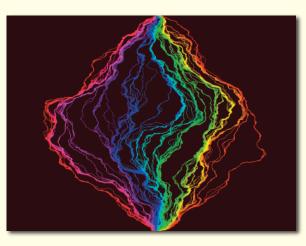
Isaac Newton Institute for Mathematical Sciences

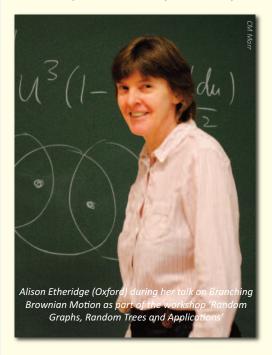
Newsletter

No. 11 November

Random Geometry success

Over the past twenty or thirty years, two-dimensional random geometry has emerged as a large and fascinating interdisciplinary subject at the interface between analysis, probability, geometry and combinatorics. The mathematical theory is rich, with new problems and connections to other areas of mathematics emerging regularly, and the subject has been growing and changing at tremendous speed. These developments have driven the theory far beyond its traditional boundaries, and have led to the development of radically new concepts and intuitions.





This explosion of ideas was the main motivation for the programme Random Geometry, which ran at INI from January to July 2015. The programme was built around the long-term participation of both established experts and extraordinarily strong younger researchers, as well as many short term visitors. Interconnectedness was cited by many as a key to the programme's success. During the programme there were five workshops: Instructional Workshop for Younger Researchers; Conformally Invariant Scaling Limits; Random Graphs, Random Trees and Applications; Random Planar Structures and Statistical Mechanics; Geometry of Random Walks and SLE: A Birthday Conference for Greg Lawler.

For many years, the unification of the existing perspectives on random planar geometry - which have grown out of different disciplines (such as conformal field theory, Gaussian multiplicative chaos, combinatorics, random planar maps, statistical physics, and string theory) - has been something of a holy grail for this subject. All these are highly sophisticated and powerful tools describing different aspects of what has been believed to be one and the same theory. Thanks to work completed during this programme, through a coordinated effort by many participants from different disciplines, much of this unification has been achieved.



See inside for

- Current Programmes
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- Uganda Medical Informatics Centre
- Mathematical Poetry

Current Programmes Update

Coupling Geometric PDEs with Physics for Cell Morphology, Motility and Pattern Formation (Jul-Dec 2015)



The aim of this programme is to create a unique forum to strengthen and develop research collaborations between state-of-the-art experimental "wet" sciences (biology, medicine, biophysics) and theoretical "dry" sciences (pure, applied and computational mathematics, theoretical physics, statistics). The programme has so far had three workshops: the first was the *Postgraduate Advanced Study Institute in Mathematical and Physical Sciences* which outlined the state-of-art methodologies and techniques in experiments, modelling, analysis and simulations as well as identifying current and future research questions. The second workshop *Multimodal Monitoring of Cell Migration* was a hands-on event at laboratories of the Institute of Complex Systems at the Forschungszentrum Juelich and the Institute of Molecular and Cellular Anatomy of

RWTH Aachen University in Germany. Participants carried out real experiments to analyse cytoskeleton structures relevant for the different modes of cell migration using different microscopy techniques in living cells and by immunocytochemistry. A third workshop on *Cell Mechanics, Morphogenesis and Pattern Formation* was held successfully in September with several keynote speakers and invited talks. Charles Elliott (Warwick) delivered the *Rothschild Lecture* on 16 September to a full seminar room, followed by a lively debate.



During all of these meetings, postgraduate students, postdocs and early-career researchers played a key role in articulating the challenges they face in breaking boundaries between theoretical, and experimental sciences. The area of cell motility and pattern formation offers them a research field that is only starting to be explored rigorously, theoretically and computationally with new methodologies and techniques in geometric PDEs and physics.

Currently, programme participants are translating research questions posed during the first three workshops as well as those emerging from informal group discussions into mathematical theoretical and computational models amenable for analysis and simulations. Still to come, the programme has a *Satellite Meeting* at the University of Sussex in November on *Multi-Physics Geometric PDE using Deformable Surfaces* and a final workshop in December at INI on *New Mathematical and Computational Problems involved in Cell Motility, Morphogenesis and Pattern Formation*.

