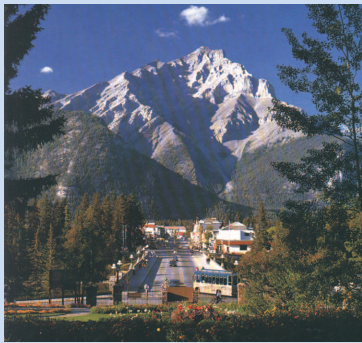


The Banff International Research Station

2003–2004 Programme

The Banff International Research Station for Mathematical Innovation and Discovery (BIRS) is a collaborative Canada-US venture initiated and administered by the Pacific Institute for the Mathematical Sciences (PIMS) and the Mathematical Sciences Research Institute (MSRI). It provides an environment for optimizing opportunities for creative interaction and the exchange of ideas, knowledge, and methods within the Mathematical Sciences and with related sciences and industry.



BIRS is located on the site of the world-renowned Banff Centre in Banff, Alberta. It has its own building (Corbett Hall) and facilities which allow mathematical scientists a secluded environment, complete with accommodation and board and the necessary facilities, for uninterrupted research activities in a variety of formats, all in a magnificent mountain setting.

The BIRS mandate is to embrace all aspects of the mathematical and statistical sciences from the most fundamental work on the great problems of algebra, number theory, geometry and analysis to modern pure and applied mathematics, theoretical and applied statistics, mathematical physics, financial and industrial mathematics, the mathematics of information technology and computer science, and bio-mathematics.

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The Banff International Research Station is sponsored by:

The Natural Science and Engineering Research Council of Canada (NSERC)

The United States National Science Foundation (NSF)

The Alberta Science Research Authority (ASRA)

The Pacific Institute for the Mathematical Sciences (PIMS)

The Mathematical Sciences Research Institute (MSRI)

The Mathematics of Information Technology and Complex Systems
Network of Centers of Excellence (MITACS)



5-day Workshops in 2003

March 15–20 **Recent Developments in Superstring Theory**

Organizers: J. Bryan, M. Rozali, G. W. Semenoff, M. Van Raamsdonk (UBC), S. Giddings (UC, Santa Barbara), M. Kapranov, A. W. Peet (Toronto), A. Karch (Washington), K. Viswanathan (SFU)

March 22–27 **Scattering and Inverse Scattering**

Organizers: R. Froese (UBC), G. Uhlmann (Washington)

March 29–April 3 **Commutative Algebra and Geometry**

Organizers: Mark Green (IPAM), Jürgen Herzog (Gesamthochschule-Essen), Bernd Sturmfels (UC, Berkeley)

April 5–10 **BIRS Workshop on Noncommutative Geometry**

Organizers: Alain Connes (IHES), Joachim Cuntz (Muenster), George Elliott (Toronto), Masoud Khalkhali (Western Ontario), Boris Tsygan (Penn State)

April 12–17 **Quantum Mechanics on the Large Scale**

Organizers: P.C.E. Stamp, G.A. Sawatzky (UBC), A.J. Leggett (Illinois, Urbana), T. Havel (MIT), S. Popescu (HH Wills Lab), R. Gill (Utrecht)

April 19–24 **Computational Fuel Cell Dynamics—II**

Organizers: John Kenna (Ballard), Trung Van Nguyen (Kansas), Keith Promislow (SFU), Brian Wetton (UBC)

April 26–May 1 **The Many Aspects of Mahler's Measure**

Organizers: David Boyd (UBC), Doug Lind (Washington), Fernando Rodriguez Villegas (Texas, Austin), Christopher Deninger (Muenster)

May 3–8 **Recent Advances in Algebraic & Enumerative Combinatorics**

Organizers: Sara Billey (MIT), Ian Goulden, David Jackson (Waterloo), Curtis Greene (Haverford College), Richard Stanley (MIT)

