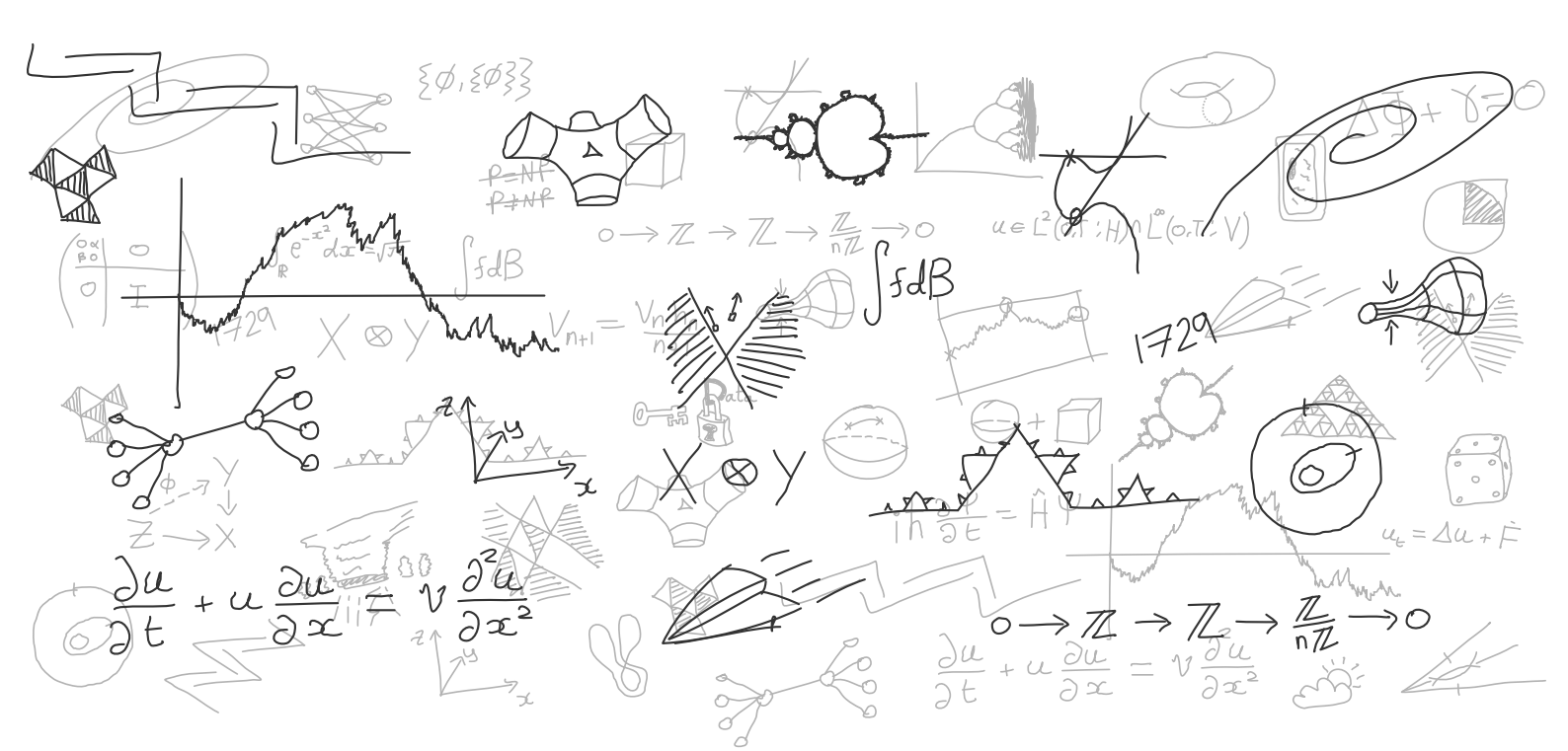
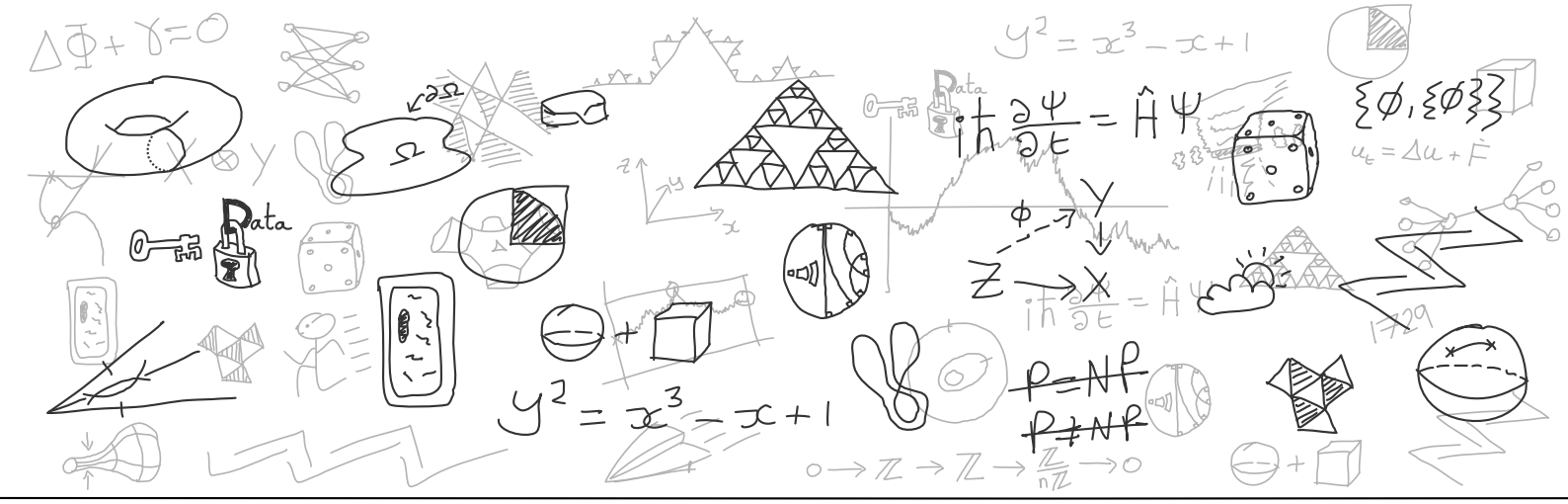


