



### MATHEMATICS AND BREXIT

#### House of Lords Science and Technology Select Committee report

'Bold steps are needed to ensure UK science has a prominent place in the global economy after Brexit', says a House of Lords Science and Technology Select Committee report.

Amongst other things the report goes on to say that: 'the UK needs to retain current scientific talent and attract even more of the world's leading scientists.

The UK should expand and enhance existing programmes. But it must also search out the world's most accomplished scientists and persuade them to pursue careers here. The government should send repeated signals to the global science community that the UK remains a welcoming place for talented scientists'.

More information and the full report are available at <http://tinyurl.com/zhph2ae>.

#### Chief scientific adviser needed at DExEU

Following a House of Commons debate in December 2016 on 'Exiting the EU: Science and Research', Stephen Metcalfe MP, Chair of the Science and Technology Committee, has written to David Davis MP, Secretary of State, Department for Exiting the European Union (DexEU), regarding the need for a Chief Scientific Adviser in the Department. The letter is available at <http://tinyurl.com/zrzgk8s>



#### New CEO of UK Research and Innovation critical for its success

The soon to be appointed CEO of UK Research and Innovation (UKRI) will be critical for making a success of the new organisation, according to a Science and Technology Select Committee report. Science and Technology Select Committee Chair, Stephen Metcalfe MP, said:

'UKRI represents a revolution in our research and innovation landscape, and the new organisation will change how the country funds and commercialises publicly-funded research. Getting UKRI right will secure our position as a research superpower at a time when it is crucial to protect and build upon our strength'.

The soon to be appointed Chief Executive of UKRI will play a crucial role in determining the success of the new organisation. They will have to address the various concerns that the science and innovation sector

### SOCIETY MEETINGS AND EVENTS 2017

- 3 April: Society Meeting at BMC, Durham *page 31*
- 18–22 April: LMS Invited Lectures, Newcastle *page 18*
- 5 May: Mary Cartwright Lecture, London
- 1 June: Northern Regional Meeting, York
- 30 June: Society Meeting, London
- 30 June: Graduate Student Meeting, London
- 11 December: SW & South Wales Regional Meeting, Cardiff

# Contents

No. 466 February 2017



## Awards

BSHM Undergraduate Essay Prize.....	10
Compositio Prize 2016.....	9

<b>Calendar of Events</b>	35
---------------------------	----

## LMS Items

Cecil King Travel Scholarship 2017.....	34
David Crighton Medal 2017.....	4
News for Early Career Researchers and Students.....	10
Undergraduate Research Bursaries in Mathematics 2017.....	17

## LMS Meetings

Algebraic Topology of Manifolds Research School.....	27
Christopher Zeeman Lecture.....	19
Invited Lecturer 2017.....	18
Microlocal Analysis and Applications Research School.....	20
New Trends in Representation Theory Research School.....	21
Orthogonal Polynomials and Special Functions Research School.....	26
Society Meeting at BMC.....	31

## Meetings

Computer-Aided Mathematical Proof INI Workshop.....	25
Computing for the Future of the Planet.....	24
Gregynog Welsh Maths Colloquium 2017.....	23
Index Theorems in Analysis, Geometry and Mathematical Physics.....	23

## Mathematical Models in Ecology

and Evolution.....	24
North British Functional Analysis Seminars.....	24
Rough Paths in Probability and Statistics.....	24
Scalable Statistical Inference INI Workshop.....	30
SciCADE.....	23

## News

EMS President - New Year Message.....	5
European News.....	6
International Mathematics Competition for University Students.....	13
Mathematics and Brexit.....	1

## Obituaries

Keller, Joseph.....	28
Reade, Maxwell.....	29
Safarov, Yuri.....	28

## Records of Proceedings

SW & South Wales Regional Meeting.....	15
--	----

## Reports

LMS SW & South Wales Regional Meeting....	15
Mathematics Society at the University of Central Lancashire.....	16
Transpennine Topology Triangle.....	14

## Reviews

My Search for Ramanujan.....	32
Single Digits.....	30
The GCHQ Puzzle Book.....	29

## Visits

Antolin, Yago.....	22
Cartier, Pierre.....	22
Treschev, Dmitry.....	22

has raised about the government's plans for UKRI. The government will need to take great care in appointing the UKRI Board to ensure it has the right balance of experience of innovation and research throughout the UK, to avoid any disconnect between UKRI's UK-wide and England-only remits'.

The full report on Setting up UKRI is available at <http://tinyurl.com/hbnfxw5>.

### Government response to Dowling Review

The Review (published in July 2015) sought to understand how businesses of all types and sizes could be encouraged to connect with UK universities through research collaborations that delivered benefit for both the collaborators and the country as a whole. The government's response states that the recommendations from the Review have already had a significant influence on government policy and makes it clear that the Review has helped to stimulate a wealth of activity in the UK aimed at improving conditions for business-university collaborations. The government's response is available at <http://tinyurl.com/jj4goba>.

## RESEARCH

### Consultation on the second Research Excellence Framework (REF2021)

The four UK funding bodies for higher education have published a joint consultation on the arrangements for research assessment in a second REF.

The consultation sets out proposals to build on the first REF, conducted in 2014, and to incorpo-

rate the principles identified in Lord Stern's Independent Review of the REF. The closing date for responses is Friday 17 March 2017.

More information is available at <http://tinyurl.com/h29ayjd>.

## SCHOOLS AND COLLEGES

### Schools Green paper consultation

The consultation on the government Green Paper Schools that Work for Everyone closed on 12 December 2016. The LMS response is now available on the LMS website at <http://tinyurl.com/guw37uh>.

### PISA results

The Organisation for Economic Co-operation and Development (OECD) recently published the results of their international student assessments. The Programme for International Student Assessment (PISA) is undertaken once every three years and tests 15-year-olds' abilities in the core academic disciplines of reading, mathematics and science.

The UK's performance in mathematics has fallen, with the UK dropping from 26th to 27th in the rankings.

More information is available at <http://tinyurl.com/hu2snx3>. UK specific results are available at <http://tinyurl.com/hmtxpbv>.

### Technical education at the centre of industrial strategy

The Prime Minister has recently outlined the next steps in her 'Plan for Britain'. The Industrial Strategy will include plans for a 'radical overhaul

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of technical education to address its historic under-valuation in the UK and provide a credible alternative to the academic route for young people who choose not to go to university'.

Among other areas the strategy will include:

- **Plans to use the successful free school model to expand the provision of specialist maths education across the country**

Working with local partners including top university maths departments to spread new specialist "mathematics schools" building on high-performing Exeter and Kings College London Mathematics Schools.

- **Action to tackle shortages of STEM skills**

Including by further encouraging the growth of STEM subjects in higher education and exploring options to incentivise growth in the number of STEM graduates. It will also look at how regional imbalances in the number of students progressing to higher-level STEM qualifications can be addressed, with Professor Sir Adrian Smith's review due to outline proposals shortly.

More information is available at <http://tinyurl.com/hn74sog>.

Dr John Johnston

Joint Promotion of Mathematics

## DAVID CRIGHTON MEDAL 2017

### Call for nominations

The David Crighton Medal was established by the Councils of the LMS and IMA in 2002 in order to pay tribute to the memory of Professor David George Crighton, FRS. The silver gilt medal will be awarded to an eminent mathematician for services **both** to mathematics and to the mathematical community, who is normally resident in the mathematical community represented by the two organisations on the 1 January of the year of the award.

In 2015 the Councils of the Institute and the Society agreed that the frequency of the award should be increased, and the award is now considered biennially by the Councils. The medal-winner will normally be presented with the

award at a joint meeting of the IMA and the LMS, and will be invited to give a lecture.

The David Crighton Medal was awarded in 2015 to Professor Frank Kelly, FRS. Previous winners of the Medal are Professor Arie Iserles and Dr Peter Neumann, OBE (2012), Professor Keith Moffat, FRS (2009), Professor Sir Christopher Zeeman, FRS (2006) and Professor Sir John Ball, FRS (2003).

Nominations are now invited. These should be made on a nomination form available on both Societies' websites (<https://www.lms.ac.uk/prizes/ima-lms-prizes>) or from the Secretary to the David Crighton Committee ([prizes@lms.ac.uk](mailto:prizes@lms.ac.uk)) by **28 February 2017**.



De Morgan House offers a 40% discount on room hire to all mathematical charities and 20% to all not-for-profit organisations. Support the LMS by booking your next London event with us.

## CONFERENCE FACILITIES



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[www.demorganhouse.org.uk](http://www.demorganhouse.org.uk)

## NEW YEAR MESSAGE FROM THE EMS PRESIDENT

Dear LMS Members

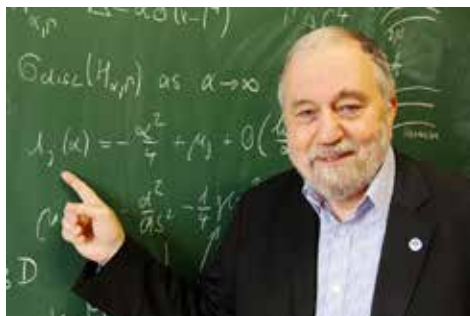


Any society's life contains both climactic and anticlimactic periods. The year just concluded was full of major events, but while

the New Year promises many things we look forward to, it is day-to-day work which will provide the Leitmotiv of the coming months. This includes the implementation of the decisions taken at our Council meeting in Berlin last summer. To begin with, the society's leadership has been substantially renewed. With deep gratitude for their devoted work we part with Franco Brezzi and Martin Raussen, and we wish success to Volker Mehrmann and Armen Sergeev who replace them as the society's vice-presidents. We also thank the other departing members of the Executive Committee: Alice Fialowski, Gert-Martin Greuel, and Laurence Halpern. We welcome the new members: Nicola Fusco, Stefan Jackowski, Vicente Muñoz, Beatrice Pelloni, and Betül Tanbay.

Equally important is the renewal of our standing committees, which form the backbone of the EMS. Around half their Chairs and a number of members have reached the end of their tenure. Their replacements were decided at the recent meeting of the Executive Committee in Tbilisi. Let me express here our gratitude to all of them, with personal thanks to follow separately. In some committees, the changes run particularly deep. This is especially true for the Education Committee, which will see a majority of new members. We wish them success and hope that the committee's scope will broaden, and include some hands-on activities.