May 10–15 **Statistical Mechanics of Polymer Models**

Organizers: Christine E. Soteris (Saskatchewan), De Witt Sumners (Florida State), Stuart G Whittington (Toronto)

May 24–29 **Constraint Programming, Belief Revision, and Combinatorial Optimization**

Organizer: Randy Goebel (Alberta)

May 31–June 5 **Symmetry and Bifurcation in Biology**

Organizers: Martin Golubitsky (Houston), William F. Langford (Guelph), Ian Stewart (Warwick)

June 7–12 **Applicable Harmonic Analysis**

Organizers: Rong-Qing Jia (Alberta), Sherman D. Riemenschneider (West Virginia), M. Victor Wickerhauser (Washington)

June 14–19 **Integration on Arc Spaces, Elliptic Genus and Chiral de Rham Complex**

Organizers: Mikhail Kapranov (Toronto), Anatoly Libgober (Illinois at Chicago), François Loeser (ENS),

June 21–26 **Point Processes—Theory and Applications**

Organizers: Peter Guttorp (Washington), Bruce Smith (Dalhousie)

June 28–July 3 **Joint Dynamics**

Organizers: Douglas Lind, Boris Solomyak (Washington), Daniel Rudolph (Maryland), Klaus Schmidt (Vienna)

July 5–10 **Mathematical Biology From Molecules to Ecosystems; The Legacy of Lee Segel**

Organizers: L. Keshet (UBC), S. A. Levin (Princeton), M. Lewis (Alberta)

July 12–17 **Perspectives in Differential Geometry**

Organizers: Richard Schoen (Stanford), Gang Tian (MIT), Jingyi Chen (UBC)

July 19–24 **Differential Invariants and Invariant Differential Equations**

Organizers: Niky Kamran (McGill), Peter J. Olver (Minnesota)

July 26–31 **Analysis and Geometric Measure Theory**

Organizers: Ana Granados (UBC), Hervé Pajot (U. Cergy-Pontoise), Tatiana Toro (Washington)

August 2–7 **Monge–Ampère Type Equations and Applications**

Organizers: Alice Chang, Paul Yang (Princeton), Pengfei Guan (McMaster)

August 9–16 **Localization Behavior in Reaction–Diffusion Systems and Applications to the Natural Sciences**

Organizers: A. Bernoff (Harvey Mudd College), P. Fife (Utah), T. Hillen (Alberta), M. J. Ward (UBC), J. Wei (Chinese U.)

August 9–16 **Defects and their Dynamics**

Organizers: Peter W. Bates (Brigham Young), Lia Bronsard (McMaster), Changfeng Gui (Connecticut)

August 16–21 **Current Trends in Arithmetic Geometry & Number Theory**

Organizers: Imin Chen (SFU), Brian Conrad, Chris Skinner (Michigan), Eyal Goren (McGill), Adrian Iovita (Washington), Nike Vatsal (UBC)

August 23–28 **Computational Techniques for Moving Interfaces**

Organizers: Randy LeVeque (Washington), Robert D. Russell, Steven Ruuth (SFU)

August 30–September 4 **A Scientific Creative Writing Workshop at BIRS**

Organizers: Marjorie Senechal (Smith College), Chandler Davis (Toronto)

August 30–September 4 **Locally Finite Lie Algebras**

Organizers: Yuri Bahturin (Memorial Newfoundland), Georgia Benkart (Wisconsin–Madison), Ivan Penkov (UC–Riverside), Helmut Strade (Hamburg), Alexander Zaleskii (Northern Anglia)

September 6–11 **Regularization in Statistics**

Organizers: Ivan Mizera (Alberta), Roger Koenker (Illinois)

September 13–18 **Topology in and Around Dimension Three**

Organizers: Steve Boyer (Quebec), Martin Scharlemann (UC Santa Barbara), Abigail Thompson (UC Davis)