Mathematical, Foundational and Computational Aspects of the Higher Infinite (Aug-Dec 2015)



When this programme was proposed, a list of the people who had expressed interest in participating in it was sent to the peer reviewers; the list read like a 'Who's Who' of set theory. The peer reviewers recommended acceptance, and expressed the wish that the programme be used as "a chance to raise the profile of set theory in the UK".

On 19 August 2015, the programme started, and thus far it has certainly lived up to the praise and wishes of the reviewers. In its second week, the programme hosted the *5th European Set Theory Conference* (5ESTC), the biennial European meeting of researchers in the field. During this conference the *Hausdorff Medal* of the European Set Theory Society was awarded (see opposite). The following week, the programme organisers worked with Anuj Dawar to host the *British Logic Colloquium 2015* (BLC 2015) at INI, the annual meeting of British logicians. These two events brought the leading researchers in set theory to Cambridge and connected set theory with the broader logic community in the UK.

On 5 October 2015, the *Rothschild Distinguished Visiting Fellow* W. Hugh Woodin gave his *Rothschild Lecture* in front of a packed seminar room, unlocking the mysteries of the higher infinite to the non-experts: What can an in-depth study of the higher infinite tell us about the continuum problem (the famous problem that was listed by David Hilbert as the first and most important problem for mathematics in the 20th century in his 1900 ICM address)? How are recent advances in research related to our sense of security in the foundations of mathematics? In what sense is Woodin's "Ultimate-L Conjecture" a watershed for the future development of the foundations of mathematics?

A sense of appreciation for the beautiful subject was awakened in many of the non-experts in the audience, and it is hoped that the remaining months of the programme will see new developments and allow participants to deepen their insight in the foundational questions, such as the ones mentioned by Woodin.



Hausdorff Medal awarded at INI

Ronald B. Jensen (Berlin) and John R. Steel (Berkeley) were awarded the Hausdorff Medal of the European Set Theory Society on 26 August 2015 during the 5th European Set Theory Conference which was being hosted by INI. This award was for the most influential work in set theory in the last five years and the pair were acknowledged for their construction of the core model without the use of a measurable cardinal.

The Hausdorff Medal is awarded every two years at the *European Set Theory*

Conference. This year the conference was hosted by the INI programme Mathematical, Foundational and Computational Aspects of the Higher Infinite (see opposite). The medal was presented by the President of the European Set Theory Society, Istvan Juhasz (Budapest).



Australian surprise!

On 6 August, INI was delighted to welcome **Dr Graham H Norton** from the University of Queensland, Australia. Dr Norton is an Honorary Associate Professor in the School of Mathematics and Physics and is a friend of the



Institute. He decided to call in and visit whilst he was in the area and was happy to pose for a picture for the *Newsletter* with the famous portrait of Isaac Newton!

Barry Cooper (1943-2015)

It is with regret we report that
Professor Barry Cooper passed away
after a brief illness on 26 October.
Barry was one of the organisers for the
programme Semantics & Syntax held
at INI in 2012 as part of the Alan
Turing Year and was Professor of Pure
Mathematics at Leeds University.

FRACTAL TREE UNVEILED

The close bonds between Poland and the University of Cambridge have been marked by the installation of a striking sculpture adjacent to INI at the Centre for Mathematical Sciences.

The Sierpiński Tree was unveiled on 13 May 2015 by the Vice-Chancellor Professor Sir Leszek Borysiewicz and the Polish Ambassador, His Excellency Witold Sobków. The sculpture is based on the geometric figure devised by Polish mathematician Wacław Sierpiński who did pioneering work on fractals in the early 20th Century.



Professor Sir Leszek Borysiewicz (left) together with His Excellency Witold Sobków (right) unveiling the Sierpiński Tree

Uganda Medical Informatics Centre



To enable countries in sub-Saharan Africa to benefit from developments in genomics and medical informatics, a data centre is being established to ensure the efficient utilisation of data resources in clinical epidemiology and large scale genomics from existing, on-going and future

research programmes. The UMIC will provide access to highly sophisticated computational resources to African scientists and their collaborators, to support medical research as well as to other disciplines contributing towards advancing knowledge of health in Africa. The storage and data processing abilities of the UMIC will enable the integration, curation, and analysis of large-scale population health resources in sub-Saharan Africa. As a truly ground-breaking initiative, the UMIC will be the most advanced resource of its kind on the continent.

