

New Director

On 1st October, Prof David Abrahams will become the Director of the Isaac Newton Institute for Mathematical Sciences, and NM Rothschild and Sons Professor of Mathematics when he succeeds Prof John Toland who has served as Director since 2011.

John stated “With his distinguished research record and wide experience working with learned societies, research councils, industrial partners, ICMS and the REF, and with colleagues from across the whole spectrum of the mathematical sciences, the recruitment of David Abrahams to the Directorship must be regarded as a coup. I look forward to working with him during the handover, starting now.”

David is currently the Beyer Professor of Applied Mathematics at the University of Manchester. He is also Scientific Director of the International Centre for Mathematical Sciences (ICMS), Edinburgh, the principal tasks of which are to organise a programme of workshops that represent the current state-of-the-art across the breadth of the subject.

“ I look forward to working with him during the handover, starting now.”

David Abrahams looks forward to the new challenges ahead



“ In just 25 years, the Isaac Newton institute (INI) has grown to become one of the principal centres in the world for the support, development and communication of novel ideas in mathematics and its applications. Its underpinning role for UK mathematical sciences was clearly recognised in last year's Infrastructure Review carried out by the Engineering and Physical Sciences Research Council, and this is endorsed by feedback from the many thousands of short- and long-term visitors who pass through its doors annually.

As to my role over the next five years, I shall endeavour to continue to run Programmes of the highest academic quality and relevance in mathematics and the applications of mathematics. The demand for such meetings has grown steadily over recent years, reflecting the

exciting developments across the whole of the mathematical sciences community, and the plethora of interdisciplinary opportunities offered by recent activities within cognate disciplines. I shall therefore actively seek a greater level of activity at INI through the widening of the range of funding partners. The Turing Gateway to Mathematics (TGM) is INI's arm for knowledge exchange and has been remarkably successful in just a few years at building links between the mathematical sciences community and 'users' of mathematics. Again, I shall seek to grow significantly the role that TGM plays for the whole UK community

As the Isaac Newton Institute exists to support the whole of the UK community, it is my responsibility to ensure that its activities are as accessible as possible to all the best researchers from across the whole of Great Britain, Northern Ireland and beyond.”

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Some of the activities at INI

Current Programmes Update

Stochastic Dynamical Systems in Biology: Numerical Methods and Applications (Jan–June 2016)



Stochastic dynamical systems, systems that evolve stepwise over time according to a random probability distribution, have been used during the last decade to model many biological processes, including gene regulation, molecular signalling, cell division, molecular transport and cell motility. However, full analysis of these models relies upon the solution of a number of challenging mathematical problems at the interface of stochastic processes, numerical analysis and differential equations.

Researchers on this programme made significant progress on all eight of the open problems posed in the opening workshop. One such problem, the integration of data and models towards their successful parametrisation, was addressed by Rothschild Professor Yannis Kevrekidis (Princeton) in his lecture *Mathematics for Data-Driven Modelling – The Science of Crystal Balls*.



Participants in the Stochastic Dynamical Systems in Biology: Numerical Methods and Applications programme

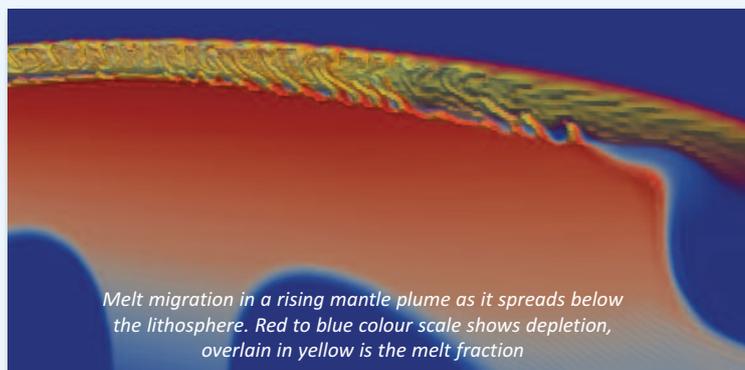
His fascinating talk described the building of algorithms that “jump directly” from data to the analysis of the model in order to make predictions about behaviour.

Sarah Harris (Leeds) gave a well received public lecture at the Satellite Workshop in Edinburgh. Entitled *Physics meets Biology in “The Garden of Earthly Delights”*, she used analogies between modern computational modelling of molecular-based processes and the famous painting by Netherlandish painter Hieronymus Bosch (1450 – 1516) to explain how the interplay between order and chaos at the molecular level gives rise to the complex behaviour of biomolecules inside living cells.



