

LONDON MATHEMATICAL SOCIETY EST, 1865

NEWSLETTER

No. 471 July 2017

SIR ANDREW WILES AWARDED COPLEY MEDAL

The London Mathematical Society (LMS) congratulates Sir Andrew Wiles KBE FRS on his award of the Royal Society Copley Medal, the world's oldest scientific prize. He receives the award for proving Fermat's Last Theorem and joins a list of winners including Charles Darwin, Humphrey Davy and Albert Einstein. Sir Andrew was also awarded the Abel Prize in 2016 and was an LMS Junior Whitehead Prize winner in 1988.

The Copley Medal was first awarded in 1731 by the Royal Society, 170 years before the first Nobel Prize, and is awarded for outstanding achievements in scientific research.

PROFESSOR ALISON ETHERIDGE RECEIVES OBE IN BIRTHDAY HONOURS

The London Mathematical Society (LMS) extends its warmest congratulations to LMS member Professor Alison Etheridge FRS, who has been awarded an OBE in the Queen's Birthday Honours.

Professor Etheridge is Professor of Probability at the University of Oxford where she holds a joint appointment in the Departments of Mathematics and Statistics and a Fellowship at Magdalen College. She is also Associate Head of the Mathematical, Physical and Life Sciences (MPLS) Division. Professor Etheridge was elected as a Fellow of the Royal Society (FRS) in 2015.

Professor Etheridge completed her BA in Mathematics at New College in 1985. After a year as a research student in Oxford, she went to McGill University before returning to New College in 1987. She then worked in Cambridge, Edinburgh, Berkeley and QMUL before returning to Oxford once more in 1997.



Her research is largely interdisciplinary and can be divided into the three interconnected areas of infinite dimensional stochastic analysis, mathematical ecology and mathematical population genetics. As well as her research contributions

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SOCIETY MEETINGS AND EVENTS 2017

- 7-8 September Prospects in Mathematics, Reading
- 18 September: Midlands Regional Meeting, Loughborough *page 38*
- 20 September: Popular Lectures, Birmingham page 9
- 12 October: Symmetry & Computation, London
- 10 November: Graduate Student Meeting, London
- 10 November: Annual General Meeting, London
- 11 December: SW & South Wales Regional Meeting, Cardiff



http://newsletter.lms.ac.uk

LMS NEWSLETTER

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Professor Etheridge has devoted time to the benefit of the wider mathematics community. She is a member and President-Elect of the Institute of Mathematical Statistics (IMS), has served on the LMS Council, and is a Fellow of the Institute of Mathematics and its Applications (IMA). Professor Etheridge provided valuable service in both the RAE2008 and the REF2014 as a sub-panel member. She has also served on a number of LMS committees, in particular the LMS Research Policy Committee, and other programmes over the years. Professor Etheridge is involved with the EPSRC, where she is currently an appointed member of the EPSRC Strategic Advisory Network (SAN) and has previously served on the EPSRC Mathematics Strategic Advisory Team (SAT).

Professor Simon Tavaré, LMS President, said: 'This is a fitting tribute to the enormous contributions Alison has made to the mathematical community in the UK'.

LMS HONORARY MEMBER SHARES 2017 SHAW PRIZE

The London Mathematical Society (LMS) congratulates LMS Honorary Member Claire Voisin, Professor and Chair in Algebraic Geometry, Collège de France, who is the joint winner of the Shaw Prize in the Mathematical Sciences. Professor Voisin shares the prize with János Kollár, Professor, Department of Mathematics, Princeton University.

This international award honours individuals who are currently active in their respective fields and who have recently achieved distinguished and significant advances, who have made outstanding contributions in academic and scientific research or applications, or who in other domains have achieved excellence. Profes-



Claire Voisin

sors Voisin and Kollár have been awarded the Prize for their 'remarkable results in many central areas of algebraic geometry, which have transformed the field and led to the solution of long-standing problems that

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had appeared out of reach'.

The Shaw Prize is an annual award first presented by the Shaw Prize Foundation in 2004. Established in 2002 in Hong Kong, it honours people working in the fields of astronomy, life science and medicine, and mathematical sciences. The 2017 Shaw Prizes are worth US\$1.2m.

Further information is available at http:// tinyurl.com/y7eq6xwa.

COLLINGWOOD MEMORIAL PRIZE

The 2017 Collingwood Memorial Prize has been awarded to Jonathan Owen, Josephine Butler College, Durham University. The Collingwood Memorial Prize, established in memory of Sir Edward Collingwood FRS, President of the London Mathematical Society 1969-1970, is awarded to a finalyear mathematics student at the University of Durham who intends to continue to a higher degree in mathematics.

A REFRESHED LMS NEWSLETTER

Later this year we'll find a new-look Newsletter in our mailboxes. The refreshed Newsletter will not only have a new appearance, but will include mathematical feature articles as well as other new types of content. We'll also see a change in the frequency we receive the Newsletter, with a new issue appearing every second month.

The refresh brings new opportuni-

EDITOR'S NOTE

With this issue I finish my term as Editor of the LMS Newsletter. I would like to thank Council for giving me this wonderful opportunity, which I have enjoyed hugely, and to express my gratitude to everyone who has contributed, and especially to the meetings editors, Stephen Huggett, Robert Wilson and Iain Stewart, and reviews editors Colva Roney-Dougal and David Singerman. Katherine Wright and her predecessors have always done a wonderful job in producing an immaculately-presented Newsletter. But very special thanks are due to Susan Oakes, ties for members, and the mathematical community as a whole, to be involved in the Society. We warmly welcome contributions to the *Newsletter* from all members, as well as non-members, and look forward to working with as many mathematicians as possible in bringing together each issue.

> lain Moffatt Incoming Editor-in-Chief

who throughout my editorship has done most of the editorial work, suggesting, soliciting and editing articles, reminding me of deadlines, and generally doing all the hard work. Susan's contribution to the *Newsletter* over the last few years has been immense, and I am privileged to have worked with her.

Like other LMS members, I am now looking forward to the newly redesigned *Newsletter* with great anticipation, and I am confident of its success under the new editorial team.

William Benter Prize in Applied Mathematics 2018

Call for NOMINATIONS

The Liu Bie Ju Centre for Mathematical Sciences of City University of Hong Kong is inviting nominations of candidates for the William Benter Prize in Applied Mathematics, an international award.

The Prize

The Prize recognizes outstanding mathematical contributions that have had a direct and fundamental impact on scientific, business, financial, and engineering applications.

It will be awarded to a single person for a single contribution or for a body of related contributions of his/her research or for his/her lifetime achievement.

The Prize is presented every two years and the amount of the award is US\$100,000.

Nominations

Nomination is open to everyone. Nominations should not be disclosed to the nominees and self-nominations will not be accepted.

A nomination should include a covering letter with justifications, the CV of the nominee, and two supporting letters. Nominations should be submitted to:

Selection Committee

c/o Liu Bie Ju Centre for Mathematical Sciences City University of Hong Kong Tat Chee Avenue Kowloon

Hong Kong

Or by email to: lbj@cityu.edu.hk

Deadline for nominations: 30 September 2017

Presentation of Prize

The recipient of the Prize will be announced at the **International Conference on Applied Mathematics 2018** to be held in summer 2018. The Prize Laureate is expected to attend the award ceremony and to present a lecture at the conference.

The Prize was set up in 2008 in honor of Mr William Benter for his dedication and generous support to the enhancement of the University's strength in mathematics. The inaugural winner in 2010 was George C Papanicolaou (Robert Grinmett Professor of Mathematics at Stanford University), and the 2012 Prize went to James D Murray (Senior Scholar, Princeton University; Professor Emeritus of Mathematical Biology, University of Oxford; and Professor Emeritus of Applied Mathematics, University of Washington), the winner in 2014 was Vladimir Rokhlin (Professor of Mathematics and Arthur K. Watson Professor of Computer Science at Yale University). The winner in 2016 was Stanley Osher, Professor of Mathematics, Computer Science, Electrical Engineering, Chemical and Biomolecular Engineering at University of California (Los Angeles).

The Liu Bie Ju Centre for Mathematical Sciences was established in 1995 with the aim of supporting world-class research in applied mathematics and in computational mathematics. As a leading research centre in the Asia-Pacific region, its basic objective is to strive for excellence in applied mathematical sciences. For more information about the Prize and the Centre, please visit *http://www.cityu.edu.bk/lbj/*





LMS PRIZES 2017

The winners of the LMS Prizes for 2017 were announced at the Society meeting on Friday 30 June 2017. The Society extends its congratulations to these winners and thanks to all the nominators, referees and members of the Prizes Committee for their contributions to the Committee's work this year.



PROFESSOR ALEX WILKIE, FRS, of the **University of Oxford and Professor Emeritus of the University of Manchester**, is awarded the **Pólya Prize** for his profound contributions to model theory and to its connections with real analytic geometry.



PROFESSOR PETER CAMERON, of the **University of St Andrews**, is awarded a **Senior Whitehead Prize** for his exceptional research contributions across combinatorics and group theory. His fertile imagination and encouragement of others have sparked activity in many fields.



PROFESSOR ALISON ETHERIDGE, FRS, of the **University of Oxford**, is awarded a **Senior Anne Bennett Prize** in recognition of her outstanding research on measure-valued stochastic processes and applications to population biology; and for her impressive leadership and service to the profession.



PROFESSOR JOHN ROBERT KING, of the **University of Nottingham**, is awarded a **Naylor Prize and Lectureship** for his profound contributions to the theory of nonlinear PDEs and applied mathematical modelling.



KEVIN COSTELLO, of the **Perimeter Institute**, **Canada**, is awarded a **Berwick Prize** for his paper 'The partition function of a topological field theory', published in the *Journal of Topology* in 2009, which characterizes the function as the unique solution of a master equation in a Fock space.

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DR JULIA GOG, of the University of Cambridge, is awarded a Whitehead Prize for her wide-ranging contributions to the mathematical understanding of disease dynamics, particularly influenza, based on both mathematical mastery and profound biological insight, gained from her long-standing collaborations with immunologists and epidemiologists.



DR ANDRÁS MÁTHÉ, of the University of Warwick, is awarded a Whitehead Prize for his original insights into deep problems from geometric measure theory, combinatorics and real analysis.



DR ASHLEY MONTANARO, of the **University of Bristol**, is awarded a **Whitehead Prize** for his outstanding and strikingly diverse contributions across the field of quantum computation and quantum information theory.



DR OSCAR RANDAL-WILLIAMS, of the University of Cambridge, is awarded a Whitehead Prize for his contributions to algebraic topology and in particular the study of moduli spaces of manifolds.



DR JACK THORNE, of the **University of Cambridge**, is awarded a **Whitehead Prize** for his contributions to number theory, and in particular to the Langlands program.



