Shen, Amy** (University of Washington)
**Siegel, Mike** (New Jersey Institute of Technology)
**Squires, Todd** (UC, Santa Barbara)
**Stebe, Kathleen** (University of Pennsylvania)
**Steen, Paul** (Cornell University)
**Thiffeault, Jean-Luc** (University of Wisconsin)
**Tseluiko, Dmitri** (Imperial College London)
**Vanden-Broeck, Jean-Marc** (University College London)
**Ward, Thomas** (North Carolina State University)
**Wilson, Stephen** (University of Strathclyde)
**Yeo, Leslie** (Monash University)
**Zhao, Hong** (Stanford University)

# Convex Algebraic Geometry
# February 14 - 19, 2010

## Organizers:

**Rekha Thomas** (University of Washington)
**Bernd Sturmfels** (University of California, Berkeley)
**Markus Schweighofer** (Universitat Konstanz)



Many geometric objects arising naturally in nature, science or engineering possess two desirable properties: they are convex and they are semialgebraic. Convex sets have the property that one can move between any two of its points along a straight line without leaving the set. Semialgebraic sets can be described combining polynomial inequalities by easy logical operations. The areas of mathematics primarily investigating these objects are Convex Analysis and Real Algebraic Geometry, respectively. Both convexity and a semialgebraic description can be exploited algorithmically, but in totally different ways and with huge restrictions. Convexity can lead to very fast numerical algorithms for navigating on a geometric object. For these algorithms to work, however, one needs additional structure, for example in the form of a nicely represented barrier. Semialgebraic sets can in principle be dealt with on a computer. Very general symbolic algorithms are known to investigate and handle them. However, these algorithms are often not efficient enough for practical purposes. Recently, some corner stones have been laid to take advantage of both features at the same time. This workshop proposed that the corresponding scientific communities join forces to create a new subject called Convex Algebraic Geometry.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5007*

## Participants:

**Ahmadi, Amir Ali** (MIT)
**Basu, Saugata** (Purdue University)
**Blekherman, Greg** (Virginia Bioinformatics Institute)
**Braenden, Petter** (Royal Institute of Technology)
**Conversano, Annalisa** (Universität Konstanz)
**Derksen, Harm** (Michigan University)
**Di Rocco, Sandra** (KTH Stockholm)
**Gouveia, Joao** (University of Washington)
**Hauenstein, Jonathan** (University of Notre Dame)
**Helton, Bill** (University of California, San Diego)
**Henk, Martin** (University of Magdeburg)
**Huisman, Johannes** (Université de Brest)
**Kaltofen, Erich** (North Carolina State University)
**Klep, Igor** (Univerza v Ljubljani)
**Kuhlmann, Salma** (Universität Konstanz)
**Kurdyka, Krzysztof** (Université de Savoie)
**Labs, Oliver** (Universität des Saarlandes)
**Lasserre, Jean-Bernard** (Université de Toulouse)
**Laurent, Monique** (CWI and Tilburg University)
**Marshall, Murray** (University of Saskatchewan)
**Netzer, Tim** (Universität Leipzig)
**Parrilo, Pablo** (MIT)
**Pasechnik, Dmitrii** (Nanyang Technological University)
**Pena, Javier** (Carnegie Mellon University)
**Plaumann, Daniel** (Universität Konstanz)
**Powers, Victoria** (Emory University)
**Putinar, Mihai** (University of California, Santa Barbara)
**Ranestad, Kristian** (University of Oslo)
**Renegar, James** (Cornell University)
**Reznick, Bruce** (University of Illinois)
**Rostalski, Philipp** (ETH Zurich)
**Sanyal, Raman** (UC Berkeley)
**Scheiderer, Claus** (Universität Konstanz)
**Schweighofer, Markus** (Universität Konstanz)
**Sinn, Rainer** (Universität Konstanz)
**Smith, Gregory G.** (Queens University)
**Sottile, Frank** (Texas A&M University)
**Sturmfels, Bernd** (University of California, Berkeley)
**Theobald, Thorsten** (Goethe-Universität Frankfurt)
**Thomas, Rekha** (University of Washington)
**Vallentin, Frank** (TU Delft)
**Vinnikov, Victor** (Ben Gurion University of the Negev)
**Vinzant, Cynthia** (University of California, Berkeley)

# Some Mathematical Problems of Material Science: Effects of Multiple Scales and Extreme Aspect Ratios
# February 21 - 26, 2010

## Organizers:

**Yanyan Li** (Rutgers University)

**Michael Vogelius** (Rutgers University)

This workshop capitalized on recent analytical progress made concerning multiple scales/extreme aspect ratios and their importance for the modeling of various phenomena in material science. In addition to the core scientific program, it sought to thoroughly mix senior and junior researchers, in the hopes of exposing up-and-coming leaders in the field to key ideas and processes.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5125*

## Participants:

**Bao, Ji-Guang** (Beijing Normal University)
**Bao, Shiting** (University of Minnesota)
**Berlyand, Leonid** (Penn State University)
**Bonnaillie-Noel, Virginie** (CNRS)
**Bonnetier, Eric** (Université Joseph Fourier)
**Bryan, Kurt** (Rose-Hulman Institute of Technology)
**Calderer, Maria-Carme** (University of Minnesota)
**Cao, Daomin** (Chinese Academy of Sciences)
**Capdeboscq, Yves** (University Of Oxford)
**Davila, Juan** (CMM & DIM Universidad de Chile)
**de Gournay, Frédéric** (Université de Versailles)
**Kang, Hyeonbae** (Inha University)
**Lee, Hyundae** (Inha University)
**Lewicka, Marta** (University of Minnesota)
**Li, Yanyan** (Rutgers University)
**Li, Haigang** (Beijing Normal University)
**Lim, Mikyoung** (Korea Advanced Institute of Science and Technology)
**Liu, Liping** (University of Houston)
**Moskow, Shari** (Drexel University)
**Musso, Monica** (Universidad Católica de Chile)
**Nguyen, Hoai-Minh** (Institute for Advanced Study)
**Nguyen, Luc** (University of Oxford)
**Onofrei, Daniel** (University of Utah)
**Shipman, Stephen** (Louisiana State University)
**Vogelius, Michael** (Rutgers University)
**Volkov, Darko** (Worcester Polytechnic Institute)
**Wei, Jun Cheng** (Chinese University of Hong Kong)
**Westdickenberg, Maria** (Georgia Inst. of Technology)
**Xu, Haoyuan** (University of Connecticut)
**Xu, Xiaojing** (Beijing Normal University)

# Randomization, Relaxation, and Complexity
# February 28 - March 5, 2010

## Organizers:

**J. Maurice Rojas** (Texas A&M University)
**Pablo Parrilo** (Massachusetts Institute of Technology)
**Leonid Gurvits** (Los Alamos National Laboratories)

Whether it be the design of biomolecules or robots, or the study of physical phenomenae, solving equations is central in mathematics. However, while the underlying theory --- algebraic geometry --- goes back many centuries, it is only recently that algebraic geometry has begun to merge with more applied areas such as numerical analysis and optimization. This workshop aimed to greatly advance this cross-pollenization by uniting recent techniques from computer science and algebraic geometry. Recent results have shown a close link between equation solving, the P=NP problem, and the Riemann Hypothesis. We are thus at a critical juncture where experts in several different communities can come together and make significant advances. In particular, while we now understand equations over the complex numbers well enough to make definitive statements and useful software, equation solving over the real numbers remains mysterious. This is where powerful ideas from randomization and approximation will come into play, and hopefully yield great advances.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5119*

## Participants:

**Ames, Brendan** (University of Waterloo)
**Avendano, Martin** (Texas A&M University)
**Bates, Daniel** (Colorado State University)
**Blekherman, Grigory** (Virginia Tech)
**Gurvits, Leonid** (Los Alamos National Laboratories)
**Harrison, Martin** (University of California (Santa Barbara))
**Hillar, Chris** (Mathematical Sciences Research Institute)
**Janovitz-Freireich, Itnuit** (CINVESTAV (Mexico))
**Koiran, Pascal** (ENS Lyon / University of Toronto)
**Leykin, Anton** (Georgia Tech)
**Li, Tien-Yien** (Michigan State University)
**Margulies, Susan** (Rice University)
**Matusevich, Laura** (Texas A&M University)
**Mourrain, Bernard** (INRIA Sophia-Antipolis)
**Nisse, Mounir** (Universite Paris VI)
**Parrilo, Pablo** (Massachusetts Institute of Technology)
**Putinar, Mihai** (University of California at Santa Barbara)
**Renegar, James** (Cornell University)
**Rojas, J. Maurice** (Texas A&M University)
**Rusek, Korben** (Texas A&M University)
**Sommese, Andrew** (University of Notre Dame)
**Thompson, David** (Sandia National Laboratories)
**Tuncel, Levent** (University of Waterloo)
**Vinnikov, Victor** (Ben Gurion University of the Negev)
**Zheng, Zhonggang** (Northeastern Illinois University)

# Quasi-Isometric Rigidity in Low Dimensional Topology Half Workshop
# March 7 - 12, 2010

## Organizers:

**Jason Behrstock** (Lehman College, CUNY)
**Walter Neumann** (Columbia University)
**Micheal Kapovich** (University of California, Davis)

Quasi-isometry refers to the study of mathematical objects up to bounded deformation. Among other things, it allows the geometric study of algebraic objects. This workshop focused on studying applications to algebraic objects associated with objects of low dimensional topology, including dynamical systems on surfaces, potential shapes for the universe, and many others, One of the attractions of the area is that it involves many other diverse fields. Despite the flurry of activity which has occurred in recent years, open problems abound, and the workshop brought together a wide range of experts to discuss them.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5051*

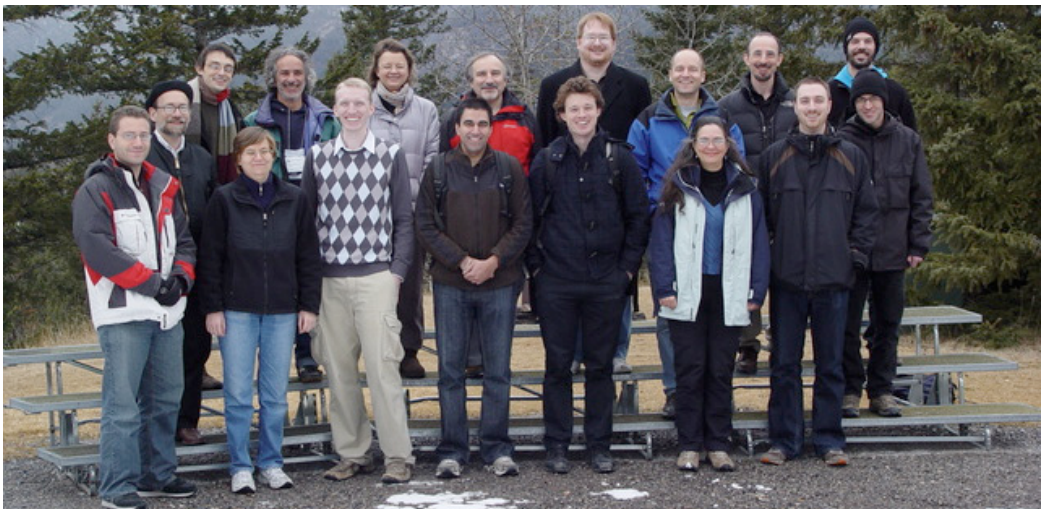
## Participants:

**Behrstock, Jason** (Lehman College, CUNY)
**Bestvina, Mladen** (University of Utah)
**Cashen, Christopher** (University of Utah)
**Dymarz, Tullia** (Yale University)
**Forehand, James** (University of California. Davis)
**Hagen, Mark** (McGill University)
**Kapovich, Michael** (University of California, Davis)
**Kramer, Linus** (Universität Münster)
**Martinez-Pedroza, Eduardo** (McMaster University)
**Mayeda, Dustin** (University of California, Davis)
**Neumann, Walter** (Columbia University)
**Sapir, Mark** (Vanderbilt University)
**Sultan, Harold** (Columbia University)
**Thomas, Anne** (University of Oxford)
**Walsh, Genevieve** (Tufts University)
**Wortman, Kevin** (University of Utah)
**Xie, Xiangdong** (Georgia Southern University)

# (0,2) Mirror Symmetry and Heterotic Gromov-Witten Invariants Half Workshop
# March 7 - 12, 2010

## Organizers:

**Ilarion Melnikov** (Albert Einstein Institute, Hannover)
**Jacques Distler** (University of Texas)
**Ron Donagi** (University of Pennsylvania)
**Savdeep Sethi** (University of Chicago)
**Eric Sharpe** (Virginia Tech)



String theory has served as a remarkable bridge builder between theoretical physics and mathematics. The former lends to the latter new, physically motivated perspectives on difficult mathematical problems, as well as suggesting interesting new directions of research. The latter is invaluable to the former by helping to precisely formulate and often solve problems that could not be tackled without new mathematical tools. One of the best known of these bridges is the study of Mirror Symmetry. The origin of this subject lies in attempts to build a four-dimensional physical world out of the ten-dimensional string theory. One way to achieve this goal is to wrap six of the dimensions in a very small space, leaving four dimensions to span something that resembles our universe. Many properties of the resulting four-dimensional physics are then encoded in the geometric properties of the internal space chosen. Mirror symmetry is a remarkable property in that there exist pairs of topolgically distinct internal spaces M and W that lead to exactly the same four-dimensional physics. Under this equivalence, difficult questions about the geometric properties of M end up being equivalent to much simpler questions about the properties of W. This property, and details of such “mirror pairs” have received great scrutiny from mathematicians and physicists, to the considerable advantage to both disciplines. There are indications in current research that this property may be significantly extended, leading to new developments in mathematics, as well as an improved understanding of physical theories that resemble more closely the four-dimensional world we inhabit. The aim of this workshop was to bring together mathematicians and physicists to attempt to formulate this extension.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5047*

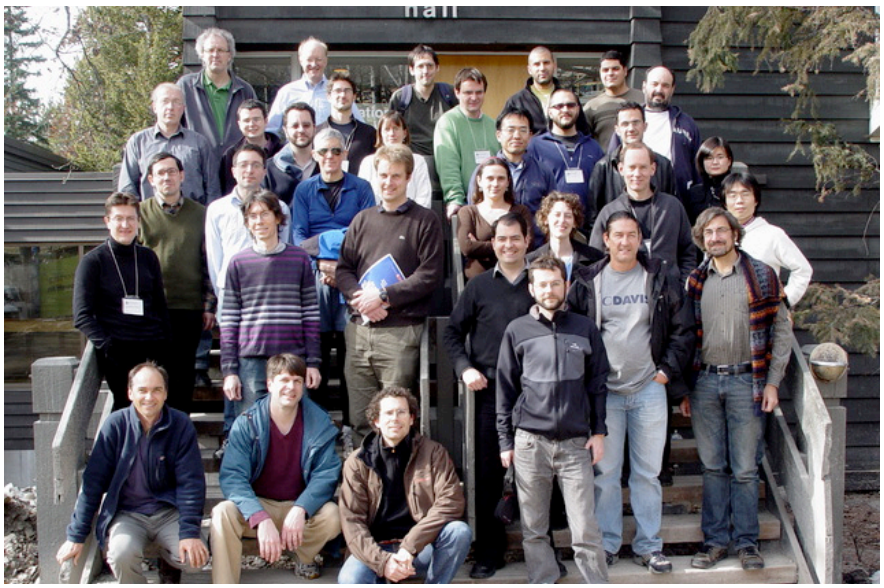
## Participants:

**Anguelova, Lilia** (University of Cincinnati)
**Aspinwall, Paul** (Duke University)
**Becker, Katrin** (Texas A & M University)
**Bouchard, Vincent** (University of Alberta)
**Candelas, Philip** (University of Oxford)
**de la Ossa, Xenia** (University of Oxford)
**Diaconescu, Duiliu-Emanuel** (Rutgers University)
**Distler, Jacques** (University of Texas)
**Donagi, Ron** (University of Pennsylvania)
**Guffin, Josh** (University of Pennsylvania)
**Jockers, Hans** (Stanford University)
**Lapan, Joshua** (UC, Santa Barbara)
**McOrist, Jock** (University of Cambridge)
**Melnikov, Ilarion** (Albert Einstein Institute Hannover)
**Plesser, Ronen** (Duke University)
**Quigley, Callum** (University of Chicago)
**Sethi, Savdeep** (University of Chicago)
**Sharpe, Eric** (Virginia Tech)

# Geometric Scattering Theory and Applications
# March 14 - 19, 2010

## Organizers:

**Peter Perry** (University of Kentucky)
**Rafe Mazzeo** (Stanford University)
**Antonio Sa Barreto** (Purdue University)
**Peter Hislop** (University of Kentucky)



Scattering theory allows the examination of the structure of a body by sending in waves and looking at how they are reflected and distorted by that body. Common examples include X-rays and ultrasound. Mathematicians have found that similar ideas can be applied to probe the geometric and topological properties of abstract objects called manifolds. This workshop focused on the use of the mathematical methods of scattering theory to probe the structures of certain classes of compact manifolds that are the distortions of spheres and other topological shapes in real and complex space.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5106*

## Participants:

**Albin, Pierre** (MIT)
**Aldana, Clara** (Universidad de los Andes)
**Alexakis, Spyros** (University of Toronto)
**Baskin, Dean** (Stanford University)
**Borthwick, David** (Emory University)
**Christiansen, Tanya** (University of Missouri)
**Christianson, Hans** (MIT)
**Datchev, Kiril** (University of California, Berkeley)
**Degeratu, Anda** (Max Planck Institute)
**Dryden, Emily** (Bucknell University)
**Froese, Richard** (University of British Columbia)
**Gell-Redman, Jesse** (Stanford University)
**Gover, A. Rod** (University of Auckland)
**Graham, Robin** (University of Washington)
**Guillarmou, Colin** (ENS Paris)
**Häfner, Dietrich** (Université de Grenoble)
**Hassell, Andrew** (Australian National University)
**Hirachi, Kengo** (University of Tokyo)
**Hislop, Peter** (University of Kentucky)
**Hora, Raphael** (Purdue University)
**Jakobson, Dmitry** (McGill University)
**Juhl, Andreas** (Humboldt-University Berlin)
**Kottke, Chris** (MIT)
**Marazzi, Leonardo** (Western Kentucky University)
**Matsumoto, Yoshihiko** (The University of Tokyo)
**Mazzeo, Rafe** (Stanford University)
**Naud, Frederic** (Université d'Avignon)
**Nicolas, Jean-Phillipe** (Université de Brest)
**Nonnenmacher, Stephane** (Commissariat à l'énergie atomique Saclay)
**Perry, Peter** (University of Kentucky)
**Qian, Randy** (Northwestern University)
**Sa Barreto, Antonio** (Purdue University)
**Tohaneanu, Mihai** (Purdue University)
**Vasy, András** (Stanford University)
**Wang, Fang** (MIT)
**Wunsch, Jared** (Northwestern University)
**Zelditch, Steven** (Johns Hopkins University)

# Deterministic and Stochastic Front Propagation
# March 21 - 26, 2010

## Organizers:

**Lenya Ryzhik** (Stanford University)
**Francois Hamel** (Université Aix-Marseille III)
**Jean-Michel Roquejoffre** (Université Toulouse III)
**Xavier Cabre** (ICREA and Universitat Politecnica de Catalunya)
**Jeremy Quastel** (University of Toronto)

Reaction-diffusion equations model problems arise in almost every branch of the physical, biological and social sciences and engineering. In combustion theory, they describe flame propagation. In theoretical physics, they are a precious tool to analyse superconducting materials and phase transitions. In epidemiology, they can predict how fast an infectious disease is likely to spread. In ecology, they help to describe population dynamics subject to environmental changes including climate modifications. They also play an important role in geometric problems such as E. de Giorgi's problem on minimal surfaces. This problem is now completely solved, after more than 20 years of efforts by a large community of mathematicians. This workshop focused on new notions of propagation; singular limits and free boundary problems, including homogenization; non-local effects; the de Giorgi conjecture; and entropy methods.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5073*

## Participants:

**Bérard, Jean** (Université Lyon I)
**Berestycki, Henri** (École des hautes études en sciences sociales)
**Brunet, Eric** (École Normale Supérieure & UPMC)
**Cabre, Xavier** (ICREA & Universitat Politecnica de Catalunya)
**Calvez, Vincent** (ENS Lyon)
**Chapuisat, Guillemette** (Université Aix-Marseille III)
**Cinti, Eleonora** (Universitat Politecnica de Catalunya)
**Comets, Francis** (Universite Paris VII)
**de Bouard, Anne** (École Polytechnique)
**del Pino, Manuel** (Universidad de Chile)
**El Smaily, Mohammad** (UBC)
**Fazly, Mostafa** (UBC)
**Ghoussoub, Nassif** (BIRS)
**Gui, Changfeng** (University of Connecticut)
**Hamel, Francois** (Université Aix-Marseille III)
**Iyer, Gautam** (Carnegie Mellon University)
**Jerrard, Robert** (University of Toronto)
**Kosygina, Elena** (Baruch College, CUNY)
**Nadin, Gregoire** (CNRS)
**Nolen, James** (Duke University)
**Novikov, Alexei** (Pennsylvania State University)
**Perthame, Benoit** (Université Pierre et Marie Curie)
**Quastel, Jeremy** (University of Toronto)
**Roquejoffre, Jean-Michel** (Université Toulouse III)
**Roques, Lionel** (INRA)
**Roussier-Michon, Violaine** (INSA Toulouse)
**Ryzhik, Lenya** (Stanford University)
**Serra, Joaquim** (Universitat Politecnica de Catalunya)
**Sire, Yannick** (Université Aix-Marseille III)
**Souganidis, Panagiotis** (University of Chicago)
**Wei, Jun Cheng** (Chinese University of Hong Kong)
**Zlatos, Andrej** (University of Chicago)

# Volume Inequalities
# March 28 - April 2, 2010

## Organizers:

**Karoly Bezdek** (University of Calgary)
**Robert Connelly** (Cornell University)
**Alexander Litvak** (University of Alberta)
**Frank Morgan** (Williams College)

Volume is one of the most fundamental concepts of mathematics and, in particular, of geometry. It plays an absolutely central role in discrete geometry, in geometric measure theory, and in asymptotic geometric analysis. This workshop brough together a good number of leading experts in the hope of generating further progress on a number of important research problems of the above mentioned three fields.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5114*

## Participants:

**Bezdek, Karoly** (University of Calgary)
**Cantarella, Jason** (University of Georgia)
**Connelly, Robert** (Cornell University)
**Cox, Simon** (Aberystwyth University)
**Csikos, Balazs** (Eotvos University)
**Devadoss, Satyan** (Williams College)
**Elser, Veit** (Cornell University)
**Engelstein, Max** (Yale University)
**Fejes Tóth, Gabor** (Alfréd Rényi Inst. of Mathematics)
**Ghomi, Mohammad** (Georgia Institute of Technology)
**Gorbovickis, Igors** (Cornell University)
**Gordon, Yehoram** (Technion)
**Hug, Daniel** (Karlsruhe Institute of Technology)
**Kuperberg, Greg** (University of California, Davis)
**Kuperberg, Wlodzimierz** (Auburn University)
**Lawlor, Gary** (Brigham Young University)
**Litvak, Alexander** (University of Alberta)
**Milman, Vitali** (Tel Aviv University)
**Milman, Emanuel** (University of Toronto)
**Morgan, Frank** (Williams College)
**Musin, Oleg** (Univ. of Texas at Brownsville)
**Pivovarov, Peter** (Fields Institute)
**Schneider, Rolf** (University of Freiburg)
**Schuett, Carsten** (Christian-Albrechts-U. zu Kiel)
**Slomka, Bo'az** (Tel Aviv University)
**Slutskiy, Dmitriy** (Russian Academy of Sciences)
**Sullivan, John** (TU Berlin)
**Swanepoel, Konrad** (London School of Economics)
**Szarek, Stanislaw** (Université Paris VI)
**Taschuk, Steven** (U. Alberta)
**Tomczak-Jaegermann, Nicole** (U. Alberta)
**Toth, Csaba D.** (University of Calgary)
**Werner, Elisabeth** (Case Western Reserve U.)
**Yaskin, Vladyslav** (U. Alberta)
**Yu, Long** (U. Alberta)
**Zvavitch, Artem** (Kent State University)