September 20–25 **Structural & Probabilistic Approaches to Graph Colouring**

Organizers: Professor Bruce Reed (McGill), Paul Seymour (Princeton)

September 27–October 2 **Stochastic Partial Differential Equations**

Organizers: Martin Barlow, Edwin Perkins (UBC), Krzysztof Burdzy (Washington), Robert Dalang (Ecole Polytechnique Fédérale)

October 4–9 **Quadratic forms, Algebraic Groups, & Galois Cohomology**

Organizers: R. Elman, A.S. Merkurjev (UCLA), J. Minac (Western Ontario), C. Riehm (McMaster)

October 11–16 **BANFF Retail Credit Risk Conference 2003**

Organizers: T. Astebro (Waterloo), P. Beling (Virginia), D. Hand (Imperial College), R. Oliver (Fair Isaac Companies), L. Thomas (Southampton)

October 18–23 **MITACS Special Industrial Forum**

Organizer: Arvind Gupta (MITACS)

October 25–30 **Current Trends in Representation Theory of Finite Groups**

Organizers: Jonathan L. Alperin (Chicago), Michel Broue (Paris VII), Gerald Cliff (Alberta)

November 1–6 **PIMS HOT TOPICS Galaxy Formation; a Herculean Challenge**

Organizers: Arif Babul, Julio Navarro, Frank van den Bosch (Victoria), Jeremiah Ostriker (Cambridge), Tom Quinn (Washington), Neal Katz (Massachusetts)

November 8–13 **MSRI HOT TOPICS**

Organizer: Michael Singer (MSRI)

November 15–20 **The Interaction of Finite Type and Gromov–Witten Invariants**

Organizers: Jim Bryan (UBC), David Auckly (Kansas State)

November 22–27 **Theory & Numerics of Matrix Eigenvalue Problems**

Organizers: J. W. Demmel (UC Berkeley), N.J. Higham (Manchester), P. Lancaster (Calgary)

November 29–December 4 **Nonlinear Dynamics of Thin Films and Fluid Interfaces**

Organizers: A. L. Bertozzi, R. P. Behringer, T.P. Witelski (Duke), R. Almgren, M. C. Pugh (Toronto), M. Shearer (NC State)

December 6–11 **Calabi–Yau Varieties and Mirror Symmetry**

Organizers: V. Batyrev (Tübingen), S. Hosono (Tokyo), J. D. Lewis (Alberta), B. H. Lian (Brandeis), S.–T. Yau (Harvard), N. Yui (Queen's), D. Zagier (Max–Planck)

December 13–18 **p–adic Variation of Motives**

Organizers: Kevin Buzzard (Imperial College), Robert Coleman (UC Berkeley), Matthew Emerton (Northwestern), Eyal Goren (McGill)

December 13–18 **Coordinate Methods in Nonselfadjoint Operator Algebras**

Organizers: Allan Donsig (Nebraska), Michael Lamoureux (Calgary)

Focused Research Groups (FRG), Research in Teams (RIT), Summer Schools (SS) and 2-Day Workshops in 2003

March 28–29 **Northwest Functional Analysis Symposium** (2-day workshop)
Organizers: M. Lamoureux (Calgary), A. Lau, N. Tomczak-Jaegermann (Alberta), I. Putnam (Victoria)

April 3–6 **Restricting Syzygies of Algebraic Varieties** (RIT)
Organizer: David Eisenbud (MSRI)

April 11–12 **Math Fair Workshop** (2-day workshop)
Organizers: Ted Lewis (U. Albert), Andy Liu (U. Alberta)

April 26–May 10 **Topological Orbit Equivalence for Dynamical Systems** (RIT)
Organizers: T. Giordano (Ottawa), C. Skau (Norwegian Science & Technology), I. Putnam (Victoria)

April 26–May 10 **Field Theory & Cohomology of Groups** (RIT)
Organizers: J. Minac (Western Ontario), A. Adem (Wisconsin–Madison), D. Karagueuzian (Binghamton)