PROFESSOR MICHAEL WEMYSS, of the **University of Glasgow**, is awarded a **Whitehead Prize** for the profound applications of algebraic and homological techniques to algebraic geometry.





LMS – NZMS AITKEN UK LECTURE TOUR 2017

The Society is delighted to announce that the 2017 LMS-NZMS Aitken Lecturer is Professor Hinke Osinga FRSNZ (University of Auckland).

Hinke Osinga, Professor of Applied Mathematics at the University of Auckland in New Zealand, is the fourth Aitken Lecturer to visit the UK. She is an expert in dynamical systems and its applications. Her publications, illustrations, animations and outreach activities have made her famous worldwide in the mathematics and arts communities.

In October 2017, Professor Osinga will return to the UK for the second Aitken Lecture Tour. She will visit Bristol, Kent, Newcastle and Warwick.

She will give lectures on "Chaos and wild chaos in Lorenz-type

systems," "The art of computing global manifolds," and "Shaken but not stirred: Using mathematics in earthquakes."







The Aitken Lectureship scheme is part of Forder-Aitken Lectureship exchange, which is a collaboration between the London Mathematical Society and the New Zealand Mathematical Society. Each Society invites an eminent mathematician from the other country to give lectures at different universities around the country.

The Aitken Lectureship, named after Professor A. Aitken - one of New Zealand's great mathematicians, is a Lecture Tour around the UK undertaken by a mathematician from New Zealand. The Forder Lectureship, named after Professor H. G. Forder (formerly of the University of Auckland and a benefactor of the London Mathematical Society) is a Lecture Tour around New Zealand undertaken by a mathematician from the UK. For further details about the Aitken Lectureship, please visit https://www.lms.ac.uk/events/lectures/forder-and-aitken-lectureship#Aitken

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LMS POPULAR LECTURES 2017

BIRMINGHAM (University of Birmingham) Wednesday 20 September at 18:30

David Tong (University of Cambridge) The Unreasonable Effectiveness of Physics in Mathematics

For centuries there has been a close relationship between mathematics and theoretical physics. For the most part, this involved physicists gleefully using ideas previously developed by mathematicians. In the past few decades, that relationship has taken a surprising twist: in their quest to understand Nature, physicists have developed new tools, such as quantum field theory and string theory, which are providing insight into questions in pure mathematics



Jason Lotay (University College London) Adventures in the 7th Dimension



In 7 dimensions there exist special shapes that may help us unlock the mysteries of the universe. Looking for this unique geometry is challenging, but nature holds a possible solution (specifically, bubbles and thermodynamics). This lecture will take us on a mathematical journey across multiple dimensions, exploring their role in art, science and popular culture.

Commences at 6.30 pm, refreshments at 7.30 pm, ends at 9.00 pm. Admission is free, with ticket. Register by **Thursday 14th September**.

You can register online at: www.lms.ac.uk/events/popular-lectures

LMS COUNCIL DIARY

8 May 2017: A personal view

Council's new agenda format, aimed at prioritizing strategic discussions, seems to have been a success. After brief preliminaries, the May meeting began with the Publications Secretary giving a presentation to Council on strategic aspects of the work of the Publications Committee. This was followed by a productive discussion of a key question: what is the purpose of the LMS's publication activity? Council explored whether the traditional answers of dissemination of mathematics and income generation could perhaps be reframed in terms of service: to authors, to readers, to those mathematicians who benefit from the conferences and other research grant schemes financed by publication proceeds, to the wider society through outreach and advocacy.

The Society puts all surplus proceeds from its publications back into the mathematical sciences. At present, roughly two-thirds of the Society's income is generated by publications, and hence the LMS's ability to support its various grant schemes is heavily dependent on the health of this income stream. The Publications Secretary therefore asked Council to consider what steer it would like to give the Publications Committee. Should we think in terms of leadership as well as service? What should the overall balance of the Society's publication portfolio be? Are we being ambitious enough? Should the Society look to grow its publications activity? What other kinds of work can Council do to support publications activity? After a chance to reflect on the information presented at this meeting, Council will discuss the matter further and give the requested response to the Publications Committee at a later meeting.

Vice-President Ken Brown then gave an

update on behalf of the Research Policy Committee. The Committee continues its efforts to monitor the people pipeline in UK mathematics, and is moving forward with its census of postdoctoral fellows and research assistants in the UK. Further, the Council for Mathematical Sciences (CMS) will be meeting with EPSRC to compare notes on the results of their independent surveys of Doctoral Training Partnership grant allocation for the mathematical sciences, in advance of the next Mathematical Sciences Strategic Advisory Team in June. It was also noted that the EPSRC's Knowledge Exchange Review had issued an open call for responses, and the Committee would be developing a short document to highlight important new applications of pure mathematics to the wider world. Council members were encouraged to submit any suggestions for this to Sam Howison. Also noted was the fact that the two previous calls to the Global Challenges Research Fund, focused on Digital Technologies and Healthcare Technologies, had been highly unsuitable for the mathematical sciences, thus excluding the mathematical sciences from accessing this source of funding. CMS has offered to provide help in designing future calls to make these more amenable to the mathematical sciences.

Council moved on to agree terms of reference in a new standardised format for Early Career Research Committee, Research Grants Committee, Research Policy Committee, Society Lectures and Meetings Committee and Women in Mathematics Committee.

The day ended with one of the Trustees' more enjoyable tasks: agreeing this year's prize winners (see pages 6–7). Tara Brendle

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COMMEMORATING A CURIOUS CONVERSATION

On Sunday 11 June 2017 I had the great pleasure of representing the London Mathematical Society at the 'unveiling' of a plaque commemorating G.H. Hardy's visit to Srinivasa Ramanujan at a nursing home in Putney – the occasion of the famous taxi-cab conversation. As Hardy himself recalled:

He [Ramanujan] could remember the idiosyncrasies of numbers in an almost uncanny way. It was Littlewood who said that every positive integer was one of Ramanujan's personal friends. I remember going to see him once when he was lying ill in Putney. I had ridden in taxi-cab No. 1729, and remarked that the number seemed to me rather a dull one, and that I hoped that it was not an unfavourable

omen. "No," he replied, "it is a very interesting number; it is the smallest number expressible as a sum of two cubes in two different ways."*

The nursing home was restored to a private house sometime in the 1920s, and we were warmly welcomed by the current owner Deborah Gauld and her family, several of whom had come over from Denmark especially for the occasion. After a delicious tea,



Plaque commemorating Hardy's visit to Ramanujan at a nursing home in Putney

complete with Indian delicacies, in Deborah's beautiful garden, we moved to the front of the house, glasses charged, for the ceremony. Simon Singh, the originator of the project, opened proceedings before handing over to Sarah Hart. Sarah, who had helped Simon bring the project to fruition with funding from the British Society for the History of Mathematics (BSHM), explained that it was part



June Barrow-Green

 $*12^3 + 1^3 = 10^3 + 9^3 = 1729.$

G.H. Hardy 'The Indian mathematician Ramanujan' *The American Mathematical Monthly* **44** (1937), 137-155 (p.147).



Deborah Gauld, Simon Singh, Sarah Hart and June Barrow-Green on the steps of 2 Colinette Road, Putney

MATHEMATICS POLICY ROUND-UP

July 2017

RESEARCH

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The role of EU funding in UK research and innovation

A new report jointly commissioned from Technopolis Group by the UK's four national academies – the Academy of Medical Sciences, the British Academy, the Royal Academy of Engineering and the Royal Society – reveals exactly where EU funding goes, what kind of activities it supports and what other investment it attracts. More information is available at http://tinyurl.com/y8b6q7fm.

SCHOOLS AND COLLEGES

Teacher retention in English secondary schools

The National Foundation for Educational Research (NFER) update *Teacher retention by subject* is the first publication in a series that forms a major new research project - funded by the Nuffield Foundation - 'to gain a deeper understanding of the dynamics within the teacher workforce in England'.

It is also one of the first pieces of research to explore differences in teacher retention rates in English secondary schools by the subject they teach. Key findings:

- Rates of early-career teachers in science, mathematics and languages leaving the profession are particularly high.
- High leaving rates of science and modern foreign languages teachers, and shortfalls in the number of entries to teacher training in these subjects compared to the Government's target, may make it difficult for the Government to achieve its aim for 90 per cent of students to be entered for GCSEs in EBacc subjects.
- The amount of curriculum time spent on science and languages has not increased since 2011. The lack of growth in curriculum time could be due to reduced teacher supply constraining schools from expanding provision in these subjects.
- The amount of curriculum time for technology subjects has fallen dramatically since 2011. The leaving rate for technology teachers is higher than average, which might be driven by schools' reduced demand for teachers as well as teachers' own career decisions.

The report is available at http://tinyurl.com/ y9bfjltn.

> Dr John Johnston Joint Promotion of Mathematics

EUROPEAN NEWS

European Industrial Doctoral Program

A European industrial doctoral program (EID) on *Reduced Order Modelling, Simulation and Optimization of Coupled Systems* has been approved within the Horizon 2020 framework. The main objective of this programme, driven by industrial applications, is to lift the application of these techniques to a new level of quality and to train the next generation of researchers in this approach. Funds are of the order of €2.8 million. Partners are from the academic sector are TU Berlin/MATHEON (consortium leader), HU Berlin, U. Bremen, FAU Erlangen-Nürnberg, INRIA Paris, U. Linz, Polytechnico di Milano, Technological Institute of Industrial Mathematics (ITMATI) Santiago, SISSA Trieste, BU Wuppertal, FAU Erlangen-Nürnberg, as well as 11 industrial partners from seven countries and the European Network EU-MATHS-IN.

Open Science Metrics

The EU Commission has recently published a report on Open Science Metrics: *Next-generation metrics: Responsible metrics and evaluation for open science.* The report can be seen at http://tinyurl.com/y9fer7z5.

French Politics

Following the legislative elections in June this

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year, Fields medallist **Cedric Villani** is now a member of the French National Assembly. He represents the Essonne 5th constituency for the centrist political party *En Marche!* of the newly-elected French president Emmanuel Macron.

EMS Newsletter

The June issue of the *EMS Newsletter* is now available at http://tinyurl.com/yam5phmq. Among many interesting items are an article by Henri Darmon on Andrew Wiles' Marvellous Proof (a transcript of the author's Abel Prize lecture in 2016), one by Karine Chemla on *The*

Diversity of Mathematical Cultures with a particular focus on some early Chinese mathematics, the fascinating story of the commemorative bench sculpture in Kraków representing Banach and Nikodym deep in mathematical conversation, an obituary article on Ludwig Fadeev, and a lively article by Christian Krattenthaler on resonances of Mathematics and Music – including a proof of Ramanujan's 'most beautiful' theorem as well as an analysis of aspects of Schubert's Sonata in A major, D959. All this and much more, enough to keep any reader well occupied over the summer. David Chillingworth

LMS/EMS Correspondent

GRATTAN-GUINNESS ARCHIVAL RESEARCH TRAVEL GRANT

Call for Applications

The estate of the late Professor Ivor Grattan-Guinness has established a limited number of career development grants to assist scholars in the early stages of their research careers in the fields of the history and philosophy of mathematics and logic as well as in the history of mathematics education and its bearing on contemporary problems.

