I. COLLABORATIVE RESEARCH GROUPS

As part of its second phase of development, PIMS is embarking on a plan that will create and support collaborative multi-university teams of mathematical scientists. These Collaborative Research Groups (CRGs) will pool talent across universities to form world-class research groups that will generate and sustain the scientific programme of PIMS in the years to come.

The research programmes of these groups will be supported through a new PIMS programme that supports concentrated activities in 5–10 research areas each year. This programme, run on a competitive basis, will support multi-site activities of selected CRGs over a 1–2 year period of concentration.

Upcoming Areas of Concentration: 2003–05

String Theory

Scientific Computing

Number Theory

Mathematical Ecology and Evolution

Topological Dynamics

Upcoming Areas of Concentration: 2004–06

Topology and Knot Theory

Probability and Statistical Mechanics

What is a PIMS CRG?

The CRGs typically consist of researchers with a common research interest and with a common desire to collaboratively develop some aspects of their research programmes. Groups may already be organizing joint seminars and workshops, making joint PDF appointments, or developing joint graduate training programmes. However, with the resources and organizational structure of PIMS they will be able to do considerably more.

The CRGs act as a vehicle for networking between universities. They effectively integrate the mathematical sciences community at the various PIMS universities into the scientific infrastructure of PIMS. They will build on already existing joint efforts and links between the researchers of Western Canada and the US Pacific Northwest thereby opening up a new era of scientific collaborations between the two countries. They will also will assume scientific leadership at the Banff Station and some will have the potential to lead industrial projects through the MITACS network.

The CRGs will create critical mass that will substantially enhance training programmes at all levels. The pooling of PIMS support with other sources and the joint planning of resource allocation will allow the CRGs to support a large number of PDFs and graduate students and will create new research opportunities for these young scientists, including exchanges, joint supervision, and summer schools.

The CRGs directly address the problems of retention and recruitment of faculty. They are a venue for new faculty to get plugged into a larger community, they give young faculty an effective network to build their research programme, and they enhance the attractiveness of the universities.

PIMS has identified 32 potential CRGs within its community, spanning five broad areas of research to which PIMS is committed: Fundamental Mathematics, Applied and computational Mathematics, Mathematical Biology and Medicine, Statistical Sciences and Theoretical Computer Science. While some are already well established and structured, in most cases they are just forming. Each CRG, which consists of 10–15 Canadian and US researchers, are to be jointly coordinated by at least 3 senior researchers representing various PIMS sites.

Periods of Concentrated activities for the CRGs

The Periods of Concentration are designed to promote and support longer term, multi-event, multi-site coordinated activities of competitively selected CRGs, in tandem with their national and international collaborators and visitors. Every year, the PIMS Scientific Review Panel will select on a competitive basis, up to 5 areas of research from those proposed by existing or developing CRGs. The selected areas will be the focus of much of the institute's programme over a 1–2 year period of concentrated activities that will be delivered through the selected CRGs. Thus, at any given time, as many as 10 CRGs may be leading the PIMS scientific enterprise. Proposals can vary greatly according to the needs of the particular group and may combine a number of existing PIMS activities. During its period of concentration, a CRG can expect to receive priority for:

- Thematic programmes and mini-programmes

- PIMS postdoctoral fellowships

- Pacific Northwest mini-conference series

- 5-day workshops at BIRS

- Focussed workshops at host universities

- Intensive two week graduate courses

- Distinguished chairs & long term visitors

- Graduate students exchanges

- Graduate & senior undergrad schools

- Industrial training camps

- International collaborations

- Research fellowships for teaching relief

With this support, a CRG can plan to gather a significant portion of the world's experts in its focus topic for periods of intense collaboration. The fruits of such intensity can be expected to persist for many years and to be exponentially greater than the results of more normal activity levels.

In due course, all 32 of the PIMS CRGs recognized so far would be given the benefit of a period of concentration. This approach should dramatically increase the effectiveness of the PIMS research programme by making its facilities and its opportunities available to all CRGs on a periodic basis.

