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Newsletter

20th Anniversary year: update on activities

During 2012 the Newton Institute is celebrating 20 years since it was opened in July 1992. Throughout the year there will be a number of events and lectures for a range of audiences.

The first of these events was on the 24 March when Kjartan Poskitt, author of the *Murderous Maths* series of books, gave a fun talk for children and adults about Isaac Newton. He then continued with some interesting puzzles and mathematical games. Kjartan performed to a packed seminar room and recruited lots of willing volunteers from the audience.



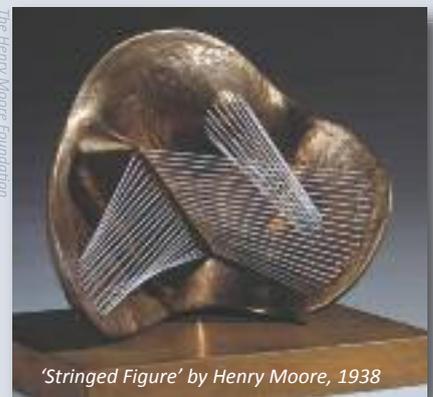
Kjartan Poskitt

A collaborative exhibition between the Newton Institute, the Royal Society, The Henry Moore Foundation and the Science Museum opened on 4 April with displays at both the Royal Society and the Science Museum. *Intersections: Henry Moore and Stringed Surfaces* explores the interface between art and mathematics and provides fascinating insights into how artist Henry Moore was inspired by mathematics, as well as exploring how contemporary scientists and mathematicians use visual thinking to inspire discovery.

The exhibition features string models by Théodore Olivier, drawings and sculptures by Moore, and computer visualisations of Calabi–Yau manifolds by Nicholas Mee (see below). The exhibition runs until the 20 June 2012 and is open to the public.

Details of this and future events are available at www.newton.ac.uk/20.

The Henry Moore Foundation

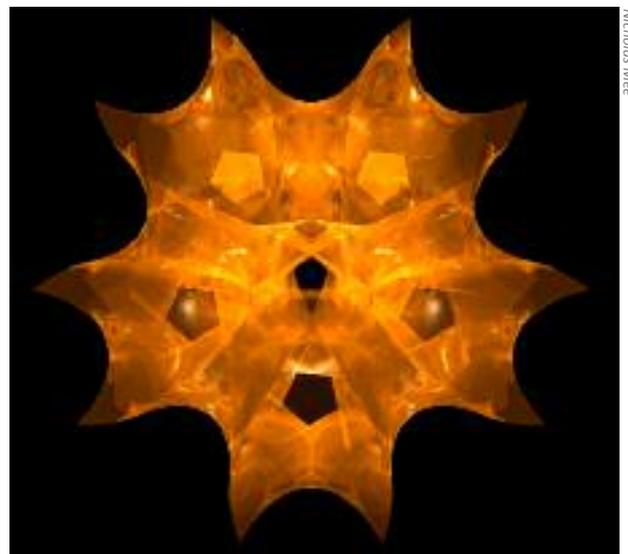


'Stringed Figure' by Henry Moore, 1938

The Rothschild Visiting Professor **Andrew Strominger** (Harvard) will give a public lecture at the Royal Society, London, on 9th May at 6.30pm entitled ***The Edges of the Universe: Black Holes, Horizons and Strings***. The talk is open to all on a first come first served basis when the doors open at 6.00pm (see back page).

Calabi–Yau manifolds

Theoretical physicist Dr Nicholas Mee (www.nicholasmee.com) provided three string theory related animations for the *Intersections: Henry Moore and Stringed Surfaces* exhibition at the Royal Society. String theory predicts that the universe has ten spacetime dimensions. To make contact with the four spacetime dimensions that we are aware of, string theorists propose that six additional spatial dimensions are wrapped up on an extremely tiny length scale, much smaller than an atomic nucleus. If they are correct, the properties of these extra dimensions determine the properties of the particles and forces that we witness in our macroscopic world. The most promising compactification schemes are based on Calabi–Yau manifolds. This image shows a projection of a six-dimensional Calabi–Yau manifold known as a quintic hypersurface. For further details on Dr Mee's latest book entitled *Higgs Force* see www.higgsforce.co.uk.



Nicholas Mee

Update on our current scientific programmes

Semantics and Syntax: A Legacy of Alan Turing (Jan–Jul 2012)

The programme aims at a synthesis between semantical (or structural) and syntactic (or symbolic) approaches in numerous research areas in mathematics and computer science. These are related to the work of Alan Turing (1912–1954) whose centenary is celebrated in 2012 in the United Kingdom. Reflecting Turing's own widespread interests and achievements, the programme is equally multi-faceted, and different months of the programme have different emphases. For instance, the month of April focusses on cryptography with a workshop including a lecture by the Rothschild Distinguished Visiting Fellow Shafi Goldwasser, and the leading European cryptography conference, EuroCrypt. Participating cryptographers have been very enthusiastic about the stimuli produced by this activity: there is talk of a new conference series or a journal.