Grattan-Guinness Archival Research Travel Grants are open to doctoral students or scholars with no more than six years of post-doctoral research in the history and/or philosophy of mathematics and/or logic and/or mathematics education. Grants will be made specifically to enable travel for research at an archive of the recipient's choice. Grants are expected to contribute to, but not fully cover, the total cost of the proposed research project. Indeed, additional funding from other sources is highly recommended, as this grant is intended to assist with travel expenses, rather than to subsidize a research project in its entirety. Therefore submission of research proposals to other funding agencies does not affect their eligibility for a Grattan-Guinness Grant.

No grant will exceed US\$3,000. Proposals must be submitted electronically to the administrators at ggart.grant@gmail.com by **31 December 2017**. Applicants will be informed of the outcome of their application by 15 February 2018. For further visit the website at http://tinyurl.com/y94xnhph.

SUMMER SCHOOL AT THE INSTITUT MITTAG-LEFFLER

Call for Proposals

The European Women in Mathematics (EWM) and the European Mathematical Society (EMS) are pleased to invite proposals for a one week summer school at the Institut Mittag-Leffler in Stockholm in summer 2018. A special feature of the summer school is that there will be a much larger than usual involvement by women. It is expected that most or all of the organising committee, at least half the participants, and if possible the lecturers, should be female.

Further details can be found on the EWM website www.europeanwomeninmaths. org under 'News'. In case of difficulty please contact Ulrike Tillmann (tillmann@maths.ox.ac. uk). The deadline for proposals is **30 July 2017**.

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BATH'S INSTITUTE FOR MATHEMATICAL INNOVATION: MODEL EVOLUTION



How can universities better release the potential that mathematics holds as an 'underpinning technology'? How can we remove the common obstacles that hinder collaborations with external organisations? How do interdisciplinary projects and collaborations themselves benefit mathematics and statistics?

These questions are particularly pertinent at the moment due to the review of knowledge exchange in the mathematical sciences currently being undertaken by EPSRC and Innovate UK, and chaired by Philip Bond (see http://tinyurl.com/kfyc2yc).

Bath is widely known for industrial engagement in the mathematical sciences and the establishment of the Bath Institute for Mathematical Innovation (IMI) nearly two years ago is the latest development in our thinking. Through IMI the university is developing a new model for interdisciplinary and business collaborations centred on the mathematical sciences.

IMI provides a coherent framework to organise three strands of activities: additional support for mathematical sciences research, interdisciplinary research collaborations involving mathematics and statistics, and external consultancy work. Details of our activities can be found at http://www.bath.ac.uk/ imi/.

As part of our support for mathematical research, for example, we match-fund LMS Undergraduate Research Bursaries and we fund additional students, making a cohort of around 20 for whom we can then design a programme of additional activities and transferable skills training. New interdisciplinary research collaborations are supported by our internal secondments scheme which has been enthusiastically taken up by academic staff from a wide variety of departments (including, by way of example, Economics, Health, Management, Mechanical Engineering, Physics, and Psychology) across the university. These secondments typically focus on a 'pump priming' activity, initiating an innovative research idea with the potential to attract future research funding.

IMI is also proud to lead the MI-NET (Mathematics for Industry Network, see https:// mi-network.org/) project, an EU COST Action chaired by Joanna Jordan that promotes collaboration in, and the benefits of, industrial mathematics. MI-NET runs industrial workshops, training weeks, study groups and short-term scientific exchange visits between academic and industrial partners.

IMI's capacity to carry out consultancy work for external partners is significantly reinforced by our team of Commercial Research

> Associates; PhD-qualified research staff who work on a wide variety of short-term projects, typically lasting from one to three months, with a flexibility that enables us to respond quickly to business needs and timescales. Recent collaborations include work with organisations in the agri-food, aerospace, energy, health, insurance, and retail sectors, and from local SMEs to global development agencies such as UNICEF.

> Our experience over the last two years has been that initial short



IMI staff and Internal Secondees

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projects can easily turn into longerterm research collaborations as the academic and industrial participants get a better understanding of each other and the relationship builds. Having carried out around 20 projects since launch, it is clear that our experience is contributing to changing the culture of how Bath engages with external partners, both in the mathematical sciences and indeed more widely across the university.

The conclusions of the Bond Review will no doubt stimulate further developments and help the entire community to maximise the

future opportunities for the mathematical sciences in the UK.



University of Bath: fifty years in the mathematical sciences landscape

Jonathan Dawes Director, Bath Institute for Mathematical Innovation

BCME 9 2018

Invitation to contribute - deadline 31 July 2017

LMS members are invited to contribute to the 9th British Congress of Mathematics Education (BCME 9) http://www.bcme.org. uk/, to be held at the University of Warwick from 3 to 6 April 2018.

BCME is a celebration of mathematics education attracting delegates from every phase (early years through to university) and aspect (teaching through to research, policy and public engagement). It takes place every four years under the auspices of the Joint Mathematical Council of the United Kingdom (JMC).

Contributions can take the form of workshop, talk, demonstration, discussion group or research presentation; aimed at practitioners concerned with Early Years Foundation Stage (EYFS), Key Stage 1 (KS1), KS2, KS3, KS4, post-16, university, initial teacher education (ITE) or teacher professional development (CPD) for 30, 60 or 90 minutes. Sessions should not be used to advertise commercial wares, but commercial wares might be used to illustrate a particular teaching approach. If your session is linked with

a particular JMC participating body, please indicate this when applying.

The draft programme, which is subject to change, can be found at www.bcme.org.uk/ Programme.

Contributions will be scheduled into 60 minute (B, C, F, G, J, K) or 90 minute (A, D, E, H, I) sessions. If you prefer a particular day or session, please indicate this on your application. If your contribution is linked to another contribution, please indicate this so they can be appropriately scheduled: for those offering 30 minute contributions, we particularly encourage you do this so that related contributions can be scheduled in the same session. Do not worry if you are unable to do so, the programme team will do its best to find some suitable way to schedule your contribution.

All contributors will be able to share resources with delegates through the website before the conference and will be

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LMS NEWSLETTER

invited to submit an article based on their contribution to the BCME proceedings. Research contributors will be able to opt to have their article refereed by members of BSRLM. Please note that this is a significant change to previous practice where the proceedings have been prepared in advance of the congress.

To accept this invitation please offer a contribution via the BCME website (http://tinyurl. com/ybjrsw82), completing all the necessary information by **31 July 2017.** You will need to provide title, description (maximum 100 words), details about the contribution (type, phase and duration) and any resource or equipment needs, including room layout (lecture style, chairs only, cabaret (groups of tables), classroom (rows of tables)). If you are a new presenter you will be able to indicate if you would like support. Please note that you will be asked to indicate an intention to register as a delegate.

If you have any queries or wish to discuss a possible contribution, email programme@ bcme.org.uk. Whilst we cannot guarantee accepting all offers of contributions as we need to ensure a broad and balanced programme, we are looking for 32 contributions at any one time so you are in with a good chance.

> Sue Pope BCME 9 Programme Chair

LA REAL SOCIEDAD MATEMÁTICA ESPAÑOLA

The Royal Spanish Mathematical Society was officially founded in Madrid in 1911, originally with the name "Sociedad Matemática Espańola". Its first president was José Echegaray, a civil engineer who is best known for having won the Nobel Prize in Literature in 1904 but who also was Professor of Mathematical Physics in the University Central at Madrid (Universidad Complutense de Madrid at present). Other preeminent names of presidents of our society include Zoel García de Galdeano, Leonardo Torres Quevedo, or Julio Rey Pastor.

As of 2016, our Society has around 1,600 individual members and 100 institutional members (such as schools, departments, and research institutes). It has reciprocity agreements with many other Spanish, European and International mathematical societies (in particular with the LMS), which allow its members to join these other societies with a reduced membership fee. The Society itself is a member of several international mathematical organisations, such as the EMS, the IMU, CIMPA and ICIAM.

The main tasks of our Society are the promotion and dissemination of mathematics and its applications, and fostering the research and teaching in all mathematical areas and educational levels. Through its conferences, meetings, and publications, the Society tries to serve as a central



reference and meeting point for all of the Spanish mathematical community. The most important scientific event organized by the Society is the biennial Congress, in which some 400-500 mathematicians meet to discuss the latest development in their research areas. The latest biennial Congress took place in Zaragoza in February 2017, and next one will be in Santander in 2019. The RSME has organized in the last few years many joint congresses with other mathematical societies (AMS, Belgian and Luxemburg, French, Swedish, Italian, Mexican, Brazilian, Argentinian, Portuguese, as well as the other Spanish mathematical societies). This is an excellent way to foster the interaction between the mathematical communities of Spain and these other countries.

The Bulletin of the RSME is a weekly newsletter which is distributed to all members with the most important news of the Society and the Spanish and International mathematical communities during the previous week. La Gaceta de la RSME is a printed journal published by the Society (currently three times

newsletter@lms.ac.uk

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Front cover of the last issue of La Gaceta de la RSME. It contains pictures from the RSME-Imaginary exhibition.



Poster of the Exposition of the bibliographical legacy of Zoel García de Galdeano, held at the library of University of Zaragoza, during days around the last biennial congress of the RSME.

a year) and distributed to all members, where one can find mathematical research articles, biographical and historical articles, interviews, book reviews, problems, and much more. The Society also edits the *Revista Matemática Iberoamericana* (http://www.ems-ph.org/journals/ journal.php?jrn=RMI), a peer-reviewed scientific journal currently published by the EMS Publishing House.

The José Luis Rubio de Francia Prize is the highest distinction awarded by the RSME. It is addressed to young researchers in mathematics who are Spanish or have done their work in Spain. Its first edition was in 2004 and it is awarded annually. The Prize Vicent Caselles is an annual distinction to young Spanish researchers whose doctoral work is of high standard and internationally recognized. The first edition was in 2015, and there are six awards annually. The RSME Medals acknowledge every year, from 2015, three relevant mathematicians of Spain for their commitment with our community and contributions to scientific advance, education or dissemination of mathematics.