Another big change concerns the Publication and Electronic Publication Committees. As technology advances, this separation has become gradually less justifiable, and we



Pavel Exner, EMS President

have invited their members to discuss the formation of a unified committee within the next few months. Before leaving the topic of committees, let me also mention the generous support the EMS has received from the Simons Foundation, targeted at mathematics in Africa. Our Committee for Developing Countries has worked hard to create appropriate grant schemes, and its five year programme is now under way.

While none of the largest mathematical meetings will occur this year, some are already looming on the horizon. On a global scale, we look forward to the ICM 2018 in Rio, and are delighted that the following meeting in 2022 will return, after sixteen years, to Europe: either Paris or Saint Petersburg. The EMS, as a society representing the entire European mathematical community, will express no preference between the two bids, but we are confident that both offer the prospect of a wonderful meeting. At the European scale, the Berlin Council decided to hold the eighth European Congress in Portorož in 2020. Our Slovenian colleagues have started working intensively, and we are certain of an attractive meeting, which will do much for the standing of mathematics in this part of Europe.

Even if it is still a long time ahead, I encourage you to contemplate possible

candidates for the EMS prizes in 2020. Our main award is highly renowned - recent confirmation can be seen from two of its latest laureates, Hugo Duminil-Copin and Georgie Williamson, winning the 2017 New Horizons in Mathematics Prize just a few days ago. It is in all our interests to keep the flag high.

A New Year message generally strikes an optimistic tone. However, I hope it won't do any harm to add a few words about our worries. Some of them, frankly, are of our own making; if I were to characterize their common root, I would suggest a lack of loyalty to the mathematical community. To give a few examples, numerous colleagues registered for the Berlin congress but did not then pay, causing a financial headache for the organizers (and we know that at least some such individuals did indeed attend). On the other hand, far from every member of the congress's organizing committee opted to attend the meeting whose programme they had designed!

There are problems we can resolve ourselves. That is less true of difficulties in our relations to the 'outside world', including European funding schemes. In last year's message I spoke about the ERC, a very valuable instrument which covers, however, only a limited segment of mathematical activities. During 2016, the European Commission led an open consultation on the role of mathematics in Horizon 2020. This was a useful exercise in which many of us participated, but it would be overly optimistic to expect an enduring effect. It is a

task for each of us to seek out opportunities within the funding system, and I would like to praise members of the EU-MATHS-IN initiative and other colleagues who have devoted their energies to such activities. This matter regularly features at the yearly meeting of the Presidents of EMS member societies, and no doubt it will be raised again in April in Lisbon.

Then we come to a still wider political scene, in which our ability to influence things is close to zero. We received a harsh reminder of this on the eve of the Berlin congress, when an attempted coup (or whatever we should call it) prevented our colleagues in Turkey from attending. An immediate consequence was that the second Caucasian Conference (planned with EMS support) had to be postponed; subsequent events in Turkey have thrown its new date into further doubt. In other countries, we see processes unfolding which may not be as violent, but which signify deep instabilities in the political climate. In such a situation, it is useful to keep in mind a double inclusion: geographical Europe is wider than political Europe, and mathematical Europe is wider than geographical Europe. We can and must hold together, even as we sail through rough waters.

Let me end on an optimistic note, after all: these political tumults are temporary, but - as we all know - mathematics is eternal. Happy New Year!

Pavel Exner  
EMS President

## EUROPEAN NEWS

### ICM 2022

The International Mathematical Union (IMU) received two bids for hosting the *International Congress of Mathematicians* (ICM) in 2022: Paris and St Petersburg. Both bids have the support of the European Mathematical Society. The Executive

Committee of the IMU will make site visits and then make a recommendation to the General Assembly which will decide on the venue of ICM 2022 at its meeting in São Paulo 29-30 July 2018 prior to the ICM 2018 in Rio de Janeiro.

## EC meeting

The EMS Executive Committee (EC) held its regular autumn meeting 4-6 November 2016, this time in Tbilisi at the kind invitation of the Georgian Mathematical Society. Decisions taken included the renewal of EMS committees and support for scientific activities in 2017. Some headlines:

*Simons Foundation support of Mathematics in Africa.* The EC discussed how the generous Mathematics in Africa grants from the Simons Foundation will be administered. The scheme devised by the EMS Committee on Developing Countries was approved and will be soon launched.

*Scientific activities in 2016.* As a result of the healthy budgetary situation the EMS was able to support a number of scientific activities last year including eight summer schools, a distinguished speaker, and the Joint EMS-Bernoulli Society Lecture.

*Society good standing in focus.* The EMS has always showed understanding for regional societies having temporary difficulties in fulfilling their duties as members. We expect, however, that they show the intention to resolve their situation. If this is not the case, the EC could recommend to the Council to reconsider the membership of such a society.

## Switzerland

Swiss researchers and organisations will now be able to participate fully in *Horizon 2020*, the European Union's research and innovation funding programme, on equal terms with entities from EU Member States and other associated countries.

## Barcelona

The Catalan Mathematical Society will hold the second *Barcelona Mathematical Days* 27-28 April 2017: see <http://abelinbcn.espais.iec.cat/>. Note also that there will be a joint meeting with the Spanish and Swedish Mathematical Societies in Umeå, Sweden 12-15 June, and with the Edinburgh Mathematical Society at ICMS 27-29 September 2017.

## Czech Republic

The Neuron Fund for Support of Science has named this year's laureates for the *Neuron Award for Contribution to Science*, who include mathematical physicist (and EMS President!) Pavel Exner and mathematical logician Mgr. Emil Jeřábek. This prestigious award recognises top Czech scientists at home and abroad who have made outstanding achievements in their field.

## CIRM 2018

CIRM Luminy (near Marseille) is widening its range of scientific events, by introducing several new types of programme from late 2018: calls for proposals are now open. The 'Multi-Year' programme will welcome events in Mathematics and in Mathematics in interaction with Medicine, Biology, Finance, Economics, Social Sciences, etc. Projects will be given the chance to stage a one-week event at CIRM over several years. The 'Interface' programme will focus on mathematics with and for industry. New SMF-sponsored weeks will complement the offer. All programmes will benefit from brand new facilities due to open at CIRM late 2018. See [www.cirm-math.fr](http://www.cirm-math.fr).

The Jean-Morlet Chair welcomes a whole semester on the subject of *KPZ-Universality and Directed Polymers*, organized by Konstantin Khanin (University of Toronto) in collaboration with Senya Shlosman (Aix-Marseille University) and others. Two large and one medium workshop are planned between January and June 2017. Interested participants can pre-register online: <http://khanin-shlosman.weebly.com/>. Funding will be available (from CIRM and other sponsors) to subsidize board and lodging.

## ICMAT

The Institute of Mathematical Sciences (Madrid) is embarking on a new four-year research program funded by the Severo Ochoa Excellence Programme, and invites applications for PhD and postdoc positions: see [www.icmat.es](http://www.icmat.es).

David Chillingworth  
LMS/EMS Correspondent

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# FOUNDATION COMPOSITIO MATHEMATICA

## Compositio Prize 2016

On 9 December 2016 the Compositio Prize was awarded to Bhargav Bhatt (right) for his paper *Derived splinters in positive characteristic*, which appeared in *Compositio Mathematica* 148 (2012) pp 1757–1786. The Compositio Prize is a prize awarded once every three years by the Foundation Compositio Mathematica for the best paper that appeared in *Compositio* in a three year period. The present prize covered the period 2011–2013 and the jury chaired by Frits Beukers came forward with the following shortlist of nominated papers.

- Bhargav Bhatt: *Derived splinters in positive characteristic* *Compositio Mathematica* 148 (2012), no. 6, pp 1757–1786
- Dieter Kotschick, Stefan Schreieder: *The Hodge ring of Kähler manifolds* *Compositio Mathematica* 149 (2013), no. 4, pp 637–657
- June Huh: *The maximum likelihood degree of a very affine variety* *Compositio Mathematica* 149 (2013), no. 8, pp 1245–1266

The paper by Bhargav Bhatt was later chosen as prize winner. The prize was handed out during a festive day with lectures by all nominated authors.

The first lecture, by June Huh from Princeton dealt with a combinatorial problem motivated by a theorem of de Bruijn and Erdős that says that a set  $E$  of points in a projective plane determines at least  $\#E$  lines unless all points are contained in a line. June Huh proves together with Botong Wang that for a subset  $E$  of a vector space  $V$  of dimension  $d$  that spans  $V$ , the poset of linear subspaces generated by  $E$  contains at least as many subspaces of codimension  $d - k$  as subspaces of dimension  $k$  if  $k \leq d/2$ . This proves the “top-heavy” conjecture of Dowling and Wilson from 1974. The surprising thing about the proof is that this simply formulated result follows from heavy cohomological weaponry, the decomposition theorem for  $\ell$ -adic intersection complexes. Despite this, June Huh was able to sketch the proof in a very vivid and attractive talk.

Dieter Kotschick from Munich and Stefan Schreieder from Bonn shared the second talk which dealt with Hirzebruch’s problem from

1954 which Chern and Hodge numbers are topological invariants. This problem was open for 60 years, but was solved in their nominated paper in an elegant way by the introduction of the Hodge ring, an analogue of the cobordism ring.



The third talk was by the prize winner, Bhargav Bhatt from Ann Arbor. Bhargav Bhatt gave a very clear and energetic talk on his proof of the fact that regular rings are derived splinters as conjectured by Johan de Jong. The notion of derived splinter was introduced in his prize winning paper: a ring (or scheme) that in the derived category splits off from the cohomology of a proper cover. This paper was motivated by the direct summand conjecture of Hochster that says that for a regular ring  $R$  which is a subring of a ring  $S$  such that  $S$  is a finitely generated  $R$ -module the ring  $R$  splits as a direct summand. Hochster proved it in case  $R$  contains a field, but it remained open for the mixed characteristic case. Bhatt’s paper led to a proof by Yves André last summer of this conjecture and shortly afterwards Bhatt found a simpler proof. The proof uses the newly developed perfectoid techniques introduced by Scholze and developed by Scholze and Bhatt.

After the talk the prize object, a model of the Cayley surface, was handed out to Bhargav Bhatt in a nearby place where the traveling exhibition ‘Imaginary’ had its temporary home. The Cayley surface was found by Cayley in 1844 and is a cubic surface in projective three-space with four ordinary double points and with  $S_4$  symmetry. It is given by the vanishing of the third elementary symmetric function of the four coordinates.

Gerard van der Geer  
President, Foundation  
Compositio Mathematica

## BSHM UNDERGRADUATE ESSAY PRIZE

The British Society for the History of Mathematics is pleased to invite submissions for its 2016-17 undergraduate essay prize. The essay may be on any topic within the history of mathematics and should be no more than 2500 words in length (excluding references). The competition is open to any person who is enrolled as an under-

graduate in a UK or Irish university during the academic year 2016-17. The value of the prize will be £100, plus free membership of the Society for three years.