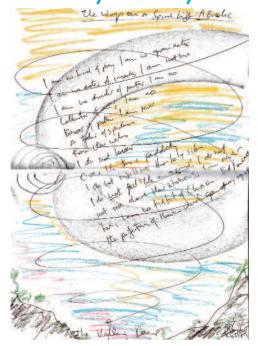
During September, INI was pleased to welcome **Brenda Akumu**, UMIC Project Administrator and **Jenny Thornton** from the African Partnership for Chronic

Disease Research to visit the Institute. The visit was part of a fact-finding mission to see how a successful Research Institute operates. When asked about her visit to INI Brenda said that

"The INI's integration of online records to complement face-to-face visitor interactions seemed particularly useful. I observed a strong teamwork spirit where staff members are fully committed and clearly support one another in their work which I will be keen to promote at the UMIC too".



Poetry in (spiral) motion



John Kinsella has recently completed the first year of a two year term as INI Poet in Residence. During this time John has produced 15 brand new pieces of work including several compositions based around spirals including a colourful composition The Wings on a Spiral Lift (see left). Two of the spiral pieces The age of Spirals and When We First Heard are written inside painted rings that were produced by German artist Karl Wiebke who has now settled in Kinsella's native Australia.

Talking about his recent work John enthused that "I LOVE maths. I LOVE poetry. I love VISUAL ART, I love SPIRALS. I love it when they all work TOGETHER!"

All of the work produced so far, including images of mathematical poetry straight from John's notebooks, can be seen on the official webpage at www.newton.ac.uk/about/art-artefacts/poet-in-residence.

CRM at INI

Neus Portet from the Centre de Recerca Matemàtica (CRM) in Barcelona has been visiting INI for a month from 5 October in order to find out how INI runs, but also to undertake some voluntary work within INI. Neus is currently the administrator at the CRM so is very familiar with running mathematical research programmes and has been extremely helpful in assisting with a variety of INI functions. Neus is the wife of Joan Bagaria, an organiser on the Mathematical, Foundational and Computational Aspects of the Higher Infinite programme.



Upcoming Events

16 November 2015

TALK Genius at Play: A reading, talk and Q&A with John Conway and Siobhan Roberts. John Horton Conway, subject of the recently published book Genius At Play, will sit down with his (inadvertently authorized) biographer Siobhan Roberts and discuss the trials and tribulations of being biographized - the genesis of the project, the process over nearly a decade, and the challenge of looking back at the span of one's mathematical career. The session will begin at 15:00 and finish at approximately 16:30 followed by a wine reception. Full details www.newton.ac.uk/seminar/20151116150017001.

9 December 2015

WORKSHOP New Mathematical & Computational Problems Involved in Cell Motility, Morphogenesis and Pattern Formation: This Open for Business half day event will bring together leading expertise from a wide range of disciplines such as mathematics, physics, biology and image process. Full details www.turing-gateway.cam.ac.uk/cmp_dec2015.shtml.

14-18 December 2015

WORKSHOP The Role of the Higher Infinite in Mathematics and Other Disciplines: This workshop will highlight the network of applications of the higher infinite in mathematics and beyond. Full details www.newton.ac.uk/event/hifw03.

15-19 February 2016

WORKSHOP From Foundations to State-of-the-Art in Magma/Mantle Dynamics: A look at some of the big questions in melt in the mantle. Full details www.newton.ac.uk/event/mimw01.



19 March 2016

OUTREACH Charles Simonyi: Practicalities of Orbital Space Tourism

A public talk by renowned space tourist Charles Simonyi recounting his experiences from 2 visits to the International Space Station. 11:00-12:00. Ages 8+. The talk is part of the Cambridge Science Festival and is sure to be popular - so save the date! Booking will open in February.

4-8 April 2016

WORKSHOP Advances in numerical and analytic approaches for the study of non-spatial stochastic dynamical systems in molecular biology: This workshop will focus on numerical methods and mathematical analysis for non-spatial stochastic dynamical models that arise in molecular biology. Full details www.newton.ac.uk/event/sdbw03.

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