RSME is very concerned with the dissemination of mathematics. The *Divulgamat* (http:// www.divulgamat.net/) website is a virtual centre for divulgation of Mathematics. The *Arbolmat* (http://www.arbolmat.com/) website contains biographies of many Spanish mathematicians. The RSME has also organized the Spanish version of the itinerant exhibition Imaginary (https://imaginary.org/). The Society is also involved with *Real Academia Espańola* in the renewal and insertion of new mathematical words in its dictionary and with *Fundación Museo Thyssen-Bornemisza* in a program on Art and Mathematics.

Further information about the RSME can be found on the website http://www.rsme.es.

Vicente Muńoz and Antonio Rojas León Members of the Governing Board of the RSME

http://newsletter.lms.ac.uk

LMS INVITED LECTURES 2017 IN NEWCASTLE Report

This year's Invited Lecture Series took place during Easter week at Newcastle University and drew an audience from far and wide. In addition to mathematicians resident in Britain there were participants from the USA, South America, South Africa, India and continental Europe.

The title of the series was *Function Theory* by *Hilbert Space Methods* and the invited lecturer was Professor Jim Agler, of the University of California at San Diego, who has



LMS Invited Lecturer Jim Agler

himself made seminal contributions to the field. He is known for his expository skills, and he duly delivered a well-judged and admirably-paced course of eight lectures, targeted at an audience containing a high proportion of research students. He showed how some of the classical theory of analytic functions on the unit disc can be developed in a simple way with the aid of the elementary theory of bounded linear operators on Hilbert space; moreover, this approach has the great



Greg Knese analyses von Neumann inequalities



Kelly Bickel is enthused by realization formulae



John McCarthy enjoys a light-hearted moment in noncommutative analysis

newsletter@lms.ac.uk

advantage that it frequently points to generalizations of the classical results to analytic functions of several complex variables (SCV). Indeed, often the proofs of the SCV theorems look identical to those of the single-variable results, with only a change in the interpretation of the notation. He identified four types of argument, called *model formulae*, *positivity*, *lurking isometry* and *duality* arguments, which in conjunction with a modest quantity of algebraic ingenuity lead to both the discovery and the proof of a wide variety of results in SCV and operator theory.

A second course, comprising five lectures, was delivered by Professor John McCarthy, of Washington University, St Louis. This course was devoted to *noncommutative analysis*, that is, the analysis of functions of several noncommuting variables. It is a topic which has attracted a lot of interest over the past ten years. Agler and McCarthy have themselves made significant contributions to the area, and McCarthy showed how the ideas described in Agler's lectures can be adapted to this relatively new field.

Brief (two-lecture) courses were also given by Dr Gregory Knese, of Washington University, St Louis (on von Neumann inequalities) and Dr Kelly Bickel, of Bucknell University, Lewisburg, Pennsylvania (on the representation of analytic functions on the bidisc). There were also a tutorial and a problem session.

> Zinaida Lykova Newcastle University

RECORDS OF PROCEEDINGS AT LMS MEETINGS ORDINARY MEETING, 1 JUNE 2017

held at the University of York as part of the Northern Regional Meeting and Workshop on *Variational Methods in Submanifold Theory*. Over 45 members and visitors were present for all or part of the meeting.

The meeting began at 2.00 pm with the Programme Secretary, Professor lain A. Stewart, in the Chair.

There were 22 people elected to membership at this Society Meeting:

Eight people were elected to Associate membership: Mr Oliver Cato, Miss Laura Cope, Dr Jennifer Creaser, Mr Calum Proctor, Mr Sean Sapsford, Mrs Aziza Sentissi, Mr Ziyi Tang and Mr Adam Richard Wilson.

Thirteen people were elected to Ordinary membership: Mr Alireza Badali Sarebangholi, Dr Christian Bick, Dr Yemon Choi, Professor Simon Dobson, Dr Nicola Gambino, Ms Roselin Gorogodo, Dr Mark Hagen, Dr Marina Kravtsova, Dr Holly Krieger, Mr Colin Neve, Dr Claudia Neves, Dr Dmitriy Rumynin and Professor Anvar Shukurov.

One person was elected to Reciprocity membership: Dr Rehana Naz.

Three members signed the book and were admitted to the Society.

Dr Ian McIntosh introduced a lecture given by Professor Fran Burstall (University of Bath) on Conformal submanifold theory for beginners.

Dr Katrin Leschke then introduced a lecture given by Professor Marta Mazzocco (University of Loughborough) on *Colliding holes in Riemann surfaces*.

After tea, Professor Niall MacKay then introduced the Lewis Fry Richardson Lecture given by Professor Dominic Joyce (University of Oxford) on *What is a derived manifold?*

The Programme Secretary, Professor Stewart, expressed the thanks of the Society to the speakers and to Ian McIntosh and Katrin Leschke for putting on such a wonderful meeting. Afterwards, the reception was held in the Department of Mathematics and the Society Dinner was held at a nearby restaurant, Carluccio's.

LMS NORTHERN REGIONAL MEETING

Report

An LMS Northern Regional Meeting was held in the mathematics department at the University of York in June this year. The meeting took place during workshop Variational а on Methods in Submanifold Theory, and in keeping with the theme of the workshop the talks had a geometric flavour. Around 15 people attended the workshop from institutions across the UK and Europe, and the workshop attendees were ioined bv

around 40 researchers and students from universities across the region for the meeting.

The meeting, chaired by lain Stewart from Durham, took place on Thursday 1 June at 2 pm, and we were delighted to have Fran Burstall (Bath), Marta Mazzocco (Loughborough) and Dominic Joyce (Oxford) to speak for us. Burstall's talk began with a reminder of classical submanifold theory in Euclidean geometry, and how an analogous approach gives the governing equations and invariants for submanifolds of the conformal n-sphere. Mazzocco told us about what happens when holes collide inside Riemann surfaces and the consequences for moduli spaces of representations of the fundamental group of a punctured surface. Joyce rounded off the event with a talk on derived differential geometry, a rela-



Professor Marta Mazzocco

tively new area of mathematics pioneered by Joyce which aims to apply methods from algebraic geometry to difficult problems in differential geometry.

The talks were followed by a wine reception held in the Topos room at the mathematics department, with attendees spilling outside to discuss the enjoyable and interesting talks in the sunshine by the campus lake. The conference dinner was a lively affair held at Carluccio's York, where we were joined by LMS representatives lain Stewart and Elizabeth Fisher.

Please visit the workshop website at https:// tinyurl.com/y8mvwgd5 to view photos from the event, as well as titles and abstracts for the workshop talks.

> Dr Kim Moore Cambridge



Professor Dominic Joyce



Professor Fran Burstall



HOLGATE LECTURES AND WORKSHOPS CALL FOR HOLGATE SESSION LEADERS

The LMS currently has two vacancies for Holgate Session Leaders, and invites applications from those interested in taking part in this scheme.

The Holgate Lectures and Workshops Sessions scheme (named in memory of Philip Holgate, who helped to ensure the success of the LMS Popular Lectures) provides session leaders who are willing to give talks or run workshops on mathematical subjects to groups of students or teachers. The sessions are intended to enrich and enhance mathematical education, looking both within and beyond the curriculum.

Holgate sessions are intended for school- and college-level students, from primary and secondary to A-Level or equivalent (including STEP/AEA). They may also cover adult education. Session leaders are also free to offer sessions to other relevant groups, e.g. teachers of mathematics, to enhance their professional mathematical development.

The local organiser of a session may be a school, a group of schools, or a local branch of a mathematical organisation. Schools will be strongly encouraged to collaborate when hosting sessions. There is no required minimum or maximum attendance for the sessions, and appointees will be free to decide whether to accept or decline a request.

Holgate session leaders do not charge a fee for giving talks, but local organisers are expected to pay travel expenses and subsistence costs, together with any local costs of organising the session. The LMS will pay an annual honorarium to the session leaders.

More information on the scheme and details of current Holgate session leaders can be found here: https://www.lms.ac.uk/events/lectures/holgate-lectures-and-workshops.

If you are interested in applying, please send a short (maximum 2-page) CV and a letter outlining a) what you could offer as a Holgate Session Leader, and b) what you believe the Holgate sessions could offer as an educational experience, to Katherine Wright: education@lms.ac.uk.

Although there is no strict person specification, applicants should have a track record in mathematics education, communicating with people and learning and/or teaching mathematics outside of HE. They may be research-active mathematicians in a university department or be someone mathematically or statistically qualified based outside of academia. Applicants do not need to be members of the LMS.

Appointments will be for an initial three-year term, renewable by agreement.

NORTH BRITISH MATHEMATICAL PHYSICS SEMINAR Report

The North British Mathematical Physics Seminar (NBMPS) is a series of one-day meetings supported by an LMS Scheme 3 grant. The LMS Scheme 3 grants provide modest funding, but it is enough for us to run three meetings per year, and it is hugely beneficial. As well as providing a wide range of interesting talks it is a very effective way to establish and maintain links between our groups, now from Durham, Edinburgh, Glasgow, Heriot-Watt, Newcastle, Nottingham and York. The inaugural meeting was held in Edinburgh on 2 March 2002. Fifteen years and fifty meetings later we held our milestone NBMPS 50 meeting at the excellent venue of King's Manor, York on 12 May 2017. Over that time we have held mostly three, sometimes four, one-day meetings each year. Our network has grown and the meetings have provided many PhD students with their first opportunity to speak outside their own group.

As usual we had talks from both early stage and well established researchers, covering a wide range of topics in mathematical physics. Mirjam Weilenmann (York) opened the meeting by presenting her recent work on understanding causal structures in classical and quantum systems using entropy vectors. Motivated by problems in quantum information theory, Arthur Jaffe (Harvard and visiting the Newton Institute) presented the pictorial *Quon language* which is now being applied more widely



Douglas Smith
 Douglas

Arthur Jaffe (Harvard) giving his talk *Some Recent Insights with Pictures.* The photo in the background was taken by Arthur during a seminar when he was a graduate student at Princeton.

Mirjam Weilenmann (York) giving her talk Analysis of the Entropy Vector Approach to Distinguish Classical and Quantum Causal Structures



The participants enjoying the celebratory dinner – some still deep in discussions, others finding time to relax!



Most of the participants outside King's Manor

to derive and prove results in various areas of physics and mathematics. We also heard from Robert Parini (York) about algebrogeometric solutions to two-dimensional integrable systems with defects, generalising well known soliton solutions. In string theory we had two different topics, Lennart Schmidt (Heriot-Watt) explaining the structure of a solution describing non-Abelian self-dual strings while Yang-Hui He (City University, London & Oxford) showed how to obtain bounds on the volume of Sasaki-Einstein manifolds by studying properties of toric Calabi-Yau cones.