Expected Impact of the Periods of Concentration

A targeted and coordinated, yet inclusive grass-roots approach of this form will present a new and innovative way for the institute to drive and stimulate research and will result in a significant impact on the research excellence of its activities. The programme's extended time scale, its multi-event nature and its cross-university character together distinguish it from any other institute programme. Its implementation will allow PIMS to achieve several of its goals. It will:

- Provide new ways of having its scientific programmes driven by its member scientists: The programme will help elicit proposals for thematic summers, miniprogrammes, BIRS events, and distinguished scholars as part of the application process. These programmes will have strong local interest and will encourage grass-roots generation and longterm planning of activities with a much more inclusive and flexible format than standard thematic programmes.

- Foster multi-site interactions and collaborations: The programme will continue to build the inter-site collaborative nature of the PIMS community and will alleviate the problems of interconnection inherent in large geographical separations between the PIMS sites. It creates a context through which researchers can collectively profit from the opportunities created by PIMS, BIRS and the MITACS network.

- Create new research opportunities and enhance training: The periods of concentration will allow for the planning of a series of advanced graduate courses at any one site with the participation of students from multiple PIMS universities. The Western Dean's agreement allows graduate students at any Western Canadian university to take courses, for credit, at any Canadian PIMS university. The result will be new opportunities for PIMS graduate students and a larger audience for PIMS and visiting scientists. This will directly lead to a vigorous graduate student exchange programme.

- Support existing collaborative research groups and foster new groups: The periods of concentration will help to strengthen groups and give them a vehicle for long-range planning of research and advanced education activities. As well it will encourage and empower isolated groups or smaller ones at one university by bringing them into larger collaborative teams.

- Effectively facilitate Canada-US collaborations: The programme will effectively integrate the mathematical sciences community at the U. of Washington into the operations of the institute. It will allow the 12 groups of Canadian and US researchers that are currently organizing the PNW Seminars to develop further their collaborative activities, and allow other groups to launch these types of activities. The programme will also provide researchers with the means to play a leadership role on the national and international level.

- Attract additional support for research: Periods of concentration will provide departments and universities with a mechanism for granting teaching and administrative releases to the scientists involved. Such programmes can also be developed in collaboration with other organizations and institutes, hence multiplying the opportunities.

Upcoming Areas of Concentration: 2003–05

String Theory

Recently, the concentration of research manpower in string theory and closely related fields in the communities associated with PIMS has reached a critical size so that it now has the potential to be a major player in the international research community. The purpose of this Period of Concentration in String Theory is to galvanize this group of researchers into a leading research unit. The members of this group already have a formal structure as a PIMS Collaborative Research Group. The Period of Concentration on String Theory gives this Group the resources to carry on a strong research programme at PIMS, to form a pan-Canadian network with the emerging groups at the University of Toronto and the Perimeter Institute and to communicate and collaborate with other string theory research groups worldwide.

The aim is to incubate significant original research in string theory and those areas of physics and mathematics that are influenced by string theory. The Period of Concentration will contribute by educating researchers on the latest developments in the field, encouraging and enhancing their research activity and providing a ready venue for dissemination of their results.

One essential part of this Period of Concentration consists of hiring Postdoctoral Fellows who help with the organization of events and participate actively in the research themes.

Members of the CRG: B. Campbell, V. Frolov, D. Page, T. Gannon (UA); G. Semenoff, M. Rozali, M. Van Raamsdonk, K. Schleich, D. Witt, M. Choptuik, W. Unruh, J. Bryan, K. Behrend (UBC); M. Walton (Lethbridge); R. Myers, L. Smolin (Perimeter Institute); K. Viswanathan (SFU); A. Peet (Toronto); and A. Karch (Washington).

A Glimpse ahead:

Ashoke Sen (Harish-Chandra Research Institute), PIMS Distinguished Chair, UBC, 2003.

PIMS Distinguished Chairs: The CRG will have another Distinguished Chair in 2003 and two more in 2004. These chairs will visit the group for at least one month and give a minicourse of lectures.

Ehud Schreiber, PIMS Postdoctoral Fellow, UBC, 2003.

PIMS Postdoctoral Fellows: This CRG will include another PDF.

Pacific Northwest Seminars on String Theory: These seminars will continue in 2003 and 2004.

Frontiers of Mathematical Physics Summer School on String Theory, PIMS-UBC, July 14–25, 2003. PIMS, the Asia Pacific Center for Theoretical Physics and the Perimeter Institute are cosponsoring this summer school. This annual summer school will again concentrate on the most recent developments in string theory and related subjects.

Recent Developments in Superstring Theory, 5-day workshop, BIRS, March 15–20, 2003.