May 10–24 **Regularity for Hypergraphs** (FRG)
Organizers: P. Haxell (Waterloo), V. Rodl (Emory), J. Skokan (Illinois Urbana–Champaign), L. Thoma (Rhode Island)

May 15–17 **The Regression Discontinuity Method in Economics Theory and Applications** (2-day workshop)
Organizer: Thomas Lemieux (UBC)

May 17–22 **PIMS Graduate Industrial Mathematics Modelling Camp** (SS)
Organizers: R. Kuske (PIMS), F. Santosa (IMA)

May 24–June 7 **Topology and Analysis Complementary Approaches to the Baum–Connes and Novikov Conjectures** (FRG)
Organizers: N. Higson (Penn State), J. Kaminker (Indiana–Purdue), S. Weinberger (Chicago)

June 7–21 **Quantum Algorithms & Complexity Theory** (FRG)
Organizer: R. Cleve (Calgary)

June 21–27 **Summer School in Differential Geometry** (SS)
Organizer: R. Bryant (UC Berkeley)

June 28–July 10 **2003 Summer IMO Training Camp** (SS)
Organizer: W. Sands (Calgary)

July 12–26 **Problems in Discrete Probability** (FRG)
Organizers: R. Pemantle (Ohio State), Y. Peres (Berkeley), P. Winkler (Bell Labs)

July 26–August 16 **Representation Theory of Linearly Compact Lie Superalgebras and the Standard Model** (RIT)
Organizers: V. Kac (MIT), A. Rudakov (NTNU)

August 2–16 **Variance of Quasi-coherent Torsion Cousin Complexes** (RIT)
Organizers: J. Lipman (Purdue), S. Nayak (Harish–Chandra Research Institute), P. Sastry (Toronto)

August 16–30 **Invariant Manifolds for Stochastic PDEs** (RIT)
Organizers: T. Caraballo (Universidad de Sevilla), J. Duan (Illinois Tech), K. Lu (Brigham Young), B. Schmalfuss (Merseburg)

August 16–September 6 **Local Uniformization & Resolution of Singularities** (RIT)
Organizers: S.D. Cutkosky (Missouri–Columbia), F.–V. Kuhlmann (Saskatchewan)

August 28–30 **Theoretical Physics Institute, University of Alberta Symposium** (2-day workshop)
Organizer: Helmy Sherif (Alberta)

September 6–20 **Arithmetic of Fundamental Groups** (RIT)
Organizers: D. Harbater (Pennsylvania), F. Pop (Bonn)

September 18–20 **Canadian Mathematics Chairs Meeting** (2-day workshop)
Organizer: Ted Biztriczky (Calgary)

September 20–October 2 **Mathematical Models for Plant Dispersal** (FRG)
Organizers: M. Lewis (Alberta), J. Bullock (NERC Centre for Ecology and Hydrology)

October 2–4 **West Coast Operator Algebra** (2-day workshop)
Organizer: B. Brenkan (Calgary)

Focused Research Groups (FRG), Research in Teams (RIT), Summer Schools (SS) and 2-Day Workshops in 2004

June 5–19 **Robust Analysis of Large Data Sets** (FRG)

Organizers: Ruben Zamar (UBC), Stefan Van Aelst (U. Ghent, Belgium)

July 10–24 **String Field Theory Camp** (FRG)

Organizers: Gordon Semenoff, Mark van Raamsdonk, Moshe Rozali (UBC)

May 15–June 5 **Maximal Functions in Non-Commutative Analysis** (RIT)

Organizers: Marius Junge (University of Illinois, Urbana–Champaign), Qianhua Xu (Besancon, France)

May 22–June 5 **Geometric Analysis of One and Several Complex Variables** (RIT)

Organizers: Steven Krantz (Washington University, St. Louis), Joseph Cima (University of North Carolina), Ian Graham (University of Toronto), Kang–Tae Kim (Pohang Institute, Korea)