# Coordinated Mathematical Modeling of Internal Waves
# April 4 - 9, 2010

## Organizers:

**Thomas Peacock** (MIT)
**Neil Balmforth** (University of British Columbia)
**Bruce Sutherland** (University of Alberta)
**Gordon Ogilvie** (University of Cambridge)

Internal waves are waves that oscillate within, rather than on the surface of, a fluid body. On Earth, internal waves in the ocean and atmosphere are so large they can be seen from space, and can pose a real danger to airplanes, oil rigs and submarines. At the same time, however, the energy they transport plays a vital role in driving circulation and determining climate. Out in space, internal waves affect the evolution of satellite systems of giant planets and nuclear reactions within stars. Despite a resurgence of interest, many aspects of internal waves still defy mathematical description. This workshop brought together a group of leading mathematicians, oceanographers, atmospheric scientists and astrophysicists to tackle the outstanding issues. Advances stemming from this workshop will improve the ability to model the Earth's climate and the dynamics of planetary systems and stars.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5083*

## Participants:

**Achatz, Ulrich** (Goethe Universität)
**Ahmed, Madiha** (Laboratoire d'Hydrodynamique)
**Alford, Matthew** (University of Washington)
**Balmforth, Neil** (University of British Columbia)
**Bouruet-Aubertot, Pascale** (Universite Paris VI)
**Buhler, Oliver** (Courant Institute)
**Buijsman, Maarten** (UC, Los Angeles)
**Carr, Magda** (St. Andrews University)
**Dauxois, Thierry** (CNRS & ENS Lyon)
**Dintrans, Boris** (Laboratoire Astrophysique de Toulouse-Tarbes)
**Fringer, Oliver** (Stanford University)
**Fritts, David** (NorthWest Research Associates)
**Garaud, Pascale** (University of California at Santa Cruz)
**Gerkema, Theo** (Royal Netherlands Institute for Sea Research)
**Goodman, Jeremy** (Princeton University)
**Grimshaw, Roger** (Loughborough University)
**Grisouard, Nicolas** (University of Grenoble)
**Helfrich, Karl** (Woods Hole Oceanographic Institution)
**Ivey, Greg** (University of Western Australia)
**Johnston, Shaun** (Scripps Institution of Oceanography)
**Klaassen, Gary** (York University)
**Klymak, Jody** (University of Victoria)
**Koseff, Jeffrey** (Stanford University)
**Legg, Sonya** (Princeton University)
**Linden, Paul** (University of California at San Diego)
**MacKinnon, Jennifer** (Scripps Inst. of Oceanography)
**Mathur, Manikandan** (MIT)
**Mercier, Matthieu** (ENS de Lyon)
**Ogilvie, Gordon** (University of Cambridge)
**Papaloizou, John** (University of Cambridge)
**Peacock, Thomas** (MIT)
**Rieutord, Michel** (Laboratoire d'Astrophysique de Toulouse-Tarbes)
**Rogers, Tamara** (University of Arizona)
**Rottman, James** (SAIC)
**Sarkar, Sutanu** (University of California at San Diego)
**Smith, Ronald** (Yale University)
**Sommeria, Joel** (University of Grenoble)
**St. Laurent, Lou** (Woods Hole Oceanographic Institution)
**Staquet, Chantal** (University of Grenoble)
**Sutherland, Bruce** (University of Alberta)
**Swinney, Harry** (University of Texas at Austin)
**Wu, Yanqin** (University of Toronto)

# Generalized Complex and Holomorphic Poisson Geometry
# April 11 - 16, 2010

## Organizers:

**Marco Gualtieri** (University of Toronto)
**Henrique Bursztyn** (Instituto Nacional de Matematica Pura e Aplicada Rio de Janeiro)
**Nigel Hitchin** (Oxford University)
**Jacques Hurtubise** (McGill University)
**Ruxandra Moraru** (University of Waterloo)
**Gil Cavalcanti** (Utrecht University)

Before this BIRS workshop, a meeting gathering the growing number of researchers investigating the various forms of generalized geometry, such as generalized complex and Kähler geometry, had never been held. There was a general consensus among many of the researchers mentioned above that a meeting focused on the subject would be of great benefit to progress in the field.The primary objective of the workshop was to gather together, in the secluded and stimulating environment of BIRS, the mathematicians who work on generalized complex geometry and closely related fields such as Poisson geometry, non-Kähler complex geometry, and integrable systems, so that they might combine their tools and approaches to further our understanding of these subjects.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5072*

## Participants:

**Aldi, Marco** (University of California Berkeley)
**Apostolov, Vestislav** (Université du Québec à Montréal)
**Arkhipov, Sergey** (University of Toronto)
**Bailey, Michael** (University of Toronto)
**Baird, Tom** (University of Oxford)
**Bartocci, Claudio** (University of Genoa)
**Brav, Chris** (University of Toronto)
**Buchweitz Ragnar-Olaf** (U. Toronto Scarborough)
**Bursztyn, Henrique** (IMPA)
**Cabrera, Alejandro** (IMPA)
**Caine, Arlo** (Notre Dame University)
**Canez, Santiago** (University of California, Berkeley)
**Cattaneo, Alberto** (Zurich University)
**Cavalcanti, Gil** (Utrecht University)
**Dancer, Andrew** (University of Oxford)
**Dixon, Kael** (University of British Columbia)
**Gauduchon, Paul** (École polytechnique)
**Gindi, Steve** (Stony Brook University)
**Goto, Ryushi** (Osaka University)
**Gualtieri, Marco** (University of Toronto)
**Hitchin, Nigel** (Oxford University)
**Hu, Shengda** (University of Waterloo)
**Hurtubise, Jacques** (McGill University)
**Karigiannis, Spiro** (University of Waterloo)
**Leung, Naichung Conan** (University of Hong Kong)
**Li, Travis Songhao** (University of Toronto)
**Li-Bland, Davis** (University of Toronto)
**Mare, Augustin-Liviu** (University of Regina)
**Meinrenken, Eckhard** (University of Toronto)
**Moraru, Ruxandra** (University of Waterloo)
**Poon, Yat Sun** (University of California Riverside)
**Pym, Brent** (University of Toronto)
**Sawon, Justin** (Colorado State University)
**Sniatycki, Jedrezej** (University of Calgary)
**Teleman, Adrei** (Universite de Provence)
**Tolman, Susan** (U. Illinois, Urbana-Champaign)
**Wade, Aissa** (Penn State University)
**Witt, Frederik** (WWU Münster)
**Wong, Michael Lennox** (McGill University)
**Zabzine, Maxim** (Uppsala University)

# Optimal Transportation and Applications
# April 18 - 23, 2010

## Organizers:

**Yuxin Ge** (Universite Paris XII)
**Young-Heon Kim** (University of British Columbia )
**Robert McCann** (University of Toronto)
**Neil Trudinger** (Australian National University)
**Alessio Figalli** (University of Texas at Austin)

Optimal transportation is the study of how to transport objects from their present positions to their desired locations as efficiently as possible. Its mathematical origins can be traced back to Gaspard Monge's famous paper of 1781, *Mémoire sur la théorie des déblais et des remblais.* Since that time it has resurfaced as a recurring theme in many sciences, ranging from engineering design to economics (where it stimulated the Nobel prize-winning research of Kantorovich and Koopmans), and most recently in geometry and mathematical analysis. The aim of this workshop was to bring together young and established researchers from a range of different fields with common interests in subjects related to the mathematics of transportation. It disseminated recent progress while stimulating new collaborations, new questions, and new lines of research. It is also hoped that it has helped to accelerate the rate of progress within mathematics and in the transfer and application of mathematical techniques between mathematics and adjacent areas of science, including economics, engineering, and meteorology, having a lasting impact through the targeting of new directions for future research.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5025*

## Participants:

**Brendle, Simon** (Stanford University)
**Chen, Shibing** (University of Toronto)
**Feldman, Mikhail** (University of Wisconsin)
**Figalli, Alessio** (The University of Texas at Austin)
**Gallouet, Thomas** (École Normale Supérieure de Lyon)
**Gangbo, Wilfrid** (Georgia Institute of Technology)
**Gigli, Nicola** (University of Bonn)
**Gualdani, Maria** (University of Texas at Austin)
**Indrei, Emanuel** (University of Texas at Austin)
**Kim, Young-Heon** (University of British Columbia)
**Lee, Paul** (University of California, Berkeley)
**Liu, Jiakun** (Australian National University)
**McCann, Robert** (University of Toronto)
**Merigot, Quentin** (INRIA Sophia-Antipolis)
**Moradifam, Amir** (University of British Columbia)
**Newsam, Garry** (Defence Science and Technology Organisation, Australia)
**Nussenzveig, Lopes Helena J.** (Universidade Estadual de Campinas)
**Pass, Brendan** (University of Toronto)
**Rifford, Ludovic** (University of Nice)
**Sei, Tomonari** (University of Tokyo)
**Sturm, Karl-Theodor** (University of Bonn)
**Takatsu, Asuka** (Tohoku University)
**Trudinger, Neil** (Australian National University)
**Wang, Shawn** (University of British Columbia)
**Warren, Micah** (Princeton University)
**Wolansky, Gershon** (Technion)
**Xia, Qinglan** (University of California, Davis)
**Yuan, Yu** (University of Washington)
**Zarate Saiz, Ramon** (University of British Columbia)

# Character Varieties in the Geometry and Topology of Low-Dimensional Manifolds
## April 25 - 30, 2010

### Organizers:

**Alan Reid** (University of Texas at Austin)
**Dick Canary** (University of Michigan)
**William Goldman** (University of Maryland)
**Steve Boyer** (Universite du Quebec a Montreal)

The study of spaces that locally look like Euclidean 3-space has been a central theme of mathematical research for many years. There have recently been tremendous leaps in our understanding of these spaces; for example, Perelman's solution to the Poincaré Conjecture. A key feature of recent developments has been the role of geometry. This workshop brought together researchers who study certain algebraic objects (the so called Character Variety) associated to these spaces and that have been important in many recent developments in low-dimensional topology and geometry.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5094*

### Participants:

**Baba, Shinpei** (Universität Bonn)
**Biringer, Ian** (Yale University)
**Boden, Hans** (McMaster University)
**Boyer, Steve** (Université du Québec à Montréal)
**Brock, Jeffrey** (Brown University)
**Bromberg, Kenneth** (University of Utah)
**Canary, Dick** (University of Michigan)
**Cavendish, Will** (Princeton University)
**Charette, Virginie** (Université de Sherbrooke)
**Chesebro, Eric** (University of Montana)
**Cooper, Daryl** (University of California Santa Barbara)
**Culler, Marc** (University of Illinois, Chicago)
**DeBlois, Jason** (University of Illionis at Chicago)
**Do, Norman** (McGill University)
**Dumas, David** (University of Illinois at Chicago)
**Gelander, Tsachik** (Hebrew University)
**Goldman, William** (University of Maryland)
**Hamenstaedt, Ursula** (Universität Bonn)
**Kent, Richard** (Brown University)
**Kerckhoff, Steve** (Stanford University)
**Landes, Emily** (University of Texas)
**Lawton, Sean** (University of Texas-Pan American)
**Lecuire, Cyril** (Université Paul Sabatier)
**Lee, Michelle** (University of Michigan)
**Leininger, Chris** (U. Illinois Urbana Champaign)
**Long, Darren** (University of California Santa Barbara)
**Macasieb, Melissa** (University of Maryland)
**Magid, Aaron** (University of Maryland)
**Mattman, Thomas** (California State University, Chico)
**McShane, Greg** (Université de Grenoble)
**Minsky, Yair** (Yale University)
**Petersen, Kate** (Florida State University)
**Porti, Joan** (Universitat Autonoma de Barcelona)
**Reid, Alan** (University of Texas at Austin)
**Segerman, Henry** (University of Texas)
**Shalen, Peter** (University of Illinois at Chicago)
**Sikora, Adam** (State University of New York, Buffalo)
**Souto, Juan** (University of Michigan)
**Tan, Ser-Peow** (National University of Singapore)
**Tillmann, Stephan** (University of Queensland)
**Walsh, Genevieve** (Tufts University)
**Wienhard, Anna** (Princeton University)

# Functional Data Analysis: Future Directions Half Workshop May 2 - 7, 2010

## Organizers:

**Jason Nielsen** (Carleton University)
**Jim Ramsay** (McGill University)
**Jiguo Cao** (Simon Fraser University)
**Fang Yao** (University of Toronto)

Functional data analysis concerns data distributed over time, space and other continuous variables, as well as models that use curves, surfaces and other smooth structures. The methodology already developed in this field has proven useful in a wide range of fields in engineering, medicine, and the natural and social sciences. After a decade of rapid progress, the time has come to take stock, and to map out future priorities. This workshop brought together the leaders in this field, representatives of related areas, and promising young researchers.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5027*

## Participants:

**Bonner, Simon** (University British Columbia)
**Cao, Jiguo** (Simon Fraser University)
**Genton, Marc** (Texas A&M University)
**Heckman, Nancy** (University of British Columbia)
**Huang, Jianhua** (Texas A&M University)
**Kneip, Alois** (Universität Bonn)
**Marron, J. S. (Steve)** (U. North Carolina Chapel Hill)
**Mizera, Ivan** (University of Alberta)
**Müller, Hans-Georg** (University of California, Davis)
**Nielsen, Jason** (Carleton University)
**Paul, Debashis** (University of California, Davis)
**Ramsay, Jim** (McGill University)
**Ray, Surajit** (Boston University)
**Sangalli, Laura Maria** (Politecnico di Milano)
**Wang, Liangliang** (University of British Columbia)
**Wang, Jane-Ling** (University of California, Davis)
**Yao, Fang** (University of Toronto)
**Zhang, Chunming** (University of Wisconsin)

# Creative Writing in Mathematics and Science
# Half Workshop
# May 2 - 7, 2010

## Organizers:

**Marjorie Senechal** (Smith College)

**Florin Diacu** (University of Victoria)


The current spate of books (fiction as well as nonfiction), plays, and films about science and mathematics attests to the hunger of a broad public for informal access to mathematical and scientific ideas. This workshop sought to expand and encourage the small community of writers actively seeking to engage the larger public in mathematics and science in a broadly creative way. To this end, it brought together writers (many of them mathematicians) in fiction, nonfiction, poetry, drama, and journalism to read, discuss, and critique each other's unpublished work. Workshop activities included a public reading.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5057*

## Participants:

**Anand, Madhur** (University of Guelph)
**Batterson, Steve** (Emory University)
**Bohannon, John** (Harvard University)
**Brandts, Wendy** (University of Ottawa)
**Burgess, Sarah Isabel** (University of Toronto)
**Chapman, Robin** (University of Wisconsin)
**Cipra, Barry** (Freelance)
**Davis, Chandler** (University of Toronto)
**Dawson, Robert** (St. Mary's University)
**Diacu, Florin** (University of Victoria)
**Dickinson, Adam** (Brock University)
**Holmes, Philip** (Princeton University)
**Karaali, Gizem** (Pomona College)
**Mazur, Joseph** (Marlboro College)
**Roberts, Siobhan** (Institute for Advanced Study)
**Rowley, Mari-Lou** (University of Saskatchewan)
**Senechal, Marjorie** (Smith College)
**Tasic, Vladimir** (University of New Brunswick)
**Varagic, Dragana** (Art. Dir. April Productions)

# Nonlinear Diffusions and Entropy Dissipation: From Geometry to Biology
## May 9 - 14, 2010

### Organizers:

**Dejan Slepcev** (Carnegie Mellon University)
**Eric Carlen** (Rutgers University)
**José Antonio Carrillo** (ICREA)
**Jean Dolbeault** (Université Paris-Dauphine)

Nonlinear diffusions and other irreversible phenomena are present in many processes important for our daily lives such as traffic flow, the production of semiconductors, and the spreading of pollutants through the ground. They appear in fields as diverse as population biology, microfluidics and differential geometry. Entropies measure, in a certain sense, how far a system is from the equilibrium configuration. As the system evolves the entropy is being dissipated. Understanding the relation between the entropy and its dissipation forms the foundation for investigating many diffusive systems and was the overarching theme of this workshop, which brought together experts from variety of fields connected by the common mathematical structure of the models studied. Researchers using a range of techniques, from numerical experiments and asymptotic expansions to theoretical analysis, came together to discuss challenging problems that the applications have set forth. This variety fostered the transfer of knowledge and techniques between diverse areas of science.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5054*

### Participants:

**Agueh, Martial** (University of Victoria)
**Biler, Piotr** (University of Wroclaw)
**Blanchet, Adrien** (Université de Toulouse)
**Bonforte, Matteo** (Universidad Autónoma de Madrid)
**Calvez, Vincent** (ENS Lyon (UMPA))
**Cañizo Rincón, José Alfredo** (Universitat Autònoma de Barcelona)
**Carlen, Eric** (Rutgers University)
**Carrillo, José Antonio** (ICREA)
**Carvalho, Maria** (U. of Lisbon & Rutgers U.)
**Chugunova, Marina** (University of Toronto)
**Corrias, Lucilla** (Université d'Evry)
**Daskalopoulos, Panagiota** (Columbia University)
**Desvillettes, Laurent** (ENS de Cachan)
**Di Francesco, Marco** (U. degli Studi dell'Aquila)
**Dolbeault, Jean** (Université Paris-Dauphine)
**Fellner, Klemens** (University of Cambridge)
**Figalli, Alessio** (The University of Texas at Austin)
**Gonzalez, Maria del Mar** (Universidad Politecnica de Catalunya)
**Kinderlehrer, David** (Carnegie Mellon University)
**Laurençot, Philippe** (Institut de Math. de Toulouse)
**Laurent, Thomas** (UC, Los Angeles)
**Lee, Paul** (UC, Berkeley)
**Lorz, Alexander** (University of Cambridge)
**Matthes, Daniel** (Technische Universität Wien)
**McCann, Robert** (University of Toronto)
**Nazaret, Bruno** (Université Paris-Dauphine)
**Raoul, Gael** (ENS de Cachan)
**Rosado, Jesus** (Universitat Autònoma de Barcelona)
**Savare, Giuseppe** (University of Pavia)
**Schmeiser, Christian** (Universität Wien)
**Schwab, Russell** (Carnegie Mellon University)
**Sesum, Natasa** (University of Pennsylvania)
**Slepcev, Dejan** (Carnegie Mellon University)
**Stanczy, Robert** (Uniwersytet Wroclawski)
**Sturm, Karl-Theodor** (Universität Bonn)
**Ulusoy, Suleyman** (University of Maryland)
**Westdickenberg, Michael** (Georgia Inst. of Tech.)

# Inverse Transport Theory and Tomography
# May 16 - 21, 2010

## Organizers:

**Plamen Stefanov** (Purdue University)
**Guillaume Bal** (Columbia University)
**Gunther Uhlmann** (University of Washington)

The purpose of this workshop is to bring together specialists in the general area of inverse transport theory. Inverse transport encompasses many theoretical and practical areas. In case of no scattering, inverse transport for example includes classical tomography, with its applications in medical and geophysical imaging. In the presence of particle scattering, applications include optical tomography (propagation of photons through human tissues) and radiation through the atmosphere (which includes the important problem in global warming of radiation through clouds). In the presence of highly scattering media, inverse transport includes the inverse theory of diffusion equations, as it is used in optical tomography and in electrical impedance tomography. This workshop invited pure and applied mathematicians and scientists in other fields to work further on those and other problems.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5063*

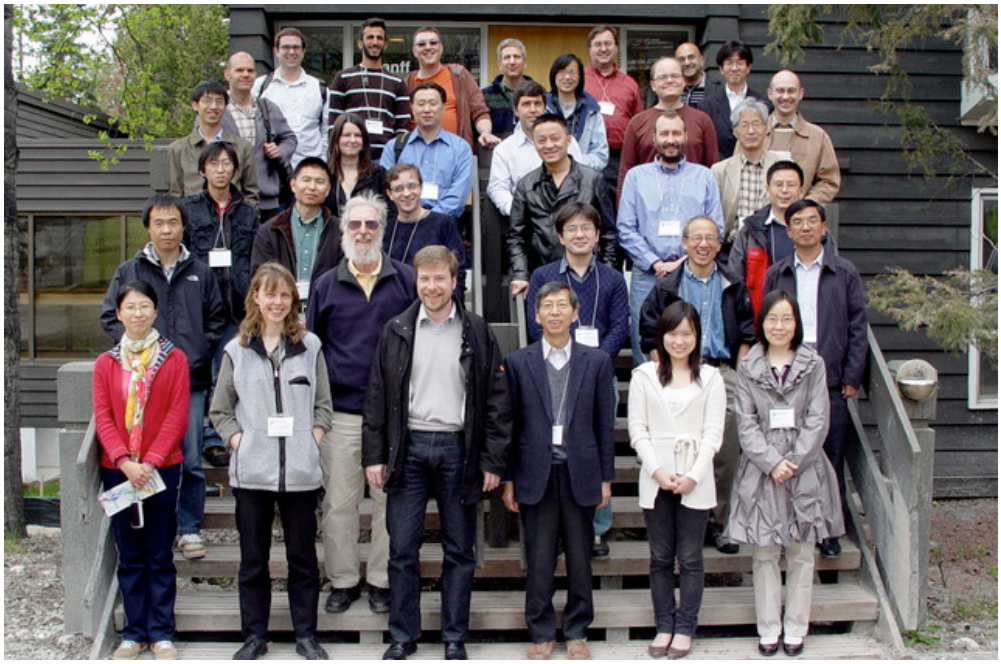
## Participants:

**Arridge, Simon** (University College London)
**Bal, Guillaume** (Columbia University)
**Boman, Jan** (Stockholm University)
**Bukhgeim, Alexander** (Wichita State University)
**Choi, Daeshik** (University of Washington)
**Courdurier, Matias** (Columbia University)
**Davis, Anthony** (Jet Propulsion Laboratory)
**de Gournay, Frédéric** (Université de Versailles)
**Gonzalez-Rodriguez, Pedro** (U. Carlos III de Madrid)
**Greenleaf, Allan** (University of Rochester)
**Hielscher, Andreas** (Columbia University)
**Hoell, Nicholas** (Columbia University)
**Holman, Sean** (Purdue University)
**Isaacson, David** (Rensselaer Polytechnic Institute)
**Jollivet, Alexandre** (Columbia University)
**Kim, Arnold** (University of California, Merced)
**Kuchment, Peter** (Texas A&M University)
**Kurylev, Yaroslav** (University College London)
**Langmore, Ian** (Columbia University)
**Lassas, Matti** (University of Helsinki)
**Liu, Hongyu** (University of Washington)
**Malcolm, Alison** (MIT)
**Markel, Vadim** (University of Pennsylvania)
**Monard, Francois** (Columbia University)
**Nachman, Adrian** (University of Toronto)
**Nakamura, Gen** (Hokkaido University)
**Patch, Sarah** (UW Milwaukee)
**Ren, Kui** (University of Texas at Austin)
**Salo, Mikko** (University of Helsinki)
**Scherzer, Otmar** (Universität Wien)
**Schotland, John** (University of Pennsylvania)
**Stefanov, Plamen** (Purdue University)
**Tamasan, Alexandru** (University of Central Florida)
**Tarvainen, Tanja** (University of Kuopio)
**Uhlmann, Gunther** (University of Washington)
**Wang, Lihong** (Washington University, St Louis)
**Zemp, Roger** (University of Alberta)
**Zhao, Hongkai** (University of California, Irvine)
**Zhou, Ting** (University of Washington)