New Horizons in String Cosmology, 5-day workshop, BIRS, June 11–16, 2004.

String Field Theory Camp, Focused Research Group, BIRS, July 9–23, 2004.

Scientific Computing

The major goal of this period of concentration is to develop the group's common research programmes and to promote research in scientific computing and increase related interdisciplinary collaboration within the region. In addition, this period of increased activity in scientific computing provides a focus to kickstart and solidly establish SFU's Centre for Scientific Computing (CSC). The majority of the activity of this concentration period will take place at the PIMS sites at SFU, UW and UBC and at BIRS. The organizers are committed to organizing a number of activities which bring in the other PIMS sites as well.

A special feature of this period of concentration is the promotion of a multidisciplinary approach to the subject and the inclusion of important research topics such as the earth and atmospheric sciences.

Members of the CRG: R. Choksi, M. C. Kropinski, T. Möller, D. Muraki, K. Promislow, B. Russell, S. Ruuth, L. Trajkovic, M. Trummer, J. Verner, R. Zahar (SFU); Y. Lin, J. Macki, P. Minev, Y. S. Wong (UA); U. Ascher, O. Dorn, S. Dunbar, I. Frigaard, A. Peirce, B. Seymour, B. Shizgal, J. Varah, M. Ward, B. Wetton, M. Yedlin (UBC); T. Ware, R. Westbrook (UC); D. Olesky, P. van den Driessche (UVic); R. LeVeque, L. Adams, D. Durran, A. Greenbaum, G. Hakim, N. Kutz, R. O'Malley, P. Schmid, J. Burke, C. Bretherton (Washington); R. Bradean, J. Kenna (Ballard); J. Lewis, S. Filipowski, M. Epton (Boeing); and S. Reddy (Quadrus Financial).

A Glimpse ahead:

PIMS Distinguished Chairs: The CRG will have two Distinguished Chairs in 2003 and two more in 2004. These chairs will visit the group for at least one month and give a minicourse of lectures.

PIMS Postdoctoral Fellows: This CRG will include two PDFs in 2003 and two more in 2004.

Pacific Northwest Seminars on Numerical Analysis: These seminars will continue in 2003 and 2004 with approximately five seminars taking place each year.

IAM-CSC-PIMS Senior Undergraduate Math Modelling Workshop, UBC, SFU, February 15-16 2003.

Computational Fuel Cell Dynamics—II, 5-day workshop, BIRS, April 19–24, 2003.

Computational Techniques for Moving Interfaces, 5-day workshop, BIRS, August 23–28, 2003.

Mathematical Foundations of Scientific Visualization, Computer Graphics and Massive Data Exploration, 5-day workshop, BIRS, May 21–26, 2004.

Number Theory

Number theory is one of the oldest, deepest and most vibrant branches of modern mathematics. It centrally incorporates some of the most sophisticated and profound mathematical ideas that have been developed (witness the recent proof of Fermat's Last Theorem) and yet remains broadly useful in many areas of pure and applied mathematics. Indeed, it is remarkable how often number theory comes to bear both in other areas of mathematics and in applications. A notable recent example is cryptography and internet security whose protocols are based on number theoretic problems.

Number theory is particularly strong in Canada with the PIMS Number Theory Group featuring prominently. The PIMS Number Theory Group is large and well distributed in the PIMS Universities. It has a number of prominent senior world-class researchers leading a group of richly talented young mathematicians. The recent influx of new number theorists into several PIMS universities has created an exciting working group.

All areas of Number Theory will be dealt with in this concentration period, including computational and arithmetic aspects.

Members of the CRG: M. Bennett, D. Boyd, B. Casselman, R. Gupta, I. Laba, G. Martin, N. Vatsal (UBC); P. Borwein, I. Chen, S. Choi, P. Lisonek (SFU); R. Guy, J. Jones, R. Mollin, R. Scheidler, H. Williams (UC); R. Greenberg, A. Iovita, N. Koblitz, B. Solomyak (Washington); A. Akbary, O. Kihel (Lethbridge); E. Dobrowolski (College of New Caledonia); M. Klassen (DigiPen Inst of Tech); K. Lauter (Microsoft); and J. Lewis (UA).

A Glimpse ahead:

Jeffrey Vaaler (U. Texas), PIMS Distinguished Chair, SFU and UBC.