July 24–August 7 **Stability and Computations for Stochastic Delay Differential Equations** (RIT)

Organizers: Salah Mohammed (Southern Illinois University), Evelyn Buckwar (Humboldt), Tony Shardlow (University of Manchester), Rachel Kuske (UBC)

July 25–August 22 **Modular Invariants and NIM-Representations** (RIT)

Organizers: Terry Gannon (University of Alberta), Matthias Gaberdiel (Kings College)

March 18–20 **Human Infant Speech Perception and Language Acquisition** (2-day workshop)

Organizers: Janet Werker (UBC)

March 25–27 **Retreat on Mathematical Ecology and Evolution** (2-day workshop)

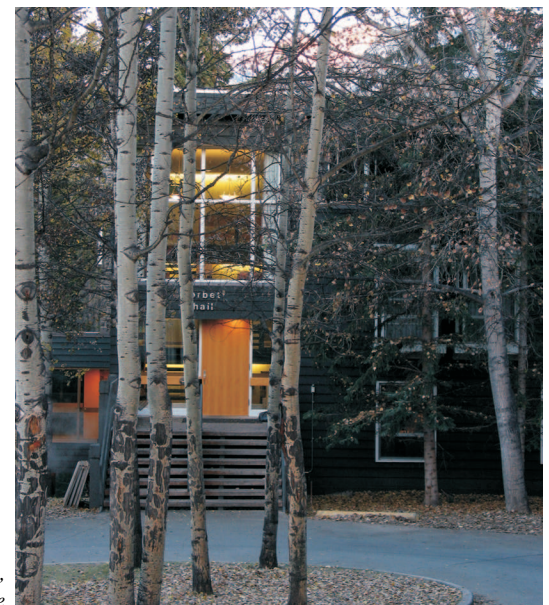
Organizers: Mark Lewis, Thomas Hillen (Alberta), Ed McCauley (Calgary), Michael Doebeli (UBC), Mark Kot (Washington)

May 6–8 **Directions in Combinatorial Matrix Theory** (2-day workshop)

Organizers: Shaun Fallat, Steve Kirkland (Regina), Hadi Kharaghani (Lethbridge), Bryan Shader (Wyoming), Michael Tsatsomeros (Washington State), Pauline van den Driessche (Victoria)

May 12–14 **Decentralized Discrete Event Systems Structure, Communication and Control** (2-day workshop)

Organizers: Peter Caines (McGill), Stephane Lafortune (Michigan), Laurie Ricker (Mount Allison), Karen Rudie (Queen's), John Thistle (Waterloo)



Corbett Hall,
The Banff Centre

5-day Workshops in 2004

March 13–18 **Interactions Between Model Theory and Geometry**

Organizers: Deirdre Haskell (McMaster), Jan Deneff (Leuven), Ehud Hrushovski (Hebrew U), Angus Macintyre (Edinburgh University), Anand Pillay (UIUC), Patrick Speissegger (Wisconsin & McMaster)

March 20–26 **Topology of Manifolds and Homotopy Theory**

Organizers: Ian Hambleton (McMaster), Erik Pedersen (SUNY, Binghamton), Gunnar Carlsson (Stanford)

March 27–April 1 **Orthogonal Polynomials; Interdisciplinary Aspects**

Organizers: Jacek Szmigielski (Saskatchewan), Percy Deift (Courant), Lance Littlejohn, David Sattinger (Utah State)

April 3–8 **Model Reduction Problems and Matrix Methods**

Organizers: Anne Greenbaum (Washington), Gene Golub (Stanford), Jim Varah (UBC)

April 10–15 **Analytic and Geometric Aspects of Stochastic Processes**

Organizers: Martin Barlow (UBC), Alexander Grigoryan (Imperial College), Elton Hsu (Northwestern)

