



Newsletter

UK Launch of Mathematics of Planet Earth 2013

On 10 December 2012 the Isaac Newton Institute hosted the UK launch of *Mathematics of Planet Earth 2013* (MPE2013) which is a worldwide initiative endorsed by UNESCO that will run throughout this year. The goals of MPE2013 are: to formulate the most urgent planetary problems that mathematics can address; to bring together world-class researchers to find solutions to these problems; and to engage the public in a dialogue about the significance of these problems.

The launch at the Institute, *The Mathematics of Extreme Climatic Events*, included an afternoon of talks by leading mathematicians, scientists and policy makers. They discussed how mathematical models and statistical analysis help us to predict, manage impact, exploit and communicate about nature's climatic extremes, and how these help Government to anticipate health-related consequences of natural catastrophic events and insurance companies to assess the financial risk of such occurrences.



David Spiegelhalter

Speakers included **Professor Lord Julian Hunt** (Emeritus Prof of Climate Modeling, UCL, Hon Prof at DAMTP and a member of the House of Lords), **Professor Virginia Murray** (Head of Extreme Events and Health Protection, HPA), **Dr Filimon Gournaris** (Securis Investments), **Professor Rod Rainey** (Head of Technology, Floating

Structures, Atkins Oil & Gas) and **Professor David Spiegelhalter** (Winton Professor for the Public Understanding of Risk, University of Cambridge).

All of the talks and the panel discussion session can be viewed or downloaded from the web at www.newton.ac.uk/programmes/INI/iniw92p.html

Grant application successful

In September 2012, the Institute made an agreed proposal to the research councils collectively for funding for 4 years from 2014. The proposal was collectively scored 35/36 by six referees and an announcement that it will be fully funded was made at the end of March 2013.



In this issue...

- Current Programmes update
- Party Hard! The maths of connections
- Turing Gateway to Mathematics initiative
- EPSRC grant update
- Remote participation
- Upcoming events and activities

Current scientific programmes update

Grothendieck–Teichmüller Groups, Deformation and Operads (Jan–Apr 2013)



The main goal of this programme is to bring together people working on the four different, but close, fields of Grothendieck–Teichmüller groups, deformation theory, operads, and multiple zeta values. These fields lie at the cross-roads of algebra, geometry, topology, number theory and mathematical physics and share common constructions and results, which are far from being all very well understood. The programme brings together the best international experts in these fields.

In the first half of the programme there were four short courses aimed at students on each of the main topics. The courses were cross-disciplinary in nature and brought the methods and theorems from one field of study to the attention of those in another.

Judging by the various passionate conversations that each course prompted, this was a great success. These courses have been enriched by three more advanced mini-courses, over two weeks, given by three key participants. This gave them enough time to explain and develop their more recent and interesting results. Further details on these courses is available at www.newton.ac.uk/programmes/GDO/lectureseries.html.

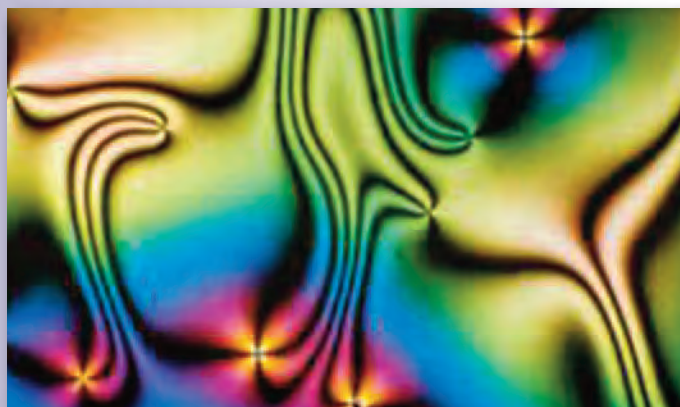
The second phase of the programme is now underway with an international focus on recently discovered advanced theorems. Since the two pairs of fields deformation theory/operads, on the one hand, and Grothendieck–Teichmüller groups/multiple zeta values, on the other hand, have interacted for more than ten years, it makes sense to have a first workshop on the two first topics and a second workshop on the two last topics. Moreover, to spread these ideas across the UK, there has been a Satellite Meeting in Oxford during April, organised with support from the Clay Mathematics Institute.