PIMS Distinguished Chairs: The CRG will have another Distinguished Chair in 2003 and two more in 2004. These chairs will visit the group for at least one month and give a minicourse of lectures.

PIMS Postdoctoral Fellows: This CRG will include two PDFs in 2003 and two more in 2004.

Pacific Number Theory Northwest Seminars: These seminars will continue in 2003 and 2004 with approximately five taking place each year.

Summer School on Diophantine Number Theory, PIMS-SFU, Summer 2003.

The Many Aspects of Mahler's Measure, 5-day workshop, BIRS, April 26–May 01, 2003.

Current Trends in Arithmetic Geometry and Number Theory, 5-day workshop, BIRS, August 16–21, 2003.

Explicit Methods in Number Theory, 5-day workshop, BIRS, November 12–17, 2004.

Diophantine Approximation and Analytic Number Theory, 5-day workshop, BIRS, November 19–24, 2004.

Mathematical Ecology and Evolution

As the current revolution in biological information progresses, there is a well recognized need for new quantitative approaches and methods to solve problems in ecology. One challenge is to model complex ecological systems—systems which depend upon a myriad of inputs, but often with incomplete details regarding the inputs.

The primary goal of this period of concentration is to develop and strengthen the synergistic interactions between mathematics and ecology in PIMS universities.

Areas of mathematical ecology research at PIMS universities include: nonlinear population dynamics, spatially structured populations, adaptive dynamics, model selection and validation and inverse methods, stochastic models for populations, and scaling laws—from individuals to populations.

Members of the CRG: M. Boyce, T. Hillen, S. Lele, M. Lewis , M. Li, J. Roland, J. So (UA); E. McCauley (UC); F. Brauer, M. Doebeli, N. Heckman, L. Keshet, J. Zidek (UBC); J. Anderson, C. Bergstrom, D. Grunbaum, R. Hilborne, M. Kot (Washington); B. Roitberg (SFU); and P. van den Driessche (UVic).

A Glimpse ahead:

Bryan Grenfell (U. Cambridge), PIMS Distinguished Chair, U. Alberta.

PIMS Distinguished Chairs: The CRG will have another Distinguished Chair in 2003 and two more in 2004. These chairs will visit the group for at least one month and give a minicourse of lectures.

PIMS Postdoctoral Fellows: This CRG will include two PDFs in 2003 and two more in 2004.

PIMS Mathematical Ecology and Biology Seminar Series: This seminar series will continue in 2003 and 2004 with at least six lectures taking place each year. The lectures will take place at U. Alberta and other PIMS sites.

Mathematics of Biological Systems Undergraduate Summer School, U. Alberta, May 2003.

Mathematical Biology: From Molecules to Ecosystems; The Legacy of Lee Segel, 5-day workshop, BIRS, July 5–10, 2003.

Retreat in Mathematical Ecology and Biology, 2-day meeting, BIRS, 2004.

Mathematical Models for Biological Invasions, 5-day workshop, BIRS, November 26–December 1, 2004.

Topological Dynamics

The study of dynamical systems has had a long and distinguished history in mathematics. This study has ranged from applications involving differential equations and information theory, to more theoretical work focusing on systems with topological or algebraic structure. In the past few decades this field has grown dramatically, and completely new directions have opened up.

Due to the diversity of the researchers in this CRG a wide range of topics will be covered including operator algebras, the dynamics of biological systems, and aperiodic order theory.

Members of the CRG: R. Moody, A. Lau, V. Runde, A. Weiss (UA); M. Lamoureux, B. Brenken, I. Nikolaev (UC); D. Lind, C. Hoffman, S. Rohde, B. Solomyak, S. Tuncel, M. Einsiedler (Washington); I. Putnam, J. Phillips, M. Laca, C. Bose, R. Edwards (UVic); K. Schmidt (Vienna); M. Boyle (Maryland); C. Denninger (Muenster); W. Parry (Warwick); and D. Rudolph (Maryland).

A Glimpse ahead:

PIMS Distinguished Chairs: The CRG will have two Distinguished Chairs in 2003 and two more in 2004. These chairs will visit the group for at least one month and give a minicourse of lectures.

PIMS Postdoctoral Fellows: This CRG will include two PDFs in 2003 and two more in 2004.

PIMS Northwest Dynamics Symposium, U. Washington, 2003.