# Self-Assembly of Block Copolymers: Theoretical Models and Mathematical Challenges
# May 23 - 28, 2010

## Organizers:

**Rustum Choksi** (Simon Fraser University)
**An-Chang Shi** (McMaster University)
**Yasumasa Nishiura** (Hokkaido University)



Block copolymers allow for the synthesis of materials with tailored mechanical, electrical and chemical properties. The main challenge of block copolymer self-assembly is to describe and predict the possible nanostructures for a given set of material parameters. The main objective of this workshop was to bring together for the first time applied mathematicians and physicists to explore mathematical issues surrounding the statistical theories of inhomogeneous polymers.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5105*

## Participants:

**Cheng, Xiuyuan** (Princeton University)
**Choksi, Rustum** (Simon Fraser University)
**Deguchi, Tetsuo** (Ochanomizu University)
**Doi, Masao** (Tokyo University)
**Garcia-Cervera, Carlos** (UC, Santa Barbara)
**Glasner, Karl** (University of Arizona)
**Kawakatsu, Toshihiro** (Tohhoku University)
**Lee, Jieun** (George Washington University)
**Li, Baohui** (Nankai University)
**Li, Weihua** (Fudan University)
**Ma, Wenye** (UC, Los Angeles)
**MacKay, Ian** (University of Guelph)
**Matsen, Mark** (University of Reading)
**Morse, David** (University of Minnesota)
**Mueller, Marcus** (University of Gottingen)
**Muratov, Cyrill** (New Jersey Institute of Technology)
**Ohta, Takao** (Kyoto University)
**Oshita, Yoshihito** (Okayama University)
**Qiu, Feng** (Fudan University)
**Ren, Xiaofeng** (George Washington University)
**Schick, Michael** (University of Washington)
**Schmid, Friederike** (Johannes Gutenberg U. Mainz)
**Shahriari, Bobak** (Simon Fraser University)
**Shi, An-Chang** (McMaster University)
**Sun, Zhaoyan** (Changchun Inst. of Applied Chemistry)
**Sun, Youhai** (McMaster University)
**Topaloglu, Ihsan** (Indiana University)
**van Gennip, Yves** (Simon Fraser University)
**Wang, Qiang** (Colorado State University)
**Wang, Zhen-Gang** (California Institute of Technology)
**Weith, Vanessa** (Universität Bayreuth)
**Wickham, Rob** (University of Guelph)
**Williams, JF** (Simon Fraser University)
**Yan, Dadong** (Chinese Academy of Sciences - Chem)
**Zhou, Jiajia** (McMaster University)
**Zvelindovsky, Andrei V.** (U. of Central Lancashire)

# Diophantine Approximation and Analytic Number Theory: A Tribute to Cam Stewart
# May 30 - June 4, 2010

## Organizers:

**Gary Walsh** (University of Ottawa and CSE)
**Michael Bennett** (University of British Columbia)
**Andrew Granville** (Université de Montréal)
**Jeff Thunder** (Northern Illinois University)

Questions about prime numbers hold distinct interest as they are easy to state, but often require extraordinarily deep methods to solve, or else remain unsolved. Significant new research into these problems has led to methodologies which have applications to other mathematical areas, one of them being the subject of determining all integer solutions to certain algebraic equations, otherwise known as Diophantine equations. This workshop emphasized the current trends in these applications, and at the same time payed tribute to Professor C.L. Stewart of the University of Waterloo for his significant contributions in these research fields.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5032*

## Participants:

**Akhtari, Shabnam** (Max Planck Institute)
**Baker, Roger** (Brigham Young University)
**Bauer, Mark** (University of Calgary)
**Bennett, Michael** (University of British Columbia)
**Beukers, Frits** (Universiteit Utrecht)
**Bilu, Yuri** (Université Bordeaux I)
**Boyd, David** (University of British Columbia)
**Brownawell, Dale** (Penn State University)
**Bugeaud, Yann** (Université de Strasbourg)
**Chahal, Jasbir** (Brigham Young University)
**Coons, Michael** (University of Waterloo)
**Dilcher, Karl** (Dalhousie University)
**Evertse, Jan-Hendrik** (Universiteit Leiden)
**Filaseta, Michael** (University of South Carolina)
**Friedlander, John** (University of Toronto)
**Gyarmati, Katalin** (Eötvös Loránd Tudományegyetem)
**Gyory, Kalman** (University of Debrecen)
**HIRATA-Kohno, Noriko** (Nihon University)
**Ingram, Patrick** (University of Waterloo)
**Luca, Florian** (UNAM)
**Maier, Helmut** (University of Ulm)
**Mignotte, Maurice** (Université de Strasbourg)
**Pinter, Akos** (U. of Debrecen, Institute of Mathematics)
**Pollington, Andrew** (National Science Foundation)
**Pomerance, Carl** (Dartmouth College)
**Roy, Damien** (University of Ottawa)
**Sarkozy, Andras** (Eötvös Loránd Tudományegyetem)
**Schinzel, Andrzej** (Polish Academy of Sciences)
**Schmidt, Wolfgang** (University of Colorado)
**Shparlinski, Igor** (Macquarie University)
**Smyth, Chris** (University of Edinburgh)
**Stange, Katherine** (Simon Fraser U. / PIMS)
**Stewart, Cameron** (University of Waterloo)
**Thunder, Jeff** (Northern Illinois University)
**Tijdeman, Robert** (Universiteit Leiden)
**Top, Jaap** (Universiteit Groningen)
**Vaaler, Jeff** (University of Texas, Austin)
**Vandeth, Drew** (CSEC)
**Velani, Sanju** (University of York)
**Walsh, Gary** (University of Ottawa & CSE)
**Williams, Hugh** (University of Calgary)

# Whittaker Functions, Crystal Bases, and Quantum Groups
# June 6 - 11, 2010

## Organizers:

**Paul Gunnells** (University of Massachusetts Amherst)
**Ben Brubaker** (Massachusetts Institute of Technology)
**Dan Bump** (Stanford University)
**Gautam Chinta** (City College of New York)

This workshop focused on intriguing relationships between two fields of mathematics, number theory and representation theory, and some connections to mathematical physics. Number theory is one of the oldest branches of mathematics. It studies properties of the whole numbers and fractions as well as more exotic constructions, and today finds many applications in computer science and cryptography. Representation theory, a more recent development, is a comprehensive tool to understand deeper symmetries in mathematical phenomena, and today plays an indispensable role in many fields of mathematics and physics. Although these branches of mathematics sound wildly different, it turns out there are many fascinating relationships between them. The workshop focused on one such relation embodied in Whittaker functions. These are special and highly symmetric functions that have traditionally appeared when one applies representation theory to number theory as in the theory of automorphic forms. Recently new connections between number theory and representation theory via these functions have been uncovered, connections that link number theory with exciting constructions in representation theory called crystal bases and quantum groups. This workshop investigated these connections by bringing together a group of researchers drawn from several fields, including physics, in the hope of building new bridges between these subjects.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5096*

## Participants:

**Beineke, Jennifer** (Western New England College)
**Berenstein, Arkady** (University of Oregon)
**Bliem, Thomas** (San Francisco State University)
**Brubaker, Ben** (MIT)
**Bucur, Alina** (University of California San Diego)
**Bump, Dan** (Stanford University)
**Chinta, Gautam** (City College of New York)
**Diaconu, Adrian** (Minnesota University)
**Frechette, Sharon** (College of the Holy Cross)
**Friedberg, Solomon** (Boston College)
**Gannon, Terry** (University of Alberta)
**Garland, Howard** (Yale University)
**Goldfeld, Dorian** (Columbia University)
**Goodman, Roe** (Rutgers University)
**Gunnells, Paul** (University of Massachusetts Amherst)
**Hamel, Angele** (Wilfrid Laurier University)
**Hoffstein, Jeffrey** (Brown University)
**Ivanov, Dmitriy** (Stanford University)
**Kamnitzer, Joel** (University of Toronto)
**Kedlaya, Kiran** (MIT)
**Kim, Henry** (University of Toronto)
**Kontorovich, Alex** (Brown University)
**Lee, Kyu-Hwan** (University of Connecticut)
**Licata, Anthony** (Stanford University)
**Lim, Li-Mei** (Brown University)
**McNamara, Peter** (MIT)
**Mirkovic, Ivan** (University of Massachusetts)
**Mohler, Joel** (Lehigh University)
**Nakasuji, Maki** (Stanford University)
**Oblezin, Sergey** (ITEP Moscow)
**Offen, Omer** (Technion)
**Okada, Soichi** (Nagoya University)
**Patnaik, Manish** (Harvard University)
**Patterson, Samuel** (Universität Goettingen)
**Ram, Arun** (Melbourne University)
**Sahi, Siddhartha** (Rutgers University)
**Savin, Gordan** (Utah University)
**Schilling, Anne** (University of California, Davis)
**Stade, Eric** (Boulder University)
**Van Steirteghem, Bart** (CUNY)

# Inclusive Fitness in Evolutionary Modeling
# Half Workshop
# June 13 - 18, 2010

## Organizers:

**Peter Taylor** (Queen's University)
**Geoff Wild** (University of Western Ontario)
**Stuart West** (University of Oxford)

Over the past 40 years a new set of mathematical ideas and tools have been developed which have transformed and rejuvenated the study of social behaviour, both organismal and human. The fundamental physical idea is that behaviour evolves under a selective regime which rewards those behaviours which are fitter, leading to an increase in their future frequency in the population. In biology this is the study of evolutionary ecology and one of the recent explosions in this field is the study of the evolution of host-pathogen interactions in infectious disease models. In economics and psychology, we use these tools to understand the tension between cooperative behaviour and self-interest and how this shapes markets and community. Mathematically the tools used are a combination of game theory, probability and dynamical systems. A key parameter in these models is the extent to which interactants have similar objectives, and in biology, genetic relatedness is a reliable indicator of this. The point is that to the extent that behaviour is genetically determined, individuals with a high probability of sharing genes will interact in a way that is likely to increase the frequency of these genes. Inclusive fitness is a method of analysis which uses this relatedness concept as a powerful summary variable, thus achieving substantial technical simplification and conceptual clarification. The purpose of the workshop was to gather together the leading researchers working with this theory to discuss its strengths and weaknesses, what it has become, and where it ought to be headed.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5017*

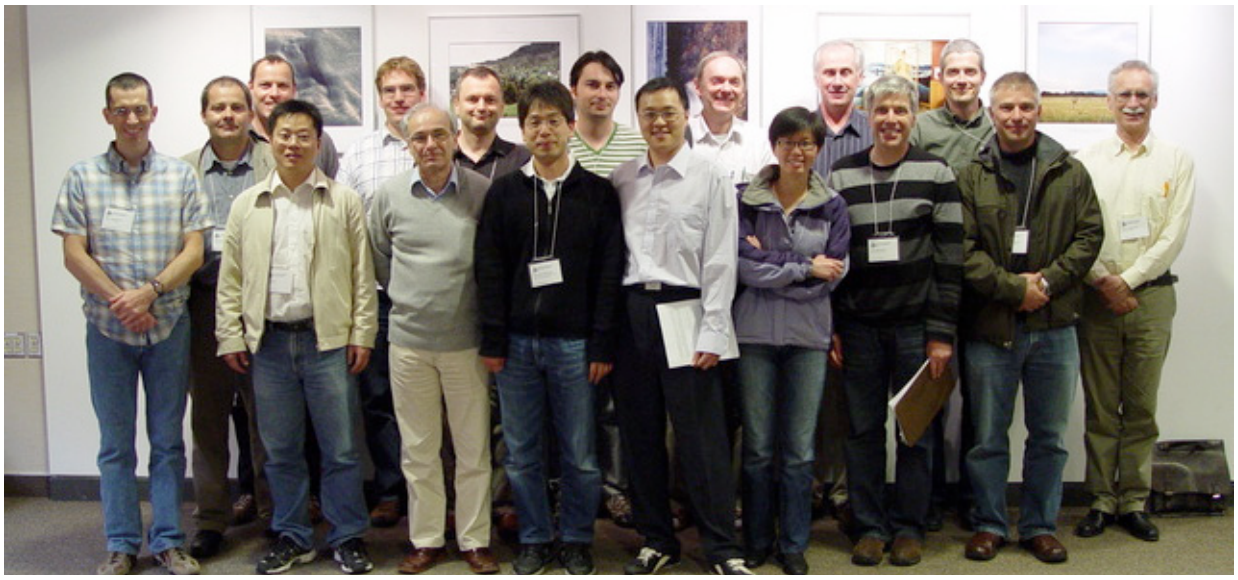
## Participants:

**Alizon, Samuel** (ETH Zentrum, Zürich)
**Alonzo, Suzanne** (Yale University)
**Day, Troy** (Queen's University)
**El Mouden, Claire** (University of Oxford)
**Foster, Kevin** (Harvard University)
**Gardner, Andy** (University of Oxford)
**Grafen, Alan** (University of Oxford)
**Greenwood-Lee, James** (University of Calgary)
**Lehmann, Laurent** (Stanford University)
**Lion, Sébastien** (University of London)
**Pen, Ido** (University of Groningen)
**Queller, David** (Rice University)
**Ronce, Ophelie** (Université Montpellier II)
**Rousset, Francois** (Université Montpellier II)
**Taylor, Peter** (Queen's University)
**Ubeda, Francisco** (University of Tennessee)
**Van Baalen, Minus** (CNRS)
**West, Stuart** (University of Oxford)
**Whitlock, Mike** (University of British Columbia)
**Wild, Geoff** (University of Western Ontario)

# Evolutionary Games
# Half Workshop
# June 13 - 18, 2010

## Organizers:

**Karl Sigmund** (Universität Wien)
**Christine Taylor** (Harvard University)
**Ross Cressman** (Wilfrid Laurier University)



Evolutionary game theory investigates the evolution of social behaviour in populations. It addresses general topics such as cooperation, foraging, sex ratio evolution etc. The aim of this workshop was to bring together people with different modeling approaches and to allow them to appraise the state of affairs in neighboring fields. This seems all the more useful as evolutionary games have been approached within several different disciplines with very different traditions and with different channels of communication (journals, conferences etc). We mention here classical, economy-based game theory versus biology-driven evolutionary models; probabilistic reasoning based on finite population models versus ordinary differential equations assuming infinite, well mixed populations; equilibrium concepts versus complex attractors; long-term versus short-term evolution; frequency-dependent population genetics versus learning models based on imitation, or endogenous aspiration levels; etc. The main focus of the workshop was mathematical methodology; however, since most new mathematical methods have been devised by applying them to very concrete examples from biology or experimental games, it was also deemed important to have several lectures concentrating on new applications. These included the effectiveness of vaccination policies in epidemiological models (Bauch) and the study of animal movement between spatially separated patches through the habitat selection game (Krivan) , as well as algorithmic theory for repeated games (Kalai). Such new directions will enhance our understanding of evolutionary methods that predict individual behavior modeled by game interactions.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5020*

## Participants:

**Antal, Tibor** (Harvard University)
**Apaloo, Joe** (St. Francis Xavier University)
**Berger, Ulrich** (Wirtschaftsuniversität Wien)
**Cressman, Ross** (Wilfrid Laurier University)
**Doebeli, Michael** (University of British Columbia)
**Fletcher, Jeff** (Portland State University)
**Fu, Feng** (Peking University)
**Garay, József** (Eötvös Loránd University)
**Hauert, Christoph** (University of British Columbia)
**Krivan, Vlastimil** (Biological Research Center)
**Lessard, Sabin** (Université de Montréal)
**Li, Cong** (Chinese Academy of Sciences)
**Miekisz, Jacek** (Warsaw University)
**Ochea, Marius** (University of Tilburg)
**Ohtsuki, Hisashi** (Tokyo Institute of Technology)
**Sandholm, Bill** (University of Wisconsin)
**Sigmund, Karl** (University of Vienna)
**Szabo, Gyorgy** (Research Institute for Technical Physics and Materials Science)
**Taylor, Christine** (Harvard University)
**Traulsen, Arne** (Max-Planck-Institute for Evolutionary Biology)

# Geometric Analysis and General Relativity
# June 20 - 25, 2010

## Organizers:

**Daniel Pollack** (University of Washington)
**Mihalis Dafermos** (University of Cambridge)
**Greg Galloway** (University of Miami)
**Lars Andersson** (Max-Planck-Institut fur Gravitationsphysik)

General Relativity has been a cornerstone of our understanding of the physical universe in which we live for the better part of the last century. The study of the mathematical problems of general relativity brings together many important areas of research in partial differential equations, differential geometry, dynamical systems and analysis. Despite the centrality of the subject in modern physics, a number of fundamental mathematical questions concerning general relativity remain unanswered and it is clear that their future resolution will be of great interest in understanding the physical limitations of the theory. This workshop provided an opportunity for leading researchers from around the world to come together in Banff to report on the most important recent advances in the field and to lay the course for future developments. The inclusion of junior mathematicians working in the field will help to spur the future progress toward resolving some of the most enticing geometric and analytical questions present in mathematics and physics today.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5011*

## Participants:

**Alexakis, Spiros** (U. Toronto & Clay Math. Institute)
**Allen, Paul T.** (Lewis & Clark College)
**Anderson, Michael** (SUNY Stony Brook)
**Andersson, Lars** (Albert-Einstein-Institut)
**Bieri, Lydia** (Havard University)
**Bizon, Piotr** (Jagiellonian University)
**Blue, Pieter** (Edinburgh University)
**Bray, Hubert** (Duke University)
**Chrusciel, Piotr** (Universität Wien)
**Corvino, Justin** (Lafayette College)
**Dafermos, Mihalis** (University of Cambridge)
**Dain, Sergio** (University of Cordoba)
**Eichmair, Michael** (MIT/Monash)
**Friedrich, Helmut** (Albert Einstein Institute)
**Galloway, Greg** (University of Miami)
**Holzegel, Gustav** (Princeton University)
**Huang, Lan-Hsuan** (Columbia University)
**Huisken, Gerhard** (Albert-Einstein-Institut)
**Isenberg, Jim** (University of Oregon)
**Jauregui, Jeff** (Duke University)
**Khuri, Marcus** (SUNY Stony Brook)
**Mars, Marc** (Universidad de Salamanca)
**Maxwell, David** (University of Alaska, Fairbanks)
**Metzger, Jan** (Albert-Einstein-Institut)
**Nguyen, Luc** (University of Oxford)
**Pollack, Daniel** (University of Washington)
**Pretorius, Frans** (Princeton University)
**Rendall, Alan** (MPI for Gravitational Physics (AEI))
**Ringström, Hans** (Max Planck Institut for Gravitational Physics)
**Rodnianski, Igor** (Princeton University)
**Schoen, Richard** (Stanford University)
**Smulevici, Jacques** (Max-Planck-Institute for Gravitational Physics)
**Sorkin, Evgeny** (Albert-Einstein-Institut)
**Tod, Paul** (University of Oxford)
**Wang, Mu-Tao** (Columbia University)
**Williams, Catherine** (Stanford University)
**Yau, Shing-Tung** (Harvard University)

# Noncommutative Lp Spaces, Operator Spaces and Applications
# June 27 - July 2, 2010

## Organizers:

**Quanhua Xu** (Université de Franche-Comté)
**Marius Junge** (University of Illinois, Urbana-Champaign)
**Gilles Pisier** (Texas A&M University )

Noncommutative integration has a long history going back to pioneering works by von Neumann, Dixmier and Segal. In the first constructions the trace of a matrix or an operator replaces the integral of a function. More recently (around 1980) generalizations to general von Neumann algebras without trace have appeared (Kosaki, Haagerup, Terp, Hilsum), thanks to great progress in operator algebra theory, notably by Connes, Takesaki and Tomita. Since the early nineties and the arrival of new theories like those of operator spaces and free probability, noncommutative integration is living another period of stimulating new developments. In particular, noncommutative Khintchine and martingale inequalities have opened new perspectives. The purpose of this workshop was to bring together researchers in noncommutative integration and operator space theory in order to stimulate exchanges of expertise and ideas, to encourage the circulation of open problems, and to deepen the synergies between these fields and other related directions.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5005*

## Participants:

**Avsec, Stephen** (U. Illinois, Urbana-Champaign)
**Blecher, David** (University of Houston)
**Bozejko, Marek** (University of Wroclaw)
**Carlen, Eric** (Rutgers University)
**Collins, Benoît** (University of Ottawa)
**Cooney, Tom** (U. Illinois, Urbana-Champaign)
**Dabrowski, Yoann** (UC, Los Angeles)
**Dirksen, Sjoerd** (Delft University of Technology)
**Effros, Edward** (UC, Los Angeles)
**Franz, Uwe** (Université de Franche-Comté)
**Goldstein, Stanislaw** (University of Lodz)
**Haagerup, Uffe** (University of Southern Denmark)
**Junge, Marius** (U. Illinois, Urbana-Champaign)
**Juschenko, Kate** (Texas A&M University)
**Kemp, Todd** (UC, San Diego)
**King, Christopher** (Northeastern University)
**Kribs, David** (University of Guelph)
**Lee, Hunhee** (Chungbuk National University)
**Lindsay, Martin** (Lancaster University)
**Mei, Tao** (U. Illinois, Urbana-Champaign)
**Musat, Magdalena** (University of Copenhagen)
**Nica, Alexandru** (University of Waterloo)
**Oikhberg, Timur** (UC, Irvine)
**Palazuelos, Carlos** (U. Complutense de Madrid)
**Parcet, Javier** (Instituto de Ciencias Matematicas)
**Paulsen, Vern** (University of Houston)
**Perrin, Mathilde** (Université de Franche-Comté)
**Piquard, Françoise** (Université de Cergy-Pontoise)
**Pisier, Gilles** (Texas A&M University)
**Potapov, Denis** (University of NSW)
**Randrianantoanina, Narcisse** (Miami University)
**Ricard, Eric** (Université de Franche-Comté)
**Rordam, Mikael** (University of Copenhagen)
**Ruan, Zhong-Jin** (University of Illinois)
**Ruskai, Mary Beth** (Tufts University)
**Scholz, Volkher** (Leibniz University of Hannover)
**Shor, Peter** (MIT)
**Skalski, Adam** (Lancaster University)
**Sukochev, Fedor** (University of NSW)
**Szarek, Stanislaw** (Université Pierre et Marie Curie)
**Thom, Andreas** (University of Leipzig)
**Winter, Andreas** (University of Bristol)
**Xu, Quanhua** (Université de Franche-Comté)

# Structure and Representations of Exceptional Groups
# July 4 - 9, 2010

## Organizers:

**Joseph Wolf** (University of California, Berkeley)
**David Vogan** (Massachusetts Institute of Technology)
**S. Twareque Ali** (Concordia University)
**Wulf Rossmann** (University of Ottawa)

Building on Cartan and Killing's original classification of simple Lie groups in the 1890s, the groups have come to be understood as belonging to two rather different types: the infinite families of classical groups (related to classical linear algebra and geometry), and a finite number of exceptional groups, ranging from the 14-dimensional groups of type G2 to the 248-dimensional groups of type E8. Often it is possible to study all simple Lie groups at once, without reference to classification; but for many fundamental problems, it is still necessary to treat each simple group separately.

For the classical groups, such case-by-case analysis often leads to arguments by induction on the dimension. This kind of structure and representation theory for classical groups uses tools from combinatorics and leads to many beautiful and powerful results.

