Isaac Newton Institute for Mathematical Sciences

Newsletter

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Nobel Prize winner at INI

As part of *Monitoring Systemic Risk: Data, Models and Metrics*, the second workshop on the INI programme *Systemic Risk: Mathematical Modelling and Interdisciplinary Approaches*, Nobel Prize-winning economist **Professor Robert Engle** gave a lecture on *The Prospects for Global Financial Stability*. In his talk he discussed how the failure of a single institution to meet its financial obligations can have serious consequences for the entire economy. He introduced the term SRisk, that is the amount of capital that a financial institution would have to raise in order to function normally through another financial crisis, and discussed the merit of a "living will" for companies to ensure, in future, that they would not need rescuing.

Professor Engle is Michael Armellino Professor of Finance at the New York University Stern School of Business. He was awarded the 2003 Nobel Prize in Economics, which he shared with Professor Clive WJ Granger (University of California, San Diego) for his work developing new statistical models of volatility that captured the tendency of stock prices and other financial variables to move between high volatility and low volatility periods. He is also an avid, and accomplished, ice dancer.

The seminar is available to download or view online at **www.newton.ac.uk/seminar/20140926113012151**

New Chair of Scientific Steering Committee

This year INI welcomes **Professor Valerie Isham**, Professor of Probability and Statistics at UCL and lately President of the Royal Statistical Society, as the first female chair of the Scientific Steering Committee. Professor Isham is no stranger to INI, having been an organiser of programmes, but this is her first involvement on the other side of the fence. Details of the role of the SSC can be found at **www.newton.ac.uk/about/governance/scientific-steering-committee**

Three parallel programmes

To deal with the growing number of strong proposals, INI has decided to organise additional programmes in parallel: three programmes: *Data Anonymisation and Privacy*, *Probability and Statistics in Forensic Sciences*, and *Theoretical Foundations of Statistical Networks*, are planned simultaneously from July to December 2016. The synergies between these programmes and their relevance to the highly topical theme of Big Data, mean that the benefits are not only practical, but significant both scientifically and to a wider society.

Current and recent scientific programmes update

Understanding Microbial Communities Function, Structure and Dynamics (Aug–Dec 2014)

On now!

The programme started in mid-August and fully kicked-off with a public seminar on 8 September by Distinguished Rothschild Visiting Professor **Stanislas Leibler** (Rockefeller University) followed by a 3-day workshop in September, the first in a series of three. Over the course of the 4-month programme INI will host over 120 scientists with a diverse set of backgrounds in mathematics, physics, microbiology, ecology, economics, and computer science. To facilitate the interaction of these scientists, there are weekly informal seminars and daily socials, in addition to the three workshops. This is now bearing fruit, with many of the participants developing collaborations and interactions that are expected to last long beyond the time-frame of the programme.

Systemic Risk: Mathematical Modelling and Interdisciplinary Approaches (Aug–Dec 2014)

On now!

The programme has thus far included several well attended workshops: *Systemic Risk: Models and Mechanisms* in August; *Monitoring Systemic Risk: Data, Models and Metrics* in September; and a mini workshop *Kinetic Models and Mean Field Games in Finance* in October which explored the mathematical modeling of the large scale behaviour and stability of economic systems of interacting agents. An *Open for Business* event organised by the Turing Gateway to Mathematics was held at the Bank of England on 13 October. It highlighted recent research contributions and regulatory initiatives, with an emphasis on the role played by network models in understanding systemic risk. Participants said: "*Best conference on systemic risk and financial networks that I have attended"* and *"The organisers were able to get almost all of the best researchers in the world on that topic*".

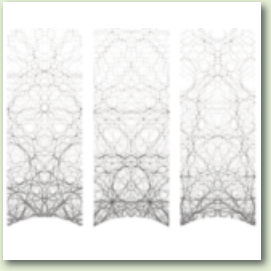
Quantum Control Engineering: Mathematical Principles and Applications (Jul–Aug 2014)

The programme brought together experimentalists and theoreticians working in quantum engineering to identify the core mathematical issues and challenges ahead including quantum filtering and the application to quantum measurement and metrology, quantum open-loop schemes, quantum feedback networks and the design of quantum controllers, quantum statistics and estimation and the connection with filtering and control, quantum information processing and its relevance to quantum control and error correction. The programme had a number of introductory seminars in the underpinning concepts of quantum open systems modelling, and mathematical control theory, together with a workshop and a number of round table discussions focussing on future directions and their exploitation.