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Melt in the Mantle (Feb-June 2016)



Melt migration in a rising mantle plume as it spreads below the lithosphere. Red to blue colour scale shows depletion, overlain in yellow is the melt fraction

Deep beneath our feet lies the Earth's mantle, a 3000 km thick layer of silicate rock. While appearing completely rigid on human timescales, on geological (million-year) timescales the mantle slowly convects, transporting heat from the Earth's deep interior to the surface. Mantle convection manifests itself in the movement of the Earth's tectonic plates and volcanism at the surface. Much like numerical models are used to model convection in the Earth's atmosphere to predict the weather, scientists develop numerical models of convection in the Earth's mantle to better understand the Earth's geological history.

Researchers at INI have just released a new code for simulating convection in the Earth's mantle. This code: Advanced Solver for Problems in Earth's ConvecTion, (ASPECT <https://aspect.dealii.org/>) uses the latest numerical methods that are at the forefront of current research. One crucial new addition to the ASPECT software, that is being developed as part of the INI "Melt in the Mantle" programme, is to model the migration to the surface of the molten mantle. This crucial bit of physics is what ultimately leads to volcanism at the Earth's surface, and only recent theoretical developments have allowed this physics to be included in global simulations of mantle convection.

<https://www.newton.ac.uk/seminar/20160519141515302>.



Programme participants discuss their latest findings

For further details on all INI scientific programmes please visit www.newton.ac.uk/science/programmes

Charles Simonyi - The Practicalities of Orbital Space Travel

Dr Charles Simonyi, the Hungarian-born former Microsoft software developer, is a high-tech pioneer and philanthropist as well as a space traveller. His contribution to computer science is immense: for 20 years and with 11 patents to his name, as head of Microsoft's Application Software group he was responsible for the development of its flagship products including Microsoft Word and Excel. But he was invited to the Institute to give a public lecture about his hobby, his passion: space travel.

Simonyi's lifelong interest in space exploration started with a contest he won as a teenager that gave him a chance to meet Soviet astronauts. In his talk, part of the 2016 Cambridge Science Festival, he explained to a gripped audience how his fascination with science and space led him to become the fifth space tourist and the first ever tourist to fly twice. He described how he spent six months before his first take-off training alongside cosmonauts in Moscow where he exercised, learned about spaceflight and survival, and studied Russian. He was examined and observed by nearly 100 doctors and had to pass dozens of medical tests. While on the International Space Station, Simonyi made excellent use of his skills as a licensed amateur radio operator, making ham radio contact with a number of schools so that the children could ask him about the experience.



Charles Simonyi prepares for space

Feedback from attendees at the INI talk showed that Dr Simonyi certainly achieved his aim to inspire young people to a heightened interest in science, maths, and space. One attendee wrote: "We've been attending the Cambridge Science Festival for more than 15 years and always find it enjoyable. This talk by Charles Simonyi is one of the most engaging I've ever attended."

Spreading the Word

As part of its mission to address the gender imbalance in mathematics, INI supports national events for female mathematicians, and INI Deputy Director Christie Marr Chaired the session for Early Career Researchers at the LMS Women in Mathematics Day held Microsoft Research Cambridge in April.

Throughout this academic year, a number of INI's female programme participants have given talks to the Emmy Noether Society. Named after the eminent algebraist, this University of Cambridge student society was founded to support and promote women studying the mathematical sciences. In February, Christie spoke at the annual joint meeting of the Emmy Noether Society and an equivalent group at Oxford University, the Mirzikhani Society, named after Maryam Mirzakhani, the first and only woman to win the Fields Medal. The talks included a blend of scientific content and personal anecdotes about career paths and opportunities available.



As part of its "Talks Elsewhere" scheme, INI welcomes requests for a speaker from Women in Mathematics societies across the UK. INI will cover the travel expenses for any long-term INI programme participants from overseas formally invited to speak to such a group although the host institution is expected to cover any accommodation and incidental costs. To request such a speaker please contact: deputy-director@newton.ac.uk

John Horton Conway - Genius at Play



John Conway in conversation with Siobhan Roberts

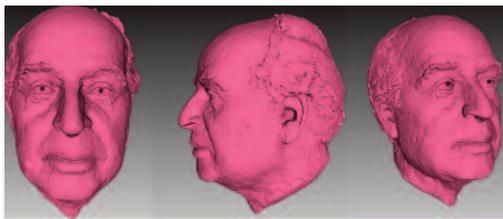
May 2016 saw **John Horton Conway** in conversation with Siobhan Roberts, the author of *Genius at Play, The Curious Mind of John Horton Conway at the Institute*.