Details about how to enter can be found on the Society website at [www.bshmath.ac.uk/ug-essay](http://www.bshmath.ac.uk/ug-essay). The deadline for receipt of submissions is the **21 June 2017**.

## NEWS FOR EARLY CAREER RESEARCHERS AND STUDENTS

### UNDERGRADUATES

#### Funding for Undergraduate Society Meetings

Funds of **up to £500** are available to support meetings of Undergraduate Mathematical Societies to cover the travel and accommodation costs for an invited speaker (from academia or industry) and to cover catering costs e.g. a wine reception after the meeting. Further information and an application form is available online: [www.lms.ac.uk/grants/LMS-Funding-Undergrad-Soc-Meetings](http://www.lms.ac.uk/grants/LMS-Funding-Undergrad-Soc-Meetings).

**16 February 2017:** deadline for receipt of applications for LMS undergraduate research bursaries. More information here: <https://www.lms.ac.uk/grants/undergraduate-research-bursaries>.

### MASTERS STUDENTS

**30 June 2017:** Graduate Student Meeting in London. Look out for further details next month.

### PHD STUDENTS, POST-DOCS AND EARLY CAREER RESEARCHERS

#### Research Schools in 2017 – Application deadlines

The London Mathematical Society and Clay Mathematics Institute Research Schools provide training for young re-

searchers in a core area of mathematics. Students and post-docs can meet a number of international leading experts in the topic as well as other young researchers working in related areas. The Research Schools are also supported by the Heilbronn Institute for Mathematics Research.

#### There will be four research schools in 2017 run in partnership with the Clay Mathematics Institute:

**24 March 2017:** Deadline for applications to the LMS-CMI Research School New Trends in Representation Theory - The Impact of Cluster Theory in Representation Theory, Leicester; 19-23 June 2017 Further details here: <https://sites.google.com/site/clustertheoryinrepththeory/>. Apply here: <https://www.surveymonkey.co.uk/r/RS-28-NewTrendsInRepresentationTheory>.

A reference will also be required so ask your referee to complete the form here: <https://www.surveymonkey.co.uk/r/RS-28RefereeForm>.

**31 March 2017:** Deadline for applications to the LMS-CMI Research School Microlocal Analysis and Applications, Cardiff; 26 June – 30 June 2017. Further details here: <https://www.math.ens.fr/~guillarmou/cardiff2017.html>.

Apply here: <https://www.surveymonkey.co.uk/r/RS-32-MicrolocalAnalysis>.

A reference will also be required so ask

your referee to complete the form here: <https://www.surveymonkey.co.uk/r/RS-32RefereeForm>.

**16 June 2017:** Deadline for applications to the LMS-CMI Research School Algebraic Topology of Manifolds, Oxford, 11-15 September 2017. Further details here: <https://people.maths.ox.ac.uk/tillmann/ATM-SCHOOL.html>. Apply here: <https://www.surveymonkey.co.uk/r/RS33-ATManifoldsApplicationForm>.

A reference will also be required so ask your referee to complete the form here: <https://www.surveymonkey.co.uk/r/RS33-ATManifoldsRefereeForm>.

**16 June 2017:** Deadline for applications for the LMS-CMI Research School Introduction to geometry, dynamics, and moduli in low dimensions, Warwick, 11-15 September 2017. Further details

here: <http://www2.warwick.ac.uk/fac/sci/maths/research/events/2017-18/symposium/igdm/>. Further details on how to apply and how your referee can submit a reference will be available shortly.

There will be also be a LMS Research School in 2017:

**31 March 2017:** Deadline for applications to the LMS Research School Orthogonal Polynomials & Special Functions, Kent; 26-30 June 2017. Further details here: <https://blogs.kent.ac.uk/opsf-summer-school/>.

Apply here: [www.surveymonkey.co.uk/r/RS31OrthogonalPolynomialsApplicationForm](http://www.surveymonkey.co.uk/r/RS31OrthogonalPolynomialsApplicationForm).

A reference will also be required so ask your referee to complete the form here: <https://www.surveymonkey.co.uk/r/RS31OrthogonalPolynomialsRefForm>.



Joe Bailey (Essex) gives a talk at the Graduate Student Meeting (Nov 2016)



Hourly Melkonian (Heriot-Watt) speaks at the Graduate Student Meeting (Nov 2016)



Organisers, Speakers and Tutors at the LMS Research School *Combinatorics and Operators in Quantum Information Theory*, QUB (Sept 2016)



Philippe Trinh (Oxford) gives a talk at the Graduate Student Meeting (Nov 2016)

The screenshot shows the homepage of the 'The Online Algorithmic Complexity Calculator'. At the top, there is a navigation bar with links: Main Page | How It Works | How To Cite | Team | GitHub Repo | Download Data and Tools | Publications. The main heading is 'The Online Algorithmic Complexity Calculator'. Below this, there are three tabs: 'For any string', 'For binary arrays', and 'For short strings'. The 'For any string' tab is selected. Under this tab, there is a section 'Strings to evaluate' with a text input field containing 'AAAAAAAA ATATATATAT ATGCCGCCT'. Below the input field, it says 'Use space to separate strings.' and 'Alphabet size' with radio buttons for 2, 4, 5, 6, and 9. At the bottom, there are logos for the Algorithmic NatureGroup, Department of Computer Science, Karolinska Institutet, John Templeton Foundation, and Vetenskapsrådet.

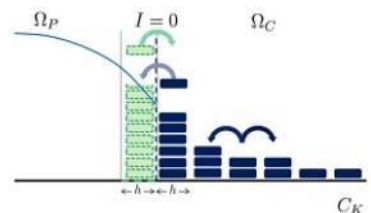
12

## Developing efficient methodologies for modelling stochastic dynamical systems in biology

A one-day conference featuring high profile speakers sharing novel methods and analysis, as well as efficient algorithms for simulation.

Further information: [go.bath.ac.uk/imi-sds](http://go.bath.ac.uk/imi-sds)

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# INTERNATIONAL MATHEMATICS COMPETITION FOR UNIVERSITY STUDENTS

## Preliminary Announcement

The 24th International Mathematics Competition for University Students (IMC) is being held from 31 July to 6 August 2017, organized by University College London and hosted by the American University in Bulgaria, Blagoevgrad, Bulgaria.

Every participating university is invited to send several students and one teacher. Individual students are welcome. The competition is planned for students completing their first, second, third or fourth year of university education and will consist of two sessions of five hours each. Problems will be from the fields of Algebra, Analysis (Real and Complex), Geometry and Combinatorics. The working language will be English. Over the previous twenty three competitions we have had participants from over two hundred institutions in over fifty countries.

The IMC is a residential competition and all student participants are required to stay in the accommodation provided by the hosts.

### Groups

Although this is an individual event, the Universities traditionally divide their participants into groups of four each. The number of students in the teams is, however, not fixed. The professor who accompanies the students is expected to be a member of the Jury.

### Selection of the problems

The problems will be chosen at the Meeting of the Jury on 1 August from those received in advance by the President of the Jury, Professor John Jayne. The problems proposed should be precisely formulated and accompanied by a detailed solution. The problems should be in fields of Algebra, Analysis (Real and Complex), Geometry and Combinatorics. The problems given at

the last twenty three competitions can give a general idea of the level expected (see the IMC website [www.imc-math.org.uk](http://www.imc-math.org.uk)). Additional topics may be also included.



### Evaluation

The students' work will be evaluated by Team Leaders and other Professors and Assistant Professors using criteria provided by the Jury.

### Necessary information

Participants are invited to confirm their intention to participate by on-line registration by the end of May 2017, providing the following information.

### Visas

The participants from some countries will need a visa to enter Bulgaria. Please, contact your travel agent or the Bulgarian Consulate in your country for details. If necessary, the organizers will post formal invitations for participation in the Competition. You must begin the visa process early as it requires time.

### Local expenses

The Competition Fee, which has not yet been finalized, will include accommodation and meals from dinner on the 31 July to breakfast on 6 August.

Send all confirmations of participation and arrival details to Professor John Jayne ([j.jayne@ucl.ac.uk](mailto:j.jayne@ucl.ac.uk)). If you would like a copy of the competition poster, send your request with postal address to John Jayne. For further information visit the website at [www.imc-math.org.uk](http://www.imc-math.org.uk).

## TRANSPENNINE TOPOLOGY TRIANGLE

## Report



Invited Speaker Tara Holm



Attendees

14

The Transpennine Topology Triangle (TTT) is a joint venture between the Universities of Leicester, Manchester and Sheffield, whose existence relies on an LMS Scheme 3 Grant. Since the inaugural meeting in Manchester in 1995, the meetings have grown in stature and influence throughout the UK. Generations of UK algebraic topology students have given their first external talk, or spoken with their first international expert, during a TTT meeting.

To mark the centenary meeting last September, the milestone TTT100 was specially enhanced with a two day programme in Manchester, and was something of a celebration of the widening influence of algebraic topology in physics. TTT100 incorporated the 2016 Adams Memorial Lecture (the Frank Adams Seminar Room was full!) which focused on potential applications of several concepts that Frank himself had helped to formulate.

The Adams Memorial Lecture was followed by a wine reception and conference dinner, which facilitated informal and relaxed discussion of matters both mathematical and social. **One important question was raised – have any other LMS meetings supported by a Scheme 3 Grant reached 100 meetings?** There was certainly a feeling that (LMS willing!) the

second 100 TTT meetings will be just as influential as the first in shaping the directions of UK algebraic topology.

The invited speakers and their one hour talks were as follows:

- Tara Holm: *Symplectic embeddings and infinite staircases*
- Andrey Lazarev: *Homotopy theory of coalgebras*
- Charles Nash: *From Hilbert's sixteenth problem to physics*
- Oscar Randal-Williams: *Finiteness properties for tautological rings of smooth manifolds*
- Constanze Roitzheim: *Algebraic models in topology*
- Hisham Sati: *Spectra and M-theory* (2016 Adams Memorial Lecture)

Further details of TTT100, and other TTT meetings (both past and future) are publicised on the TTT homepage, <http://sarah-whitehouse.staff.shef.ac.uk/ttt/TTTOnWWW.htm>.

The TTT is grateful for its sponsorship by the London Mathematical Society; additional support for TTT100 was provided by MIMS, The University of Sheffield and The Open University.