Theory of Water Waves (Jul–Aug 2014)

Water waves are a dramatic, potentially dangerous, yet beautiful phenomena that is omnipresent and impacts every aspect of life on the planet. From a mathematical viewpoint water waves pose rich challenges. The solutions to the equations that describe fluid motion are elusive and whether they even exist in the most general case is one of the most difficult unanswered questions in mathematics. In light of recent developments the questions are now clearer, new methodologies are emerging and computational approaches are becoming much more sophisticated. This programme brought together experts on water waves with sessions held on: initial-value problem (IVP); the existence and classification of waves; the linear and nonlinear stability of waves; dynamical systems and geometric techniques; and beyond irrotational flow.

Interactions between Dynamics of Group Actions and Number Theory (Jun–Jul 2014)



In the last decade there have been several important breakthroughs in number theory and diophantine geometry, where progress on long-standing open problems has been achieved by utilising ideas originated in the theory of dynamical systems on homogeneous spaces. Dynamical systems techniques are applicable to a wide range of number-theoretic objects that have many symmetries. The aim of this programme was to bring together researchers working in number theory and homogeneous dynamics to discuss the recent developments and open problems that lie at the crossroads of these fields and to encourage more interaction among people working in these diverse areas.

For links to these programmes and further details on science at INI see
www.newton.ac.uk/science/programmes

VIP VISITORS

Ingrid Daubechies, chair of the International Mathematical Union (IMU - the non-governmental body for the promotion of co-operation in mathematics world wide) visited the Institute in September to speak to the Director who sits on the IMU Executive Committee. Ingrid is one of the world's most distinguished mathematicians and will deliver a plenary lecture in Cambridge next Easter.

Walter Craig, Director of the Fields Institute in Toronto, came to INI in July to discuss the possibility of collaboration on scientific programming and possibly the sharing of AV technologies, in particular for live streaming and archiving of seminars and lectures.

A spectacle in the seminar room!

On 23 June 2014, **Ray Goldstein** (University of Cambridge) gave a Plenary Lecture at INI entitled *How a Volvox embryo turns itself inside out* as part of the *International Conference on Free Boundary Problems: Theory and Applications*.

He explained how during the growth of daughter colonies of the multicellular alga Volvox the spherical embryos must turn themselves inside out to complete their development. This process of 'inversion' has many features in common with gastrulation, the process by which an initially convex spherical shell of animal cells develops an invagination, leading to the formation of a gastric system. In both cases it is understood that cell shape changes play a major role in guiding the process, but quantification of the dynamics, and formulation of a mathematical description of the process, have been lacking.

In his talk, Professor Goldstein described advances made by his group on both fronts. Using the technique of SPIM (selective plane illumination microscopy) the group have obtained the first real-time three-dimensional time-lapse movies of inversion in Volvox, using several species displaying distinct morphological events.

The talk is available to watch at **www.newton.ac.uk/seminar/20140623100010451**

The audience were invited to wear 3D glasses to take full advantage of the time-lapse movie

Delegations visit INI to learn the secrets of success

During the summer INI welcomed delegates from two institutions who visited to find out what it takes to run a successful scientific research institute.

The Agency for Science, Technology and Research (A*STAR), Singapore, visited INI to understand and study governance structures, resource frameworks and scientific programmes with particular regard to how these support and facilitate interdisciplinary research. The delegates, led by Chief Scientist **Professor Sir David Lane** and Managing Director **Professor Raj Thampuran**, met with organisers and participants of the programmes on *Free Boundary and Related Topics* and *Advanced Monte Carlo Methods for Complex Inference Problems.* They met with the INI Senior Management Team before being given a tour of the facilities by Institute Administrator **Christine West**.