For the exceptional groups, such arguments are not available. The groups are not directly connected to classical combinatorics. What makes mathematics possible in this world is that there are only finitely many exceptional groups – some questions can be answered one group at a time, by hand or computer calculation. The same peculiarity makes the possibility of connecting the exceptional groups to physics an extraordinarily appealing one. Two years ago Garrett Lisi proposed an extension of the Standard Model in physics, based on the structure of the 248 dimensional exceptional Lie algebra E8. Lisi's paper raises a number of mathematically interesting questions about the structure of E8, for instance this one: previous publications gave a great deal of information on the complex subgroups of complex simple Lie groups. For Lisi's work, one needs to know about real subgroups of real simple groups: which real forms of SL(5) x SL(5) can appear in a particular real form of E8? A mathematical study of these questions is interesting for its own sake, and may provide some constraints on the structure of the physical theories that can be built using E8. The goal of this workshop was to introduce mathematicians to these physical ideas, and to describe much of the recent mathematical work on the exceptional Lie groups.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5039*

## Participants:

**Achar, Pramod N.** (Louisiana State University)
**Adams, Jeffrey** (University of Maryland)
**Barbasch, Dan** (Cornell University)
**Binegar, Birne** (Oklahoma State University)
**Ciubotaru, Dan** (University of Utah)
**Cunningham, Clifton** (University of Calgary)
**Cushman, Richard** (University of Calgary)
**Dray, Tevian** (Oregon State University)
**Eastwood, Michael** (Australian National University)
**Garibaldi, Skip** (Emory University)
**Harris, Benjamin** (MIT)
**Howard, Tatiana Katarzyna** (Univesity of Michigan)
**Huang, Jing-Song** (HKUST)
**Huckleberry, Alan** (Ruhr-Universität Bochum)
**Kobayashi, Toshiyuki** (University of Tokyo)
**Kostant, Bertram** (MIT)
**Lisi, Garrett**
**Magaard, Kay** (University of Birmingham)
**Manogue, Corinne** (Oregon State University)
**Mare, Augustin-Liviu** (University of Regina)
**Milev, Todor** (Jacobs University Bremen)
**Neeb, Karl-Hermann** (Darmstadt Technichal University)
**Orsted, Bent** (University of Southern Denmark)
**Percacci, Roberto** (Perimeter Institute)
**Rossmann, Wulf** (University of Ottawa)
**Salmasian, Hadi** (University of Ottawa)
**Savin, Gordan** (Utah University)
**Sternheimer, Daniel** (Keio University)
**Varadarajan, V. S.** (UCLA)
**Vogan, David** (MIT)
**Wilson, Rob** (Queen Mary London)
**Wolf, Joseph** (UC, Berkeley)
**Yee, Wai Ling** (University of Windsor)

# Statistical Issues Relevant to Significance of Discovery Claims July 11 - 16, 2010

## Organizers:

**Richard Lockhart** (Simon Fraser University)
**Louis Lyons** (Univeristy of Oxford)
**James Linnemann** (Michigan State University)

Particle Physics studies the structure of matter at the very smallest scale. Its basic units are quarks and leptons, and the way that these interact with each other depends on various bosons. Astrophysicists and Cosmologists are concerned with the origin and subsequent development of the Universe at the largest scale. These scientists discover and study galaxies, supernovae, black holes, dark matter, dark energy, etc. Both subject areas have recently acquired new machines -- the Large Hadron Collider at the CERN Lab in Geneva for Particle Physics, and the GLAST observatory in space for Astrophysics/Cosmology. These facilities will collect data which will hopefully result in exciting new discoveries. It will be most important to ensure that claimed discoveries really do correspond to real new phenomena, rather than being due to random fluctuations in the data. This workshop dealt with just such issues, in order to quantify the extent to which the data validates the new discoveries.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5068*

## Participants:

**Araujo, Henrique** (Imperial College)
**Barlow, Roger** (Manchester University)
**Berger, James** (Duke Univerisity)
**Bloom, Elliott** (SLAC)
**Brady, Patrick** (University of Wisconsin, Milwaukee)
**Chiang, James** (SLAC)
**Cousins, Robert** (UCLA)
**Cowan, Glen** (Royal Holloway)
**Cranmer, Kyle** (New York University)
**Currie, Alastair** (Imperial College London)
**Demortier, Luc** (Rockefeller University)
**Feldman, Gary** (Harvard University)
**Gross, Eilam** (Weizmann Institute)
**Hand, David** (Imperial College London)
**Hans, Chris** (The Ohio State University)
**Heinrich, Joel** (University of Pennsylvania)
**Junk, Tom** (Fermilab)
**Lauritzen, Steffen** (University of Oxford)
**Lawrence, Earl** (Los Alamos National Laboratory)
**Linnemann, James** (Michigan State University)
**Lockhart, Richard** (Simon Fraser University)
**Loredo, Tom** (Cornell University)
**Lyons, Louis** (University of Oxford)
**Meinshausen, Nicolai** (University of Oxford)
**Moneta, Lorenzo** (CERN)
**Murray, Bill** (Rutherford Appleton Lab)
**Prosper, Harrison** (Florida State University)
**Pumplin, Jon** (Michigan State University)
**Rolke, Wolfgang** (University of Puerto Rico)
**Scargle, Jeffrey** (NASA Ames Research Center)
**Schafer, Chad** (Carnegie Mellon University)
**Sen, Bodhisattva** (Columbia University)
**Sommers, Paul** (Penn State University)
**Thorne, Robert** (University College London)
**Trotta, Roberto** (Imperial College London)
**van Dyk, David** (University of California, Irvine)
**Vitells, Ofer** (Weizmann Institute)
**Woodroofe, Michael** (University of Michigan)
**Yabsley, Bruce** (University of Sydney)

# Statistical Genomics in Biomedical Research
# July 18 - 23, 2010

## Organizers:

**Darlene Goldstein** (École Polytechnique Fédérale de Lausanne)
**Sandrine Dudoit** (University of California, Berkeley)
**Jane Fridlyand** (Genentech Inc.)
**Jennifer Bryan** (University of British Columbia)
**Katherine Pollard** (Gladstone Institutes, UC, San Francisco)
**Sunduz Keles** (University of Wisconsin, Madison)

This workshop was intended to foster deeper connections between basic and clinical scientists and statisticians and to be a forum for (1) the dissemination of cutting-edge biotechnological and methodological developments; (2) discussion of approaches to effective translation of putative biomarkers into clinical trial design; and (3) the identification of open data analysis problems. The challenges in these areas include analyzing genotypes, gene and protein expression and DNA-protein interaction data, relating these to phenotypic data, such as clinical outcomes and predicted mechanism of action of a drug, relating all of these to existing databases containing different types of meta-data, and finally incorporating the findings with clinical drug development. Mathematical problems in the field are diverse and touch upon statistical modeling, probability, computational and algorithmic optimization, and data visualization. The workshop enabled statisticians to articulate grounded statistical formulations of existing and emerging computational biological and clinical problems; created an exceptional opportunity for exchanging ideas; and provided a meaningful quantitative framework for translational research, bridging the gap between basic experimental findings and clinical practice.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5076*

## Participants:

**Bryan, Jennifer** (University of British Columbia)
**Bullard, James** (UC, Berkeley)
**Delorenzi, Mauro** (Swiss Institute of Bioinformatics)
**Dudoit, Sandrine** (UC, Berkeley)
**Eng, Kevin** (University of Wisconsin, Madison)
**Erwin, Genevieve** (J. David Gladstone Institutes)
**Fridlyand, Jane** (Genentech Inc.)
**Gilad, Yoav** (University of Chicago)
**Gilbert, Houston** (Genentech, Inc.)
**Goldstein, Darlene** (École Polytechnique Fédérale de Lausanne)
**Hansen, Kasper** (John Hopkins University)
**Haverty, Peter** (Genentech, Inc)
**Holloway, Alisha** (J. David Gladstone Institutes)
**Huber, Wolfgang** (European Molecular Biology Lab)
**Jacob, Laurent** (UC, Berkeley)
**Keles, Sunduz** (University of Wisconsin, Madison)
**Leek, Jeff** (Johns Hopkins Bloomberg School of Public Health)
**Lieb, Jason** (University of North Carolina, Chapel Hill)
**Melsted, Pall** (University of Chicago)
**Neuvial, Pierre** (UC, Berkeley)
**Ngai, John** (UC, Berkeley)
**Olshen, Adam** (UC, San Francisco)
**Pollard, Katherine** (J. David Gladstone Institutes)
**Portales-Casmar, Elodie** (University of British Columbia)
**Pritchard, Jonathan** (University of Chicago)
**Roach, Jared** (Institute for Systems Biology)
**Ruczinski, Ingo** (Johns Hopkins University)
**Scharpf, Rob** (Johns Hopkins University)
**Segal, Mark** (UC, San Francisco)
**Seshan, Venkatraman E** (Memorial Sloan-Kettering Cancer Center)
**Sun, Lei** (University of Toronto)
**Taub, Margaret** (Johns Hopkins University)
**Vert, Jean-Philippe** (Mines ParisTech)
**Wall, Jeff** (UC, San Francisco)
**Wang, Ting** (Washington University, St. Louis)
**Wirapati, Pratyaksha** (Swiss Institute of Bioinformatics)
**Yeh, Ru-Fang** (UC, San Francisco)

# Analysis and Boundary Value Problems on Real and Complex Domains
# July 25 - 30

## Organizers:

**Loredana Lanzani** (University of Arkansas)
**Carlos Kenig** (University of Chicago)
**David Barrett** (University of Michigan)
**Alexander Nagel** (University of Wisconsin)
**Malabika Pramanik** (University of British Columbia)
**Andreas Seeger** (University of Wisconsin-Madison)
**Elias M. Stein** (Princeton University)
**James Wright** (Edinburgh University)
**John Erik Fornaess** (University of Michigan)

This workshop congregated leading mathematicians working in the areas of Several Complex Variables, Harmonic Analysis and Partial Differential Equations. By providing a venue for the exchange of ideas and for the interaction among professionals with different areas of expertise and diverse geographic affiliations (North America, Europe and Australia) the workshop promoted scientific diversity and new modes of collaboration. Several Complex Variables, Harmonic Analysis and Partial Differential Equations are major branches of mathematics. They are of paramount importance in pure and applied sciences and have vastly contributed to our present-day understanding of such basic phenomena as heat transfer and celestial mechanics.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5066*

## Participants:

**Badger, Matthew** (University of Washington)
**Barrett, David** (University of Michigan)
**Boggess, Al** (Texas A&M University)
**Bolt, Michael** (Calvin College)
**Brown, Russell** (University of Kentucky)
**Capogna, Luca** (University of Arkansas)
**Christ, Michael** (UC, Berkeley)
**David, Guy** (University of Paris-Sud, France)
**Dimler, Kay** (Humboldt University Berlin)
**Dindos, Martin** (University of Edinburgh)
**Dwilewicz, Roman** (Missouri U. of Sci. and Tech)
**Ehsani, Dariush** (Humboldt University in Berlin)
**Fu, Siqi** (Rutgers University-Camden)
**Greiner, Peter** (Academia Sinica)
**Harrington, Phillip** (University of Arkansas)
**Herbig, Anne-Katherine** (University of Vienna)
**Kinzebulatov, Damir** (University of Toronto)
**Lacey, Michael** (Georgia Institute of Technology)
**Lanzani, Loredana** (University of Arkansas)
**Leiterer, Jurgen** (Humboldt University Berlin)
**Lewis, John** (University of Kentucky)
**Mitrea, Irina** (University of Minnesota)
**Nagel, Alexander** (University of Wisconsin)
**Peloso, Marco** (University of Milano)
**Poletsky, Evgeny** (Syracuse University)
**Pramanik, Malabika** (University of British Columbia)
**Raich, Andrew** (University of Arkansas)
**Shen, Zhongwei** (University of Kentucky)
**Stein, Elias M.** (Princeton University)
**Street, Brian** (University of Washington, Madison)
**Wainger, Steve** (University of Wisconsin)
**Zeytuncu, Yunus** (Ohio State University)

# Computational Complexity
# August 1 - 6, 2010

## Organizers:

**Valentine Kabanets** (Simon Fraser University)
**Paul Beame** (University of Washington)
**Stephen Cook** (University of Toronto)
**Russell Impagliazzo** (UC, San Diego)
**Avi Wigderson** (Institute for Advanced Study)

Computational complexity is a field of research whose main objective is to understand the powers and limitations of efficient computation. The area was born in the 1960's, when it was realized that some problems solvable in principle on a computer may not be solvable in practice, as they may not have any efficient algorithmic solution. Complexity theory has witnessed quite remarkable progress since its inception, with new methods developed, some questions resolved, and many more important open questions formulated. Despite this progress, many basic questions about efficient computation remain unresolved. One of the main open questions is the famous "P versus NP" problem, considered one of the most important challenges for mathematical research in the 21st century. This workshop brought together the top experts in computational complexity from around the world to examine recent methods and tools developed in complexity theory and to propose new directions for research.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5028*

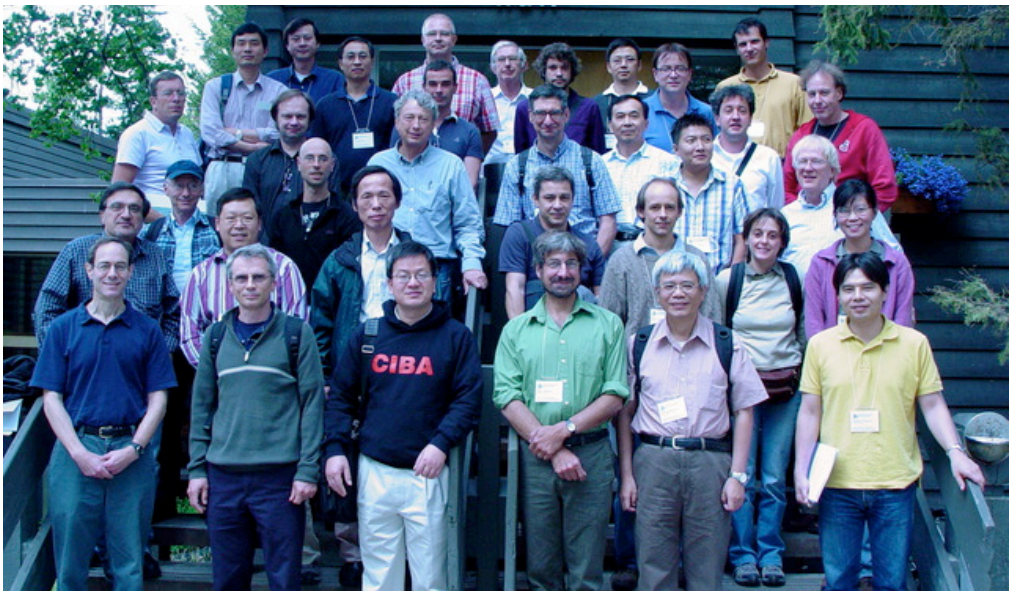
## Participants:

**Aaronson, Scott** (MIT)
**Barak, Boaz** (Princeton University)
**Beame, Paul** (University of Washington)
**Braverman, Mark** (University of Toronto)
**Bulatov, Andrei** (Simon Fraser University)
**Chattopadhyay, Arkadev** (University of Toronto)
**Cook, Stephen** (University of Toronto)
**Dvir, Zeev** (Institute for Advanced Study)
**Filmus, Yuval** (University of Toronto)
**Guruswami, Venkat** (Carnegie Mellon University)
**Impagliazzo, Russell** (UC, San Diego)
**Kabanets, Valentine** (Simon Fraser University)
**Khot, Subhash** (New York University)
**Kindler, Guy** (Hebrew University of Jerusalem)
**Klivans, Adam** (University of Texas, Austin)
**Kolokolova, Antonina** (Memorial University)
**Kopparty, Swastik** (MIT)
**Lovett, Shachar** (Weizmann Institute of Science)
**Moshkovitz, Dana** (Institute for Advanced Study)
**Paturi, Ramamohan** (UC, San Diego)
**Pitassi, Toniann** (University of Toronto)
**Pudlak, Pavel** (Institute of Mathematics, Prague)
**Raghavendra, Prasad** (Georgia Tech)
**Rao, Anup** (University of Washington)
**Regev, Oded** (Tel-Aviv University)
**Saks, Michael** (Rutgers University)
**Santhanam, Rahul** (University of Edinburgh)
**Saraf, Shubhangi** (MIT)
**Shaltiel, Ronen** (University of Haifa)
**Sherstov, Alexander** (Microsoft Research)
**Shpilka, Amir** (Technion)
**Steurer, David** (Microsoft Research New England)
**Sudan, Madhu** (Microsoft Research)
**Umans, Chris** (California Institute of Technology)
**Valiant, Leslie** (Harvard University)
**van Melkebeek, Dieter** (University of Wisconsin)
**Viola, Emanuele** (Northeastern University)
**Wehr, Dustin** (University of Toronto)
**Williams, Ryan** (IBM Almaden Research Center)
**Yehudayoff, Amir** (Institute for Advanced Study)
**Zuckerman, David** (University of Texas, Austin)

# Recent Advances on de Giorgi's Conjecture and the Study of Entire Solutions of Nonlinear Scalar Equations: Interaction of PDEs and Differential Geometry
# August 8 - 13, 2010

## Organizers:

**Changfeng Gui** (University of Connecticut)
**Manuel del Pino** (Universidad de Chile)
**Jun Cheng Wei** (Chinese University of Hong Kong)




This workshop was a forum for the dissemination of current advances in the study of De Giorgi's Conjecture, and of entire solutions for the Allen-Cahn and Nonlinear Schrodinger equations which model various physical phenomena, including superconductors and superfluids, phase transitions, and quantum mechanics. A better understanding of these equations naturally leads to new insights in the physical models. The focus was on the new-found connection between the theories of minimal and constant mean curvature surfaces and partial differential equations.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5036*

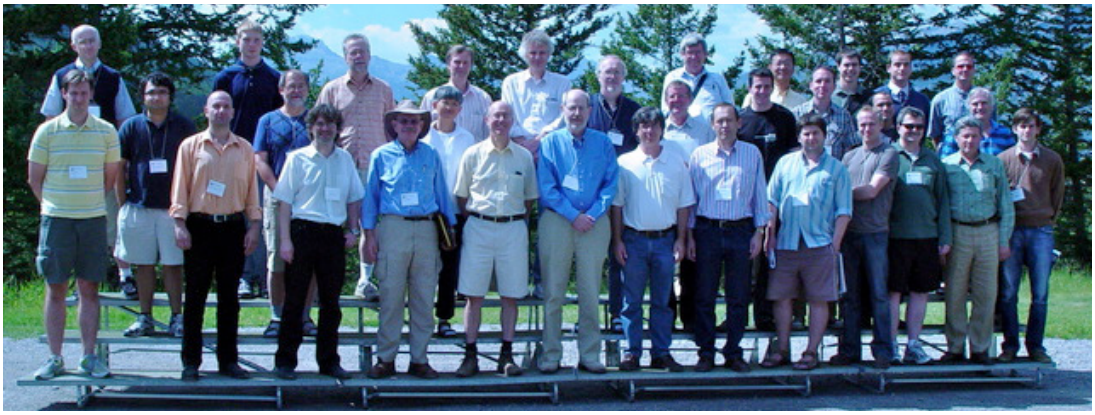
## Participants:

**Bates, Peter** (Michigan State University)
**Chen, Wenxiong** (Yeshiva University)
**Dancer, E. Norman** (University of Sydney)
**Davila, Juan** (CMM & DIM Universidad de Chile)
**del Pino, Manuel** (Universidad de Chile)
**Du, Yihong** (University of New England)
**Farina, Alberto** (Université de Picardie)
**Ghoussoub, Nassif** (BIRS)
**Gui, Changfeng** (University of Connecticut)
**Jerison, David** (MIT)
**Kapouleas, Nicolaos** (Brown University)
**Kowalczyk, Michal** (Universidad de Chile)
**Kusner, Rob** (U. of Massachusetts at Amherst)
**Li, Congming** (University of Colorado at Boulder)
**Lin, Chang-Shou** (National Taiwan University)
**Malchiodi, Andrea** (Scuola Internazionale Superiore di Studi Avanzati di Trieste)
**Matano, Hiroshi** (University of Tokyo)
**Mazzeo, Rafe** (Stanford University)
**Meeks, William** (University of Massachusetts)
**Montecchiari, Piero** (U. Politecnica delle Marche)
**Musso, Monica** (Universidad Católica de Chile)
**Nguyen, Xuan Hien** (Kansas State University)
**Pacard, Frank** (Université Paris XII)
**Polacik, Peter** (University of Minnesota)
**Rabinowitz, Paul** (University of Wisconsin, Madison)
**Ratzkin, Jesse** (University College Cork)
**Roquejoffre, Jean-Michel** (Université Toulouse III)
**Sire, Yannick** (Université Paul Cezanne)
**Sternberg, Peter** (Indiana University)
**Tonegawa, Yoshihiro** (Hokkaido University)
**Tsogtgerel, Gantumur** (McGill University)
**Valdinoci, Enrico** (University of Rome II)
**Wang, Xuefeng** (Tulane University)
**Wei, Jun Cheng** (Chinese University of Hong Kong)
**Yan, Shusen** (University of New England)

# Multivariate Operator Theory
# August 15 - 20, 2010

## Organizers:

**Ronald Douglas** (Texas A & M University)
**Kenneth Davidson** (University of Waterloo)
**Mihai Putinar** (UC, Santa Barbara)
**Joerg Eschmeier** (Universität des Saarlandes)



Operator theory, which arose from the study of problems in physics and engineering, has been studied for over a hundred years. Over the past two decades the field has broadened to include algebras of operators involving analyticity. As a result, more geometric techniques and methods have become important and recent results have had an impact on these other areas. Opportunities have opened up not only for major advances in our understanding of operator theory, but also for possible significant developments in other areas of mathematics. There may be applications of such results to engineering and physics as well. The main goal for the workshop was to bring together leading researchers and young mathematicians from multivariate operator theory along with experts from related areas to survey, consolidate and extend the many advances in the field over the past two decades.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5081*

## Participants:

**Agler, Jim** (UC, San Diego)
**Ambrozie, Calin-Grigore** (Mathematical Institute of the Czech Academy)
**Ball, Joseph** (Virginia Tech)
**Biswas, Shibananda** (Indian Inst. of Sci. at Bangalore)
**Cade, Pat** (SUNY at Albany)
**Carlsson, Marcus** (Purdue University)
**Davidson, Kenneth** (University of Waterloo)
**Douglas, Ronald** (Texas A & M University)
**Dritschel, Michael** (Newcastle University)
**Englis, Miroslav** (Mathematics Institute AS CR)
**Eschmeier, Joerg** (Universität des Saarlandes)
**Hamilton, Ryan** (University of Waterloo)
**Jury, Michael** (University of Florida)
**Katsoulis, Elias** (East Carolina University)
**Kennedy, Matthew** (University of Waterloo)
**Kissunko, Veniamine** (University of Toronto)
**Knese, Gregory** (UC, Irvine)
**Li, Wing-Suet** (Georgia Tech University)
**McCarthy, John** (Washington University)
**McCullough, Scott** (University of Florida)
**Meyer, Jonas** (University of Iowa)
**Muhly, Paul** (University of Iowa)
**Muller, Vladimir** (Mathematical Institute of the Czech Academy)
**Paulsen, Vern** (University of Houston)
**Popescu, Gelu** (University of Texas, San Antonio)
**Putinar, Mihai** (UC, Santa Barbara)
**Raghupathi, Mrinal** (Vanderbilt University)
**Richter, Stefan** (University of Tennessee)
**Shalit, Orr** (University of Waterloo)
**Shyam Roy, Subrata** (IISER Kolkata)
**Spjut, Richard** (UC, Santa Barbara)
**Sundberg, Carl** (University of Tennessee)
**Trent, Tavan** (Alabama)
**Upmeier, Harald** (Philipps University)
**Vasilescu, Florian** (Université Lille I)
**Vinnikov, Victor** (Ben Gurion University)
**Wick, Brett** (Georgia Tech)
**Yang, Rongwei** (SUNY Albany)