As well as the formal talks, our meetings always provide ample opportunity for the participants to discuss over coffee and lunch, and this meeting was no exception. The speakers were engaging and this generated many interesting discussions throughout the day. The wide variety of topics also contributed to the success of the meeting. Of course we wanted to celebrate our milestone, so we had a dinner after the meeting, very much enjoyed by those who were there. We thank the York group and particularly the local organiser, Eli Hawkins, for the memorable 50th meeting.

For further details of NBMPS 50, see http:// www-users.york.ac.uk/~eh555/NBMPS50. html or go to our main NBMPS page at https://empg.maths.ed.ac.uk/NBMPS/ for full details of past meetings, for announcements of future meetings, or to sign up to our mailing list. All meetings are open to everyone, not just those within the network.

> Douglas Smith Department of Mathematical Sciences Durham University

VISIT OF WILLIAM BOGLEY

Professor William A. Bogley (Oregon State University) will be visiting the UK from 3 to 23 September 2017. Professor Bogley works on topological aspects of group theory. Details of his talks during his visit are:

 Thursday 7 September, University of Essex Shift Dynamics for Cyclically Presented Groups (contact Gerald Williams:

gerald.williams@essex.ac.uk)

- Wednesday 13 September, University of Southampton Asphericity and Equations over Finite Groups
- (contact lan Leary: i.j.leary@soton.ac.uk)Friday 22 September, University of Nottingham

Alternatives to Asphericity (contact Martin Edjvet:

martin.edjvet@nottingham.ac.uk)

Further details of these arrangements may be obtained from Gerald Williams (gwill@ essex.ac.uk). The visit is supported by an LMS Scheme 2 grant.

VISIT OF ANDREAS PROHL

Professor Andreas Prohl (full Professor in Numerical Analysis, Institute of Mathematics, University of Tübingen, Germany) will be visiting the UK between 10 and 22 September 2017. His main research interests are in finite element methods, both their theory and applications including hydrodynamics (Navier-Stokes equations, in particular), magnetism (eg, the Landau-Lifshitz equation), multi-phase flows (eg, the Cahn-Hilliard equation), liquid crystals, etc, and in stochastic partial differential equations and stochastic control. During his visit Professor Prohl will lecture on:

- Monday 11 September, 14:00-15:15, University of York, Department of Mathematics, Topos (G/N/024) (contact Zdzislaw Brzezniak: Zdzislaw.Brzezniak@york.ac.uk)
- Thursday 14 September, 12.00-13.00, University of Chester, Department of Mathematics, Room TSU102 (contact Dimitra Antonopoulou: d.antonopoulou@chester.ac.uk)

- Monday 18 September, 15.00-16.00, University of Nottingham, School of Mathematical Sciences, Room A17 (contact Michael Tretyakov: Michael.Tretyakov@nottingham.ac.uk)
- Thursday 21 September, 14.00-15.00, University of Sussex, Department of Mathematics, Room 5c11 (contact Max Jensen: M.Jensen@sussex.ac.uk)

For further details contact Michael Tretyakov (Michael.Tretyakov@nottingham. ac. uk). The visit is supported by an LMS Scheme 2 grant.

VISIT OF HENNA KOIVUSALO

Dr Henna Koivusalo (University of Vienna) will visit the UK during August 2016 supported by an LMS Scheme 2 grant. She will give lectures at the Universities of St Andrews, Glasgow and Durham as well as engaging in collaborations at each institution on a broad range of topics. Dr Koivusalo is an exciting and talented mathematician as well as being an exceptional speaker. Her research interests span several different areas, including: fractal geometry, probability theory, Diophantine approximation, number theory, cut-and-project sets, tiling theory and ergodic theory. She has an excellent reputation for her ability to communicate mathematics, both at research level and to a general audience. For example, those following recent LMS events closely, may remember her very wellreceived public lecture at the LMS Northern Regional Meeting on Dynamical systems, ergodic theory and applications, hosted by Jonathan Fraser in Manchester in June 2016. She is also regularly invited to give seminars and speak at international conferences across the full range of her research interests.

Dr Koivusalo will visit Jonathan Fraser, who recently returned to his alma mater St Andrews, to work on self-affine sets and dimension theory. Jonathan visited Dr Koivusalo and Professor Henk Bruin in Vienna in October 2016 and is looking forward to returning the hospitality! In Glasgow, Dr Koivusalo will visit Michael Whittaker to work on random substitution tilings and connections to fractal geometry through fractal dual tilings. Dr Whittaker is a recently appointed lecturer in Glasgow working on noncommutative geometry, dynamical systems and operator algebras. We anticipate this visit being a catalyst for further interaction between the groups in Glasgow and St Andrews. The final visit will be to the University of Durham to work with Jamie Walton and John Hunton on ongoing work on pattern complexity of cutand-project tilings and connections with Diophantine approximation.

The precise dates of the visit are still being worked out, but the current estimates are that Dr Koivusalo will be in Durham the week of the 7 August, Glasgow the week of the 14 August, and then St Andrews the week of the 21 August. Good luck catching Henna at some point during her much anticipated visit!

VISIT OF PETER ŠEMRL

Professor Peter Šemrl (University of Ljubljana) who is currently the president of the International Linear Algebra Society will be visiting the University of Reading between 30 June and 7 July 2017. His area of research include linear and nonlinear preserver problems, geometry of matrices and symmetries of effect algebras. During his visit he will continue research with György Pál Gehér on isometries of Grassmann spaces, and he will be giving the following presentation:

Adjacency Preservers at the Pure Mathematics Seminar, Wednesday 5 July, 16.00-17.00, J.J. Thomson Building, RH Lecture Theatre, University of Reading

For further details contact György Pál Gehér (G.P.Geher@reading.ac.uk or gehergyuri@gmail.com). The visit is supported by an LMS Scheme 4 Research in Pairs grant.

OPPORTUNITIES FOR THE FUTURE - WOMEN IN MATHEMATICS

The School of Mathematics, University of Bristol, will host an event from 4 pm on Tuesday 7 November to 5 pm on Wednesday 8 November 2017 to encourage female mathematics students from across the UK to consider continuing their studies to PhD level.

The event features talks from mathematicians working both in Universities and industry, giving insight into their current roles and their careers to date. Even more importantly, there is ample time to talk in small groups to the other participants who are facing the same decisions, and also to current PhD students who have recently faced the same questions. Speakers will include Dr Heather Harrington (Oxford). Some funding is available for travel, and early registration is encouraged via http:// bristol.ac.uk/maths/events/2017/wim-pg-2017.html.

TUTTE CENTENARY

A conference will take place in Cambridge from 10 to 12 July 2017 to celebrate the centenary of the birth of William Tutte, who made remarkable contributions to mathematics and codebreaking. The keynote speakers include:

- Noga Alon (Tel Aviv)
- Mireille Bousquet-Mélou (Bordeaux)
- Jérémie Bouttier (ENS, Paris)
- Joanna Ellis-Monaghan (St. Michael's College)
- András Frank (ELTE, Budapest)
- Timothy Gowers (Cambridge)
- James Oxley (LSU)
- Richard Pinch (GCHQ)
- Alexander Scott (Oxford)
- Ramarathnam Venkatesan (Microsoft) For conference details and to book your place, please visit the website at https:// www.dpmms.cam.ac.uk/events/tutte100/.

FUNCTION THEORY MEETING

The One Day Function Theory Meeting will be held on Monday 4 September 2017 at De Morgan House, 57-58 Russell Square, London. This is a long-standing annual gathering of complex analysts and function theorists. Invited keynote speakers are:

- Aimo Hinkkanen (University of Illinois at Urbana-Champaign, USA)
- Norbert Steinmetz (Technische Universität Dortmund, Germany)

The meeting is open to all and there is no requirement to register in advance but if you would like to have further information contact the organiser, Thomas Kecker (odftm.mail@ gmail.com) or visit the meeting website https:// sites.google.com/site/ functiontheorymeeting.

Funding is available to cover travel expenses for a limited number of UK based research students – contact the organiser in advance. There will be a registration fee of ± 10 , payable on the day, which is waived for the retired or unemployed. The meeting is supported by an LMS Conference grant.

MODEL THEORY OF VALUED FIELDS

A one day meeting on the *Model Theory of Valued Fields* will take place on 4 August 2017 at the Jeremiah Horrocks Institute, which is part of the University of Central Lancashire, based in Preston.

This meeting is being supported by the LMS Celebrating New Appointments scheme, and will be an opportunity to share some recent developments in the subject area. Both new and established researchers are very welcome. There is a limited amount of funding available to support the travel of research students, and the opportunity.

Details of this meeting can be found at anscombe.sdf.org/newdirections.html. For more information, please contact the organiser Sylvy Anscombe (sanscombe@ uclan.ac.uk).

BRITISH LOGIC COLLOQUIUM 2017

The British Logic Colloquium 2017 will take place at the University of Sussex (Falmer Campus) from 8 to 9 September 2017, with the BLC PhD day on 7 September.

This is the annual meeting of the British Logic Colloquium. The scope of the event includes mathematical and philosophical logic as well as logic in computer science and applications of logic. The meeting is a forum for British logicians to present their work and discuss recent developments in logic. It also gives promising young researchers the opportunity to make themselves known to the logic community in the UK.

The following invited speakers have agreed to give keynote lectures:

- Hazel Brickhill (Bristol)
- Oliver Kullmann, Swansea)
- James Ladyman (Bristol)
- Sam Staton (Oxford)
- Tamara von Glehn, Cambridge)
- Katrin Tent (Münster)

The organiser of the British Logic Colloquium 2017 is Bernhard Reus (University of Sussex). For more information visit www.sussex.ac.uk/blc17. Some limited financial support will be available for UK based research students. The colloquium is supported by an LMS Conference grant.

BRITISH TOPOLOGY

The 32nd British Topology Meeting (BTM32) will be held at the University of Leicester from 6 to 8 of September 2017. Invited speakers include Moritz Groth, Jelena Grbić, Magdalena Kędziorek, Richard Hepworth, Paolo Salvatore and Markus Szymik.

There will be an opportunity for a number of contributed talks, and postgraduate students and early career researchers are particularly encouraged to participate. The organisers expect to cover expenses of all UK based research students and of all speakers. Programme, registration and accommodation details can be found at http:// www.le.ac.uk/british-topology-mtg, and for other enquiries email Andy Tonks (apt12@le.ac.uk). The meeting is organised by Andy Tonks, Frank Neumann, Simona Paoli and Teimuraz Pirashvili. The meeting is supported by an LMS Conference grant.

ALGEBRAIC STRUCTURES IN PHYSICS AND GEOMETRY

A workshop, joint with ARTIN meeting, on Noncommutative and non-associative algebraic structures in physics and geometry will be held at Queen's University Belfast from 30 August to 2 September 2017.