A group of three visitors from The Advanced Institute for Materials Research at Tohoku University, Japan, came to INI with a particular remit to examine the internal structures and administrative functions including finance, governance and housing. The delegation consisted of **Hiroshi Oikawa**, Assistant Chief International Relations Unit, **Koki Yamada**, Assistant Administrative Director and **Hirotaka Hirayama**, Chief, Property Management Section.

New Website goes live

Over the summer, INI has launched a new website with improved navigation, additional content and a fresh modern look and feel. Development will continue on the site as more content is added, so please have a look and let us know what you think. Comments can be sent by clicking on the 'Send Feedback' button at the bottom of each page. See **www.newton.ac.uk.**

Bequest to INI

Dr Graham H Norton (School of Mathematics and Physics, University of Queensland, Brisbane) has made a significant bequest to INI for the support of up to ten visiting fellows per year. INI wishes Dr Norton a long and fruitful life and wishes to express its gratitude for his extraordinary generosity.

If you are interested in supporting the INI, full details are on the web: www.newton.ac.uk/support.

If you would like to discuss any aspect of supporting INI, please do not hesitate to contact the Director, John Toland.
tel: +44(0)1223 335980,
email: director@newton.ac.uk

Mathematical Poetry

A Poet in Residence at INI

INI is delighted to welcome one of Australia's leading literary figures to be INI *Poet in Residence* beginning a two-year term beginning this autumn. **Professor John Kinsella** is one of Australia's leading literary figures and is a poet, novelist, critic and essayist who has published over fifty books. He is a Professorial Research Fellow at the University of Western Australia, Professor of Sustainability and Literature at Curtin University and an Extraordinary Fellow at Churchill College, Cambridge.

John said about the residency *"The Isaac Newton Institute is a unique environment in which I will be able to come into contact with a wide array of mathematical practices discussed and explored in a collaborative environment. A poet thrives on exposure to new ideas, and I expect to be challenged and have new doors of perception opened on a consistent basis."*

Updates on John's work at INI will be posted on the official webpage at **www.newton.ac.uk/about/art-artefacts/poet-in-residence**.

Upcoming highlights

24 November 2014: 16:00-17:00 ***Systemic Risk in Banking Ecosystems***
INI has deliberately scheduled concurrently the programmes on systemic risk and understanding microbial communities as they have shared interests, and indeed shared participants. On Monday 24th November former President of the Royal Society and Chief Scientific Adviser to the Government, **Professor Bob May**, aka The Right Honourable The Lord May of Oxford and a participant on both programmes, will give a talk on systemic risk in banking ecosystems. He observes that in the run-up to the financial crisis there emerged an increasingly elaborate set of financial instruments intended to optimize with minimal risk returns to individual institutions. Unfortunately the possible effects on the stability of the system as a whole was not considered.

Drawing analogies with the dynamics of ecological food webs and with networks within which infectious diseases spread, Professor May will explore the interplay between complexity and stability in deliberately simplified models of financial networks. He concludes that it took a generation for ecological models to adapt and that the same may be true of banking and finance.

4 December 2014: ***Open for Business: Understanding Microbial Communities - Developing the Potential***
This half day event will highlight industrial, medical and academic approaches and interests in the area of microbial communities and will investigate how the various stakeholders can work together collaboratively in the future. It will be of interest to individuals from a number of areas such as biology, medical/health, biotechnology, environment and energy. For full details and to register to attend please visit **www.turing-gateway.cam.ac.uk/umc_dec2014**.

10 December 2014: ***Maths and Public Policy***
The Turing Gateway to Mathematics is delivering a programme of work and associated events that are sponsored by EPSRC, that will bring together mathematical sciences researchers and policy makers to explore modelling and problem solving. This will include a launch event on 10th December 2014 at the Royal Society, followed by workshops in January and March 2015 that will engage stakeholders to help disseminate information and encourage a greater level of activity across the mathematics for public policy landscape. Full details and registration information are available at **www.turing-gateway.cam.ac.uk/mpp_dec2014.shtml**.