# Extreme Events in Climate and Weather - An Interdisciplinary Workshop August 22 - 27, 2010

## Organizers:

**Peter Guttorp** (University of Washington)

**Montserrat Fuentes** (North Carolina State University)

Are the recent catastrophic hurricanes in the Caribbean and the USA caused by climate change? In this workshop, climate scientists and statisticians discussed and developed tools for such assessments. A changing climate causes particular statistical difficulties, in that historical data become hard to compare to present (and future) data. The use of climate models in combination with data is a promising solution to these difficulties.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5016*

## Participants:

**B Krishnamurthy, Chandra Kiran** (Columbia U.)
**Berrocal, Veronica** (SAMSI)
**Brattström, Gudrun** (Stockholm University)
**Cooley, Dan** (Colorado State University)
**Dean, Charmaine** (Simon Fraser University)
**Geirsson, Óli Páll** (University of Iceland)
**Gilleland, Eric** (National Center for Atmospheric Research)
**Guttorp, Peter** (University of Washington)
**Hamadieh, Kam** (Rice University)
**Hammerling, Dorit** (University of Michigan)
**Holst, Ulla** (Lund University)
**Hrafnkelsson, Birgir** (University of Iceland)
**Hsieh, William** (University of British Columbia)
**Huerta, Gabriel** (University of New Mexico)
**Hurtado Rua, Sandra** (University of Connecticut)
**Katz, Richard** (National Center for Atmospheric Research)
**Linder, Ernst** (University of New Hampshire)
**Lindgren, Georg** (University of Lund)
**Palmer, Mark** (CSIRO)
**Rootzen, Holger** (Chalmers Institute of Technology)
**Shaby, Ben** (SAMSI)
**Shook, Kevin** (University of Saskatchewan, Centre for Hydrology)
**Sillman, Jana** (Canadian Centre for Climate Modelling & Analysis)
**Smith, Leonard** (LSE & Oxford)
**Stoev, Stilian** (University of Michigan)
**Thorarinsdottir, Thordis** (University of Heidelberg)
**Wehner, Michael** (Lawrence Berkeley Lab-Scientific Computing Group)
**Whitfield, Paul** (Environment Canada)
**Wolpert, Robert** (Duke University)
**Zhang, Kai** (University of Michigan)
**Zhang, Jun** (Stats and Applied Math Sciences Inst.)
**Zhang, Zhengjun** (University of Wisconsin)

# Rate-Independent Systems: Modeling, Analysis, and Computations
# August 29 - September 3, 2010

## Organizers:

**Ulisse Stefanelli** (Istituto di Matematica Applicata e Tecnologie Informatiche del CNR)

**Giuseppe Savare** (University of Pavia)

Variational evolution models are almost ubiquitous in applications and have been considered in connection with fluid dynamics, phase transitions, thin films, quantum models, nonlinear diffusion and transport problems, chemical reactions, rate-independent phenomena, and material modeling, just to mention a few hot topics. The mathematical analysis of such systems has recently attracted an increasing attention from many different viewpoints, which nevertheless reveal interesting and deep connections. This workshop was an occasion to interact, start up or progress in collaborations, and to exchange information and vision. on the topics of: rate-independent and sweeping processes; variational and quasi-variational inequalities; regularization techniques and viscous regularization; space and time-discretizations; gamma-convergence, relaxation, and approximation techniques; multiscale problems, homogenization and scaling limits; young measures techniques; models in Solid and Fracture Mechanics; and material modeling and phase change in solids and microstructures.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5075*

## Participants:

**Artioli, Edoardo** (Università degli Studi di Roma 'Tor Vergata`)
**Bonetti, Elena** (Università di Pavia)
**Brokate, Martin** (Technische Universität München)
**Carstensen, Carsten** (Humboldt Universität zu Berlin)
**Dolzmann, Georg** (University of Regensburg)
**Dondl, Patrick** (University of Bonn)
**Fiaschi, Alice** (Istituto di Matematica Applicata e Tecnologie Informatiche - CNR)
**Francfort, Gilles** (Université Paris-Nord Villetaneuse)
**Hoemberg, Dietmar** (Weierstrass Institute for Applied Analysis and Stochastics)
**Knees, Dorothee** (Weierstrass Institute for Applied Analysis and Stochastics)
**Kopfova, Jana** (Mathematical Institute of the Silesian University)
**Kruzik, Martin** (Academy of Sci`s of the Czech Rep.)
**Larsen, Christopher** (Worcester Polytechnic Institute)
**Lazzaroni, Giuliano** (Université Paris VI)
**Liero, Matthias** (Humboldt Universität zu Berlin)
**Negri, Matteo** (Università di Pavia)
**Ortner, Christoph** (University of Oxford)
**Petrov, Adrien** (Weierstrass Institute for Applied Analysis and Stochastics)
**Plechac, Petr** (University of Tennessee)
**Reali, Alessandro** (Università di Pavia)
**Recupero, Vincenzo** (Politecnico di Torino)
**Reddy, Daya** (Cape Town University)
**Rindler, Filip** (University of Oxford)
**Rossi, Riccarda** (Università di Brescia)
**Roubicek, Tomas** (Charles University)
**Savare, Giuseppe** (Università di Pavia)
**Schweizer, Ben** (Technische Universität Dortmund)
**Sittner, Petr** (Institute of Physics of the AVCR)
**Stefanelli, Ulisse** (Istituto di Matematica Applicata e Tecnologie Informatiche del CNR)
**Sullivan, Timothy J.** (California Inst. of Technology)
**Thomas, Marita** (WIAS)
**Toader, Rodica** (Università di Udine)
**Veneroni, Marco** (Technische Universität Dortmund)
**Zeman, Jan** (Czech Technical University)
**Zimmer, Johannes** (University of Bath)

# New Trends in Structural Graph Theory
# September 5 - 10, 2010

## Organizers:

**Ken-ichi Kawarabayashi** (National Institute of Informatics)
**Bojan Mohar** (Simon Fraser University)
**Bruce Reed** (McGill University)
**Paul Seymour** (Princeton University)

Two of the most successful projects in graph theory are the proof of the strong perfect graph theorem and the Graph Minors project with numerous applications and extensions. They both involve deep structural results that gave rise to what is recently known as the Structural graph theory. This workshop focused on new advances and trends in this area of pure mathematics.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5121*

## Participants:

**Alexeev, Boris** (Princeton University)
**Amini, Omid** (CNRS-École Normale Superieure)
**Demasi, Lino** (Simon Fraser University)
**DeVos, Matt** (Simon Fraser University)
**Dujmovic, Vida** (Carleton University)
**Dvorak, Zdenek** (Charles University, Prague)
**Fox, Jacob** (Massachusetts Institute of Technology)
**Fradkin, Alexandra** (Princeton University)
**Funk, Daryl** (Simon Fraser University)
**Galluccio, Anna** (Consiglio Nazionale Ricerche)
**Gerards, Bert** (CWI, Amsterdam)
**Goddyn, Luis** (Simon Fraser University)
**Guenin, Bertrand** (University of Waterloo)
**Huynh, Tony** (University of Waterloo)
**Joret, Gwenael** (Université Libre de Bruxelles)
**Kakimura, Naonori** (University of Tokyo)
**Kapadia, Rohan** (Univeristy of Waterloo)
**Kim, Ilhee** (Princeton University)
**King, Andrew** (Columbia University)
**Klimosova, Tereza** (Charles University)
**Kostochka, Alexandr** (U. Illinois, Urbana-Champaign)
**Kral, Daniel** (Charles University)
**Li, Zhentao** (McGill University)
**McDonald, Jessica** (Simon Fraser University)
**Milans, Kevin** (University of Illinois)
**Mohar, Bojan** (Simon Fraser University)
**Norin, Sergey** (Princeton University)
**Oum, Sang-il** (KAIST)
**Ozeki, Kenta** (National Institute of Informatics)
**Postle, Luke** (Georgia Institute of Technology)
**Reed, Bruce** (McGill University)
**Scheide, Diego** (Simon Fraser University)
**Singer, Nathan** (Simon Fraser University)
**Skoda, Petr** (Simon Fraser University)
**Thomas, Robin** (Georgia Institute of Technology)
**Whittle, Geoff** (Victoria University of Wellington)
**Yu, Xingxing** (Georgia Institute of Technology)
**Zwols, Yori** (Columbia University)

# Test Problems for the Theory of Finite Dimensional Algebras September 12 - 17, 2010

## Organizers:

**Vlastimil Dlab** (Carleton University)
**Helmut Lenzing** (University of Paderborn)
**Claus Michael Ringel** (Universität Bielefeld)
**José Antonio de la Peña** (UNAM)

To check the status of a sufficiently mature mathematical theory, the late Irving Kaplansky coined the concept of a "test problem" (in the context of infinite abelian groups). The function of a test problem is to carry out a stress test of existing theory, thereby stretching its capabilities to its limits or well beyond. From such a test of present theory we hope to identify both core problems and theories holding a strong promise for further development. The workshop focused on such problems with a high potential in establishing fresh links to mathematical subjects of neighboring fields. We applied such tests to a number of directions by focussing on the most pressing questions of the present research.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5069*

## Participants:

**Angeleri Huegel, Lidia** (Università degli Studi di Verona)
**Buan, Aslak** (NTNU, Trondheim)
**Chen, Xueqing** (U. Wisconsin, Whitewater)
**Chen, Xiao-Wu** (University of Paderborn)
**de la Pena, Jose Antonio** (UNAM)
**Dlab, Vlastimil** (Carleton University)
**Dowbor, Piotr** (Nicolaus Copernicus University)
**Ebeling, Wolfgang** (Leibniz Universität Hannover)
**Hajduk, Adam** (Nicolaus Copernicus University)
**Happel, Dieter** (Technische Universität Chemnitz)
**Hille, Lutz** (Universität Münster)
**Iyama, Osamu** (Nagoya University)
**Keller, Bernhard** (Université Paris VII)
**Kerner, Otto** (University of Duesseldorf)
**King, Alastair** (University of Bath)
**Kleiner, Mark** (Syracuse University)
**Krause, Henning** (Universität Bielefeld)
**Kussin, Dirk** (Universität Bielefeld)
**Ladkani, Sefi** (Max-Planck-Institute for Mathematics)
**Lenzing, Helmut** (University of Paderborn)
**Meltzer, Hagen** (University of Szczecin)
**Minamoto, Hiroyuki** (Kyoto University)
**Mori, Izuru** (Shizuoka University)
**Oppermann, Steffen** (NTNU, Trondheim)
**Ploog, David** (Leibniz Universität Hannover)
**Reiten, Idun** (NTNU, Trondheim)
**Ringel, Claus Michael** (Universität Bielefeld)
**Schmidmeier, Markus** (Florida Atlantic University)
**Skowronski, Andrzej** (Nicolaus Copernicus U.)
**Smith, Paul** (University of Washington)
**Takahashi, Atsushi** (Osaka University)
**Takahashi, Ryo** (Shinshu University)
**Ueda, Kazushi** (Osaka University)
Zacharia, Dan (Syracuse University)

# Classification of Amenable C*-Algebras
# September 19 - 24, 2010

## Organizers:

**George Elliott** (University of Toronto)
**Andrew Toms** (Purdue University)
**Soren Eilers** (University of Copenhagen)
**Marius Dadarlat** (Purdue University)
**Mikael Rordam** (University of Copenhagen)

Classification is a natural theme in mathematics, one that is particularly rich in the area of operator algebras. These algebras, which arose from attempts to give a mathematical framework to quantum physics, are naturally equipped with invariants, a sort of identification tag which encodes some structure of the algebra. It has been surprising to find that seemingly coarse invariants can encode all of the structure of the operator algebra in many important cases. The objective of this workshop was to understand the roots of the aforementioned "classification by invariants" phenomenon in operator algebras, and to extend its validity to some natural but previously inaccessible classes of algebras (for instance, to the case of the operator algebra associated to an arbitrary discrete time evolution of a space). To this end it gathered 42 of the top researchers in this field, from a pool of more than 100, with a rich variety of academic emphases and talents.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5092*

## Participants:

**an Huef, Astrid** (University of Otago)
**Arklint, Sara** (University of Copenhagen)
**Blackadar, Bruce** (University of Nevada at Reno)
**Blanchard, Etienne** (CNRS, Jussieu, Paris)
**Brenken, Berndt** (University of Calgary)
**Ciuperca, Alin** (University of New Brunswick)
**Dadarlat, Marius** (Purdue University)
**Dean, Andrew** (Lakehead University)
**Eilers, Soren** (University of Copenhagen)
**Elliott, George** (University of Toronto)
**Farah, Ilijas** (York University)
**Giordano, Thierry** (University of Ottawa)
**Gong, Guihua** (University of Puerto Rico)
**Hirshberg, Ilan** (Ben Gurion University of the Negev)
**Ivanescu, Cristian** (Grant MacEwan University)
**Kerr, David** (Texas A&M University)
**Kirchberg, Eberhard** (Humboldt-Universität zu Berlin)
**Lamoureux, Michael** (University of Calgary)
**Larsen, Nadia S.** (University of Oslo)
**Li, Liangqing** (U. Puerto Rico, Rio Piedras)
**Lin, Huaxin** (University of Oregon)
**Matui, Hiroki** (Chiba University)
**Meyer, Ralf** (Universität Gottingen)
**Niu, Zhuang** (Memorial University)
**Ortega, Eduard** (Copenhagen University)
**Pasnicu, Cornel** (U. Puerto Rico, Rio Piedras)
**Perera, Francesc** (U. Autònoma de Barcelona)
**Phillips, N. Christopher** (University of Oregon)
**Putnam, Ian** (University of Victoria)
**Raeburn, Iain** (University of Wollongong)
**Restorff, Gunnar** (University of the Faroe Islands)
**Robert, Leonel** (York University)
**Rordam, Mikael** (University of Copenhagen)
**Ruiz, Efren** (University of Hawaii Hilo)
**Santiago Moreno, Luis** (U. Autònoma de Barcelona)
**Sierakowski, Adam** (York University / U. Toronto)
**Strung, Karen** (University of Nottingham)
**Thiel, Hannes** (University of Copenhagen)
**Tikuisis, Aaron** (University of Toronto)
**Tomforde, Mark** (University of Houston)
**Wassermann, Simon** (University of Glasgow)
**White, Stuart** (University of Glasgow)
Winter, Wilhelm (University of Nottingham)

# Mathematical Foundations of Mechanical Biology
# September 26 - October 1, 2010

## Organizers:

**Alain Goriely** (University of Oxford)
**Marcelo Epstein** (University of Calgary)
**Krishna Garikipati** (University of Michigan)

As biological sciences become increasingly quantitative, there is a realization that mathematical sciences can play a central role in organizing fundamental ideas and can provide a framework for the analysis and understanding of key phenomena. In particular, in the last decade, biologists have become increasingly interested in various mechanical aspects of biological systems from the genetic to the organismal level. For instance, it has been acknowledged that biological growth and development has an important mechanical component that plays a role in both genetic programing as well as in the regulation of physiological processes such as heart and arteries remodeling. However, a unified theory of the growth of elastic tissues that addresses the fundamental coupling between geometric quantities and physical and chemical fields is still lacking. A proper formulation relies on various branches of mathematics and mechanics (differential geometry, thermodynamics, nonlinear elasticity) and the analysis of key problems uses the most advanced techniques in nonlinear analysis, dynamical systems, and computational mathematics. These issues in the mathematical formulation of biological problems arise in many different fields and represent a truly multi-disciplinary endeavor for which mathematics has a unique window of opportunity to play an central organizing role. The goal of the workshop was to gather experts from different fields (mathematics, engineering, mechanics, biophysics...) to identify current scientific challenges in the mechanics of biological systems and to develop the mathematical foundations and techniques relevant for these problems.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5056*

## Participants:

**Ambrosi, Davide** (Politecnico di Milano)
**Arroyo, Marino** (Universitat Politecnica de Catalunya)
**Assidi, Mohamed** (LEMTA, Nancy)
**Bellini, Chiara** (University of Calgary)
**Ben Amar, Martine** (École Normale Supérieure)
**Buehler, Markus J.** (MIT)
**Chenchiah, Isaac** (University of Bristol)
**Cowin, Steve** (City College)
**Di Martino, Elena** (University of Calgary)
**Dorfmann, Luis** (Tufts University)
**Epstein, Marcelo** (University of Calgary)
**Fu, Yibin** (Keele University)
**Ganghoffer, Jean-Francois** (ENSEM)
**Garikipati, Krishna** (University of Michigan)
**Geitmann, Anja** (Université de Montréal)
**Goriely, Alain** (University of Oxford)
**Goyal, Sachin** (Emory University)
**Hall, Cameron** (Oxford University)
**Klika, Vaclav** (Czech Technical University, Prague)
**Klug, William** (UC, Los Angeles)
**Kuhl, Ellen** (Stanford University)
**Lowengrub, John** (UC, Irvine)
**Maugin, Gerard** (Université Paris VI)
**Moulton, Derek** (University of Arizona)
**Neukirch, Sebastien** (U. Paris VI, CNRS)
**Newell, Alan** (University of Arizona)
**Preziosi, Luigi** (Politecnico di Torino)
**Prusinkiewicz, Przemyslaw** (University of Calgary)
**Purohit, Prashant** (University of Pennsylvania)
**Secomb, Timothy** (University of Arizona)
**Shipley, Rebecca** (University of Oxford)
**Shipman, Patrick** (Colorado State University)
**Tabor, Michael** (University of Arizona)
**van der Heijden, Gert** (University College London)
**Waters, Sarah** (Oxford University)
**Yavari, Arash** (Georgia Institute of Technology)

# Linking Neural Dynamics and Coding: Correlations, Synchrony, and Information
# October 3 - 8, 2010

## Organizers:

**Eric Shea-Brown** (University of Washington)
**Kresimir Josic** (University of Houston)
**Andre Longtin** (University of Ottawa)
**Brent Doiron** (University of Pittsburgh)
**Nancy Kopell** (Boston University)

Understanding the mechanisms by which the nervous system represents and processes information is a fundamental challenge for mathematical biology. This challenge is compounded not only due to the brain's massive scale (100 billion neurons!), but also because the information carried by neural tissue can be much more or much less than the sum of the parts contributed by individual neurons. In other words, the cooperative features of neural responses can be essential. This poses a pair of theoretical questions for the mathematical sciences: What are the basic mechanisms by which cooperative activity can emerge from the dynamics of neural networks; and what are the consequences of these mechanisms for information processing and coding? This workshop gathered international experts applying three approaches to these questions: dynamical systems, statistical mechanics, and information theory. The participants spent a week sharing their latest research and studying new opportunities for synergy among their approaches and disciplines.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5102*

## Participants:

**Averbeck, Bruno** (National Institute of Health)
**Barreiro, Andrea** (University of Washington)
**Beck, Jeff** (University College London)
**Beggs, John** (Indiana University)
**Best, Janet** (Ohio State University)
**Canolty, Ryan** (UC, Berkeley)
**Chacron, Maurice** (McGill University)
**Cohen, Marlene** (Harvard Medical School)
**Doiron, Brent** (University of Pittsburgh)
**Dragoi, Valentin** (University of Texas at Houston)
**Ermentrout, Bard** (University of Pittsburgh)
**Fiete, Ila** (The University of Texas at Austin)
**Graupner, Michael** (New York University)
**Hu, Yu** (University of Washington)
**Josic, Kresimir** (University of Houston)
**Katz, Donald** (Brandeis University)
**Kay, Leslie** (University of Chicago)
**Koepsell, Kilian** (UC, Berkeley)
**Kohn, Adam** (Albert Einstein College of Medicine)
**Kramer, Mark** (Boston University)
**Kumar, Ashok** (Carnegie Mellon University)
**Lefebvre, Jeremie** (University of Ottawa)
**Longtin, Andre** (University of Ottawa)
**Maler, Leonard** (University of Ottawa)
**Middleton, Jason** (University of Pittsburgh)
**Moore-Kochlacs, Caroline** (Boston University)
**Moreno-Bote, Ruben** (University of Rochester)
**Nykamp, Duane** (University of Minnesota)
**Oswald, Anne-Marie** (Carnegie Mellon University)
**Pack, Christopher** (Montreal Neurological Institute)
**Paninski, Liam** (Columbia University)
**Pouget, Alexandre** (University of Rochester)
**Prinz, Astrid** (Emory University)
**Reyes, Alex** (New York University)
**Rosenbaum, Robert** (University of Houston)
**Rubin, Jonathan** (University of Pittsburgh)
**Sharpee, Tatyana** (Salk Inst. for Biological Studies)
**Shea-Brown, Eric** (University of Washington)
**Thivierge, Jean-Philippe** (University of Ottawa)
**Tolias, Andreas** (Baylor College of Medicine)
**Trousdale, James** (University of Houston)

# New Perspectives in Univariate and Multivariate Orthogonal Polynomials
# October 10 - 15, 2010

## Organizers:

**Plamen Iliev** (Georgia Institute of Technology)
**Edward Saff** (Vanderbilt University)
**Tom Bloom** (University of Toronto)
**Jeffrey Geronimo** (Georgia Institute of Technology)
**Doron Lubinsky** (Georgia Institute of Technology)

Some of the world's leading experts in univariate and multivariate orthogonal polynomials participated in this BIRS workshop. Orthogonal polynomials have a myriad of applications ranging from signal processing to mathematical physics to numerical analysis. The event brought together experts in these areas to encourage an exchange of ideas.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5061*

## Participants:

**Aptekarev, Alexander** (Keldysh Institute of Applied Mathematics)
**Baratchart, Laurent** (INRIA-Sophia-Antipolis)
**Benko, David** (University of South Alabama)
**Bloom, Tom** (University of Toronto)
**Breuer, Jonathan** (Hebrew University of Jerusalem)
**Chalykh, Oleg** (University of Leeds)
**Christiansen, Jacob** (University of Copenhagen)
**Dragnev, Peter** (University of Indiana, Purdue)
**Gasper, George** (Northwestern University)
**Geronimo, Jeffrey** (Georgia Institute of Technology)
**Grunbaum, F. Alberto** (UC, Berkeley)
**Hardin, Douglas** (Vanderbilt University)
**Harnad, John** (Concordia University / CRM)
**Iliev, Plamen** (Georgia Institute of Technology)
**Ismail, Mourad** (City U. of Hong Kong/King Saud U.)
**Knese, Gregory** (UC, Irvine)
**Koornwinder, Tom** (KdV Institute for Mathematics, University of Amsterdam)
**Kuijlaars, Arno** (Katholieke Universiteit Leuven)
**Levenberg, Norm** (Indiana University)
**Levin, Eli** (Open University of Israel)
**Lubinsky, Doron** (Georgia Institute of Technology)
**Marcellan, Francisco** (Universidad Carlos III,Madrid)
**Mina-Diaz, Erwin** (University of Mississippi)
**Pinar, Miguel** (Universidad de Granada)
**Pritsker, Igor** (Oklahoma State University)
**Prokhorov, Vasiliy** (University of South Alabama)
**Rahman, Mizan** (Carleton University)
**Rains, Eric** (California Institute of Technology)
**Remling, Christian** (University of Oklahoma)
**Saff, Edward** (Vanderbilt University)
**Sidi, Avram** (Technion)
**Stylianopoulos, Nikos** (University of Cyprus)
**Terwilliger, Paul** (University of Wisconsin)
**Totik, Vilmos** (U. Szeged / U. of South Florida)
**Van Assche, Walter** (Katholieke Universiteit Leuven)
**Vinet, Luc** (Université de Montéeal)
**Wang, Xiang-Sheng** (York University)
**Wong, Manwah** (Georgia Tech)
**Xu, Yuan** (University of Oregon)
**Yattselev, Maxim** (University of Oregon)