Gareth Williams  
Open University

## RECORDS OF PROCEEDINGS AT LMS MEETINGS

### SOUTH WEST & SOUTH WALES REGIONAL MEETING

held on 20 December 2016 at the University of Bath as part of the South West & South Wales Regional Workshops on *New Developments at the Interface between Geometry and Physics* (19–20 December 2016) and *Partially Ordered Materials – Mathematical Perspectives and Challenges* (21 December 2016). Over 35 members and visitors were present for all or part of the meeting.

The meeting began at 2.15 pm with The Vice-President, Professor John Greenlees, in the Chair.

No members were elected to membership.

One member signed the book and was admitted to the Society.

Dr Johannes Nördstrom introduced a lecture given by Professor Simon Donaldson FRS (Simons Center for Geometry and Physics, and Imperial College) on *Progress and Problems on  $G_2$  Manifolds*. After tea, Dr Apala Majumdar introduced a lecture by Professor Carlos Conca (Universidad de Chile) on *An Inverse Problem in Biological Olfactory Cilia*.

The Vice-President expressed the thanks of the Society to the local organisers for putting on such an interesting meeting.

Afterwards, Dr Jon Dawes invited participants to a wine reception, which was held at the Department of Mathematics in Building 4 West, and the Society Dinner took place at Woods Restaurant.

## LMS SOUTH WEST & SOUTH WALES REGIONAL MEETING 2016

### Report

The 2016 LMS South West and South Wales Regional Meeting took place at the University of Bath on Tuesday 20 December, between two workshops on *New Developments at the Interface Between Geometry and Physics* (19–20 December) and *Partially Ordered Materials* (21 December). The Regional Meeting was chaired by Professor John Greenlees, LMS Vice-President who welcomed participants and presided over the traditional formal business of the meeting, including inviting members of the Society to sign the Membership Book if they had not previously done so.

The two speakers at the Regional Meeting delivered engaging illustrations of the themes of the two workshops. The first speaker was Professor Simon Donaldson (Simons Center for Geometry and Physics, and Imperial College London) who conveyed extremely successfully the motivations and rationale behind the study of  $G_2$  manifolds, starting from only undergraduate-level

geometry and algebra. He was followed by Professor Carlos Conca (Universidad de Chile) who described an inverse problem motivated by the detailed biology within cell membranes that holds the key to our ability to smell. Seemingly small changes in the mathematical model enable the well-posed formulation of an inverse problem that produces explicit results with which the mathematicians can provoke the biologists. As a pair of survey talks aimed at a general mathematical audience, both speakers are to be highly commended for their presentations, coming from very different parts of the mathematical spectrum. The Regional Meeting was, as usual, followed by a wine reception and dinner, well-attended and thoroughly enjoyed by speakers and participants in both workshops as well as the LMS representatives.

The workshop days contained a total of twelve presentations; five in the *Geometry and Physics* workshop given by (alphabeti-

cally) Bobby Acharya (ICTP & KCL), Jeffrey Giansiracusa (Swansea), Mathew Pugh (Cardiff), David Skinner (Cambridge), and Katrin Wendland (Freiburg). Speakers discussed a range of geometric and algebraic problems and their various connections to particle physics and field theories. The seven speakers in the *Partially Ordered Materials* workshop were David Bourne (Durham), Isaac Chenchiah (Bristol), Kirill Cherednichenko and Roger Moser (Bath), Nicolas Dirr and Federica Dragoni (Cardiff) and Xianmin Xu (Chinese Academy of Sciences). Topics covered included mathematical problems

concerning materials that are magnetic, elastic, stochastic or undergoing fracture. In both cases the combination of regional and international speakers neatly highlight both research strengths in the region and how globally connected the communities are.

The workshops and meeting were very ably organised by Dr Apala Majumdar, Dr Johannes Nordström and Ms Elaine Ritchie (all from the University of Bath) whose efforts were greatly appreciated by all the participants.

Jonathan Dawes  
University of Bath

## MATHEMATICS SOCIETY AT THE UNIVERSITY OF CENTRAL LANCASHIRE

### 16 Report

The Mathematics Society at the University of Central Lancashire (UCLan) has hosted its first seminar on the 28 November 2016. The speaker was Ann Copestake, Professor in Computational Linguistics at the University of Cambridge, who spoke about *Symbolic models of natural language in the era of deep learning*. The talk was well received, with 50 participants from various areas of research in the univer-

sity: mathematics, physics, computing and languages. We thank Ann for her talk which was accessible, interesting and very interdisciplinary, bringing together for the first time the above mentioned research groups.

The seminar received LMS funding for Undergraduate Mathematical Society Meetings.

Amy Cottom  
Chair of the Mathematics Society





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## London Mathematical Society Undergraduate Research Bursaries in Mathematics 2017

### Nature of Awards

The purpose of the awards is to give experience of research to undergraduates to explore the potential of becoming a researcher and to encourage them to consider a career in scientific research.

The awards provide support for the student at a rate of £180 per week (or £190 per week in London), for a period of between 6 and 8 weeks.

**The closing date for receipt of applications is 5pm Thursday 16 February 2017.**

### Eligibility

- Students may only take up the award during the summer vacation between the **intermediate years** (i.e. 2/3, 2/4 or 3/4) of their undergraduate degree. Students in the final year of their degree intending to undertake a taught Masters degree immediately following their undergraduate degree may apply. Applications on behalf of first-year undergraduates will not be considered.
- Researchers in Mathematics at universities and research institutions within the UK are eligible to apply. Interdisciplinary projects will be considered providing the project has significant mathematical content.
- **Postdoctoral researchers and new lecturers**, early in their careers are also encouraged to apply, and should note this on the application form.
- Only **one** application should be submitted by a supervisor.
- **Departments are asked to provide match-funding** for half of the grant awarded (for example, for a 6 week grant at £180 per week, departments will be asked to contribute £540 and the Society will contribute £540). Departments offering match-funding will be able to receive funding for up to 4 half-funded Bursaries. Departments not willing to provide match-funding will only be able to receive funding for up to 2 Bursaries. Please bear in mind that this is a national scheme with a limited number of bursaries.
- **Mature students** are eligible to apply, but must not have a previous degree in any subject.
- Students will normally be expected to be on track for a first class degree in order to be considered.
- Students must be **registered at a UK institution** for the majority of their undergraduate degree.
- Supervisors and students do not necessarily have to be based at the same institution, however we expect that they will work together at the same institution for the duration of the project and have regular meaningful personal contact (an average of 1 hour per week meeting in person is the minimum expected).
- Bursaries will not be awarded for projects that are a part of degree work, or that take place overseas for more than 50% of the project time.
- Bursaries will only be granted for the student named on the application form; awards are not transferable between students.

### How to apply

- Application Forms can be downloaded from the Society's website: [www.lms.ac.uk/content/grants](http://www.lms.ac.uk/content/grants).
- Applications must be made by the project supervisor on behalf of the student, and not by the student.
- Applications should be discussed with the nominated student, who should also contribute to the project design.
- Applications should include the student's academic record and a supporting statement from his/her academic tutor.
- Applications must be signed by the Head of Department to confirm his/her approval for the award to be administered by the department and to confirm any match-funding contributions by the department (awards are not offered directly to individual researchers but to the institutions to which they belong).

**Further information including the Guidelines on How to Apply are available from the Society website: [www.lms.ac.uk/content/grants](http://www.lms.ac.uk/content/grants). Queries may also be addressed to Katy Henderson ([urb@lms.ac.uk](mailto:urb@lms.ac.uk)).**



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## LMS INVITED LECTURER 2017

### Professor Jim Agler (UCSD)

*Function Theory by Hilbert Space Methods*

**18-22 April 2017, Herschel Building, Newcastle University**

Our topic will be a powerful machinery that has been developed in the last 60 years both to discover and to prove theorems about analytic functions in one and several complex variables through the construction of operators on Hilbert space.

The lectures will begin with expositions of the elementary operator theory that is required to achieve interesting results in function theory.

Next we will show how a number of classical results in the theory of analytic functions in one variable, when cast in a Hilbert space setting, can be proved by operator-theoretic methods which are largely algebraic in nature. These results will include the Herglotz Representation Theorem, the Carathéodory and Pick Interpolation Theorems, Nevanlinna's Representation Theorems, the Carathéodory-Julia Theorems, and Loewner's Theorem.

The remainder of the talks will focus on how the operator-theoretic proofs of these one-variable theorems can be generalized to yield a variety of new results in several complex variables.

#### Guest Lectures

There will also be supplementary lectures by:

**Professor John McCarthy** (Washington University in St. Louis, USA)

Research interests: Analysis, especially Operator Theory and one/several Complex Variables

**Associate Professor Greg Knese** (Washington University in St. Louis, USA)

Research interests: Complex Function Theory, Operators, Harmonic Analysis

**Assistant Professor Kelly Bickel** (Bucknell University, Lewisburg, PA, USA)

Research interests: Multivariate Operator Theory, Several Complex Variables, Harmonic Analysis

#### Accommodation, Travel Funding and Registration

Accommodation will be provided at the Osborne Hotel.

Limited financial support is available with preference given to UK research students. Please contact the organiser for further details: Zinaida Lykova [zinaida.lykova@newcastle.ac.uk](mailto:zinaida.lykova@newcastle.ac.uk). **Deadline for funding: 1 April 2017.**

For further details and how to register for the 2017 Invited Lectures please visit:  
[http://www.mas.ncl.ac.uk/~nek29/lmslectures2017/function\\_theory.html](http://www.mas.ncl.ac.uk/~nek29/lmslectures2017/function_theory.html)



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## Christopher Zeeman Lecture and Medal Presentation

### Rob Eastaway

Wednesday 22 March 2017 at 6.00 p.m. followed by a reception  
at The Royal Society, Carlton House Terrace,  
London, SW1Y 5AG  
Registration will open at 5.30 p.m.

## Maths, Teamwork and Googlies



**Abstract:** Maths is usually regarded as a solo activity, yet some of the richest mathematical experience can come from collaboration: think of Hardy and Ramanujan...Lovelace and Babbage... Duckworth and Lewis. Rob Eastaway takes a light-hearted look back at some of his own mathematical partnerships that have explored games, puzzles, mathematical modelling of everyday life... and even (a little bit of) cricket.

**Rob Eastaway** will give the Christopher Zeeman Lecture and be presented with the Christopher Zeeman Medal, which is awarded biennially by the Institute of Mathematics and its Applications and the London Mathematical Society.