Together they discussed her trials and tribulations of writing this biography - the genesis of the project, the process over nearly a decade, and the challenge of looking back at the expanse of his mathematical career.

During his time at Cambridge as a lecturer and fellow of Sidney Sussex College, 1970 saw him discovering the Game of Life (with which he currently maintains a love/hate relationship), as well as the surreal numbers (of which he is proudest), and Conway groups. As a great story teller, he entertained the audience with his playful tales about his life and how engaging with his autobiographer was such a trial.

John joked that in 1986 he moved from Cambridge (where he was famous for his incessant game playing in the common room) to Princeton (where he became known for the same).

Two Heads Better than One



Scans of the bust of Sir Michael Atiyah prior to the making a 3D copy

As INI prepares to say farewell to current Director John Toland and to welcome David Abrahams as its 6th Director it seems fitting to reflect on the series of eminent mathematicians that have led the Institute, the first being Sir Michael Atiyah OM FRS FRSE FMedSci FEng who was Director from 1991 - 1996. In fact Sir Michael, or rather a bust of Sir Michael donated to the Institute by its architects Duncan Annand and Jeremy Mustoe and sculpted by David Annand, Duncan's brother, has kept a watchful eye on the Institute throughout.

Recently, Sir Michael's son David commissioned a copy of the bust of his father to be made and donated to the Royal Society. This copy was done by Ben Martin using 3-D printing following a scan of the original. It is now in situ on the Nash Staircase outside the Present's Suite at the Royal Society in the company of Paul Dirac, Neils Bohr and Dorothy Hodgson.

James Rothman Lecture

In April 2016 James Rothman, Professor of Biomedical Sciences at Yale University visited INI and had meetings with many participants on the Stochastic Dynamical Systems in Biology (SDB) programme. Awarded the Nobel prize in Physiology or Medicine together with Randy Schekman and Thomas C. Südhof "for their discoveries of machinery regulating vesicle traffic, a major transport system in our cells", he reported that he greatly enjoyed his visit and thought that the INI building was "very impressive" and "designed for interaction".

During his visit Prof Rothman gave a talk on "*The Structural Biochemical Mechanism of Synaptic Neurotransmission in the Brain*", observing that neurotransmitters stored in synaptic vesicles at nerve endings are synchronously released in less than one millisecond after the action potential arrives and calcium ions secondarily enter the pre-synaptic cytoplasm (this is by far the fastest membrane fusion mechanism in nature, and is required for all thought and action) and yet neurotransmission relies on the same SNAREpin zipper mechanism that powers more leisurely and less coherent hormone release and vesicle trafficking within the cell. He addressed in his talk the question of how the same molecular machine can provide for actions on such differing time scales, varying by up to a factor of 10,000. He explained that the calcium sensor, Synaptotagmin, assembles into rings that



Professor James Rothman

can impede fusion until they disassemble upon binding calcium ions. The rod-like Complexin molecule can organize two layers of SNAREpins into zig-zag arrays while at the same time impeding completion of zippering.

Prof Rothman praised the efforts of the SDB programme highlighting the importance of this research area because so many fields, not least synaptic transmission the topic of his talk, are increasingly understood at a biochemical and biophysical level.

It is with sadness that we report the passing of Wendy Abbott who was a member of INI's staff from May 1996 until June 2004, most recently as Administrative Assistant. We send our condolences to her family from all the staff members who remember Wendy.



Upcoming Events

30 August-2 September 2016

WORKSHOP The Nature of Questions Arising in Court that can be Addressed via Probability and Statistical Methods: seeks to understand the scope, limitations, and barriers of using statistics and probability in court. Full details www.newton.ac.uk/event/fosw01

12-16 September 2016

WORKSHOP Data Linkage: Techniques, Challenges and Applications: The objective of this second workshop on data linkage is to set an agenda of the big challenges in the area. Full details <https://www.newton.ac.uk/event/dlaw02>

26-29 September 2016

WORKSHOP Bayesian Networks and Argumentation in Evidence Analysis: This workshop will be devoted to investigating the use of Bayesian networks in evidence analysis models for actual criminal cases ranging from the simplest (with very little evidence) to more complex ones. Full details www.newton.ac.uk/event/fosw02

A full listing of all scientific events at INI is available on the web at www.newton.ac.uk/events

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