The workshop will consider noncommutative and nonassociative algebras and more general structures appearing in various applications, in particular in physics, analysis, geometry, topology, homotopy theory and coding theory. Speakers include:

- Vladimir Bavula (Sheffield)
- Ken Brown*(Glagow)
- Dietrich Burde (Vienna)
- Paula Carvalho (Porto)
- Arnfinn Laudal (Oslo)
- Christian Lomp (Porto)
- Michael Pevzner (Reims)
- Dmitriy Piontkovskii (Moscow)
- Vladimir Rubtsov (Angers)
- Dmitri Rumynin (Warwick)
- Sue Sierra, (Edinburgh)
- Agata Smoktunowicz (Edinburgh)

If you are interested in participating, email Natalia lyudu (acd2009@qub. ac.uk). Some financial support will be available for UK based research students. For further information visit the website at: http://tinyurl.com/y7tbtgr8. The workshop is supported by an LMS Conference grant.

BRITISH ALGEBRAIC GEOMETRY MEETING

The third British Algebraic Geometry Meeting (BrAG) will take place from 11 to 13 September 2017 at the Centre for Mathematical Sciences, University of Cambridge. The aim is to bring the UK algebraic geometry community together and showcase the best research in the field happening both nationally and internationally. The meeting is designed with particular interest to the needs of younger participants, and contains a number of pretalks aimed purely at graduate students, a poster session, and a professional development session. The speakers are:

- Arend Bayer (Edinburgh)
- Cinzia Casagrande (Università di Torino)
- Barbara Fantechi (SISSA)
- Elham Izadi (UCSD)
- James McKernan (UCSD)
- Johannes Nicaise (Imperial College and KU Leuven)
- Dan Petersen (University of Copenhagen)
- Jørgen Vold Rennemo (Oxford)
- Gregory Sankaran (Bath)

More information along with registration can be found at www.bragmeeting.uk. The meeting is supported by an LMS Conference grant, as well as the EPSRC and the Clay Foundation.

DIOPHANTINE PROBLEMS

A five day conference on *Diophantine Problems* (DIOP) will take place at the University of Manchester from 11 to 15 September 2017. This conference is part of the celebration of the recent reformation of the number theory group. The most famous period for number theory in Manchester was during the 1920's-1940's, when Mordell worked there and attracted such eminent number theorists as Davenport, Erdős and Mahler.

The conference will have 17 speakers, and will revolve around topics in number

theory inspired by the work of Mordell and Davenport (broadly interpreted), with the central theme being applications of analytic number theory, algebraic geometry, and model theory to the study of Diophantine problems.

Funding is available for accommodation expenses for a limited number of UK based PhD students in the Mathematical Sciences. The organisers are Gareth Jones and Daniel Loughran. For further information visit the website at https://sites.google.com/ site/diophantine2017/home.The meeting is supported by an LMS Conference grant.

ASYMPTOTICS FOR STOCHASTIC DYNAMICAL SYSTEMS

The workshop on Asymptotics for Stochastic Dynamical Systems will be held at the Department of Mathematics of Swansea University from 29 to 31 August 2017. Stochastic dynamical systems have been widely used in many branch of science and industry, for example, engineering, physics, biology, finance, renewable energy and medicine, etc. The conference aims to bring UK researchers and their research students together with international invited speakers to promote, encourage, and influence more cooperation, and to bring together various approaches eg, theoretical, numerical and applied, to better understand stochastic dynamical systems and solve practical problems. More than 20 speakers have been invited.

Funding is available to cover travel and accommodation expenses for a limit number of UK based PhD students in mathematical sciences. Send expressions of interest to c.yuan@swansea.ac.uk, giving a short description of your research area. For more information visit: https://mathsaworkshop. wordpress.com. The workshop is supported by an LMS Conference grant and the Department of Mathematics of College of Science of Swansea University.

http://newsletter.lms.ac.uk



BRITISH SCIENCE FESTIVAL 2017

The Festival is organized by the British Science Association (a.k.a. the British Association for the Advancement of Science) and is hosted this year by the University of Brighton and the University of Sussex from Tuesday 5 to Saturday 9 September: www. britishscienceassociation.org/british-sciencefestival

These are some of the mathematical sciences related events in the main programme.

28 Presidential Lecture and Reception Colva Roney-Dougal

(University of St Andrews) The million-dollar shuffle: symmetry and



complexitv The codebreaker Alan Turing kicked off the study of what problems can be solved bv computers. Many of them become easier when they have symmetries: finding a route is easier in a city with

a grid of streets than in one with a chaotic layout. Colva Roney-Dougal explores how mathematics can be used to crack symmetrical problems, and shows that sometimes symmetry itself is the issue.

Date: Tuesday 5 September 2017 Time: 15.30–16.30 Location: University of Sussex, Falmer Campus, Attenborough Centre. Gardner Tower

Robert Cuffe (GSK)

Drugs, condoms and the theory of experimentation

How do we develop drugs that prevent HIV transmission? The answers are clinical, political, personal and statistical. Sometimes smart people and great scientists "don't do stats", losing a voice in debates about research and treatment. This talk will help you spot bluff masquerading as statistical expertise, with particular reference to HIV prevention and some interactive demonstrations of psychological research on how our minds work.

Date: Friday 8 September 2017 Time: 13.30–14.30 Location: University of Sussex, Falmer Campus, Asa Briggs Arts, A1



© Hermes Gadêlha

Mathematical Reconstruction of human sperm swimming experiment

Hermes Gadêlha (University of York)

Male fertility: do the maths

Hermes Gadêlha applies mathematics to understanding what makes "good" sperm and envisions how this will impact, if not revolu-

newsletter@lms.ac.uk

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tionise, our understanding of fertility, from treatments, to contraceptives and even the development of 'robo-sperm'.

Date: Saturday 9 September 2017 Time: 15.00–16.00 Location: Brighton City, Old Courtroom Theatre

Daniel Colquitt (University of Liverpool) Invisible mathematics

Daniel Colquitt researches the mathematics of invisibility. Invisibility cloaks have been created for light, sound and water. If we can make all these invisible, what else can we design cloaks for? It was once hoped that invisibility cloaks would allow us to protect buildings from earthquakes, but it was deemed impossible. Discover how mathematics provides us with an elegant solution. Date: Tuesday 5 September 2017 Time: 13.00–14.00 Location: University of Brighton Campus, Westlain 100

Alexander Movchan and Luca Argani

(University of Liverpool)

Towards better aneurysm treatments

Alexander Movchan and Luca Argani describe a distinctive new mathematical model used to treat abdominal aneurysms known as 'EVAS', comprising an aneurysm together with stents and blood vessel sealants. Discover the future of EVAS and how it is impacting on treatment for the disorder.

Date: Friday 8 September 2017 Time: 16.30–17.30 Location: University of Sussex Falmer Campus, Asa Briggs Arts, A2

John Howse (University of Brighton) Picturing problems

Diagrammatic reasoning is about more than assembling Ikea furniture and solving Rubix cubes. The use of intuitive shapes opens up new opportunities for communicating problems, so if you fancy yourself as a problem-solver join John Howse to see if you can solve some fiendish diagrammatic reasoning challenges.

Date: Thursday 7 September Time: 11.30–12.30

Time. 11.50–12.50

Location: University of Sussex, Falmer Campus, Attenborough Centre, Gardner Tower

Andy Fiss, Laura Kasson Fiss and Amy Chambers

The Mathematikado

The Mathematikado, a clever parody of Gilbert and Sullivan's operetta. The Mikado produced and performed by female students

> in 1886, used parody and song to argue that women could master college-level maths. Find out what this student production reveals about the opening-up of science and mathematics degrees to women in the 19th Century and the issues surrounding female participation in traditionally male fields of study. Date: Friday 8 September 2017

Time: 16.00–17.00 Location: University of Brighton, Falmer Campus, Checkland, C122



Earthquake Waves (Daniel Colquitt)

ISaac Newton Institute for Mathematical Sciences

GENERATIVE MODELS, PARAMETER LEARNING AND SPARSITY

30 October – 3 November 2017

in association with the Isaac Newton Institute programme Variational Methods, New Optimization Techniques and New Fast Numerical Algorithm (29 August 2017 - 20 December 2017)

A key issue in image reconstruction, and in inverse problems as a whole, is the correct choice of image priors (or regularisation functionals) and data models (or fidelity terms) in a variational or Bayesian reconstruction model. Depending on the setup of the model. very different qualitative image reconstruction results are obtained. A setup of a variational imaging approach is influenced by the type of image one aims to reconstruct, as well as the way the image or data is acquired. The knowledge of the image properties -- such as the regularity of the image or present scales of image structures -- and the capability of modelling them, are crucial for an accurate setup of the image prior and as such for faithfully reconstructing the image contents. The image prior can have various forms, such as a regularisation term or a basis in which the image should be expanded. Sparsity plays a central role here. Sparsity promoting regularization is a widespread and very popular approach to solve inverse problems. Standard SPR methods like total variation (TV) or 11 regularization have been shown to be powerful tools to recover inverse problems solutions from a reduced amount of noisy measurements. Nevertheless, despite their ability of capturing important features such as discontinuities, these model-based regularizations are also well known to produce artefacts, such as the staircasing effect, if the measured data does not fit the corresponding model. An ideal SPR for a given application should be tailor-made, and reconstruct solutions one would expect rather than to create best fits to a standardized model.

The mechanism of the data acquisition process embodies the data model. This model explains how the data is related to the underlying image, containing information about the noise distribution, the amount of under-sampling and the physics of the image acquisition technique. Several strategies for deriving an optimal choice for an image enhancement approach have been considered in the literature. More heuristic approaches derive the model setup from the physics behind the acquisition process. Statistically grounded approaches are more data driven in the sense that they estimate or learn the noise and structure from the data itself. Adaptive regularisation approaches for instance are capable of adjusting the parameter values locally taking into account the noise level and the local scale of structures in the image. Moreover, machine learning methods, e.g. dictionary learning, are very powerful techniques to determine the correct basis in which an image should be reconstructed. Recent approaches in the community also propose to learn the imaging model by bilevel optimisation techniques. For gaining more insight into the reconstruction abilities of regularis ers their analysis via singular vectors has also proven valuable in some recent works in the community.