# Front Propagation in Heterogeneous Media: Mathematical, Numerical, and Statistical Issues in Modelling a Forest Fire Front
# October 17 - 22, 2010

## Organizers:

**John (Willard) Braun** (University of Western Ontario)

**Anne Bourlioux** (Université de Montréal)
**Chris Bose** (University of Victoria)

Forests are one of Canada's great resources. Forest fires are a natural component of these ecosystems, but they can also pose threats to public safety, property and forest resources. Every year, forest fires cause millions of dollars worth of damage and force the evacuation of some communities. Such problems will be exacerbated as climate change alters forest vegetation and weather. Because of those potential impacts, forest fire simulations tools have been developed in Canada and elsewhere in the world where such problems are significant (USA, Australia and Mediterranean countries, for example). For all realistic simulators, the underlying mathematical representation is that of an infinitesimally thin front propagating with a deterministic but highly heterogeneous rate of spread, reflecting variations in the local vegetation, topography, weather conditions and other physical variables that affect the combustion process. Such simulators are indispensable tools for strategic management of fire-control resources before and during fires. Straightforward numerical implementation of such deterministic spread models typically leads to very challenging issues that affect the robustness and accuracy of the predictions. Many questions remain open regarding how to best handle this class of front propagation problems from a numerical point of view, how to best incorporate in the models effects such as ignition ahead of the front by firebrand, or interaction with the weather conditions, and how to make incorporate probability into any prediction. This workshop sought to address some of these issues.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5077*

## Participants:

**Anderson, Kerry** (Natural Resources Canada)
**Babak, Petro** (University of Alberta)
**Bose, Chris** (University of Victoria)
**Boulioux, Anne** (Université de Montréal)
**Braun, John W.** (University of Western Ontario)
**Bryce, Robert** (Brandon University)
**Dean, Charmaine** (Simon Fraser University)
**Deardon, Rob** (Guelph University)
**Desfosses Foucault, Alexandre** (Université de Montréal)
**El-Shaarawi, Adbel** (Canada Centre for Inland Waters)
**Esterby, Sylvia** (University of British Columbia, Okanagan)
**Finney, Mark** (USDA Forest Service, Missoula)
**Francis, Michael** (University of Victoria)
**Han, Lengyi** (University of Western Ontario)
**Hillen, Thomas** (University of Alberta)
**Jenkins, Mary Ann** (York University)
**Johnson, Ed** (University of Calgary)
**Kulperger, Reg** (University of Western Ontario)
**Lee, Johnathan** (University of Western Ontario)
**Ma, Kevin** (University of Western Ontario)
**Martell, David** (University of Toronto)
**Martin, Jonathan** (University of Alberta)
**Yu, Hao** (University of Western Ontario)

# Control and Optimization with Differential-Algebraic Constraints October 24 - 29, 2010

## Organizers:

**Stephen Campbell** (North Carolina State University)
**Larry Biegler** (Carnegie Mellon University)
**Volker Mehrmann** (Technische Universität Berlin)

Differential Algebraic Equations (DAEs) are mixed systems of differential and algebraic equations. In some areas they are referred to as descriptor systems. It has been recognized for some time now that they have great potential both theoretically and in applications. DAEs form one of the most elegant and simple ways to model a physical system because they allow for the creation of separate models for subcomponents that can then be pasted together via a network. As a consequence, this concept is used in many modern CAD systems like SIMULINK, Scicos and DYMOLA although most software packages cannot fully exploit the full potential of DAE models. Once a system has been modeled it becomes important to optimize its performance for both economic and ecological reasons. This workshop worked on the development of improved methods of optimization of DAE modeled physical systems.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5029*

## Participants:

**Antoulas, Thanos** (Rice University)
**Ascher, Uri** (University of British Columbia)
**Barton, Paul** (MIT)
**Benner, Peter** (Technische Universität Chemnitz)
**Betts, John** (Boeing (Retired))
**Biegler, Larry** (Carnegie Mellon)
**Bock, H. Georg** (Universität Heidelberg)
**Borelli, Francesco** (UC, Berkeley)
**Campbell, Stephen** (North Carolina State University)
**Daoutidis, Prodomos** (University of Minnesota)
**Enright, Wayne** (University of Toronto)
**Freund, Roland** (UC, Davis)
**Gerdts, Matthias** (University of Wuerzburg)
**Griewank, Andreas** (Humboldt-Universität Berlin)
**Guay, Martin** (Queens University)
**Gugercin, Serkan** (Virginia Polytechnic Institute)
**Hager, Bill** (University of Florida)
**Ilchmann, Achim** (Technische Universität Ilmenau)
**Jay, Laurent** (University of Iowa)
**Kågström, Bo** (Umeå University)
**Kameswaran, Shivakumar** (United Technologies Research Center)
**Kostina, Ekatarina** (Universität Marburg)
**Kunkel, Peter** (Universität Leipzig)
**Kurina, Galina** (Voronezh State Forest Engineering Academy)
**Losse, Philip** (Technische Universität Chemnitz)
**März, Roswitha** (Humboldt-Universität Berlin)
**Mehrmann, Volker** (Technische Universität Berlin)
**Mengi, Emre** (Koc University)
**Palanki, Srinivas** (University of South Alabama)
**Reis, Timo** (Technische U. Hamburg-Harburg)
**Sager, Sebastian** (Universität Heidelberg)
**Scholz, Lena** (Technische Universität Berlin)
**Spiteri, Ray** (University of Saskatchewan)
**Stykel, Tatjana** (Technische Universität Berlin)
**Swartz, Christopher** (McMaster University)
**Thompson, Karmethia** (North Carolina State U.)
**Varga, Andreas** (German Aerospace Center)
**Vu, Hoang Linh** (Vietnam National University, Hanoi)

# Integrable and Stochastic Laplacian Growth in Modern Mathematical Physics
# October 31 - November 5, 2010

## Organizers:

**Mihai Putinar** (University of California, Santa Barbara)
**Darren Crowdy** (Imperial College London)
**Bjorn Gustafsson** (Royal Institute of Technology, Stockholm)
**John Harnad** (Concordia University / Centre de Recherche Mathematique)
**Mark Mineev** (Max Planck Institute for the Physics of Complex Systems)

Several moving boundary processes, such as solidification, electrodeposition, viscous fingering of an interface between two fluids (such as oil in water), and bacterial or cancerous proliferation, can be reduced, after some idealizations, to the so called Laplacian growth model. In spite of more than a century of continuous research and fundamental discoveries, the mathematical aspects of this apparently innocent two dimensional theory remain intriguing and very challenging. A statistical interpretation of the same expansion phenomenon is currently under a rapid and thorough investigation, with unexpected ramifications to modern quantum field theory. This workshop gathered internationally renown experts in pure and applied mathematics, theoretical and mathematical physics, and computer science currently working on aspects of this fascinating interdisciplinary area.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5019*

## Participants:

**Bertola, Marco** (Concordia University)
**Bleher, Pavel** (Indiana U. / Purdue U. at Indianapolis)
**Crowdy, Darren** (Imperial College London)
**Green, Christopher** (Imperial College London)
**Gustafsson, Bjorn** (Royal Inst. of Tech, Stockholm)
**Harnad, John** (Concordia University / CRM)
**Hoppe, Jens** (Royal Inst. of Tech, Stockholm)
**Khavinson, Dmitry** (University of South Florida)
**Lee, Seung-Yeop** (California Institute of Technology)
**Lin, Yu-Lin** (Academia Sinica)
**Lundberg, Erik** (University of South Florida)
**Marchal, Olivier** (Université de Montréal)
**Markina, Irina** (University of Bergen)
**Martin, Charles** (UC, Santa Barbara)
**McDonald, Robb** (University College London)
**Mineev, Mark** (Max Planck Institute for the Physics of Complex Systems)
**Onodera, Michiaki** (National Taiwan University)
**Orlov, Alexander** (Russian Academy of Sciences)
**Putinar, Mihai** (UC, Santa Barbara)
**Sakai, Makoto** (Tokyo Metropolitan University)
**Savin, Tatiana** (Ohio University)
**Sebbar, Ahmed** (Université Bordeaux I)
**Tanveer, Saleh** (Ohio State University)
**Teodorescu, Razvan** (University of South Florida)
**Vasconcelos, Giovani** (U. Federal de Pernambuco)
**Vasil'ev, Alexander** (University of Bergen)
**Yermolaeva, Oksana** (Institut Henri Poincaré, UPMC)

# Topological Methods in Toric Geometry, Symplectic Geometry and Combinatorics
# November 7 - 12, 2010

## Organizers:

**Tony Bahri** (Rider University)
**Megumi Harada** (McMaster University)
**Fred Cohen** (University of Rochester)
**Matthias Franz** (University of Western Ontario)
**Samuel Gitler** (Cinvestav, San Pedro Zacatenco)

The subject of toric topology and in particular the study of generalized moment-angle complexes has experienced a wide range of activity with connections among different mathematical areas including algebraic geometry, homotopy theory, symplectic geometry, combinatorics, dynamical systems, and robotics. This workshop brought some of the leading experts to Banff in these different but significantly overlapping areas. The main purpose of this conference was to communicate the current state of the art and to facilitate interactions in order to foster new developments. A second purpose was to encourage the development of younger mathematicians and for them to make contact with the diverse frontiers in these subjects.The focus of the conference was on the investigation of toric manifolds, generalized moment-angle complexes and their applications, the equivariant cohomology and K-theory of toric orbifolds, and related topics in topological and combinatorial geometry.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5026*

## Participants:

**Adem, Alejandro** (University of British Columbia)
**Anderson, Dave** (University of Washington)
**Bahri, Tony** (Rider University)
**Batyrev, Victor** (University of Tubingen)
**Bendersky, Martin** (City University of New York)
**Braden, Tom** (University of Massachusetts)
**Carrell, Jim** (University of British Columbia)
**Choi, Suyoung** (Osaka City University)
**Cohen, Fred** (University of Rochester)
**Davis, Michael** (Ohio State University)
**De Concini, Corrado** (University of Rome)
**Denham, Graham** (University of Western Ontario)
**Flowers, Garrett** (University of Victoria)
**Franz, Matthias** (University of Western Ontario)
**Gitler, Samuel** (Cinvestav, San Pedro Zacatenco)
**Gonzalez, Eduardo** (University of Massachusetts, Boston)
**Grbi'c, Jelena** (University of Manchester)
**Harada, Megumi** (McMaster University)
**Huettemann, Thomas** (Queen's University Belfast)
**Kamiyama, Yasuhiko** (University of the Ryukyus)
**Kasprzyk, Alexander** (University of Sydney)
**Kaveh, Kiumars** (University of Pittsburgh)
**Krepski, Derek** (McMaster University)
**Lee, Carl** (University of Kentucky)
**Lopez de Medrano, Santiago** (UNAM)
**Masuda, Mikiya** (Osaka City University)
**Meerseman, Laurent** (Université de Bourgogne)
**Notbohm, Dietrich** (Vrije Universiteit Amsterdam)
**Panov, Taras** (Moscow State University)
**Puppe, Volker** (University of Konstanz)
**Ray, Nigel** (University of Manchester)
**Salvetti, Mario** (University of Pisa)
**Schenck, Henry** (University of Illinois)
**Smith, Gregory G.** (Queens University)
**Suciu, Alexander** (Northeastern University)
**Suh, Dong Youp** (KAIST)
**Tolman, Susan** (University of Illinois, Urbana-Champaign)
**Tymoczko, Julianna** (University of Iowa)
**Verjovsky, Alberto** (UNAM)
**Yerakhavets, Mikalai** (Moscow State University)

# Quasisymmetric Functions
# November 14 - 19, 2010

## Organizers:

**Sara Billey** (University of Washington)
**Louis Billera** (Cornell University)
**Richard Stanley** (Massachusetts Institute of Technology)

For over a century, symmetric functions have played a major role in mathematics with applications in algebraic topology, combinatorics, representation theory, and geometry. Quasisymmetric functions are extensions of symmetric functions that are becoming of comparable importance. This workshop brought together the researchers using these functions in different ways. The goal of the workshop was to make further connections between the various aspects of their work, to foster new developments, and to enhance the common understanding of the applications.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5031*

## Participants:

**Aguiar, Marcelo** (Texas A&M University)
**Armstrong, Drew** (University of Miami)
**Assaf, Sami** (MIT)
**Bandlow, Jason** (University of Pennsylvania)
**Bergeron, Nantel** (York University)
**Billera, Louis** (Cornell University)
**Billey, Sara** (University of Washington)
**Blanco, Saul** (Cornell University)
**Brenti, Francesco** (Università di Roma "Tor Vergata")
**Crites, Andrew** (University of Washington)
**Ehrenborg, Richard** (University of Kentucky)
**Garsia, Adriano** (UC, San Diego)
**Gessel, Ira** (Brandeis University)
**Haglund, Jim** (University of Pennsylvania)
**Hersh, Patricia** (North Carolina State University)
**Hicks, Angela** (UC, San Diego)
**Hsiao, Sam** (Bard College)
**Huang, Jia** (University of Minnesota)
**Hyatt, Matthew** (University of Miami)
**Klivans, Caroline** (University of Chicago)
**Lauve, Aaron** (Loyola University, Chicago)
**Luoto, Kurt** (University of British Columbia)
**Malvenuto, Claudia** (Università Roma I)
**Mason, Sarah** (Wake Forest University)
**McNamara, Peter** (Bucknell University)
**Morse, Jennifer** (Drexel University)
**Naruse, Hiroshi** (Okayama University)
**Petersen, Kyle** (DePaul University)
**Readdy, Margaret** (Institute for Advanced Study)
**Reiner, Victor** (University of Minnesota)
**Reutenauer, Christophe** (U. du Québec à Montréal)
**Shareshian, John** (Washington University)
**Skandera, Mark** (University of Michigan)
**Sottile, Frank** (Texas A&M University)
**van Willigenburg, Stephanie** (U. British Columbia)
**Wachs, Michelle** (University of Miami)
**Warrington, Greg** (University of Vermont)

# Nonstandard Discretizations for Fluid Flows
# November 21 - 26, 2010

## Organizers:

**Peter Minev** (University of Alberta)
**Guido Kanschat** (Texas A&M University)
**Vivette Girault** (Université Paris VI)
**Jean-Luc Guermond** (Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur)

Simulating fluid flows numerically is a common practice nowadays. For instance weather prediction, car and airplane aerodynamics, ground water management, or oil production depend to a certain extent on computer simulations. All these computations rely on sophisticated mathematical algorithms and the goal of this workshop was to bring together applied mathematicians to discuss and exchange new techniques which should make numerical simulations faster, more accurate, and more reliable.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5041*

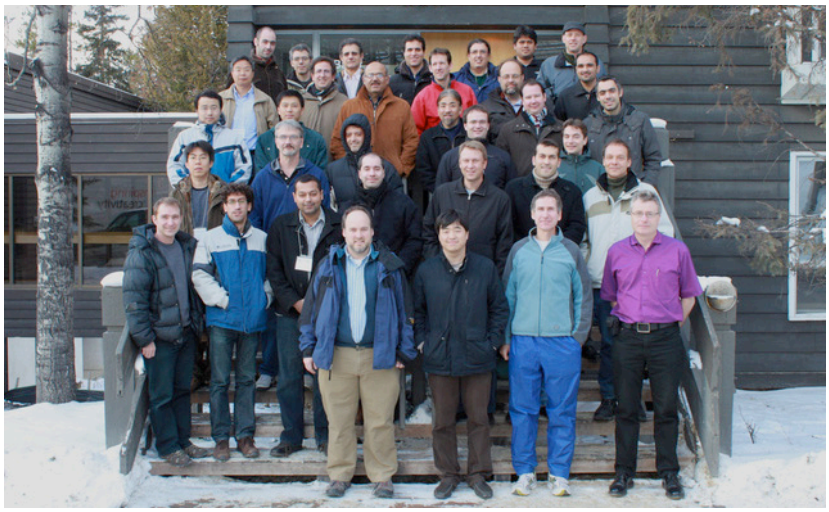
## Participants:

**Angot, Philippe** (Universté de Provence Aix-Marseille)
**Boffi, Daniele** (University of Pavia)
**Bonito, Andrea** (Texas A&M University)
**Bourgault, Yves** (University of Ottawa)
**Boyaval, Sebastien** (Université Paris Est)
**Braack, Malte** (University of Kiel)
**Burman, Erik** (University of Sussex)
**Chacon Rebollo, Tomas** (University of Sevilla)
**Codina, Ramon** (Universitat Politècnica de Catalunya)
**Coupez, Thierry** (Mines Paristech)
**Croisille, Jean-Pierre** (University of Metz)
**Despres, Bruno** (UPMC-LJLL)
**Ern, Alexandre** (Université Paris-Est)
**Eymard, Robert** (Université Paris-Est)
**Fabrèges, Benoit** (Université Paris XI)
**Fairweather, Graeme** (American Math Society)
**Gerbeau, Jean-Frederic** (INRIA Paris-Rocquencourt)
**Girault, Vivette** (Université Paris VI)
**Guermond, Jean-Luc** (Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur)
**Heister, Timo** (University of Göttingen)
**Herbin, Raphaele** (Université d'Aix Marseille I)
**Hoffman, Johan** (Royal Institute of Technology)
**Janssen, Bärbel** (University of Heidelberg)
**Kanschat, Guido** (Texas A&M University)
**Keating, Johnwill** (University of Alberta)
**Lozinski, Alexei** (Université Toulouse III)
**Lube, Gert** (University of Goettingen)
**Malandin, Mathias** (CORIA)
**Matthies, Gunar** (University of Kassel)
**Minev, Peter** (University of Alberta)
**Olshanskii, Maxim** (Moscow Lomonosov State U.)
**Quintela, Peregrina** (U. of Santiago Compostela)
**Salgado-Gonzalez, Abner** (University of Maryland)
**Sangalli, Giancarlo** (University of Pavia)
**Schoetzau, Dominik** (U. of British Columbia)
**Shen, Jie** (Purdue University)
**Silvester, David** (University of Manchester)
**Tobiska, Lutz** (University of Magdeburg)
**Volker, John** (Weierstrass Institute for Applied Analysis and Stochastics)
**Yotov, Ivan** (University of Pittsburgh)
**Zhang, Shangyou** (University of Delaware)

# Sampling and Reconstruction: Applications and Advances
# November 28 - December 3, 2010

## Organizers:

**Alireza Entezari** (University of Florida)
**Dimitri Van De Ville** (École Polytechnique de Lausanne)
**Torsten Moeller** (Simon Fraser University)



The goal of this workshop was to bring together researchers from diverse backgrounds (mathematics, signal processing, and computer sciences), who actively research problems of the representation, reconstruction, analysis, processing, and visualization of multidimensional data. The workshop focused on the mathematical underpinnings of these subject areas. Largely, it aimed at gathering researchers from the established disciplines of signal and image processing, numerical analysis and such application areas as visualization and medical imaging.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5122*

## Participants:

**Aldroubi, Akram** (Vanderbilt University)
**Alim, Usman** (Simon Fraser University)
**Bajaj, Chandrajit** (University of Texas, Austin)
**Beagley, Nathaniel** (Pacific Northwest National Lab.)
**Castro, Rui** (Eindhoven University of Technology)
**Chang, Hyun Sung** (MIT)
**Chin, Peter** (Johns Hopkins University)
**Condat, Laurent** (GREYC-CNRS / UCBN / ENSICAEN)
**Davies, Mike** (University of Edinburgh)
**Demanet, Laurent** (MIT)
**Di Bella, Edward** (University of Utah)
**Eldar, Yonina** (Israel Institute of Technology)
**Entezari, Alireza** (University of Florida)
**Fadili, Jalal** (CNRS-ENSICAEN)
**Goossens, Bart** (Ghent University)
**Han, Bin** (University of Alberta)
**Hormati, Ali** (École Polytechnique de Lausanne)
**Hu, Tao** (Howard Hughes Medical Institute, Janelia Farm Research Campus)
**Ignjatovic, Aleksandar** (University of New South Wales)
**Jiang, Qingtang** (University of Missouri, St. Louis)
**Kim, Minho** (University of Seoul)
**Labate, Demetrio** (University of Houston)
**Larkin, Kieran G.** (Canon Information Systems Research Australia Pty Ltd)
**Lindstrom, Peter** (Lawrence Livermore National Lab.)
**Ni, Karl** (MIT Lincoln Laboratory)
**Peters, Jorg** (University of Florida)
**Portilla, Javier** (Consejo Superior de Investigaciones Científicas)
**Rauhut, Holger** (University of Bonn)
**Saito, Naoki** (UC, Davis)
**Selesnick, Ivan** (Polytechnic Institute of NYU)
**Silva, Jorge** (Duke University)
**Singh-Alvarado, Alexander** (University of Florida)
**Tristan Vega, Antonio** (Harvard Medical School)
**Unser, Michael** (École Polytechnique de Lauseanne)
**Van De Ville, Dimitri** (École Polytechnique de Lausanne)
**Warren, Joe** (Rice University)
**Whitaker, Ross T.** (University of Utah)
**Willett, Rebecca** (Duke University)
**Zayed, Ahmed** (DePaul Univeristy)

# Teachers as Stakeholders in Mathematics Education Research (MER) Half Workshop
# December 5 - 10, 2010

## Organizers:

**Guenter Toerner** (Universität Duisburg-Essen)
**Sharon Friesen** (University of Calgary)

**Klaus Hoechsmann** (Pacific Institute for the Mathematical Sciences)
**Bharath Sriraman** (University of Montana)

In continuation of an international workshop at the Mathematical Research Institute at Oberwolfach (Germany) in November 2007, BIRS hosted another international conference on the professional development of teachers under the auspices of PIMS and DMV (German Mathematical Society). The aim was to bring together mathematicians, researchers and practitioners representing the international scene. Both PIMS and DMV view it as part of their responsibility to promote ideas and initiatives for a sustainable improvement of mathematics in schools.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/5-day-workshops/10w5030*

## Participants:

**Alvarez-Adem, Melania** (PIMS)
**Berndtsen, Britta** (Universität Duisburg-Essen)
**Beswick, Kim** (University of Tasmania)
**Biehler, Rolf** (University of Paderborn)
**Chapman, Olive** (University of Calgary)
**Couillard, Erin** (Calgary Science School)
**Down, Natalie** (Calgary Science School)
**Friesen, Sharon** (University of Calgary)
**Goodchild, Simon** (University of Agder)
**Heinze, Aiso** (IPN Kiel)
**Hodgson, Bernard** (Université de Laval)
**Hoechsmann, Klaus** (PIMS)
**Howe, Roger** (Yale University)
**Jarry-Shore, Michael** (Calgary Girls School)
**Krainer, Konrad** (University of Klagenfurt)
**Kramer, Juerg** (Humboldt-Universität zu Berlin)
**Lagu, Indy** (Mount Royal University)
**Liljedahl, Peter** (Simon Fraser University)
**McNeil, Sandra** (Calgary Girls School)
**Pegg, John** (SIMERR National Centre)
**Roesken, Bettina** (Universität Duisburg-Essen)
**Schoenfeld, Alan H.** (UC, Berkeley)
**Sirotic, Natasa** (Southpointe Academy)
**Sole Kahler, Diana** (Mount Royal University)
**Sriraman, Bharath** (University of Montana)
**Toerner, Guenter** (Universität Duisburg-Essen)
**Winter, Ekkehard** (Deutsche Telekom Foundation)
**Zehetmeier, Stefan** (University of Klagenfurt)

# Banff International Research Station

**2010**

**2-Day Workshops**

# Cascades Topology
# April 9 - 11, 2010

## Organizers:

**Veronique Godin** (University of Calgary)
**Kristine Bauer** (University of Calgary)
**Peter Zvengrowski** (University of Calgary)
**Jens von Bergmann** (University of Calgary)

The Cascade Topology Seminar is a biannual gathering of topologists from the Pacific Northwest and Southwestern Canada. The diversity of the seminar is one of its strengths, and the seminar`s topics vary a great deal within topology. This meeting of the seminar had contributions from string topology, knot and braid invariants, stable homotopy theory, and K-theory as well as a featured talk on the solution to the Kervaire conjecture, which was recently solved.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/2-day-workshops/10w2165*

## Participants:

**Bauer, Kristine** (University of Calgary)
**Bleiler, Steven** (Portland State University)
**Budney, Ryan** (University of Victoria)
**Clay, Adam** (University of British Columbia)
**Cockett, Robin** (University of Calgary)
**Cohen, Ralph** (Stanford University)
**Eldred, Rosona** (University of Illinois at Urbana-Champaign)
**Gerhardt, Teena** (Michigan State University)
**Godin, Veronique** (University of Calgary)
**Gomez, Jose** (University of British Columbia)
**Hedden, Matthew** (Michigan State University)
**Hill, Mike** (University of Virginia)
**Isaacson, Samuel** (University of Western Ontario)
**Jabuka, Stanislav** (University of Nevada-Reno)
**Johnson, Brenda** (Union College)
**Lam, Kee Yuen** (University of British Columbia)
**Malm, Eric** (Stanford University)
**Naik, Swatee** (University of Nevada at Reno)
**Peschke, George** (University of Alberta)
**Powell, Beth** (University of Alberta)
**Rahmati, Saeed** (University of Alberta)
**Ramras, Daniel** (New Mexico State University)
**Sadofsky, Hal** (University of Oregon)
**Sadykov, Rustam** (University of Toronto)
**von Bergmann, Jens** (University of Calgary)
**Zvengrowski, Peter** (University of Calgary)

# Ted Lewis Workshop on SNAP Math Fairs
# April 23 - 25, 2010

## Organizers:

**Tiina Hohn** (Grant MacEwan University)
**Ted Lewis** (University of Alberta)
**Andy Liu** (University of Alberta)

This was the eighth annual math fair workshop at BIRS.