The Mathematics of Liquid Crystals (Jan–Jul 2013)

This programme has brought together a wide range of participants from across the mathematical sciences including bifurcation and stability analysts, PDE practitioners, theoretical physicists, computational specialists. New collaborations have sprung up across the disciplines to work on new problems and revisit some notorious older problems that bedevil liquid crystals in new ways. The programme started with a most entertaining historical overview by Tim Sluckin based on his successful book that showed there was much to learn from our predecessors, including from their foibles!

The first workshop in January, *Symmetry, Bifurcation and Order Parameters* heard of instabilities in the flow of liquid crystal polymers which have been stimulating for bifurcators, pattern formation studies, PDEs and have led to new collaborations and results. The programme has continued with regular and informal seminars, discussions groups, short courses, and of course incessant discussion at blackboards and around coffee and the problems aired have been those underpinning the subject. The second workshop, *Analytical and Computational Paths from Molecular Foundations to Continuum Descriptions*, took these fundamentals all the way from mathematical existence and convergence questions to device physics. The third workshop, *Nonlinear Analysis of Continuum Theories*, was held in Oxford at the beginning of April and discussed recent advances in the nonlinear analysis of both static and dynamic models of liquid crystals.



The final months of the programme will include an opportunity for research students and postdoctoral researchers in theoretical aspects of liquid crystals to attend a workshop where there will be the opportunity for all participants to give a short presentation and to have individual discussion on their research with a senior researcher attending the programme. During June there will be a workshop on *Liquid Crystal Defects and their Geometry* which will have considerable synergy with a parallel workshop that covers the dynamics of suspensions, gels, cells and tissue. Joint sessions will be held on active nematics, and other topics of mutual interest to the two communities.

This year sees the launch of the *Turing Gateway to Mathematics*, an initiative to widen access to non-mathematical scientists, offering mathematical insights into their research and inviting them to raise questions that may prove challenging to the mathematical community. The initiative is so named because of Turing's wide influence across a broad front, and is being developed as a channel for the interchange of knowledge and ideas between academics and users of mathematics.

The first Gateway events took place between 25–28 March and consisted of a series of one-day sessions on: Industrial Statistics; Policy Support in Communities and Local Government; Stochastic and Statistical Models at the Interface of Modern Industry and the Mathematical Sciences; Mathematics of Liquid Crystals: Industrially Inspired Problems (see below); and Mathematics of Financial Risk Management.

The current scientific programme *Mathematics of Liquid Crystals* (see opposite) has had spectacular application to device physics and technology, and therefore it was an obvious area to convene a *Turing Gateway to Mathematics* meeting. The aim was to encourage researchers from industry to air their current problems so that in a workshop environment they could be taken up by mathematical practitioners. A half-day meeting was held with five case studies being presented with discussions and suggestions after each one followed by a brainstorming session that attempted to distill problems from the material that had been presented. Colleagues from industry led the meeting and acted as reporters. Further details on all Gateway activities are available at www.newton.ac.uk/programmes/TGM/.



The Institute welcomes Jane Leeks into the brand new post of Knowledge Transfer Facilitator. Jane has special responsibility for managing the Gateway events and for developing contacts with non-mathematical academics, with industry and business. Contact Jane via email at j.leeks@newton.ac.uk or by telephone 01223 765733.

Institute Director awarded Sylvester Medal

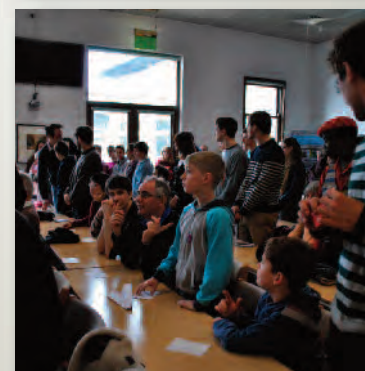


Professor John Toland, has been awarded the 2012 Sylvester Medal for "his original theorems and remarkable discoveries in nonlinear partial differential equations, including applications to water waves". The Sylvester Medal is awarded by the Royal Society biennially for the encouragement of mathematical research. The Medal was presented by Professor John Pethica, Physical Secretary and Vice-President of the Royal Society.

Party hard! The maths of connections

How many guests need to come to a party, to guarantee that at least five of them either all know each other or are mutual strangers?