> Further information available from the website www.newton.ac.uk/event/vmvw02 Closing date for receipt of applications 31 July 2017

ISaac Newton Institute for Mathematical Sciences

in association with the Isaac Newton Institute programme *Mathematics of sea ice phenomena* (21 August – 20 December 2017)

ICE-STRUCTURE INTERACTION

6 – 10 November 2017

Interaction of ice with structures appears as an important process in numerous engineering applications including icing of structures (planes, turbines, cables, ships etc.), thermally induced loads on structures from ice and frozen soils, and mechanical loads on offshore and coastal structures due to the contact interaction. The physical mechanisms of ice-structure interactions are physically related to phase changes, ice micro-structure, the rheology and strength of ice, properties of contact interaction of ice with different materials, properties and behaviour of structures under the loading, and the driving forces applied to the ice when it interacts with structures. Understanding of the physical phenomena and proper formulation of mathematical models describing ice-structure interactions are necessary for adequate numerical simulations with useful input for industry. The workshop program includes lectures and seminars. Lecturing will be performed by well-known scientists experienced in experimental investigations of physical and mechanical properties of ice, laboratory and field studies of ice actions on different structures, formulation of mathematical models and numerical simulations according to industry needs. Seminars are organized for students with mathematical background to gain experience with mathematical models and conceptions used for the description of ice-structure interactions and ideas for their further development.

Further information available from the website www.newton.ac.uk/event/sipw03 Closing date for receipt of applications 6 August 2017

ICE FRACTURE AND CRACKS

4 – 8 December 2017

This workshop will foster interactions between researchers investigation cracking phenomena at different scales and practitioners interested in explanations at different scales. Broadly speaking, the fracture of sea ice occupies three settings: downscale (sea ice mechanics), mesoscale (the marginal ice zone, MIZ) and upscale (sea ice dynamics). At the downscale, the primary motivation is ice-structure interaction with a sea ice cover that may be deformed, discontinuous, comprised of pressure ridges, rafted ice, ice rubble and discrete ice floes.

At the mesoscale, the steady increase in the width of the MIZ (apparently caused by global warming), is unexplained by present wave-ice knowledge; the breakup of sea ice floes and aggregates of floes is the subject of intense study. At the upscale, the primary motivation is the development of continuum models of sea ice rheology suitable for inclusion within regional or global climate models, and the challenge is to accurately forecast the extent of sea ice in the Arctic (which is steadily declining), and in the Antarctica, which has recently recorded three record sea ice extents 2013-2015 (a reverse trend). At this workshop, the focus is on the roles of fracture mechanics and damage mechanics in the breakup of ice shelves, river and sea ice breakup, ice-structure indentation, FEM-DEM models, probabilistic models, crack nucleation, hydrofracture, refrozen leads, ice edge failure processes, brittle compressive failure, Coulombic faulting, and anisotropic sea ice dynamics.

Further information available from the website www.newton.ac.uk/event/sipw04 Closing date for receipt of applications 3 September 2017

ISaac Newton Institute for Mathematical Sciences

in association with the Isaac Newton Institute programme Growth Form and Self-Organisation (22 August - 20 December 2017)

SHAPE ANALYSIS AND COMPUTATIONAL ANATOMY

13 - 17 November 2017

The aim of this workshop is to review recent advances in mathematical aspects of shape analysis (SA), and some of their implications for computational anatomy (CA), in the context of open problems relating to growth, self-organisation, and shape, both in living and inanimate systems. The term "shape analysis" is understood here broadly, not only as a tool for analyzing MRI or PET images of human anatomy via CA, but also as a general mathematical approach to shape differentiation, variation, and development. Mathematically, SA is the study of smooth invertible maps (diffeomorphisms) on embedded manifolds and immersions. The diffeomorphic methods of shape analysis are important tools in CA, for example in image registration regarded as an optimal control problem for shapes. These methods can be discretized using well-adapted forms of finite elements called "diffeons," associated with momentum maps. Momentum maps may be tailored to biomedical image data, so applications of SA are ubiquitous in CA.

Further information available from the website http://www.newton.ac.uk/event/gfsw03

Closing date for receipt of applications 11 August 2017

FORM IN ART, TOYS, AND GAMES

29 November - 1 December 2017

This workshop's theme is more open in its scope. Mathematicians and scientists working on the physical aspects of art, on the art-making processes, and on the physics of toys— whether those made for entertainment or designed from the start to serve pedagogical purposes—are working individually, "on the side," or in small groups disconnected from one another. One of the purposes of this workshop, therefore, is to establish links between researchers pursuing such diversions and perhaps begin forming a community. The theme of this workshop encompasses both the emergence of form in art, including the mathematical and physical aspects of artistic processes and techniques, and the properties and role of form in finished artworks. These issues are at the interface between science and art and the goal is to shed light on the artists' techniques and their implications for the artworks and, potentially, for art history and art appreciation. A somewhat separate but related theme concerns the dynamics of "artful" toys and devices.

Further information available from the website http://www.newton.ac.uk/event/gfsw04

Closing date for receipt of applications: 1 September 2017





BCS-FACS Evening Seminar Joint event with the London Mathematical Society Thursday 2 November 2017 6:00 pm



Professor Erika Ábrahám (RWTH Aachen University)

Symbolic Computation Techniques in SMT Solving

The satisfiability problem is the problem of deciding whether a logical formula is satisfiable. For firstorder arithmetic theories, in the early 20th century some novel solutions in form of decision procedures were developed in the area of Mathematical Logic. With the advent of powerful computer architectures, a new research line of Symbolic Computation started to develop practically feasible implementations of such decision procedures.

Independently, for checking the satisfiability of propositional logic formulas, around 1960 a new technology called SAT solving started its career. Despite the fact that the problem is NP complete, SAT solvers showed to be very efficient when employed by formal methods for verification. Motivated by this success, the power of SAT solving for Boolean problems had been extended to cover also different theories. Nowadays, fast SAT-modulo-theories (SMT) solvers are available also for arithmetic problems. These sophisticated tools are continuously gaining importance, as they are at the heart of many techniques for the analysis of programs and probabilistic, timed, hybrid and cyber-physical systems, for test-case generation, for solving large combinatorial problems and complex scheduling tasks, for product design optimisation, planning and controller synthesis, just to mention a few well-known areas.

Due to their different roots, Symbolic Computation and SMT solving tackle the satisfiability problem differently, offering potential for combining their strengths. This talk will provide a general introduction to SMT solving and decision procedures for non-linear arithmetic, and show on the example of the Cylindrical Algebraic Decomposition method how algebraic decision procedures, rooted in Symbolic Computation, can be adopted in the SMT solving context to synthesise beautiful novel techniques for solving arithmetic problems.

Venue: London Mathematical Society, De Morgan House, 57-58 Russell Square, London WCIB 4HS. Refreshments will be available from 5.30pm.

The seminar is free of charge. If you would like to attend, please email Imscomputerscience@Ims.ac.uk.

SIMON FAIRTHORNE



Simon Fairthorne, who was elected a member of the London Mathematical Society on 21 December 1972, died on 14 May 2017, aged 76.

Peter Saunders writes: Simon was born in Farnbor-

ough, where his father was working for the Royal Aircraft Establishment. He obtained a mathematics degree at Imperial College in 1963 and after three years at Birkbeck College became assistant lecturer and then lecturer at Queen Elizabeth College (QEC).

While he was at QEC, computers started to become important in UK universities and Simon was one of the many mathematicians who turned their attention to this new field. He helped set up and run QEC's link to the University of London main frame and also its own small machine. He lectured on computer science as well as mathematics and was co-author of an early text on computing, *Using Computers*, published in 1977. In 1985, when QEC and Chelsea merged with King's College London, there was a suggestion that Simon might transfer to the new Computer Science department, but he chose to remain in mathematics.

Simon was a very popular lecturer and someone that students would look to for advice and encouragement. He was still teaching a module this past session, long after he had officially retired, and he was a tutor with the Open University for more than 40 years. He also had many interests outside mathematics. These included some you might have expected in someone with his background, such as bridge, philately, the Hampshire cricket club and genealogy – but American football too.

He is survived by Belinda, to whom he was married for 53 years, and their two daughters, Rosanna and Marianne.

BRILLIANT GEOMETRY IN EDINBURGH

An interactive exhibition called *Brilliant Geometry* was held at the Summerhall Gallery in Edinburgh, from 13 May to 4 June 2017. The target audience was the general public, not just academics. In total, there were over 1,650 visitors. There were stories about the exhibition in *The Times, The Scotsman, Glasgow Herald,* and even *Metro!*

The highlight of the exhibition was a threedimensional zoetrope illustrating a hypercube rotating in four dimensional space. Thirty 3D printed projections of the hypercube, in various stages of rotation, are attached to a spinning disc and illuminated by a synced stroboscope. The viewer's eyes and brain combine the strobing images to visualize an animated three dimensional object.

The starting point of the Edinburgh exhibition was an exhibition by Henry Segerman (Oklahoma State) and Saul Schleimer (Warwick) entitled "Illustrating Geometry", held in June and July 2014 at the Simons Center in Stony Brook. In August 2014 they gave a joint colloquium at the School of Mathematics of the University of Edinburgh. The colloquium included a demonstration of how shadows, cast by point light-sources, of various 3D printed spheres illustrate the distinctions of euclidean, spherical, and hyperbolic geometry. This was the seed for the Edinburgh exhibit, at which Segerman and Schleimer developed their ideas much further. The colloquium was attended by Peter Reid and Mark Revnolds of the University of Edinburgh College of Science and Engineering Engagement Team, who were subsequently inspired to design, with Schleimer and Segerman, and build, the zoetrope as well as the other interactive installations appearing in the exhibition. Other than the

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zoetrope, each exhibit showed the shadow cast by a bright LED through a 3D printed sphere. The 3D prints were produced by Shapeways.com. Explanatory posters were produced by Schleimer and Sabetta Matsumoto, School of Physics, Georgia Tech. The exhibition was jointly funded by the University Warwick of and the University of Edinburgh. The exhibition was staffed by students from the Outreach Team of the Edinburgh School of Mathematics.

The YouTube video https://www.youtube.com/ watch?v=1FUMJPjPSqQ is

a walk through the exhibition. The website http://www.maths.ed.ac.uk/~aar/brilliantge ometry has further background about the exhibition and the mathematics involved.



The organisers are eager for the exhibition to travel to other venues.

Andrew Ranicki Edinburgh





THE JOY OF SET: THE MANY MATHEMATICAL DIMENSIONS OF A SEEMINGLY SIMPLE CARD GAME by Liz McMahon, Gary Gordon, Hannah Gordon & Rebecca Gordon, Princeton University Press, 2016, pp 320, £24.95, US\$29.95, ISBN 978-0691166148.



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Mathematicians began playing SET® in the 1990's, and ever since, we have been looking for a book like this! This card game, happy by-product а of genetic research by Marsha Falco, connections has to a myriad of mathematics disciplines, and this

text is the first delve into those topics. Liz McMahon, Gary Gordon, and their daughters, Hannah and Rebecca, have developed a book that is fun and accessible, in the spirit of the game itself.

The Joy of SET is a pleasure to read. The personalities of the authors shine through the text. The preface begins, "We love SET^{\circ}," and each chapter is an affirmation of this sentiment. Photographs and illustrations illuminate complex concepts. Simpsons references, SET^{\circ} puns, and little jokes litter the pages. How did they manage to fit in so much math?