**Admission** to the lecture and reception is by ticket only.

For tickets please contact Alison Penry at the IMA, Catherine Richards House, 16 Nelson Street, Southend-on-Sea, SS1 1EF or email [alison.penry@ima.org.uk](mailto:alison.penry@ima.org.uk) by **1 March 2017**. Tickets are free of charge and will be allocated on a first come, first served basis.

Please confirm whether you wish to attend the lecture and reception, or the lecture only.



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# Microlocal Analysis and Applications

## LMS-CMI Research School

Cardiff

26 – 30 June 2017

**Organisers:** S. Eswarathan (Cardiff), C. Guillarmou (ENS, Paris), R. Schubert (Bristol)

Microlocal analysis is a study of partial differential equations through the lens of symplectic geometry and Fourier analysis. The field has a wide range of applications towards, and not limited to, spectral theory, scattering theory, inverse problems, and dynamical systems. The purpose of this school is to introduce graduate students and young researchers to both its foundations and recent applications.

### Lecture Courses

**Alexander Strohmaier** (University of Leeds) and **Jared Wunsch** (Northwestern University)

*Basic ideas in Microlocal Analysis*

**Stéphane Nonnenmacher** (Université Paris-Sud, 11) and **Andrew Hassell** (Australian National University)

*Scattering Theory and Spectral Theory*

**Viviane Baladi** (Institut de Mathématiques de Jussieu) and **Colin Guillarmou** (CNRS, Université Paris-Sud, 11)

*Pollicott-Ruelle Resonances, Mixing in Dynamical Systems, and X-Ray Transform*

These lecture courses will be supplemented by tutorial sessions.

### Distinguished Speakers

**Maciej Zworski** (Spectral Theory, University of California, Berkeley)

**Günther Uhlmann** (Inverse Problems, University of Washington, Seattle)

**Mark Pollicott** (Dynamical Systems, University of Warwick)

Click here for further information: <https://sureshes.wordpress.com/lms-cmi-research-school/>

**Apply by 31 March 2017:** <https://www.surveymonkey.co.uk/r/RS-32-MicrolocalAnalysis>.

A reference will also be required so your referee should complete this form: <https://www.surveymonkey.co.uk/r/RS-32RefereeForm>.

\*All applicants will be contacted within three weeks after the deadline; information about individual applications will not be available before then.\*

### Fees

Research students: **£150**. There will be no charge for subsistence costs.

Early career researchers: **£250**. There will be no charge for subsistence costs.

Other participants (e.g. those working in industry): **£250** plus subsistence costs.

Research students who will not have completed their PhDs by the start of the Research School (who would otherwise be unable to attend under the title of “research student”) can apply for financial aid.

Fees are not payable until a place at the Research School is offered but will be due by 26 May 2017.



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# New Trends in Representation Theory - The Impact of Cluster Theory in Representation Theory

LMS-CMI Research School

University of Leicester

19 – 23 June 2017

**Organisers:** Karin Baur (U Graz) and Sibylle Schroll (Leicester)

The focus of the course is on recent advances that have emerged in representation theory through cluster theory:  $n$ -representation theory, integrable systems and friezes, and tilting and infinite dimensional representations. These areas of mathematics are enriched by their interactions with other areas of mathematics such as category theory, dynamical systems and mathematical physics.

## Lecture Courses

**Peter Jorgensen** (Newcastle) *[n-representation theory](#)*

**Sophie Morier-Genoud** (Paris) *[Integrable systems and friezes](#)*

**Lidia Angeleri-Hügel** (Verona) *[Infinite dimensional representations](#)*

These lecture courses will be supplemented by tutorial sessions.

**Guest lectures:** **M. Herschend** (Uppsala), **P.-G. Plamondon** (Orsay) and **M. Prest** (Manchester)

For further information, please visit: <https://sites.google.com/site/clustertheoryinrepthory/>

**Apply by 24 March 2017:** [www.surveymonkey.co.uk/r/RS-28-NewTrendsInRepresentationTheory](http://www.surveymonkey.co.uk/r/RS-28-NewTrendsInRepresentationTheory).

A reference will also be required so your referee should complete this form: <https://www.surveymonkey.co.uk/r/RS-28RefereeForm>. Research students, post-docs and those working in industry are invited to apply.

\*All applicants will be contacted within three weeks after the deadline; information about individual applications will not be available before then.\*

## Fees

Research students: **£150**. There will be no charge for subsistence costs.

Early career researchers: **£250**. There will be no charge for subsistence costs.

Other participants (e.g. those working in industry): **£250** plus subsistence costs.

Research students who have not completed their PhDs by the start of the Research School and who would otherwise be unable to attend can apply for financial aid.

Fees are not payable until a place at the Research School is offered but will be due by 19 May 2017.

## VISIT OF YAGO ANTOLIN

Dr Yago Antolin (Universidad Autonoma de Madrid, Spain) will visit the UK between 6 and 18 March 2017. His main research interest is in geometric and combinatorial group theory, and he will visit and collaborate with mathematicians in this area at the universities of Heriot-Watt, Royal Holloway and Southampton. Dr Antolin will give the following presentations:

- Wednesday 8 March  
MAXIMALS (Algebra) Seminar, Heriot-Watt  
(contact Laura Ciobanu: l.ciobanu@hw.ac.uk)
- Monday 13 March  
Pure Mathematics Seminar, RHUL  
(contact Aditi Kar: Aditi.Kar@rhul.ac.uk)
- Friday 17 March  
Pure Mathematics Colloquium,  
Southampton  
(contact Armando Martino:  
A.Martino@soton.ac.uk)

Dr Antolin will participate in other research events following his visit of the three universities, such as the Young Geometric Group Theory meeting in Oxford. The visit is supported by an LMS Scheme 2 grant. For further information contact Laura Ciobanu (l.ciobanu@hw.ac.uk).

## VISIT OF PIERRE CARTIER

Professor Pierre Cartier (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette) will be visiting the UK between 15 and 25 February 2017. Professor Cartier was formerly an associate of the legendary Bourbaki group, and his name is associated with notions for a number of objects (e.g. Hopf algebras, divisors, duality) in many different areas of research. His current long term project concerns the 'cosmic Galois group', combining Grothendieck's ideas about motives with the algebra of Feynman diagrams in Quantum Field Theory. Details of Professor Cartier's talks during his visit are:

- Thursday 16 February, Durham University  
(Collingwood Lecture, aimed at a Maths undergraduate audience)  
*Is there a future for the cosmic Galois group?*  
(contact Herbert Gangl:  
herbert.gangl@durham.ac.uk)

- Monday 20 February, ICMS Edinburgh  
(Maxwell Colloquium)  
*A non-commutative Galois theory for differential equations*  
(contact Christian Saemann:  
c.saemann@hw.ac.uk)
  - Tuesday 21 February, University of Edinburgh (general audience)  
*Hopf Algebras as a source for exotic groups*  
(contact Natalya Iyudu: n.iyudu@ihes.fr)
  - Friday 24 February, University of Oxford  
(Arithmetic Algebraic Geometry Seminar)  
*A new construction of Nori motives*  
by Caramello and Barbieri-Viale, Joyal and Cartier  
(contact Francis Brown:  
francis.brown@all-souls.ox.ac.uk)
- Further details of these arrangements may be obtained from Herbert Gangl (herbert.gangl@durham.ac.uk). The visit is supported partially by an LMS Scheme 2 grant.

## VISIT OF DMITRY TRESCHEV

Professor Dmitry Treschev (Steklov Mathematical Institute, Moscow, Russia) will be visiting the UK between 20 and 31 March 2017. Professor Treschev works on Hamiltonian dynamical systems. Details of Professor Treschev's talks during his visit are:

- Tuesday 21 March, Warwick University  
*Locally linearizable billiard map*  
(contact Vassily Gelfreich:  
V.Gelfreykh@warwick.ac.uk)
- Thursday 23 March, Imperial College, London  
*Arnold diffusion in a priori unstable case*  
(contact Dmitry Turaev:  
d.turaev@imperial.ac.uk)
- Wednesday 29 March, Loughborough University  
*On the inclusion of a map into a flow*  
(contact Alexander Veselov:  
A.P.Veselov@lboro.ac.uk)

Further details of these arrangements may be obtained from Anatoly Neishtadt (a.neishtadt@lboro.ac.uk). The visit is supported by an LMS Scheme 2 grant.

## INDEX THEOREMS IN ANALYSIS, GEOMETRY AND MATHEMATICAL PHYSICS

A one-day conference on *Index Theorems in Analysis, Geometry and Mathematical Physics* will take place at the University of Kent in May 2017. The speakers are:

- Alexander Strohmaier (Leeds)
- Ulrich Pennig (Cardiff)
- Nils Waterstraat (Kent)

The exact date of the meeting will be announced soon. Anyone interested is welcome to attend and can contact the organiser Nils Waterstraat (N.Waterstraat@kent.ac.uk). The meeting is supported by an LMS Conference grant Celebrating New Appointments.

## GREGYNOG WELSH MATHEMATICS COLLOQUIUM 2017



The *Gregynog Welsh Mathematics Colloquium 2017* will be held at Gregynog Hall, Newtown, Powys, Wales from 22 to 24 May 2017. This is a long-standing annual event with a broad mathematical outlook across areas of pure and applied mathematics, statistics and OR. It is aimed at bringing together mathematicians at Welsh HEIs, while also welcoming mathematicians from other parts of the UK. It plays an important

role in fostering mathematical discussion and collaboration between staff and post-graduates in Wales, both on research topics and on higher education policy, and offers a stimulating environment for postgraduate researchers to present their results with ample time for follow-up discussion. The following invited plenary speakers have agreed to give keynote lectures:

- Chris Budd OBE (University of Bath and Gresham College)
- Chris Farmer (University of Oxford)
- Sarah Hart (Birkbeck University of London)

The organisers of the Gregynog Welsh Mathematics Colloquium 2017 are Matthew Lettington and Karl Michael Schmidt (Cardiff University School of Mathematics). For more information please email LettingtonMC@cf.ac.uk or SchmidtKM@cf.ac.uk. Some financial support is available for UK based research students. The Colloquium is supported by an LMS Conference grant.