April 17–22 **Celestial Mechanics**

Organizers: Florin Diacu (University of Victoria), Donald Saari (UC, Irvine)

April 17–22 **BIRS Workshop in Creative Scientific Writing**

April 24–29 **Microeconometrics of Spatial and Grouped Data**

Organizers: Thomas Lemieux (UBC), David Card (UC, Berkeley)

May 1–6 **Mathematical Structures in Economic Theory & Econometrics**

Organizers: Ivar Ekeland (UBC), Pierre-Andre Chiappori (Chicago)

May 1–6 **Singular Cardinal Combinatorics**

Organizers: Claude Laflamme (Calgary), Matthew Foreman (UC, Irvine), Stevo Todorovic (Toronto, CNRS Paris)

May 8–13 **Knots and their Manifold Stories**

Organizers: Kent Orr (Indiana), Cochran Tim (Rice), Rolfsen Dale (UBC)

May 15–20 **New Developments on Variational Methods & their Applications**

Organizers: Changfeng Gui (Connecticut), Kung-Ching Chang (Peking), Paul Rabinowitz (Wisconsin, Madison), Jingyi Chen (UBC)

May 22–27 **Mathematical Foundations of Scientific Visualization, Computer Graphics, and Massive Data Exploration**

Organizers: Torsten Moller, Robert Russell (SFU), Bernd Hamann (UC, Davis)

May 29–June 3 **Aperiodic Order; Dynamical Systems, Combinatorics, & Operators**

Organizers: Michael Baake (Institut fuer Mathematik), David Damanik (Caltech), Ian Putnam (Victoria), Boris Solomyak (Washington)

June 5–10 **Semimartingale Theory and Practice in Finance**

Organizers: Tom Hurd (McMaster), Thaleia Zariphopoulou (Texas, Austin), Philip Protter (Cornell), Lane Hughston (King's College)

June 12–17 **New Horizons in String Cosmology**

Organizers: James Cline (McGill), Robert Brandenberger (Brown), Steve Giddings (UC, Santa Barbara), Brian Greene (Columbia), Rob Myers (Perimeter Institute), Gordon Semenoff (UBC)

June 19–24 **PIMS Hot Topic Workshop**

June 26–July 8 **PIMS International Summer School (2 weeks)**

July 10–15 **Convex Geometric Analysis**

Organizers: Nicole Tomczak-Jaegermann (Alberta), Vitali Milman (Tel Aviv), Elisabeth Werner (Case Western Reserve)

July 17–22 **Modeling Protein Flexibility and Motions**

Organizers: Walter Whiteley (York), Michael Thorpe, Leslie Kuhn (Michigan State)

July 24–29 **Geometric Evolution Equations**

Organizers: Christine Guenther (Pacific University), Jingyi Chen (UBC), Bennett Chow (UC, San Diego), Klaus Ecker (Freie Universitaet Berlin)

July 31–August 5 **Conformal Geometry**

Organizers: Thomas Branson (Iowa), Michael Eastwood (Adelaide), McKenzie Wang (McMaster)

August 7–12 **Stochastic Processes in Evolutionary and Disease Genetics**

Organizers: Ellen Baake (Greifswald), Don Dawson (Carleton), Warren

Ewens (Pennsylvania), Bruce Rannala (Alberta)

August 14–19 **Statistical Science for Genome Biology**

Organizers: Jennifer Bryan (UBC), Sandrine Dudoit, Mark van der Laan (UC, Berkeley)

August 21–26 **Dynamics, Control & Computation in Biochemical Networks**

Organizers: Leon Glass (McGill), Erik Winfree (Caltech), John Reintz (SUNY, Stony Brook), Brian Ingalls (Waterloo), Eduardo Sontag (Rutgers), Jim Collins (Boston)

August 28–September 2 **Combinatorial Hopf Algebras**

Organizers: Frank Sottile (Massachusetts), Nantel Bergeron (York), Louis Billera (Cornell), Stephanie van Willigenburg (UBC)