But the most intensive phase of the programme is still to come in the month of June when Cambridge becomes the epicentre of the world's Turing activities: the 23rd of June is Turing's birthday, and the programme is heavily involved in the Cambridge celebrations, including a public movie screening, the Turing Centenary Conference CiE 2012, and the launch of the new journal *Computability*.



The Mathematics and Applications of Branes in String and M-Theory (Jan–Jun 2012)

The programme opened with a workshop on the mathematical aspects of M-theory. Its broad theme covered progress in generalised geometry, the moonshine conjecture and many other different aspects of the novel mathematics being generated by string theory inspired ideas. The Microsoft Visiting Fellow Jeffrey Harvey gave an inspired set of lectures on the moonshine and its intimate relationship to string theory. Steven Miller from Rutgers presented ground breaking work on the automorphic forms of exceptional groups and their relation to string scattering. The themes running through the early months have been an exploration of generalised geometry; properties and proposals for the now notorious multiple M5 brane theory; and the inevitable examination of ABJM/BL theories. This has been supplemented with a study of localisation in field theories which is now proving to be a key nonperturbative tool for field theory. With the arrival of spring and the daffodils comes the more applied side of the programme. First a workshop on scattering amplitudes organised by the Queen Mary group and then a hugely popular school on the AdS-Condensed matter organised by a group from Cambridge. In May a satellite workshop on black holes will be held in London as the programme becomes more gravitationally biased with the arrival of the Rothschild Visiting Professor Andrew Strominger (see upcoming events on the back page). Finally, in June the transition from pure to applied will be complete as the programme hosts the *String Phenomenology 2012* conference. 🍀

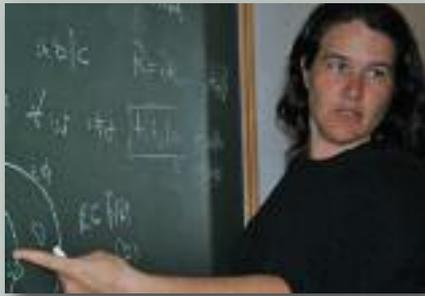


Michael Atiyah at the Institute

Professor Sir Michael Atiyah OM, former president of the Royal Society and founding Scientific Director of the Institute visited on the 6 March for coffee and an opportunity to find out about the current scientific programmes. Sir Michael engaged in vigorous conversation with participants on the programme on the *Mathematics and Applications of Branes in String and M-Theory* and was shown around the Institute by Professor John Toland, Institute Director and Dr Christie Marr, Deputy Director. 🍀

Interactions with the UK Mathematical Community

The Newton Institute is a key part of the infrastructure supporting mathematical research across the UK. To encourage sustained national engagement, the Deputy Director, Dr Christie Marr, gave presentations at both BMC and BAMC and Satellite Meetings were held in Cardiff and Oxford in March and April.



A number of events have taken place around the UK in the six months since the last Newsletter and we present highlights here. These events allow the Institute to engage with a national audience and to interact with the mathematical sciences community. Listings of all our events are available at www.newton.ac.uk/events.

Topics addressed included the role of the Dirichlet to Neumann operator, and m -function Inverse spectral problems that occur as a consequence of integrable systems, in particular to the Camassa–Holm equation on the real line and inverse problems on graphs.

A Satellite Meeting on *Inverse Spectral Problems in One Dimension* took place at ICMS, Edinburgh in October. Speakers included J Behrndt (Technische Universität Graz), F Gesztesy (Missouri), P Kurasov (Stockholm), M Malamud (Donetsk), S Naboko (St Petersburg), B Rundell (Texas A&M University), G Teschi (Vienna) and R Weikard (Birmingham, Alabama). The meeting focused on aspects of inverse spectral problems for one dimensional problems.

As part of the programme *Semantics and Syntax: a Legacy of Alan Turing*, there was a Satellite Meeting held at St John's College, Oxford on 14–16 March entitled *Pattern Formation: The Inspiration of Alan Turing*. The meeting featured a number of keynote speakers and brought together researchers ranging from those who do experiments to demonstrate pattern formation, to those who develop mathematical and computational techniques to analyse proposed models.