## SCICADE 2017

SciCADE is a long-running conference series on *Scientific Computation and Differential Equations*. It meets every two years, and has recently been held in Valladolid (2013) and Potsdam (2015). The University of Bath will host the next SciCADE from 11 to 15 September 2017. The programme includes the following plenary speakers:

- Martin Burger (University of Muenster)
- Martin Gander (University of Geneva)
- Anne Gelb (Arizona State University)
- Patrick Joly (ENSTA ParisTech)
- Rachel Kuske (UBC Vancouver)
- Hans Munthe-Kaas (University of Bergen)
- Anne-Karin Tornberg (KTH Stockholm)

For more information see <https://sites.google.com/site/scicade2017>. There is some financial support available for UK-based research students. SciCADE is supported by an LMS Conference grant, the EPSRC network Climathnet, the IMA, SIAM UKIE, and the University of Bath.

## ROUGH PATHS IN PROBABILITY AND STATISTICS

A one day meeting on *Rough Paths in Probability and Statistics* will take place on 2 May 2017 in the Department of Mathematics and Statistics, University Reading. The meeting aims to bring together researchers working on the theory and application of rough paths and to provide an opportunity for research students to present short summaries of their work on rough paths. The speakers are:

- Horatio Boedihardjo (Reading)
- Thomas Cass (Imperial College)
- Anastasia Papavasiliou (Warwick)

There will also be short talks by graduate students. Details about the conference can be found at <https://sites.google.com/site/roughpathsprobat/>. There is a limited amount of funds available to cover the travelling expenses for UK based research students who wish to attend the meeting. Contact [h.s.boedihardjo@reading.ac.uk](mailto:h.s.boedihardjo@reading.ac.uk) for further details. The meeting is supported by a LMS conference grant.

## MATHEMATICAL MODELS IN ECOLOGY AND EVOLUTION

City, University of London will host the 6th bi-annual *Mathematical Models in Ecology and Evolution* conference from 10 to 12 July 2017. The call for abstracts and registration for the conference are now open. The organising committee are welcoming abstracts on the latest developments in the field and the importance of modelling to the next generation of researchers.

Abstracts should be submitted via the conference website by 15 March 2017. Early bird registration will close on 1 June 2017. Visit the website <http://tinyurl.com/htf6vod> to book your place and for conference and submission details. The conference is supported by an LMS Conference grant.

## COMPUTING FOR THE FUTURE OF THE PLANET

The 2017 Bakerian Lecture will be given by Professor Andy Hopper (Cambridge) on *Computing for the future of the planet* at the Royal Society, London on Thursday 2 March 2017. He will explore using the power of digital technologies to solve problems facing the planet, such as sustainability.

The talk is a public lecture which is free to attend and no registration is required (on a first come, first served basis). It starts at 6:30 pm. More information about the talk can be found at <https://royalsociety.org/science-events-and-lectures/2017/03/bakerian-lecture/>.

## NORTH BRITISH FUNCTIONAL ANALYSIS SEMINARS

The next meeting will be held at the University of Birmingham on Friday 10 and Saturday 11 March 2017. The speakers will be Professor Kevin Beanland (Washington and Lee University, USA) and Professor Enrico Le Donne (Finnish Academy and University of Jyväskylä, Finland).

Further details on the programme including abstracts of the talks are available on the NBFAS website at <http://www1.maths.leeds.ac.uk/nbfas/belf16.html>.

NBFAS is partly supported by an LMS Scheme 3 grant which is gratefully acknowledged.

A meeting of the *North British Functional Analysis Seminar* (NBFAS) was held at the University of Warwick on Friday 11 November 2016. Professor Jouni Luukkainen of the University of Helsinki, Finland gave two lectures entitled *Assouad dimension* and *Lipschitz manifolds*, respectively. A joint dinner was held for the participants in the evening.

Dr Martin Mathieu  
Queen's University Belfast  
NBFAS Secretary



## COMPUTER-AIDED MATHEMATICAL PROOF

10 – 14 July 2017

in association with the Isaac Newton Institute programme

*Big Proof*

(26 June - 4 August 2017)

Proofs as constructive demonstrations of mathematical validity have been at the heart of mathematics since antiquity. Formal proof systems capture the definitions, statements, and proofs of mathematical discourse using precisely defined formal languages and rules of inference. Formal proofs have enabled mathematicians to rigorously explore foundational issues of expressiveness, consistency, independence, completeness, computability, and decidability. The formalisation of proof facilitates the representation and manipulation of mathematical knowledge with modern digital computers.

During the last sixty years, the digitisation of formal mathematics has yielded satisfiability solvers, rewriting engines, computer algebra systems, automated theorem provers, and interactive proof assistants. Proof technology can be used to perform large calculations reliably, solve systems of constraints, discover and visualise examples and counterexamples, simplify expressions, explore hypotheses, navigate large libraries of mathematical knowledge, capture abstractions and patterns of reasoning, and interactively construct proofs. The scale and sophistication of proof technology is approaching a point where it can effectively aid human mathematical creativity at all levels of expertise. Modern satisfiability solvers can efficiently solve problems with millions of Boolean constraints in hundreds of thousands of variables. Automated theorem provers have discovered proofs of open problems. Interactive proof assistants have been used to check complicated mathematical proofs such as those for the Kepler's conjecture and the Feit-Thompson odd order theorem. Such systems have also been applied to the verification of practical artifacts such as central processing units (CPUs), compilers, operating system kernels, file systems, and air traffic control systems. Several high-level programming languages employ logical inference as a basic computation step.

Further information available from the website  
<http://www.newton.ac.uk/event/bprw01>

**Closing date for receipt of applications: 8 April 2017**



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## ORTHOGONAL POLYNOMIALS & SPECIAL FUNCTIONS

### LMS Research School

University of Kent, Canterbury, UK; 26–30 June 2017

**Organisers:** Peter Clarkson (Kent) and Ana Loureiro (Kent)

#### Course outline

Modern developments in theoretical and applied science depend on knowledge of the properties of various mathematical functions, from elementary trigonometric to the multitude of orthogonal polynomials and special functions. These lectures cover various aspects of orthogonal polynomials and special functions of current interest and undergoing rapid development.

The three main lecture course topics are:

- Properties of Orthogonal Polynomials, Kerstin Jordaan (University of Pretoria, South Africa)
- Discrete Painlevé Equations, Nalini Joshi (University of Sydney, Australia)
- Multiple Orthogonal Polynomials, Walter Van Assche (KU Leuven, Belgium)

These lecture courses will be supplemented by tutorial sessions.

#### Guest lectures

- **Adri Olde Daalhuis** (University of Edinburgh, UK)
- **Andrei Martinez-Finkelstein** (University of Almería, Spain)

Apply online; see details below. Research students, post-docs and those working in industry are invited to apply. All applicants will be contacted within three weeks after the deadline; information about individual applications will not be available before then\*

#### Fees

*Research students:* **£150** (no charge for subsistence costs).

*Early career researchers:* **£250** (no charge for subsistence costs).

*Other participants:* **£250** (plus subsistence costs).

Research students who will not have not completed their PhDs by the start of the Research School and who would otherwise be unable to attend can apply for financial aid.

Fees are not payable until a place at the Research School is offered but will be due by 26 May 2017.

Further information: <https://blogs.kent.ac.uk/opsf-summerschool>

Apply online at [www.surveymonkey.co.uk/r/RS31OrthogonalPolynomialsApplicationForm](http://www.surveymonkey.co.uk/r/RS31OrthogonalPolynomialsApplicationForm) by **31 March 2017**



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# Algebraic Topology of Manifolds

LMS-CMI Research School

Oxford

11 – 15 September 2017

Organiser: Ulrike Tillmann (Oxford)

Manifolds are at the centre of much of geometry and topology, and through the influence of axiomatic topological quantum field theory they have become an important organising force in category and representation theory.

Classically, in the 1960s, algebraic topology was at the heart of their classification theory in form of characteristic classes and numbers, cobordism theory, surgery theory, and later Waldhausen's K-theory of manifolds. We are now experiencing a renaissance of the field as well as a paradigm shift where manifolds not only are the objects of study but become the tools.

The school aims at inspiring the next generation with this exciting success story of interwoven ideas bouncing between different fields, and giving the participants the tools to contribute to this lively research area.

27

## Lecture Courses

**Dan Freed** (Austin, USA)

*Topological Quantum Field Theory*

**Oscar Randall-Williams** (Cambridge, UK)

*Characteristic classes & moduli spaces of manifolds*

**Greg Arone** (Virginia, USA)

*The Goodwillie–Weiss embedding calculus*

**Nathalie Wahl** (Copenhagen, Denmark)

*Homological stability*

These lecture courses will be supplemented by tutorial sessions. In addition there will be guest lectures.

For further information, please visit: <https://people.maths.ox.ac.uk/tillmann/ATM-SCHOOL.html>

**Apply online** ([www.surveymonkey.co.uk/r/RS33-ATManifoldsApplicationForm](http://www.surveymonkey.co.uk/r/RS33-ATManifoldsApplicationForm)) by **16 June 2017**. Research students, post-docs and those working in industry are invited to apply. \*All applicants will be contacted within three weeks after the deadline; information about individual applications will not be available before then\*

## Fees

Research students: **£150**. There will be no charge for subsistence costs.

Early career researchers: **£250**. There will be no charge for subsistence costs.

Other participants: **£250** plus subsistence costs.

Research students who will not have completed their PhDs by the start of the Research School and who would otherwise be unable to attend can apply for financial aid to cover their travel costs.

Fees are not payable until a place at the Research School is offered but will be due by 21 July 2017.

## JOSEPH KELLER



Joseph Bishop Keller, who was elected a member of the London Mathematical Society on 16 June 2006, died on 7 September 2016, aged 93.

*Alice Whittemore writes:*  
Keller was Professor Emeritus of Mathematics and

Mechanical Engineering at Stanford University and member of the Geophysical Fluid Dynamics Program at the Woods Hole Oceanographic Institute. Considered by many as the 'Dean of Applied Mathematics', Keller was best known for his geometrical theory of diffraction, a method for determining how acoustic or electromagnetic waves are deflected by the surface of an object. This research has had broad applications to radar, stealth technology and antenna design. Keller also studied many other issues related to national security, including the possibility that underwater explosions of atomic bombs might cause a tsunami - a question prompted by the US testing of nuclear devices at Bikini Atoll more than 50 years ago.

Keller's work was inspired by a wide-ranging curiosity and gift for finding a problem's mathematical essence. With a child at a party, he might discuss how tiny soda bubbles form patterns in a glass, and later discuss the nuances of wave propagation with a colleague. He developed and used a method of approximation known as 'asymptotic analysis' to tackle problems that cannot be solved exactly, and applied it to predict behavior in many fields. For example, he used the method to describe

eigenvalue spectra in quantum mechanics, to develop optimal strategies for runners in a race, to study the propagation of nerve pulses, to model the development of the visual system in mammals, and to understand the locomotion of worms and how it differs from that of snakes. His explanations for why teapots dribble and why joggers' ponytails swing from side to side received two Ig Nobel Prizes for 'research that makes you laugh and then makes you think'.