Summer School in Aperiodic Order, U. Victoria, 2004.

Coordinate Methods in Nonselfadjoint Operator Algebras, 5-day worksop, BIRS, December 13–18, 2003.

Aperiodic Order; Dynamical systems, Combinatorics and Operators, 5-day worksop, BIRS, May 28–June 2, 2004.

Upcoming Areas of Concentration: 2004–06

Topology and Knot Theory

The PIMS community has an active group of researchers in topology and related fields. Their research may be roughly divided into two major themes: geometric and algebraic. Among the geometric issues being studied by PIMS topologists are the classification of manifolds (particularly in dimension 3 and 4), group actions on Riemann surfaces, knot theory and its applications, and relating 3-manifold topology to relativity theory. A sample of the contributions in algebraic topology are: application of algebraic topology to robotics, developing equivariant minimal models in homotopy theory, applying subtle algebraic properties of projective spaces and bundles to solve classical problems in quadratic forms and combinatorics. Because of their geographic separation and diversity of interests, this community of scientists is particularly well-served by forming a collaborative research group.

Members of the CRG: G. Peschke, J. Timourian (U. Alberta); J. Bryan, K. Lam, D. Rolfsen, L. Scull, D. Sjerve (UBC); K. Varadarajan, P. Zvengrowski (U. Calgary); E. Babson, E. Devinatz, M. Freedman, S. Mitchell, J. Palmieri, J. Segal (U. Washington).

A Glimpse ahead:

PIMS Distinguished Chairs: The CRG will have two Distinguished Chairs in 2004. One will be based at UBC and the other at U. Calgary. These chairs will visit the group for at least one month and give a minicourse of lectures.

PIMS Postdoctoral Fellows: This CRG will include two PDFs in 2004.

"Knots at PIMS" Miniprogramme, UBC, 2 weeks, 2004.

MSRI-PIMS Summer Graduate Course, UBC, 2 weeks, 2004.

Topology of Manifolds and Homotopy Theory, 5-day workshop, BIRS, March 19–24, 2004.

Knots and their Manifold Stories, 5-day workshop, BIRS, May 7–12, 2004.

Braid Groups and Applications, 5-day workshop, BIRS, October 15–20, 2004.

Cascade Topology Seminar, 2-day meeting, BIRS, 2004.

Probability and Statistical Mechanics

Much of the original motivation for the study of spatially interactive stochastic systems came from stochastic models in statistical physics. An intensive area of recent research centers around the idea that complex local dynamics can lead to a small number of well-understood continuum models upon space-time rescaling. When the underlying system is at or near criticality the limit invariably seems to be closely related to super-Brownian motion.

Other local interactions arising in models for competing species, predator-prey systems or symbiotic branching lead to more complex stochastic models which behave locally like superprocesses but with branching, migration and drift coefficients which depend on the current state of the system. Two challenging and related topics are therefore:

I. The development of a general theory of interactive superprocesses and in particular methods to characterize these processes and study their properties.

II. The use of such models in mathematical ecology and evolution.

Members of the CRG: D. Brydges, J. Feldman, G. Slade, M. Barlow, E. Perkins, J. Walsh (UBC); B. Schmuland, M. Kouritzin (U. Alberta); C. Burdzy, Z.-Q. Chen, B. Erickson, S. Rohde (U. Washinton); J. Chayes, C. Borgs, O. Schramm, D. Wilson (Microsoft Research); C. Soteros, R. Srinivasan (U. Saskatchewan); R. van der Hofstad (Eurandon); Don Dawson (McGill).

A Glimpse ahead:

PIMS Distinguished Chairs: The CRG will have two Distinguished Chairs in 2004. These chairs will visit the group for at least one month and give a mini-course of lectures.

PIMS Postdoctoral Fellows: This CRG will include two PDFs in 2004.

Pacific Northwest Statistics Meeting: These seminars will be part of this CRG in 2004 with at least two seminars taking place.

PIMS Summer School in Loewner Evolution, UBC, 2004.

Seminar on Stochastic Processes, 2004.

Statistical Mechanics of Polymer Models, 5-day workshop, BIRS, May 10–15, 2003.

Stochastic Partial Differential Equations, 5-day workshop, BIRS, September 27–October 2, 2003.

Analytic and Geometric Aspects of Stochastic Processes, 5-day workshop, BIRS, April 9–14, 2004.