This was one of the questions posed by Dr Colva Roney-Dougal from the University of St Andrews during her talk at the Institute as part of the Cambridge Science Festival. During the talk Colva explained some unexpected applications of the maths behind this still-unsolved problem, from modelling flu epidemics to galaxy formation. In order to accommodate the large number of people who wished to attend the talk, a plasma screen was set up in the Institute foyer so that people could watch a live broadcast. Also attending was a group of 15 students from St Michaels Catholic Grammar School in Barnet who were given a tour of the Institute before the talk by Deputy Director, Dr Christie Marr. Many positive comments were received from the audience after the talk from a delighted audience. The video recording of the talk can be viewed or downloaded from the Institute website at <http://sms.cam.ac.uk/media/1446005>.



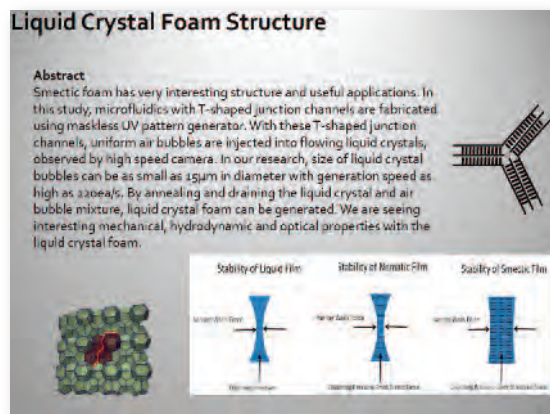
Pictures clockwise from top left. Colva explaining the possible connections between party guests during her talk. Students from St Michaels Catholic Grammar School after their tour of the Institute. The audience help to show percolation theory in action.

Remote participation?...no problem

The Institute has been looking for different ways of widening participation from mathematical scientists who may not be able to visit in person by holding remote seminars by video link. On 4 April Professor Yuka Tabe from Waseda University, Tokyo gave an outstanding talk by video link as part of the programme *Mathematics of Liquid Crystals*. After a brief description of Waseda University and the introduction of her research group, she described her work on orientational motion and flow due to vapour transport through membranes of chiral liquid crystals. Her research results generated a great deal of interest; as did her answers to questions from the audience, both during and after her talk. Although her observations are consistent with general symmetry considerations, detailed modelling of the dynamics and its time evolution presents a challenge to the community. This remote seminar was an example of how a colleague, unable to attend, was able to contribute greatly to the scope of the programme. The meeting participants discussed her inspirational work long after they had said farewell to her by video link. It is hoped that further remote seminars and video conferences will take place at the Institute in the future.



Shuoqia Shi from the Liquid Crystal Institute at Kent State during her remote poster session presentation together with one of her slides



Another innovation for the Institute and the *Mathematics of Liquid Crystals* programme was a remote poster sessions that concentrated on student presentations so that young people could be connected with the activities of the programme. On 22 March 2013 ten groups from the Liquid Crystal Institute at Kent State University, Ohio, each prepared posters in the form of ten slide power point presentations converted to pdf, and accompanied it by a one-minute introductory video. The posters were viewed in advance from participant offices which had a poster, laptop with an active video link to the student presenter. More than one office could connect to the discussion and there was

often more than one student at the other end. The students had ample time to present their work and could easily refer to material by the numbered slide on the poster. This system allowed for students to be questioned closely and participants were able to select several posters for discussion that most closely corresponded to their own interests. Such sessions will be a fruitful way for the Institute to extend its reach, both geographically and to younger researchers. It was an interesting group experience for all concerned at the Institute, with attendees circulating between offices, or engaging in discussion between offices by video link and having the students participate.

Upcoming events and activities

The Mathematics of Liquid Crystals: Young Researchers Meeting

21–22 May 2013

Applications are invited from research students and postdoctoral researchers in theoretical aspects of liquid crystals to attend this meeting, during which there will be the opportunity for all participants to give a short presentation and to have individual discussion on their research with a senior researcher attending the programme.

www.newton.ac.uk/programmes/MLC/mlcw05.shtml

Open for Business Event: Polynomial Optimisation

8 August 2013

This *Open for Business meeting* is held in collaboration with the Knowledge Transfer Network for Industrial Mathematics. The purpose of the meeting is to give businesses and other organisations an opportunity to interact with international research leaders who have expertise in the modelling and solution of hard discrete and/or non-linear optimisation problems. It will consist of surveys from academics on the state-of-the-art in optimisation, presentations from non-academic delegates, and a panel discussion.

www.newton.ac.uk/ofb/ofb015/

For all scientific events at the Institute please visit www.newton.ac.uk/events.

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