September 4–9 **Pluripotential Theory and its Applications**

Organizers: Len Bos, Alex Brudnyi (Calgary), Eric Bedford (Indiana), Al Taylor (Michigan)

September 11–16 **Commutative Algebra; Homological & Birational Theory**

Organizers: Ragnar-Olaf Buchweitz (Toronto), Paul Roberts (Utah), Bernd Ulrich (Purdue)

September 18–23 **Quantum Computation and Information Theory**

Organizers: John Watrous, Richard Cleve (Calgary), Umesh Vazirani (UC, Berkeley)

September 25–30 **Interaction of Finite Dimensional Algebras with Other Areas of Mathematics**

Organizers: V. Dlab (Carleton), C. Ringel (Bielefeld), L. Scott (Virginia)

October 2–7 **Self-Stabilizing Distributed Systems**

Organizers: Lisa Higham (Calgary), Anish Arora (Ohio State), Faith Fich (Toronto), Maurice Herlihy (Brown), Ted Herman (Iowa)

October 9–14 **Free Probability Theory**

Organizers: Alexandru Nica (Waterloo), Roland Speicher (Queen's), Dan Voiculescu (UC, Berkeley)

October 16–21 **Braid Groups and Applications**

Organizers: Dale Rolfsen (UBC), Joan Birman (Columbia), Patrick Dehornoy (Caen), Roger Fenn (Sussex), Vaughan Jones (UC, Berkeley)

October 23–28 **Mathematical Image Analysis and Processing**

Organizers: Mary Pugh (Toronto), Selim Esedoglu (UCLA), Sung Ha Kang (Kentucky), Jackie Shen (Minnesota)

October 30–November 4 **The Structure of Amenable Systems**

Organizers: George Elliott (Toronto), Andrew Dean (Lakehead), Thierry Giordano (Ottawa), Guihua Gong (Puerto Rico), Huaxin Lin, N. Christopher Phillips (Oregon)

November 6–11 **New Techniques in Lorentz Manifold**

Organizers: Virginie Charette (Manitoba), Todd Drumm (Swarthmore College), William Goldman (Maryland)

November 6–11 **Functional Differential Equations**

Organizers: Jianhong Wu (York), Hans-otto Walther (Giessen), John Mallet-paret (Brown)

November 13–18 **Explicit Methods in Number Theory**

Organizers: Peter Borwein (SFU), H. W. Lenstra (UC, Berkeley), P. Stevenhagen (Leiden), H. Williams (Calgary)

November 20–25 **Diophantine Approximation & Analytic Number Theory**

Organizers: Michael Bennett, Greg Martin (UBC), John Friedlander (Toronto), Andrew Granville (Montreal), Cameron Stewart (Waterloo), Trevor Wooley (Michigan)

November 27–December 2 **Mathematical Models for Biological Invasions**

Organizers: Mark Lewis (Alberta), Mark Kot (Washington), Pauline van den Driessche (Victoria)

December 4–9 **Numeracy and Beyond**

Organizers: Klaus Hoechsmann (PIMS), Tony Gardiner (Birmingham), Yarom Sagher (Illinois), Guenter Toerner (Duisburg)

December 4–9 **Generalizations of de Bruijn Cycles and Gray Codes**

Organizers: Brett Stevens (Carleton), Joe Buhler (Reed College), Persi Diaconis (Stanford), Fan Chung, Ronald Graham (UC, San Diego), Frank Ruskey (Victoria)

December 11–16 **Workshop on Resolution of Singularities, Factorization of Birational Mappings, and Toroidal Geometry**

Organizers: Kenji Matsuki, Jaroslaw Wlodarczyk (Purdue), Dan Abramovic (Boston), Edward Bierstone, Pierre Milman (Toronto), Steven Dale Cutkosky (Missouri)