The workshop is extremely popular with teachers in elementary and secondary schools, provides them with resources for their lesson plans, and it is helping to to reshape the ways in which mathematics is being approached in the schools. Problem solving and puzzles in the classroom are now a specific area of the new curriculum and most 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 2-day workshop is a 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 fairs in their own schools is the best and most useful information to others.

Teachers in Alberta and participants from outside view the Ted Lewis Workshop as one of PIMS and BIRS' most valuable education initiatives.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/2-day-workshops/10w2161*

## Participants:

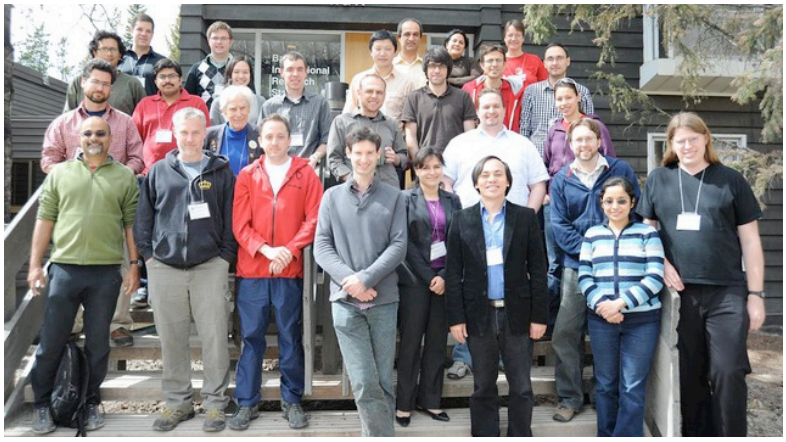
**Beltaos, Elaine** (Grant MacEwan University)
**Beltaos, Angela** (Teslacentral Enterprises)
**Champion, Leeanne** (St. Mary's University College)
**Francis-Poscente, Krista** (St. Mary's U. College)
**Harris, Tara** (Edmonton Public Schools)
**Harris, Jessica** (University of Alberta)
**Hoffman, Janice** (Edmonton Public Schools)
**Hohn, Tiina** (Grant MacEwan University)
**Jacobs, Rebecca** (St. Mary's University College)
**Leiser, Estee** (St. Mary's University)
**Lewis, Ted** (University of Alberta)
**Liu, Andy** (University of Alberta)
**Marinova, Rossitza** (Concordia U. College of Alberta)
**Mckenzie, Hannah** (University of Alberta)
**Nichols, Ryan** (Edmonton Public Schools)
**Pasanen, Trevor** (University of Alberta)
**Rainsong, Kathleen** (St. Mary's University College)
**Rioux-Wilson, Judith** (St.Catherine School)
**Semenko, Svitlana** (Edmonton Public Schools)
**Wheeler, Jeanette** (University of Alberta)

# Alberta Number Theory Days - L-functions
# April 30 - May 2, 2010

## Organizers:

**Paul Buckingham** (University of Alberta)

**Matthew Greenberg** (University of Calgary)



"Number theory" is perhaps a surprising name for a branch of mathematics, since you could be forgiven for thinking that all mathematics was about numbers. In fact, number theorists are those mathematicians who are interested in whole numbers: 1, 2, 3, 4 and so on. Yet how could numbers which appear so simple on face value be of any interest at all? Appearances are as deceptive in mathematics as they can be in real life, since some of the greatest mathematical problems today are about the whole numbers. For example, it was only about fifteen years ago that the three-and-a-half century old Fermat's Last Theorem was finally proven, even though the statement of the theorem can be understood by anyone who knows how to add and multiply two numbers together. This lively and far-reaching mathematical discipline is as useful as it is challenging: Every credit card transaction, every email sent, relies upon number theory to ensure it is transmitted securely. Alberta is home to a number of very active groups of number theorists, but with hours of driving separating them - Edmonton, Calgary, Lethbridge - it can sometimes be hard to discuss ideas. This is why they came together for a weekend in one place - Banff - in order to exchange thoughts, plan projects, and forge links to ensure that Alberta continues to be a leading contributer to number theory.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/2-day-workshops/10w2162*

## Participants:

**Akbary, Amir** (University of Lethbridge)
**Buckingham, Paul** (University of Alberta)
**Cheung, Amy** (University of Calgary)
**Christie, Aaron** (University of Calgary)
**Cipra, Barry** (Freelance)
**Cunningham, Clifton** (University of Calgary)
**Fodden, Brandon** (University of Lethbridge)
**Fontein, Felix** (PIMS / University of Calgary)
**Goswami, Souvik** (University of Alberta)
**Greenberg, Matthew** (University of Calgary)
**Guy, Richard** (University of Calgary)
**Jacobson, Michael** (University of Calgary)
**Kadiri, Habiba** (University of Lethbridge)
**Kostiuk, Jordan** (University of Alberta)
**Lavasani, Syed** (University of Calgary)
**McNeilly, David** (University of Alberta)
**Moody, Dustin** (University of Calgary)
**Musson, Matthew** (University of Calgary)
**Ng, Nathan** (University of Lethbridge)
**Quan, Diane** (University of Calgary)
**Rezai Rad, Monireh** (University of Calgary)
**Riveros Pacheco, David** (University of Alberta)
**Scheidler, Renate** (University of Calgary)
**Sinha, Kaneenika** (PIMS / University of Alberta)
**Sylvestre, Jeremy** (University of Alberta, Augustana)
**Vatsal, Vinayak** (University of British Columbia)
**Weir, Colin** (University of Calgary)
**Wu, Qingquan** (University of Calgary)

# Western Canada Linear Algebra Meeting
# May 7 - 9, 2010

## Organizers:

**Carissa Matthews** (University of Calgary)
**Peter Lancaster** (University of Calgary)
**Shaun Fallat** (University of Regina)
**Hadi Kharaghani** (University of Lethbridge)
**Pauline van den Driessche** (University of Victoria)
**Michael Tsatsomeros** (Washington State University)

Linear algebra has to do with the mathematics of arrays. Frequently rectangular or square arrays of numbers are of a very large size. They play important roles in many parts of mathematics and its applications. They often have certain characteristic properties which provide vital information about the source of data in compact form. The treatment of such arrays and the extraction of the condensed information gives rise to a host of mathematical problems - which were the topic of this workshop.

The 2010 Western Canada Linear Algebra Meeting (WCLAM) was the ninth in a series of biennial workshops on linear algebra including theory, algorithm design, and applications in several disciplines. The workshop maintained the following traditions:

(a) Hosting plenary speakers of international repute.

(b) Providing a forum for the well-established researchers in the North-West of Canada and the USA.

(c) Encouraging the active participation of graduate students and post-doctoral fellows.

(d) Encouraging participation from across Canada and internationally.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/2-day-workshops/10w2137*

## Participants:

**Barrett, Wayne** (Brigham Young University)
**Binding, Paul** (University of Calgary)
**Bodine, Elizabeth** (Washington State University)
**Brenken, Berndt** (University of Calgary)
**Burk, Jimmy** (Washington State University)
**Catral, Minerva** (Xavier University)
**Cavers, Michael** (University of Regina)
**Davis, Chandler** (University of Toronto)
**Deaett, Louis** (University of Victoria)
**Fallat, Shaun** (University of Regina)
**Friedland, Shmuel** (University of Illinois, Chicago)
**Garvey, Seamus** (University of Nottingham)
**Greenbaum, Anne** (University of Washington)
**Grundy, David** (University of Victoria)
**Guo, Chun-Hua** (University of Regina)
**Hogben, Leslie** (Iowa State University)
**Ipsen, Ilse** (North Carolina State University)
**Kharaghani, Hadi** (University of Lethbridge)
**Kirkland, Stephen**(National U. of Ireland, Maynooth)
**Lancaster, Peter** (University of Calgary)
**McDonald, Judi** (Washington State University)
**Melvin, Tim** (Washington State University)
**Olesky, Dale** (University of Victoria)
**Pereira, Rajesh** (University of Guelph)
**Prells, Uwe** (University of Nottingham)
**Streifel, Amy** (Washington State University)
**Tisseur, Francoise** (The University of Manchester)
**Tsatsomeros, Michael** (Washington State U.)
**van den Driessche, Pauline** (University of Victoria)
**Vander Meulen, Kevin** (Redeemer U. College)
**Xing, Yongjun** (University of Regina)
**Zaballa, Ion** (Euskal Herriko Unibertsitatea)
**Zhang, Dali** (University of Calgary)
**Zinchenko, Yuriy** (University of Calgary)
Zizler, Peter (Mount Royal College)
Zuniga Anaya, Juan Carlos (U. of Guadalajara)

# PIMS Mathematical and Statistical Graduate Education Roundtable May 21 - 23, 2010

## Organizer:

**Malcolm Roberts** (University of Alberta)

Ensuring that students in masters and doctoral programs are efficiently trained with relevant skill sets is a problem faced by all universities' mathematics and statistics departments. Since math education conferences generally focus on undergraduate issues, developments in graduate education are not, unfortunately, often shared between universities, which end up working in isolation. Since many universities face similar challenges with their graduate programs, we hope that increased communication will result in more qualified students and better graduate programs.

Graduate students play a vital role in post-secondary institutions, and their training and support constitute a large and important role in mathematics and statistics departments. Different universities often face similar problems, but solutions are not often shared between universities, partly because there is no forum for discussion of graduate education in mathematics and statistics. To address this problem, BIRS played host to the PIMS Mathematical and Statistical Graduate Education Roundtable, which it was hoped would help to establish a dialogue between faculty and graduate students in PIMS universities.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/2-day-workshops/10w2062*

## Participants:

**Balmforth, Neil** (University of British Columbia)
**Bell, Peter** (University of British Columbia)
**Bisztriczky, Ted** (University of Calgary)
**Bose, Chris** (University of Victoria)
**Cavers, Michael** (University of Regina)
**Dahl, Alexander** (University of Toronto)
**Garaschuk, Kseniya** (University of Victoria)
**Hillen, Thomas** (University of Alberta)
**Holder, Cody** (University of Alberta)
**Holzmann, Wolf** (University of Lethbridge)
**Kharaghani, Hadi** (University of Lethbridge)
**Kohler, David** (University of British Columbia)
**Kooistra, Remkes** (University of Alberta)
**Kuttler, Jochen** (University of Alberta)
**Lunney, Scott** (University of Victoria)
**Martin, Greg** (University of British Columbia)
**Musson, Matthew** (University of Calgary)
**Rios, Cristian** (University of Calgary)
**Roberts, Malcolm** (University of Alberta)
**Schuetz, Tara** (University of Alberta)
**Sniatycki, Jedrzej** (University of Calgary)
**Soteros, Christine** (University of Saskatchewan)
**Srinivasan, Raj** (University of Saskatchewan)
**Steinberg, David** (University of British Columbia)
**Weir, Colin** (University of Calgary)
**Yupitun, Lee** (University of British Columbia)

# New Geometric and Numeric Tools for the Analysis of Differential Equations
# August 13 - 15, 2010

## Organizers:

**Greg Reid** (University of Western Ontario)
**Elizabeth Mansfield** (University of Kent)
**Andrew Sommese** (University of Notre Dame)
**Jukka Tuomela** (University of Joensuu)

This workshop brought together researchers in the Geometry of differential equations and in Numerical Analysis. The complex motions of a medical robot or the moving components of a vehicle are described by differential equations often involving polynomial expressions in the quantities of interest and in design parameters. From a geometrical viewpoint, the states of such mechanisms are represented by points in a high dimensional space (e.g. 100-dimensional space, versus the 3-dimensional space we are familiar with). These kind of models typically involve parameters which are only known approximately. Hence to analyse and solve such models we must make sure that the algorithms used are stable with respect to small perturbations in the data. This can be achieved by combining ideas of Algebraic Geometry (the study of polynomial equations and their solutions) with Numerical Analysis. Charles Wampler and Andrew Sommese were both speakers at the workshop, pioneers in the unification of Numerical Analysis with the traditionally exact area of Geometry. It was applied problems in automotive design that originally inspired Sommese to start working on this unification. Topological ideas including continously deforming the equations into forms in which they could be easily solved; and representing higher dimensional solution sets by certain generic points on the solutions, were key in the generalization and creation of a new subject, representing the unification of Numerical Analysis and Algebraic Geometry: Numerical Algebraic Geometry. Because of the computational size of even simple problems, it is important to thoroughly understand qualitative, in other words geometric, features of the model. In this task the analysis of the algebraic structure of the problem using symbolic computation is essential; for example, analysing and then exploiting the symmetry of a problem may easily transform a computationally impossible problem to a tractable one. Although the geometry of problems is the unifying theme of the workshop it is clear that in any real applications extensive symbolic and numeric computation is required. This implies that a lot of care is needed in the implementation of relevant algorithms and indeed a number of participants are deeply involved with developing new software which is helpful and useful in the analysis of the differential systems.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/2-day-workshops/10w2134*

## Participants:

**Anco, Stephen** (Brock University)
**Bluman, George** (University of British Columbia)
**Butz, Edward** (University of British Columbia)
**Celledoni, Elena** (Trondheim Universitet)
**Gaudreau, Philippe** (University of Alberta)
**Hao, Wenrui** (University of Notre Dame)
**Hauenstein, Jonathan** (Fields Institute)
**Hydon, Peter** (University of Surrey)
**Ilie, Silvana** (Ryerson University)
**Kolokolnikov, Theodore** (Dalhousie University)
**Leok, Melvin** (UC, San Diego)
**Liao, Wenyuan** (University of Calgary)
**Liu, Xuan** (University of Western Ontario)
**Mazalov, Vadim** (University of Western Ontario)
**McCoy, Timothy** (University of Notre Dame)
**Muite, Benson** (University of Michigan)
**Owren, Brynjulf** (Norwegian Inst of Sci and Tech)
**Reid, Greg** (University of Western Ontario)
**Roche, Austin** (Waterloo Maplesoft Inc)
**Shmoylova, Elena** (Waterloo Maplesoft Inc)
**Slevinsky, Richard** (U. of Alberta, Campus St-Jean)
**Sommese, Andrew** (University of Notre Dame)
**Tsogtgerel, Gantumur** (McGill University)
**Tuomela, Jukka** (University of Joensuu)
**Vasudev, Pranai** (University of Alberta)
**Verdier, Olivier** (Norwegian Inst of Sci and Tech)
**Wampler, Charles** (General Motors / U. Notre Dame)
**Williams, JF** (Simon Fraser University)
**Wolf, Thomas** (Brock University)
**Wulfman, Carl** (University of the Pacific)
**Zhang, Yang** (University of Manitoba)
**Zheng, Zhonggang** (Northeastern Illinois University)

# Information Processing, Rational Beliefs and Social Interaction
# August 27 - 29, 2010

## Organizers:

**Giacomo Bonanno** (University of California)
**Randy Goebel** (University of Alberta)
**James Delgrande** (Simon Fraser University)
**Hans Rott** (University of Regensburg)
**Jerome Lang** (Universite Paris-Dauphine)

The study of the mathematical aspects of belief formation, information processing and rational belief change is of central importance in a number of different fields. The most important question in Game Theory is how to rationally form a belief about other players' behavior and how to rationally revise those beliefs in light of observed actions. A new branch of logic, called Dynamic Epistemic Logic, has emerged that investigates the foundations of game theory from the point of view of formal logic. Another, related, new field of research, called Social Software, maintains that mathematical models developed to reason about the knowledge and beliefs of a group of agents can be used to deepen our understanding of social interaction and can aid in the design of successful social institutions. This fworkshop will brought together researchers in three broad areas: philosophy and formal logic, computer science and artificial intelligence, and economics and game theory. It provided them with a unique opportunity for the dissemination of ideas and interdisciplinary collaboration.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/2-day-workshops/10w2133*

## Participants:

**Agotnes, Thomas** (University of Bergen)
**Bonanno, Giacomo** (UC, Davis)
**Delgrande, James** (Simon Fraser University)
**Eckert, Daniel** (University of Graz)
**Oveisi, Mehrdad** (Simon Fraser University)
**Pelletier, Francis Jeffry** (University of Alberta)
**Renne, Bryan** (University of Groningen)
**Rott, Hans** (University of Regensburg)
**Satoh, Ken** (National Institute of Informatics)
**Schaub, Torsten** (Universität Potsdam)

# Hierarchical Bayesian Methods in Ecology
# September 10 - 12, 2010

## Organizers:

**Devin Goodsman** (University of Alberta)
**Christian Robert** (Université Paris-Dauphine)
**Francois Teste** (University of Alberta)

Ecological systems are extraordinarily complex. For example, if a researcher wishes to study lodgepole pine susceptibility to mountain pine beetle, they can look at the question on a stand level. The question would then be which pine stands are more susceptible to mountain pine beetle? The researcher could then ask whether certain trees within a pine stand are more resistant to mountain pine beetle attack. This is a tree-level question. Mountain pine beetles are analogous to ferries with passengers: they carry a variety of nematode worms, mites, fungi and bacteria that may help or hinder their colonization of host trees. Therefore a curious scientist could then ask how all of these organisms interact and how that affects beetle populations within trees and within stands. The answer to such questions requires the synthesis of beetle level processes, tree level factors and stand level variables. An elegant and adaptable numerical analysis is required to capture and accommodate such complexity. Bayesian statistics are gaining in popularity amongst mathematical biologists and ecologists. The appeal of Bayesian methods lies in the simple interpretation of the results and their ability to model the uncertainty that arises when researchers collect, analyze, and interact with complex data. However, the great adaptability and complexity that is possible with Bayesian methods requires the researcher to have a deep understanding of models and distributions. Prominent mathematical ecologists advocate the use of Bayesian statistics. However, Bayesian statistics are not commonly taught and are difficult to self-teach. Respected French statistician Christian Robert thus led an intensive workshop that allowed local ecologist to apply Bayesian methods to their own datasets. Dr. Robert is the author of numerous books on Bayesian statistics and works extensively with environmental scientists internationally.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/2-day-workshops/10w2170*

## Participants:

**Auger-Methe, Marie** (University of Alberta)
**Blanchet, Guillaume** (University of Alberta)
**Daemi, Maryam** (University of Alberta)
**Gaertner, Stefanie** (University of Alberta)
**Goodsman, Devin** (University of Alberta)
**Hahn, Aria** (University of Alberta)
**Horn, Hannah (Heidi)** (University of Alberta)
**Koh, Saewan** (University of Alberta)
**Lopez, Claudia** (University of Alberta)
**Matsuoka, Steve** (University of Alberta)
**Pina, Pablo** (University of Alberta)
**Robert, Christian** (Université Paris-Dauphine)
**Schlaegel, Ulrike** (University of Alberta)
**Schoonmaker, Amanda** (University of Alberta)
**Solymos, Peter** (University of Alberta)
**Stralberg, Diana** (University of Alberta)
**Teste, Francois** (University of Alberta)
**Voicu, Mihai** (Silvacom)
**Wagner, Michael** (University of Alberta)

# Prediction and Control of Pandemic Outbreak
# October 1 - 3, 2010

## Organizers:

**Carlos Lange** (University of Alberta)
**Malcolm King** (University of Alberta)
**Babak Pourbohloul** (University of British Columbia)

Despite recent improvements in diagnostic tools and epidemiological models to determine the transmission dynamic of the spread of the Influenza A viruses, such as H1N1, there are knowledge gaps resulting in less than optimal intervention strategies of control. How exactly does a pathogen like the H1N1 virus get transmitted from person to person, and expand within and among neighbourhoods, cities, countries and continents? How much do known preventative measures (covering mouth while coughing, using mask etc.) reduce the probability of transmission? What is the impact of innovative protection measures (bioaerosol suppressant, new mask designs)? Which are the most cost effective measures of containment? These are all questions that must be answered, as Public Health policy makers need to know if simple and less expensive measures to prevent transmission of the novel H1N1 virus are effective, or if more advanced and more expensive measures are necessary to curb an outbreak.This meeting brought together world-class Canadian and foreign experts to identify the most significant factors of virus transmission and to plan how to quantify these, so they can be incorporated into an advanced epidemiological model that is capable of taking these factors into account. The meeting provided a unique opportunity for these experts to interact, since there is usually no common forum of discussion for this diverse group. The outcome of the collaborative work that resulted from this meeting was a new and unique tool for developing efficacious management strategies and interventions to prevent transmission and to control the outbreak of the novel H1N1 virus, as well as other future outbreaks.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/2-day-workshops/10w2173*

## Participants:

**Bansal, Shweta** (Penn State University / National Institutes of Health)
**Chiang, Jonathan M. C.** (University of Alberta)
**Dwyer, Terry** (U. Mississippi Medical Center)
**Fiegel, Jennifer** (University of Iowa)
**Green, Michael** (Queens University)
**Hasan, MD Anwarul** (Alberta Innovates Technology Future)
**King, Malcolm** (University of Alberta)
**Lange, Carlos** (University of Alberta)
**Miller, Joel** (Harvard School of Public Health)
**Moser, Flavia** (UBC Centre for Disease Control)
**Nicholas, David** (University of Calgary)
**Pelude, Linda** (Public Health Agency of Canada)
**Pourbohloul, Babak** (University of British Columbia)
**Rogak, Steven** (University of British Columbia)
**Tellier, Raymond** (Provincial Laboratory for Public Health / University of Calgary)
**Zayas, Jose Gustavo** (University of Alberta)
Zayas, Jose G. (City of Edmonton)

# Operator Algebras and Representation Theory: Frames, Wavelets and Fractals
# October 8 - 10, 2010

## Organizers:

**Palle Jorgensen** (The University of Iowa)
**Berndt Brenken** (University of Calgary)
**Gestur Olafsson** (Louisiana State University)
**Sergei Silvestrov** (Lund University)