Keller was a member of the US National Academy of Science (NAS), a Foreign Member of the Royal Society of London, and Honorary Professor of Mathematical Sciences at the University of Cambridge. He received many scientific honors, including the Wolf Prize in Mathematics (1997), the Frederick E. Nemmers Prize (1996), the NAS Award in Applied Mathematics and Numerical Analysis (1995), the National Medal of Science (1988), the Timoshenko Medal (1984), the Eringen Medal (1981), and the von Karman Prize (1979). He was the Gibbs Lecturer of the American Mathematical Society (1977), and the von Neumann Lecturer of the Society of Industrial and Applied Mathematics (1983). His work earned him honorary doctorates from eight universities throughout the world.

In awarding him the Wolf Prize in Mathematics, the Wolf Foundation noted that Keller 'brought a deep understanding of physics and a superb skill at asymptotics to an astonishing range of problems', adding, 'He is really the model of what a mathematician interested in a wide variety of physical phenomena can and should be'.

## IN MEMORY OF YURI SAFAROV

The *Journal of Spectral Theory* has published a special issue (volume 6 (2016) issue 4) in memory of Professor Yuri Safarov who died on 2 June 2015, aged 57. It is a collection of papers in subject areas related to Safarov's work which are written by people who knew him well. This

special issue (<http://tinyurl.com/zfpnxrr>) has a preface which serves as an extended obituary and describes Safarov's research.

Professor Safarov was elected a member of the London Mathematical Society on 21 January 1994 and awarded a Whitehead Prize in 1996.

## MAXWELL READE

Professor Maxwell O. Reade, who was elected a member of the London Mathematical Society on 18 March 1948, died on 13 April 2016, aged 100 years and two days. Professor Reade was a Professor of Mathematics at

the University of Michigan for 40 years, until he retired in 1986, specializing in Complex Analysis, publishing 83 papers. Professor Maxwell was the fifth longstanding LMS member.

## THE GCHQ PUZZLE BOOK

by Michael Joseph, Penguin Books, 2016, pp 368, £12.99, ISBN 780-718185541.

2016 was an excellent year for puzzle books, with outstanding collections from David Singmaster (Problems for Metagrobologists, recently reviewed by Colin Wright in this Newsletter) and Alex Bellos (Can you solve my problems?). And just before the end of the year they were joined by this exciting volume from GCHQ (the Government Communications Headquarters). It comes with an introduction from HRH the Duchess of Cambridge, whose grandmother worked at Bletchley Park during the War, and who with her husband is spearheading the Heads Together campaign tackling stigma around mental health: all GCHQ proceeds from the book are going to Heads Together. While there may be an element of post-Snowden public relations at play in the publication, this is a thoroughly enjoyable collection.

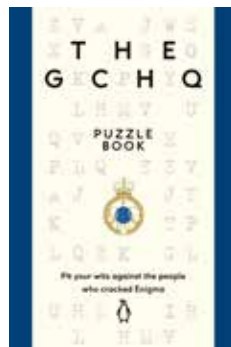
The puzzles are all set by people who work, or have worked, at GCHQ: many of them come from the organisation's annual internal Christmas Quiz (or, as they regrettably term it, Kristmas Kwiz). In style they are reminiscent of the BBC Radio 4 Round Britain Quiz, often having many parts leading to an overall answer: a few involve codes but generally the puzzles are not just mathematical but require wide general knowledge, logical thinking and imagination. They vary in difficulty but, although they initially look baffling, they are not all impossible! There is a helpful section explaining some of the different kinds of puzzle, and some "starter" questions with clues available to get you going. And as a bonus we get sixteen

pages of fascinating historic photographs (in colour where possible) relating to cryptography.

The book also contains the 2016 GCHQ Kristmas Kwiz comprising 41 questions. That this is designed to be solved by teams of up to four over

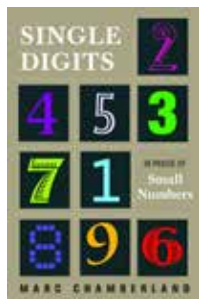
a period of seven weeks indicates that this is quite a challenge! (Answers to this one are not in the book, for obvious reasons, but will be made available on the web in due course.) There is also a competition, with the closing date of 28 February 2017, so you still have time to enter!

The questions are rarely straightforward – unless you are a much better solver than I am, you won't get many answers immediately, but it is very satisfying when an insight eventually comes. Perhaps the problems are ideally tackled with company: the references are drawn from such a wide range of fields that teamwork would be very helpful. I cannot imagine that any reader of this Newsletter who likes a challenge will not be delighted by this collection. That any purchase helps a good cause is an additional reason to purchase.



## SINGLE DIGITS: IN PRAISE OF SMALL NUMBERS

by Marc Chamberland, Princeton University Press, 2015, pp 240, hb £19.95, US\$26.95, ISBN 978-0691161143, pb June 2017, £14.95, US\$17.95, ISBN 978-069117560.



All mathematicians will be familiar with theorems which begin "If  $n$  is a sufficiently large integer, ...". Professor Chamberland sets out to investigate the gaps left, where small values of the parameters involved lead to strange and fascinating phenomena.

His investigation is wide-ranging, covering various areas of both pure and applied mathematics, as well as oddities such as origami and magic tricks. While mathematicians will find many familiar topics among those he investigates, the variety is such that everyone will find some material which is new to them and sparks their interest.

The book is divided into nine chapters, each dealing with one of the first nine positive integers. It will come as no surprise to find that the chapters on 2 and 3 are by far the longest, but Professor Chamberland introduces topics

of lively interest in each chapter. Chapters are divided into sections (of varying length) on the topics covered, making it easy to dip into the book even when one has only a few minutes to spare.

The areas covered vary in difficulty – from those easily accessible to a mathematically inclined amateur, to those which are definitely research level – but all are well set out and clearly explained, with diagrams where necessary.

With such wide-ranging topics it is not easy to give a full list of helpful references, so if one particular topic catches your interest you may well need to do your own investigation. However, Professor Chamberland does give a list of useful books and articles for those who wish to brush up on their background knowledge.

Altogether, this is an interesting and entertaining book on a wide range of material. If you are looking for a present for a mathematically inclined friend, this is it!

Mary Jones  
Southampton University

## SCALABLE STATISTICAL INFERENCE

3 – 7 July 2017

in association with the Isaac Newton Institute programme

*Scalable Inference; Statistical, Algorithmic, Computational Aspects*

(3 - 28 July 2017)

The complexity and sheer size of modern data sets, of which ever increasingly demanding questions are posed, give rise to major challenges and opportunities for modern statistics. Many of those challenges are of a computational nature and the aim of the workshop is to bring together researchers from a broad range of horizons with an interest in such issues, in particular scalability.

Further information available from the website

<http://www.newton.ac.uk/event/sinw01>

**Closing date for receipt of applications: 27 March 2017**



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## BMC 2017: 3–7 April 2017

including

### LMS Society Meeting

Monday 3 April

Durham

**3:45 pm** LMS Society Meeting

Plenary Lecture: Isabelle Gallagher (Université Paris-Diderot, IMJ-PRG)

This Society Meeting is part of the British Mathematical Colloquium 2017. The full conference will also include a public lecture by **Noam Elkies** (Harvard), and plenaries given by **Eva Bayer-Fluckiger** (EPFL), **Kenji Fukaya** (Kyoto University/Simons Center), **Laurent Lafforgue** (IHÉS), **Jacob Lurie** (Harvard University) and **George Lusztig** (MIT).

#### **MORNING SPEAKERS**

Alessandra Bernardi, Gérard Besson, Tara Brendle, Jan Bruinier, Olivia Caramello, Alexander Grigor'yan, Fanny Kassel, Ari Laptev, Diane Maclagan, Oscar Randal-Williams, James Robinson.

#### **Workshops (Tue & Wed afternoon)**

**Algebra**, organiser: Emilie Dufresne

**Analysis**, organisers: Norbert Peyerimhoff, Ari Laptev

**Geometry**, organiser: John Parker

**Number Theory**, organiser: Jens Funke

**Topology**, organiser: Dirk Schuetz

The plenary and morning talks will take place in the Calman Learning Centre (CLC) on the Science Site. The tea/coffee and lunches will be served in the Earth Sciences (ES) building, adjacent to the CLC. Rooms E101 and E102 are in the Engineering building and CM101 is in the Maths building.

The **cost of registration** is £50 (early bird until 28 February 2017; £80 thereafter). The registration fee for postgraduate students is £50. The conference dinner is £50.

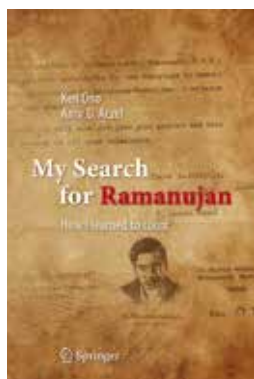
The accommodation is in Collingwood College, which is a 10min walk from where the Science Site, where the conference will take place.

For further information and to register: <http://www.maths.dur.ac.uk/bmc2017/index.xhtml>

Early bird registration is now open.

## MY SEARCH FOR RAMANUJAN

by K. Ono and A.D. Aczel, Springer, 2016, pp 238, £19.99, ISBN 978-3319255668.



This book is a non-technical narrative of the life journeys of three mathematicians, namely Emory University professor Ken Ono, his father Takashi Ono, a professor at Johns Hopkins University, and the Indian mathematical genius

book, recounts the story of Ramanujan. His remarkable journey from obscurity to world-fame, all made possible by the depth and breadth of his mathematical discoveries, has been told by several authors. G.H. Hardy's classic work [2] (and its modern variant [3]) give an overview of large parts of Ramanujan's mathematics. But going beyond the mathematics, it is the story of Ramanujan's *life* that is so fascinating both professional and lay people alike.

The popular biography *The Man Who Knew Infinity* by R. Kanigel has attracted public attention, both through the book itself, as well as its adaptation to the screen by Matt Brown. In it, we see a young man who was passionately absorbed in mathematics, who by the power of his hard work, had made discoveries on par with the greatest mathematicians of history, and who was only partially recognized in his day. We also see the heart-wrenching tragedy of aspects of his life that must have weighed heavily on him at an emotional level and wonder whether he would have achieved even greater scientific heights had there been a way of resolving those issues. We see a young man who came to England eager to share his ideas with Hardy, a leading mathematician of the day, and for which he had to endure cultural racism. And we see him die at the very young age of 32.