In each of the first five chapters and interludes, the mathematics fits into conversations between three friends. Each chapter has a new set of heroes, always with the initials S., E., and T. For example, Socrates, Euclid, and Theano discuss SET[®] and geometry in chapter five. These chapters cover the mechanics of the game and some counting, probability, modular arithmetic, and geometry. Combinatorial proofs are disguised as elegant arguments given to convince the reader of interesting results. These chapters are crafted to be extremely accessible, employing complex techniques including correcting for over counting and arguing by incidence counting without losing the reader and without losing the reader's interest. The heroes of each chapter exit the story to play SET®, and the authors regularly invite the reader to take a break and play SET ®, too.

The interlude gives advice to improve your SET® game and variations on the game play. As a failsafe, the authors provide empirically tested methods to make your opponent do worse. For example, "Have a cat around when you play...This will prevent you from seeing some of the cards, but the good news is that it will prevent others from seeing those cards as well (p.147)."

The last five chapters go deeper into mathematics. The conversation construct goes, but the conversational style stays. These chapters speak to mathematicians who enjoy SET[®], not to a general audience, covering more advanced combinatorics, probability and statistics, linear algebra and vectors, deeper analysis of SET[®] as an affine geometry, and computer simulations and computations. The authors assume mathematical maturity in these chapters. For example, chapter seven employs the derivative of the binomial theorem. The familiar mathematics text format, with problems and suggested projects after each chapter with solutions at the back of the book, stands out more here than in the preceding chapters.

Overall, the text is driven by guestions that SET [®] players have likely asked themselves. How many SETs are there in a deck? In 12 cards, what is the probability that there is no SET? How many groups of three cards are not SETs? What types of SETs are most common? What is the probability that three cards in a SET will have different colors, shapes, numbers, and shading? Can we examine the final board after a game to check if anyone cheated? This text addresses these while illuminating the underlying mathematics, employing a variety of mathematical techniques at varying levels of difficulty. This book is a gem, appropriate for everyone from a high school SET® enthusiast to a professional mathematician.

Deborah Chun

West Virginia University Institute of Technology

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SUMMING IT UP: FROM ONE PLUS ONE TO MODERN NUMBER THEORY by Avner Ash and Robert Gross, Princeton University Press, hb: 2016, pp 248, £22.95, US\$27.95, ISBN 978-0691170190, pb: 2018 January, pp 248, £14.95, US\$16.95 ISBN 978-0691178516.



This is а lovely book, written in an engaging and jaunty style, which takes the reader on a journey from verv simple sums (such as Euler's famous closed form for the sum of the first N positive integers) to the advanced theory modular forms, of

going via many interesting diversions such as Waring's problem (on sums of squares, cubes, etc) and the theory of partitions.

Many times the authors give a sense of *why* something is studied. For instance they show changing the question from "is this number a sum of squares?" to "in how many ways is this number a sum of two squares" leads to deeper, more interesting maths. There is a real sense of going on a exploration of discovery with the authors throughout the book.

For some of the simpler results, the authors provide proofs, with sufficient precision required for accuracy, but avoiding being too pedantic. At other points, the nature of the advanced material they are addressing forces them to either simply state a result ("We won't prove anything about this here, but we will tell you the answer") or give hints as to how a proof would be constructed ("The proofs of most of these results are too advanced to include, but we can give glimpses of why modular forms come into the game").

Another lovely aspect of this book is that the authors often present the motivations behind a proof, rather than giving it as a *fait accompli* (for instance in their discussion to show that every integer can be written as the sum of four squares, or when they are finding the dimension of M_k the vector space of modular forms of weight k). Their driving motivation is to build up enough mathematics to study and understand modular forms and their applications. The authors have two other books, and, although each can certainly be read stand-alone, they clearly think of them as a trilogy. Indeed, I get the sense this book was written to give a treatment of modular forms that was missing from the first two books, and the final chapter is effectively a supplement to the previous books.

The first section is meant to be accessible to a high school student, with the next couple of sections needing knowledge typically taught in the first year of a maths degree. (Of course, the fact that deep mathematical questions can be asked with little background knowledge is not new; this book does a remarkable job of shining light on the mathematics needed to solve such questions). Think of this book as an ideal colloquium talk: It gives a flavour of a very interesting topic, shows the kind of questions asked and the applications found, and gives a hint as to the maths used in finding the answers.

Not every decision they made is perfect. For instance I felt there was possibly too much fiddly detail in the section on summing powers of n in Chapter 6 (although that chapter is titled 'Sums of Powers Using Lots of Algebra'), where the reader needs to be comfortable with integration, infinite series and partial derivatives --- not the sort of material a typical high school student would have seen! I also felt the title of the book is not indicative of its contents. But these are minor criticisms.

I strongly recommend this book. It was a delight to read, and would be a suitable gift to stretch a schoolchild who's deeply interested in mathematics, or for an undergraduate to help them see the underlying beauty, reason and connectedness in their subject, or for a professional mathematician to appreciate some of the amazing applicability of modular forms – a current and active area of research.

> Chris Hughes University of York



LMS Midlands Regional Meeting and Workshop Modern Geometry and Physics

18 September 2017 Loughborough University

The LMS Midlands Regional Meeting will take place at Loughborough University on Monday 18 September 2017.

The speakers are:

- Giovanni Felder (ETH, Zurich)
- Nigel Hitchin (Oxford)
- Nikita Nekrasov (Simons Center, Stony Brook)

The meeting will be followed by a three-day workshop on *Modern Geometry and Physics*, 19-21 September. The speakers include Barbara Bolognese (Sheffield), Andrea Brini (Imperial), Leonid Chekhov (Moscow), Domenico Fiorenza (Rome), Boris Dubrovin (Trieste), Vladimir Fock (Strasbourg), Lotte Hollands (Heriot-Watt), Marina Logares (Plymouth) and Elisa Postinghel (Loughborough).

Funds may be available to support the attendance of the UK research students.

Enquiries should be addressed to the organisers: H.Ahmadinezhad (H.Ahmadinezhad@lboro.ac.uk) and A.P. Veselov (A.P.Veselov@lboro.ac.uk)

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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). Please send updates and corrections to calendar@lms.ac.uk.

JULY 2017

3-5 Gravity and Black Holes, Cambridge (468) 3–7 Orthogonal Polynomials, Special Functions and Applications, University of Kent (470) 3-7 Scalable Statistical Inference, INI Cambridge (466) 3-7 BSDEs, SPDEs and their Applications Workshop, Edinburgh 3–7 British Combinatorial Conference, Strathclyde (464) 6-7 Stochastic Epidemic Models with Structured Populations, University of Nottingham (470) 9–13 Formal Power Series and Combinatorics Conference, OMUL (470) 10–11 Boundary Integral Methods, Nottingham Trent University (468) 10–12 Mathematical Models in Ecology and Evolution Conference, City, University of London (470) 10–12 Tutte Centenary Conference, Cambridge (471)10-14 Computer-aided Mathematical Proof, INI Cambridge (466) 10–19 Foundations of Computational Mathematics Conference, Barcelona (461) 17-21 Conference on Applications of Computer Algebra, Jerusalem 31–5 Aug International Mathematics Competition, Blagoevgrad, Bulgaria (466)

AUGUST 2017

1–4 Interactions of Symplectic and Algebraic
Geometry, Warwick (470)
1–4 Young Researchers in Mathematics
Conference, University of Kent (469)
4 Model Theory of Valued Fields, University of
Central Lancashire (471)
6-12 Groups St Andrews Conference, Birmingham (469)
7–10 Nonlinear Water Waves, INI Cambridge (468)
29–31 Asymptotics for Stochastic Dynamical
Systems, Swansea University (471)
30–2 Sept Noncommutative and Non-Associative
Algebraic Structures in Physics and Geometry,
Queen's University Belfast (471)

SEPTEMBER 2017

1 Christopher Hoolev and the Artin Conjecture: 50 Years On, Bristol (468) 4 Function Theory Meeting, De Morgan House, London (471) 4-8 September European Study Groups with Industry, Warwick (468) 4-8 Variational Methods. New Optimisation Techniques and New Fast Numerical Algorithm, INI Cambridge (468) 5–9 British Science Festival, Brighton (471) 6-8 British Topology Meeting, University of Leicester (471) 8-9 British Logic Colloquium 2017, University of Sussex (471) 7-8 LMS Prospects in Mathematics Workshop, Reading (470) 10–15 Mathematics Education for the Future Decade, Balatonfüred, Hungary (460) 11–13 British Algebraic Geometry Meeting, Cambridge (471) 11–15 Algebraic Topology of Manifolds LMS-CMI Research School, Oxford (470) 11-15 Diophantine Problems, University of Manchester (471) 18 LMS Midlands Regional Meeting, Loughborough (471) 18–22 Navier–Stokes and Euler Equations Workshop, Sussex 20 LMS Popular Lectures, Birmingham (471)

OCTOBER 2017

2–6 Ice–Fluid Interaction INI Workshop,
Cambridge (470)
12 Symmetry and Computation LMS-IMA Joint
Meeting, De Morgan House, London (470)
30–3 Nov Generative Models, Parameter Learning
and Sparsity INI Workshop, Cambridge (471)

NOVEMBER 2017

2 Symbolic Computation Techniques in SMT Solving, BCS-FACS Evening Seminar, London (471) 6–10 Ice-Structure Interaction INI Workshop, Cambridge (471) 7–8 Opportunities for the Future: Women in Mathematics, Bristol (471) 10 Graduate Student Meeting, London 10 LMS Annual General Meeting, London 13–17 Shape Analysis and Computational Anatomy INI Workshop, Cambridge (471) 29–1 Dec Form and Art, Toys, and Games INI Workshop, Cambridge (471)

LMS REPRESENTATIVES DAY held at De Morgan House on 10 May 2017

The LMS Representatives Day is an annual meeting of the Society with its nationwide network of representatives, held at the home of the Society in London: De Morgan House. The meeting is held to assess how the UK mathematical community is doing, and importantly gives Society members the chance to directly inform the Society of steps it can take in order to further advance the mathematical sciences.



Treasurer Professor Robert Curtis discussing how the finances of the Society function.



President-Designate Professor Caroline Series highlighting a future Women in Mathematics event.



Dr Ola Törnkvist explaining the intricacies of the developing one of the Society's journals.



Heidi Morstang, director of 'Frames of Mind', discussing the presentation of her documentary into how mathematicians think.



Dr Dmitry Rumynin and President-Designate Professor Caroline Series discussing the meeting in front of the Plücker Collection.



Professor John Hunton, Publications Secretary at the LMS, gives a talk on the work of LMS Publications