Frames and their refinement, fusion frames, like the notion of bases, offer numerical representations of vectors. While the representations are stable, they are typically non-unique, hence their use in applications with intrinsic redundancies: filter bank theory, sigma-delta quantization, image processing, and wireless communications. Other applications to distributed processing and sensor networks in the human brain require the clever splitting of large frame systems into sets of (overlapping) smaller systems. Mathematically, this must be done in a way that allows for effective processing within each individual subsystem. This has recently led to the development of a theory of fusion frames. It offers a mathematical model for these applications as well as efficient algorithms with robustness. Key to this workshop was the use of tools from operator algebras and harmonic analysis in attempts to solve specific problems in mathematics, physics, and the applied sciences. The focus was on specific problems within the theory of wavelets, frames and fractals: their construction, their analysis, their representations, their spectral theory, their algorithms, and their implementations. On the surface, these areas appear quite different; however, recent important advances reveal a commonality in the underlying mathematics involved.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/2-day-workshops/10w2163*

## Participants:

**Bownik, Marcin** (University of Oregon)
**Brenken, Berndt** (University of Calgary)
**Casazza, Peter** (University of Missouri)
**Christensen, Jens** (University of Maryland)
**Dutkay, Dorin** (University of Central Florida)
**Gabardo, Jean Pierre** (McMaster University)
**Giordano, Thierry** (University of Ottawa)
**Han, Deguang** (University of Central Florida)
**Han, Bin** (University of Alberta)
**Jorgensen, Palle** (University of Iowa)
**Kornelson, Keri** (University of Oklahoma)
**Lamoureux, Micheal** (University of Calgary)
**Li, Shidong** (San Francisco State University)
**Massopust, Peter** (Helmholtz Zentrum München Institute for Biomathematics and Biometry / Technische Universität München)
**Öinert, Johan** (University of Copenhagen)
**Olagsson, Gestur** (Louisiana State University)
**Packer, Judith** (University of Colorado)
**Sun Qiyu** (University of Central Florida)

# Canadian Math Kangaroo Contest Workshop
# November 26 - 28, 2010

## Organizers:

**Rossitza Marinova** (Concordia University College of Alberta)

**Valeria Pandelieva** (Statistics Canada)
**Olga Zaitseva-Ivrii** (University of Toronto)

The Canadian Math Kangaroo Contest is a volunteer-run, not-for-profit organization which aims to spread the joy of mathematics. This workshop was for Canadian Math Kangaroo coordinators and volunteers already involved or interested in joining the organization of the contest. The workshop focused on educational and promotional activities popularizing mathematics among students, parents, and educators. These activities include Math Kangaroo-related clubs, classes, preparation sessions as well as development of outreach math related materials.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/2-day-workshops/10w2174*

## Participants:

**Chrysostomou, Sophie** (U. Toronto, Scarborough)
**Currie, James** (University of Winnipeg)
**Essien, Eddy** (Concordia U. College of Alberta)
**Estabrooks, Manny** (Red Deer College)
**Hitesman, Josey** (Concordia U. College of Alberta)
**Kilough, Brady** (Mount Royal University)
**Kondratiiva, Margo** (Memorial University)
**Marinova, Rossitza** (Concordia U. of Alberta)
**Meneses, Laura** (Mount Royal University - Guest)
**Pandeliev, Todor** (Communication Research Centre, Industry Canda)
**Pandelieva, Valeria** (Statistics Canada)
**Pelczer, Ildiko** (École Polytechnique de Montréal)
**Scott, Bill** (Mount Royal University)
**Semenko, Svitlana** (Edmonton Schools)
**Sherman, Mooney** (IEEE Northern Canada)
**Svishchuk, Mariya** (Mount Royal College)
Zaitseva-Ivrii, Olga (University of Toronto)

# Banff International Research Station

**2010**

**Research in Teams**
**Focused Research Groups**

# Convergence of Loop-Erased Random Walk to SLE(2) in the Natural Parametrization
# January 17 - 24, 2010

## Organizers/Participants:

**Robert Masson** (University of British Columbia)
**Michael Kozdron** (University of Regina)
**Tom Alberts** (University of Toronto)

One of the broad goals of statistical mechanics is to understand the behaviour of a physical system at criticality; that is, at (or near) the temperature at which a phase transition occurs. For instance, water changes phase from solid to liquid at 0 C and liquid to gas at 100 C. In elaborate continuous physical systems it is useful to approximate this continuous system by a discrete, or lattice, model. These lattice models lend themselves better to simulation. The introduction in 1999 of a collection of planar random curves called the Schramm-Loewner evolution (SLE) has been of fundamental importance in the field of statistical mechanics, as it has provided scaling limits for many extensively studied planar lattice models. We study one such model, the loop-erased random walk (LERW). While the LERW has been proved to scale to SLE, this scaling only takes into account the geometry of the path and ignores how the model evolves in time. We attempt to resolve this issue by proving the convergence of LERW to SLE as time-parametrized curves.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/research-in-teams/10rit143*

# Theory of Functions of Noncommuting Variables and Its Applications
# February 21 - 28, 2010

## Organizers/Participants:

**Victor Vinnikov** (Ben Gurion University of the Negev)
**Dmitry Kaliuzhnyi-Verbovetskyi** (Drexel University)

Our research deals with functions on matrices of all sizes satisfying certain compatibility conditions as we vary the size of matrices (respecting direct sums and simultaneous similarities). These functions come equipped with a noncommutative difference-differential calculus. Our approach integrates various approaches of other researchers in this area, leading us to a unified theory. We expect important applications to noncommutative polynomials and rational functions, especially in the problems arising from the study of linear matrix inequalities (LMIs) in control. We also expect applications to free probability and to spectral theory (functional calculus) for noncommuting operators.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/research-in-teams/10rit141*

# Local-Global Principles for Etale Cohomology
# March 7 - 14, 2010

## Organizers/Participants:

**David Harbater** (University of Pennsylvania)
**Daniel Krashen** (University of Georgia)
**Julia Hartmann** (RWTH Aachen University)

Our project uses patching to obtain local-global principles in cohomology. Both of these notions concern studying an object by doing so locally. In the case of patching, a global object can be constructed by doing so locally and indicating how the parts fit together. In the case of local-global principles, whether an object exists globally is determined by whether it exists locally. Through the application of patching to the study of local-global principles, we are able to obtain results about symmetries of mathematical objects; and from that we can obtain applications to solutions to quadratic polynomials in several variables and to certain algebraic systems in which multiplication is associative. In our Research in Teams program, our goal was to extend this approach to obtain new local-global principles that concern the deeper structure of algebraic systems, and that would have applications even to some systems where the associative law does not hold.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/research-in-teams/10rit149*

# H-holomorphic Maps in Symplectic Manifolds
# April 11 - 18, 2010

## Organizers:

**Jens von Bergmann** (University of Calgary)
**Richard Hind** (University of Notre Dame)
**Ely Kerman** (University of Illinois at Urbana-Champaign)
**Olguta Buse** (Indiana University / Purdue University Indianapolis)

Symplectic geometry is the modern mathematical language for classical mechanics. This formulation leads naturally to general questions about the behavior of all Hamiltonian systems. Ultimately we would like to obtain classification theorems that tell us for example what kind of dynamics a certain phase space allows. Gromov showed that all Hamiltonian dynamics on real four-dimensional phase space (which is "standard" at infinity) is the same as Hamiltonian dynamics on the standard $R^4$. This workshop aimed to generalize this result to phase spaces with other topologies.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/research-in-teams/10rit146*

## Participants:

**Buse, Olguta** (Indiana University-Purdue University Indianapolis)
**Hind, Richard** (University of Notre Dame)
**von Bergmann, Jens** (University of Calgary)

# Boundary Problems for the Second Order Elliptic Equations with Rough Coefficients
# April 18 - 25, 2010

## Organizers/Participants:

**Svitlana Mayboroda** (Purdue University)
**Jill Pipher** (Brown University)
**Carlos Kenig** (University of Chicago)
**Steven Hofmann** (University of Missouri)

This workshop is concerned with the study of certain partial differential equations of the ‘‘elliptic type". These problems naturally arise in various branches of physics, such as electrostatics, thermodynamics, and elasticity. An example of an equation of elliptic type is Laplace's equation: a solution to this equation represents the steady state of heat flow given a particular distribution of temperature on the surface of a solid body. This workshop is focused on modeling the behavior of solutions to these equations when, for example, the solid body has a rough surface. The problems therefore are very natural. Their study is useful when models of real problems introduce errors which in turn create discontinous or rough boundaries, data, or equations. This work will contribute to further progress in the aforementioned areas of science and engineering, and will enhance graduate and postdoctoral training in the general field of analysis and partial differential equations.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/research-in-teams/10rit135*

# Alexandrov Geometry
# May 2 - 9, 2010

## Organizers/Participants:

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

The team was working on a comprehensive book entitled "Alexandrov Geometry". This subject, which has been much developed in the last 20 years, concerns the structure of very general spaces that are not flat like standard Euclidean space, but are curved in ways that allow them to be compared with Euclidean space. Perelman's celebrated solution of the Poincaré conjecture has drawn wide attention to the theory of such spaces. These spaces also have turned out to interact extensively with other branches of mathematics and its applications. At present, no text exists that covers both the basics and the modern techniques and advances, and we wished to remedy this situation.

For details, please refer to the workshop webpage
*hhttp://www.birs.ca/events/2010/research-in-teams/10rit151*

# Pentagram Map, Complete Integrability and Cluster Manifolds
# May 30 - June 6, 2010

## Organizers/Participants:

**Valentin Ovsienko** (Institut Camille Jordan, Université Lyon I)

**Sophie Morier-Genoud** (Université Paris VI)
**Sergei Tabachnikov** (Pennsylvania State University)

The pentagram map is a natural operation on polygons. Given an n-gon P, the new n-gon, T(P), is the convex hull of the intersection points of consecutive shortest diagonals of P. The map T exhibits a quasi-periodic behavior and is completely integrable. The dynamics, geometry and algebra of the pentagram map is intimately related with a number of important research areas: discrete differential geometry, completely integrable systems of soliton type, and the theory of cluster algebras. The case of pentagons is classical and goes back to C.-F. Gauss.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/research-in-teams/10rit139*

# Borel Measurable Functionals on Measure Algebras
# July 4 - 11, 2010

## Organizers:

**Harold Garth Dales** (University of Leeds)

**Anthony To-Ming Lau** (University of Alberta)

We are concerned with algebras of functions on a group and of measures on those groups. For example, we include study of the functions on the real line which have a Fourier transform; these functions form an algebra. rWe have written two memoirs on these topics, but many basic questions remainopen, and we continue to explore them.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/research-in-teams/10rit156*

## Participants:

**Dales, Harold Garth** (Universiy of Leeds)
**Lau, Anthony To-Ming** (University of Alberta)

**Strauss, Dona** (University of Leeds)

# Analytic Index Theory
# July 25 - August 1, 2010

## Organizers:

**Adam Rennie** (Australia National University)

**John Phillips** (University of Victoria)

The aim of our research team is to write a text on analytic index theory. This is to make a rapidly growing area of research accessible to young researchers and specialists in related fields. The team hoped to synthesise all recent developments in the area of analytic index theory, with a view to producing a single, unified, coherent text.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/research-in-teams/10rit136*

## Participants:

**Carey, Alan** (Australia National University)
**Philips, John** (University of Victoria)
**Rennie, Adam** (Australia National University)
**Sukochev, Fedor** (University of NSW)

# Subordination Problems Related to Free Probability
# August 15 - 22, 2010

## Organizers/Participants:

**Serban Belinschi** (University of Saskatchewan)
**Alexandru Nica** (University of Waterloo)
**Michael Anshelevich** (Texas A&M University)
**Maxime Fevrier** (Université Paul Sabatier / Institut de Mathématiques de Toulouse)

Free probability is a line of research which parallels aspects of classical probability, in a context where tensor products are replaced by free products, and independent random variables are replaced by free noncommutative random variables. Free probability originated in the 1980s, as a line of attacking some longstanding problems about free products of operator algebras. Since then, it has emerged as a subject in its own right, with connections to several other parts of mathematics, and (via its relation to random matrices) to the study of wireless communications in electrical engineering. A current topic of research within free probability is the use of analytic subordination (a well-known tool from classical complex analysis) in order to study certain types of convolution operations performed on free random variables. We proposed to address several inter-related problems arising in connection to this concept.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/research-in-teams/10rit159*

# Research in Photonics: Modeling, Analysis, and Optimization
# September 12 - 19, 2010

## Organizers/Participants:

**Fadil Santosa** (University of Minnesota)
**David Dobson** (University of Utah)
**Stephen Shipman** (Louisiana State University)
**Michael Weinstein** (Columbia University)

This “Research in Teams” program brought four active researchers together to work on pressing mathematical problems arising in photonics. Photonics refer to nano-devices that are optical equivalents of electronic devices. They have an important role in development of next generation communication tools and optical computing. The goals were:

1. To learn about common problems of interest
2. To start collaborating on specific problems
3. To develop a multi-year research agenda
4. To plan a joint proposal

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/research-in-teams/10rit160*

# Derived Category Methods in Commutative Algebra II
# October 31 - November 7, 2010

## Organizers:

**Henrik Holm** (University of Copenhangen)
**Hans-Bjorn Foxby** (University of Copenhagen)
**Lars Christensen** (Texas Tech University)

At the Research in Teams workshop “Derived Category Methods in Commutative Algebra II”, Professors Hans-Bjorn Foxby, Lars Winther Christensen, and Henrik Holm returned to BIRS to finish a 500-page book manuscript entitled "Derived category methods in commutative algebra".The book was written for researchers and advanced graduate students in commutative algebra with the purpose of providing an introduction to derived category methods and their applications. It offers a systematic development of hyperhomological algebra. This includes the construction of the derived category of a general (associative) ring and a careful study of the functors of importance in ring theory. To demonstrate the strength and utility of the theory, and to motivate the choice of topics, the book includes an extensive course in cenrtal homological aspects of commutative ring theory. This part includes many recent results, which were discovered by means of derived category methods, and gives valuable new insight into the theory of commutative rings and their modules.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/research-in-teams/10rit158*

## Participants:

**Christensen, Lars** (Texas Tech University)
**Holm, Henrik** (University of Copenhagen)

# Hyperbolicity in the Symplectic Category
# March 28 - April 4, 2010

## Organizers:

**Richard Hind** (University of Notre Dame)
**John Bland** (University of Toronto)
**Jens von Bergmann** (University of Calgary)
**Marianty Ionel** (University of Toledo)
**Min Ru** (University of Houston)

In the theory of surfaces it is a classical result that surfaces are determined by their genus. For example, a Riemann surface of genus zero is a sphere, a surface of genus one is a torus, a donut with a single hole, and in general a surface genus is a donut with g holes. The sphere is said to be rational, a torus is said to be elliptic and a surface of genus g ge 2 is said to be hyperbolic. The theory of complex hyperbolic geometry is the study of higher dimensional complex hyperbolic spaces. In higher dimension we can no longer visualize spaces so a problem is how one can decide whether a higher dimensional space is hyperbolic? Geometers introduced higher dimensional invariants (generalizing the concept of genus for surfaces) to help settle such questions. The next step is figure out how we can extend this theory to almost complex spaces - this is a much bigger class and the theory is still at its initial stage. Much work needs to be done to answer such questions.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/focussed-research-groups/10frg147*

## Participants:

**Bland, John** (University of Toronto)
**Brudnyi, Alex** (University of Calgary)
**Hind, Richard** (University of Notre Dame)
**Ru, Min** (University of Houston)
**von Bergmann, Jens** (University of Calgary)

# Theory of Rotating Machines
# May 9 - 16, 2010

## Organizers:

**Peter Lancaster** (University of Calgary)
**Seamus Garvey** (University of Nottingham)
**Ion Zaballa** (Euskal Herriko Unibertsitatea)

Machines with rotating parts such as magnetic bearings, for example, present difficult problems for design engineers. Unusually large gyroscopic forces are present and require the design and development of new techniques for analysis of appropriate mathematical models. The international team of five engineers and mathematicians involved in this project was studying problems of this kind - including the development of relevant computational algorithms.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/focussed-research-groups/10frg138*

## Participants:

**Garvy, Seamus** (Unversity of Nottingham, UK)
**Lancaster, Peter** (University of Calgary)
**Popov, Atlanas** (University of Nottingham)
**Prells, Uwe** (University of Nottingham)
**Tisseur, Francoise** (The University of Manchester)
**Zaballa, Ion** (Euskal Herriko Unibertsitatea)

# Sparse Pseudorandom Objects
# May 23 - 30, 2010

## Organizers:

**Penny Haxell** (University of Waterloo)

**Vojetch Rodl** (Emory University)

Many mathematical objects can be naturally decomposed into a `pseudorandom', chaotic part and/or a highly organized `periodic' component. Theorems or heuristics of this type have been used in combinatorics, harmonic analysis, dynamical systems and other parts of mathematics for many years, and have been extremely useful in modelling real-world phenomena such as large networks or complex biological systems. Recently, there have been some important advances in the theory of pseudorandom objects, resulting in new and very general structural theorems. The aim of this workshop is to address certain key problems about sparse combinatorial objects in the context of these new approaches. Solutions to these problems could have wide implications for many fields, and enhance our understanding of the behaviour of large complex systems in general.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/focussed-research-groups/10frg131*

## Participants:

**Dellamonica, Domingos** (Emory University)
**Haxell, Penny** (University of Waterloo)
**Luczak, Tomasz** (Adam Mickiewicz University)
**Mubayi, Dhruv** (University of Illinois at Chicago)
**Nagle, Brendan** (University of South Florida)
**Person, Yury** (Humblodt University)
**Rodl, Vojtech** (Emory University)
**Schacht, Mathias** (University of Hamburg)

# The Mathematical Genesis of the Phenomenon Called 1/f Noise
# June 6 - 13, 2010

## Organizers:

**Priscilla Greenwood** (Arizona State University)

**Lawrence Ward** (University of British Columbia)

Why does the frequency spectrum of data from a great variety of sources take a particular form which indicates that events far in the past still have a great influence on events in the present? As early as the 1920's this effect was noticed in data from electrical devices. More recently the same effect has been seen and studied in seismic data connected with earthquakes, and in biological data from heart rhythms, brain waves, motor behavior, and many other sources.. What is common to all these processes? BIRS hosted a group of scientists and mathematicians from across Canada and several other countries in June to study this question. Through mathematical modeling of random processes which arise in essentially different settings they hoped to discover basic similarities in the mathematical forms of the different models which will then lead to an understanding of essential similarities in the apparently very different phenomena. Such insights into underlying unity enhance our understanding of our world.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/focussed-research-groups/10frg132*

## Participants:

**Baek, Chongryong** (The University of North Carolina at Chapel Hill)
**Davidsen, Joern** (Univeristy of Calgary)
**Erland, Sveinung** (Gassco Norway (a company))
**Kaulakys, Bronislovas** (Institute of Theoretical Physics and Astronomy, Vilnius University)
**Moloney, Nicholas R** (Max Planck Institute for the Physics of Complex Systems)
**Pipiras, Vladas** (Technical University of Lisbon)
**Polonik, Wolfgang** (University of California Davis)
**Ward, Lawrence** (University of British Columbia)

# Discrete Probability
# June 13 - 27, 2010

## Organizers:

**Omer Angel** (University of British Columbia)  **Alexander Holroyd** (Microsoft Research)

Discrete probability is a booming field at the intersection of statistical physics and the theory of computing. Recent progress and new applications for randomized algorithms, probabilistic combinatorics, and discrete physical models have attracted major talent from several communities, and there is still enormous scope for applying powerful methods from these areas to the many unsolved problems.This meeting focused on topics in geometric probability and probabilistic number theory. Probabilistic models on geometric structures arise naturally in a broad range of applications in physics, biology, and information technology. Such models can exhibit astonishing phenomena such as phase transitions and self-organization, despite the simplicity of the underlying mechanisms. Number theory is a cornerstone of modern cryptography, and many of the algorithms currently in use are randomized. However, the rigorous analysis of such randomized algorithms is in its infancy. This meeting addressed some of the many questions that arise in these two areas.r

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/focussed-research-groups/10frg155*

## Participants:

**Angel, Omer** (University of British Columbia)
**Holroyd, Alexander** (Mcrosoft Research)
**Kozma, Gady** (Weizmann institute)
**Martin, James** (University of Oxford)
**Propp, James** (U. Massachussetts, Lowell)
**Romik, Dan** (University of California, Davis)
**Wastlund, Johan** (Chalmers University of Technology)
**Wilson, David** (Microsoft)
**Winkler, Peter** (Dartmouth College)

# Nonlinear Discrete Optimization
# July 18 - 25, 2010

## Organizers:

**Jon Lee** (International Business Machines Corporation)

Optimization is the study of finding the best or least-cost solution of a complex system. Applications range mainly through the sciences and engineering. Most large complicated systems involve a combination of continuous quantities (e.g., volumes of materials, money, pressure, voltage) and discrete quantities (e.g., go/no-go decisions, indivisible goods like airplanes and tunnels, and sequencing of activities). Furthermore, many phenomena that link variables are naturally modeled by nonlinear functions (e.g., pressure loss due to friction of fluid in a pipe, risk and chemical blending). The study of optimization involving some discrete variables, in the presence of nonlinear functions, is of vital importance as we try to make the best use of limited resources, especially in the context of operating more and more complex technologies. ThisFocused Research Group studied nonlinear discrete optimization, aiming to gain mathematical insights that will have significant impact on our understanding of such problems as well as our ability to solve practical instances.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/focussed-research-groups/10frg140*

## Participants:

**De Loera, Jesus** (University of California, Davis)
**Hemmecke, Raymond** (Technische U. Munich)
**Koeppe, Matthias** (University of California, Davis)
**Lee, Jon** (Int'l Business Machines Corporation)
**Onn, Shmuel** (Technion)
**Weismantel, Robert** (ETH Zurich)

# Cortical Spreading Depression and Related Phenomen August 1 - 8, 2010

## Organizers:

**Huaxiong Huang** (York University)

**Robert Minura** (New Jersey Institute of Technology)

Cortical spreading depression (CSD for short) was discovered over 60 years ago by A.A.P. Leao, a Brazilian physiologist doing his doctoral research on epilepsy at Harvard University. Cortical spreading depression is characterized by massive changes in ionic concentrations and slow nonlinear chemical waves, with speeds on the order of mm/min, in the cortex of different brain structures in various experimental animals. In humans, CSD is associated with migraine with aura, where a light scintillation in the visual field propagates, then disappears, and is followed by a sustained headache. To date, CSD remains an enigma, and further detailed experimental and theoretical investigations are needed to develop a comprehensive picture of the diverse mechanisms involved in producing CSD.This gathering brought together a group of researchers in the areas of mathematical modeling and biochemistry as well as experimentalists to address some of the fundamental issues related to CSD. The main objective of the workshop was to discuss recent advances in experimental studies and to build theoretical models based on the fundamental laws of biochemistry and biophysics which are capable of reproducing observed phenomenon and to make predictions that can be verified by further experimental studies.

For details, please refer to the workshop webpage
*http://www.birs.ca/events/2010/focussed-research-groups/10frg116*

## Participants:

**Huang, Huaxiong** (York University)
**Miura, Robert** (New Jersey Institute of Technology)
**Mori, Yoichiro** (University of Minnesota)
**Sugiyama, Kazuyasu** (The University of Tokyo)
**Takagi, Shu** (Riken and The University of Tokyo)
**Tao, Louis** (Peking University)
**Wilson, Phil** (University of Canterbury)
**Wylie, Jonathan** (City University of Hong Kong)

Front: Photo kindly provided by 09w5050
Back: Banff mountains by Gordon Weber; and
deer and magpie by Brent Kearney

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

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