Industry Day - An Open for Business event

On 30 November 2011 the Institute hosted a special Industry Day as part of the programme *Design and Analysis of Experiments*. This one-day meeting brought together academic and industrial researchers and practitioners for the interchange of ideas on the design and analysis of experiments and included presentations on current and future industrial applications. The keynote lecture was given by Tim Davis, a former Henry Ford Technical Fellow and Quality Director for the Ford Motor Company, and past Vice-President of the Royal Statistical Society. His talk demonstrated the importance and utility of considering scientific theory and knowledge when designing and analysing industrial experiments. This was followed by four further presentations from scientists and statisticians in the automotive, pharmaceutical, consumer and oil industries, demonstrating the application of modern and novel design methods to industrial problems and presenting some new challenging problems.

Open for Business events form part of the Institute's mission to foster links between academic research and the business world. For more information please see www.newton.ac.uk/ofb/.

Grenville Davey, Artist-in-Residence

The Newton Institute is delighted to welcome Turner Prize winning sculptor Grenville Davey as the artist-in-residence for the duration of the *Mathematics and Applications of Branes in String and M-Theory* programme from January to June 2012. Professor Davey is working with Dr David Berman, one of the programme organisers, who is an expert in M-theory, an extension of string theory. Davey's recent interests and work have been inspired by the ideas from string theory and its way of describing our universe. Grenville will be working with visiting mathematicians during his residency and hopes to produce a sculptural piece using blackboards which will be displayed at the Institute.



David Berman lectures on string theory

A special joint public lecture took place on 14 March which began with an accessible introduction to string theory by David Berman followed by a presentation and discussion with Grenville Davey on his art and how aspects of string theory and contemporary physics have been an inspiration. The event was attended by over 80 people and was followed by a wine reception. There will be a further public talk on 10 July at the Institute. Further details will be posted on the artist-in-residence webpage at www.newton.ac.uk/art/gdavey/.



Grenville Davey lectures on duality

Turing Machine on display

In connection with the current programme *Semantics and Syntax: A Legacy of Alan Turing* the Institute currently has a Turing Machine which is kindly on loan from the Heinz Nixdorf MuseumsForum in Paderborn, Germany.



It was built by Gisbert Hasenjaeger in the 1950s and is an early computing device. Hasenjaeger was a German mathematician and logician and after being severely injured in World War II, he was assigned to the central cryptographic unit of the German army in 1942. He was unwittingly competing with Alan Turing, as he was assigned the task of breaking the Enigma code to test the security of the cryptographic system. However, he did not find the vulnerabilities that Alan Turing and Gordon Welchman exploited.

The machine can be viewed in the reception area at the Institute until 13 June 2012. 📍

New mathematical sculptures arrive at the Institute

In January 2012 the Institute was delighted to accept a wonderful perspex sculpture by the late Walter Ritchie entitled *Newton's Interpretation of the Cosmos*. The sculpture is on long-term loan from the Greene King Brewery who originally commissioned Ritchie to create the piece for the Isaac Newton pub in Cambridge. Following the removal from the pub, the sculpture was displayed at Woolsthorpe Manor, the birthplace of Isaac Newton, before finding a home at the Institute. The sculpture shows five diagrams engraved into perspex behind a profile of Newton and stretching across a representation of the heavens. The diagrams show the fundamental theorem of calculus, the oblique impact of two perfectly elastic bodies, Newton's organic construction of curves, the determination of a comet's orbit by successive approximations and the reduction of the cubic.



Also in January, the Institute was kindly gifted a sculpture by artist Dick Onians entitled *Infinity*. It shows a single sided surface, such that if an ant were to walk along the length of the sculpture it would return to its original starting point having traversed

both sides of the shape but not crossing an edge. The sculpture examines the endlessness of time, space, and regeneration.

The Institute has a growing collection of artworks which demonstrate the intersection between art and mathematics. For more information on our artwork please see our website at www.newton.ac.uk/art/. 📍

Upcoming events and activities

Intersections: Henry Moore and Stringed Surfaces

until 20 June 2012 at the Royal Society, London

Please telephone 020 7451 2606 to arrange your visit or ask at the main reception desk at the Royal Society. Further information is available at <http://royalsociety.org/events/2012/intersections-exhibition/>

The Edges of the Universe: Black Holes, Horizons and Strings

9 May 2012 6.30pm-7.30pm at the Royal Society, London

The Rothschild Visiting Professor **Andrew Strominger** (Harvard) will give a public lecture at the Royal Society as part of the *Intersections: Henry Moore and Stringed Surfaces* exhibition. This event is free to attend and open to all. No tickets are required. Doors open at 6.00pm and seats will be allocated on a first come first served basis.

Celebration Day to mark the Inauguration of the Institute

11 July 2012 2.00pm onwards

There will be a selection of special events at the Institute to mark the anniversary of the inauguration. Doors open at 2.00pm. For further information please see www.newton.ac.uk/20.

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