Both the scientific and the human aspects of Ramanujan's story are powerful in their appeal. Subramanian Chandrasekhar, a Nobel laureate in Physics and for many years a professor at the University of Chicago, wrote: "The fact that Ramanujan's early years were spent in a scientifically sterile atmosphere, that his life in India was not without hardships, that under circumstances that appeared to most Indians as nothing short of miraculous, he had gone to Cambridge, supported by eminent mathematicians, and had returned to India with every assurance that he would be considered, in time, as one

Srinivasa Ramanujan, who never held an academic position. It is touching, at times moving, and a compelling human story.

While it is reasonable to expect that the narrative of the father-son pair would be intertwined, the introduction of Ramanujan into the story, is both unexpected and inspiring. It is unexpected because of the time, location and culture separating Ramanujan from the Ono family. And it is inspiring as it illustrates the power of ideas and thoughts, and perhaps more importantly, the power of the human struggle, to bridge the chasm of time and space and culture.

While we often hear of human unity in terms of basic physical needs of food and shelter, it is important to note that there are also basic emotional, intellectual and spiritual needs. In the book, these needs are poignantly described through Ken Ono's early life, growing up as the youngest son in a Japanese immigrant family in America, facing the clash of cultures and the racism of the time, and then narrating how a letter from Janaki Ammal, the widow of Ramanujan, brought father and son together, and showed the young Ono a direction forward. This occupies Part 1 of the book.

Part 2, which is about one fourth of the

of the most original mathematicians of the century – these facts were enough – more than enough – for aspiring young Indian students to break their bonds of mathematical confinement and perhaps soar the way that Ramanujan had.” [1, pp. 3-4]

But the inspirational power of the story of Ramanujan was not just confined to India. Atle Selberg, the famous Norwegian mathematician and Fields medalist, wrote how through his brother he was able to see a copy of the *Collected Papers* of Ramanujan. “It seemed quite like a revelation – a completely new world to me, quite different from any mathematics book I had ever seen – with much more appeal to the imagination, I must say. And frankly, it still seems very exciting to me and also retains that air of mystery which I felt at the time. It was really what gave the impetus which started my own mathematical work.” [4, pp. 695-696] And there are countless others, both mathematicians and non-mathematicians, who have been inspired by Ramanujan’s scientific and human legacy.

The third and final part, which occupies about half the book, describes Ken Ono’s awakening to his own mathematical destiny, always guided in some way by the work, ideas and life of Ramanujan. It details his path towards becoming a professional mathematician. We see him as an undergraduate at Chicago, then as a graduate student at UCLA, where he found similarities between his advisor Basil Gordon and Ramanujan’s mentor G.H. Hardy, and his path to Emory through various positions at different universities.

In one of the final chapters, Ono reflects on what this entire adventure has taught him about how to live life and in a TedX talk summarizes his view as ‘how to live mathematically, but not by the numbers’, where ‘living mathematically’ means to live life with creativity, flexibility, confidence and determination. He concludes with a brief discussion on the connection to spirituality and says “My search for Ramanujan has transformed me. Raised with no religion, I found

the strong need to come to terms with the sense of awe elicited by Ramanujan’s formulas, and more generally the beautiful infinite complexity of the universe. Thanks to this awakening, I now wish to experience the world, to enjoy its beauty and its people. My curiosity pushes me, and it has left me open to discovering my spirituality.”

To many, mathematics is seen as an impenetrable wall of logic, symbols and formulas. I would highly recommend this book to those who want to get a meaningful glimpse of what is behind the wall and how the wall can be penetrated. There are too few books that describe the artistic, creative and human, and even spiritual aspect of the mathematical enterprise. “My search for Ramanujan” is therefore a welcome addition to this literature.

While the entire narrative is told in the context of a mathematical journey, the deeper message is of the fundamental interconnectedness of humanity in terms of our aspirations and our struggles, and the power of ideas to transcend national or cultural boundaries. This is something that should appeal to a broad audience. Moreover, it is essential that stories of this interconnectedness be widely heard and discussed. For at a time when forces around the world threaten to drive people and nations apart, we need to hear about the humanity, nay the spirituality, that connects us all.

V. Kumar Murty  
Department of Mathematics  
University of Toronto

#### References

1. S. Chandrasekhar, “On Ramanujan”, in: *Ramanujan Revisited*, pp. 1-6, eds. G. Andrews, et. al., Academic Press, San Diego, 1988.
2. G.H. Hardy, *Ramanujan: Twelve lectures on subjects suggested by his life and work*, 3rd edition, Chelsea, New York, 1978.
3. M. Ram Murty and V. Kumar Murty, *The mathematical legacy of Srinivasa Ramanujan*, Springer India, New Delhi, 2013.
4. Atle Selberg, “Reflections around the Ramanujan Centenary”, in *Collected Papers*, Volume 1, Springer, Berlin, 1989.



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## CECIL KING TRAVEL SCHOLARSHIP

The London Mathematical Society annually awards a £5,000 Cecil King Travel Scholarship in Mathematics, to a young mathematician of outstanding promise. The Scholarship is awarded to support a period of study or research abroad, typically for a period of three months. Study or research in all areas of mathematics is eligible for the award.

The award is competitive and based on a written proposal describing the intended programme of study or research abroad, and the benefits to be gained from such a visit. A shortlist of applicants will be selected for an interview during which they will be expected to make a short presentation on their proposal.

Applicants must be nationals of the UK or the Republic of Ireland, either registered for or having completed a doctoral degree within 12 months of the closing date.

Applications should be made using the form available on the Society's website (<https://www.lms.ac.uk/prizes/cecil-king-travel-scholarship>) or by contacting [education@lms.ac.uk](mailto:education@lms.ac.uk). The closing date for applications is **Friday 31 March 2017**. It is expected that interviews will take place in London in late May or early June.

*The Cecil King Travel Scholarship was established in 2001 by the Cecil King Memorial Fund. The award is made by the Council of the London Mathematical Society on the recommendation of the Cecil King Prize Committee, nominated by the Society's Research Meetings Committee.*

The London Mathematical Society is a registered charity for the promotion of mathematical knowledge.

## CALENDAR OF EVENTS

This calendar lists Society meetings and other mathematical events. Further information may be obtained from the appropriate LMS Newsletter whose number is given in brackets. A fuller list is given on the Society's website ([www.lms.ac.uk/content/calendar](http://www.lms.ac.uk/content/calendar)). Please send updates and corrections to [calendar@lms.ac.uk](mailto:calendar@lms.ac.uk).

### FEBRUARY 2017

2–3 Mathematical Medicine and Mathematical Pharmacology, Swansea (465)  
 11 Mathscon, Imperial College London  
 20–21 Origins of Numerical Abilities Royal Society Scientific Discussion Royal Society London (463)  
 20–21 Mathematical Imaging with Partially Unknown Models, Cambridge (465)  
 23–24 COW and Calf in Cardiff (465)

### MARCH 2017

2 Computing for the Future of the Planet, Royal Society, London (466)  
 10–11 North British Functional Analysis Seminar, Birmingham (466)  
 20–24 Young Geometric Group Theory Meeting, Oxford (465)  
 22 Maths, Teamwork and Googlies, Rob Eastaway, Christopher Zeeman Medal Lecture, London (466)  
 29–31 Young Functional Analysts' Workshop, Glasgow (465)  
 30 Spectral Geometry, Leeds (465)

### APRIL 2017

3 Society Meeting at BMC, Durham (466)  
 3–6 BMC, Durham (463)  
 10 Developing Efficient Methodologies for Modelling Stochastic Dynamical Systems in Biology, Bath (465)  
 10–12 BAMC, Surrey (463)  
 18–21 Research Students Conference, Durham (465)  
 18–22 Function Theory by Hilbert Space Methods, Jim Alger, LMS Invited Lecturer, Newcastle (466)  
 25 Reforms to Mathematics Qualifications Westminster Education Forum Seminar, London  
 27–28 Mathematical Ecology Workshop, Swansea (464)

### MAY 2017

2 Rough Paths in Probability and Statistics, Reading (466)  
 5 Mary Cartwright Lecture, London  
 8–12 Approximation, Deformation, Quasification INI Workshop, Cambridge (464)  
 22–24 Gregynog Welsh Mathematics Colloquium, Gregynog Hall, Newtown, Powys (466)

### JUNE 2017

1 LMS Northern Regional Meeting, York  
 19–23 Group Actions and Cohomology In Non-Positive Curvature, INI Cambridge (465)  
 19–23 New Trends in Representation Theory LMS–CMI Research School, Leicester (466)  
 26–30 Quantum Topology and Categorized Representation Theory, INI Cambridge (465)  
 26–30 Orthogonal Polynomials and Special Functions LMS–CMI Research School, Kent (466)  
 26–30 Microlocal Analysis and Applications LMS–CMI Research School, Cardiff (466)  
 30 LMS Graduate Student Meeting, London  
 30 LMS Society Meeting, London

### JULY 2017

3–7 Scalable Statistical Inference, INI Cambridge (466)  
 3–7 BSDEs, SPDEs and their Applications Workshop, Edinburgh  
 3–7 British Combinatorial Conference, Strathclyde (464)  
 10–12 Mathematical Models in Ecology and Evolution Conference, City, University of London (466)  
 10–14 Computer-aided Mathematical Proof, INI Cambridge (466)  
 10–19 Foundations of Computational Mathematics Conference, Barcelona (461)  
 31–5 Aug International Mathematics Competition, Blagoevgrad, Bulgaria (466)

### SEPTEMBER 2017

10–15 Mathematics Education for the Future Decade, Balatonfüred, Hungary (460)  
 11–15 Algebraic Topology of Manifolds LMS–CMI Research School, Oxford (466)  
 11–15 Scientific Computation and Differential Equations, Bath (466)  
 24–29 Heidelberg Laureate Forum (465)

# LMS SOUTH WEST AND SOUTH WALES REGIONAL MEETING

Friday 20 December 2016

(Report on page 15)



Organiser Johannes Nördstrom  
signing the LMS Membership Book



Simon Donaldson, first speaker  
*Progress and Problems on G2 Manifolds*



Organiser Apala Majumdar introducing the  
second speaker Carlos Conca



Carlos Conca, second speaker  
*An Inverse Problem in Biological Olfactory Cilia*



Questions from the audience



LMS Vice-President, Professor John Greenlees,  
chairing the meeting