YRM 2014



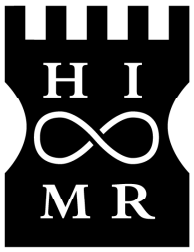
Young Researchers in Mathematics

University of Warwick

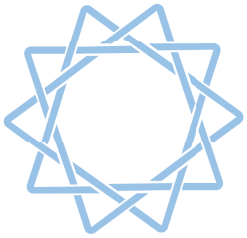
30th June - 3rd July

Warwick Mathematics Institute

YRM 2014 would not be possible without the generous support of:



Heilbronn Institute *for* Mathematical Research



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Research Student Skills Programme

YRM 2014

Welcome

Welcome to *Young Researchers in Mathematics 2014*! Thank you for coming to the Warwick Mathematics Institute and being part of this student-run event. While you're here we hope that you'll take the opportunity to introduce yourself to the other participants, and find out about research in your area at other universities — this is the perfect opportunity to sow the seeds of collaboration between people who you might never have thought of working with!

We hope that you enjoy the conference, including all the keynote talks, plenary lectures, and track talks. We hope to provide a friendly, informal atmosphere in which to learn about your peers' research, so please ask questions in the talks and don't be afraid to approach the speaker at the end if there's something you want to talk about!

Above all, we hope that you enjoy yourselves here at YRM 2014!

Acknowledgments

We couldn't have made YRM happen alone: we have had lots of help from many, many people. We would especially like to thank Martine Barons, Yvonne Collins, Hazel Graley, Hazel Higgens, Nav Patel, James Robinson and Samir Siksek for their advice and assistance. We would also like to thank all the organising committees of previous YRM conferences for their help.

We are grateful to all the Warwick postgraduates who volunteered as track chairs for the event; namely Mark Bell, Federico Botta, Watthanan Jatuviriyapornchai, Neil Jenkins, Malavarayan Kabilan, Céline Maistret, Yuchen Pei, Daniel Rogers, Daniel Seco, and Magdalena Zajaczkowska.

Further thanks are due to the representatives of YRM 2014 who helped publicise this conference at their universities; namely Lucy Barnes, Johannes Biniok, Rachel Carey, Alex Corner, Jonathan Crawford, Kevin Crooks, Matthew Dawes, Susana Gomes, Sam Kamperis, Moritz Kuentzler, Adam Morgan, Stephen Muirhead, Simon Myerson, Thomas Oliver, Emilio Pierro, Carmen Rovi, Ana Rovi, Daniel Rust, Mairi Walker, Michael West, and Nicola Wittur.

Finally, and most importantly, we would like to extend our thanks and gratitude to all the speakers and all the conference participants for making this conference what it is.

Florian Bouyer, Jenny Cooley, Heline Deconinck, Karim El Haloui, Dave McCormick, Ben Pooley

Young Researchers in Mathematics 2014 Committee

www.warwick.ac.uk/yrm2014

Information

If you have any questions, please ask one of the organisers, who are all wearing **yellow** T-shirts. Alternatively, you can ask one of the track chairs, who are wearing **purple** T-shirts.

YRM 2014 is being held in the **Zeeman Building**, where the Warwick Mathematics Institute is located. A map of Warwick campus can be found on the back cover of the booklet, and a map of the Zeeman building can be found on the inside back page (page 32).

The conference formally begins at 12:30 with the Welcome Talk in MS.02. The **registration desk** is in the foyer of the Zeeman building, known as the Street, just inside the front door. It will be manned from 09:00 on Monday; anyone arriving after the conference has started should seek out one of the organisers to register. The front doors to the Zeeman building are open from 08:30 to 21:00, and are card access only outside these hours.

Please ensure that you wear your **conference badge** at all times, especially during the tea and coffee breaks and the meals; this enables us to make sure only conference participants take our food and drink.

Giving a talk

If you are giving a talk, please try and find your track chair before your talk and check it is in a compatible format. All rooms have blackboards, whiteboards, computers, digital projectors and overhead projectors, but some warning for those giving talks on overhead transparencies would be appreciated. For computer slideshows, it is easiest if you transfer your slides (in either PDF or Powerpoint format) to a USB stick; you can also plug in your laptop to the projector if you wish.

Please note that all track talks should be no more than 20 minutes long, with up to 5 minutes of questions at the end; in order to ensure fairness and enable people to transfer rooms between talks, track chairs will cut speakers off strictly 20 minutes after starting the talk.

Meals

Lunch will be served in the Street every day around 12:30 or 13:00 (check the timetable for details).

Tea and Coffee will be served in the Street at 10:30 and 15:00 every day during the conference. Unfortunately we are unable to provide coffee before the first talk, so caffeine addicts are advised to get their fix at breakfast, or buy a coffee from one of the outlets on campus.

Dinner will start at 19:00 each evening. There will be a variety of dinner events over the three evenings:

- On Monday evening, the poster presentation will take place in the Street, accompanied by a wine reception and hot buffet, sponsored by the Heilbronn Institute.
- On Tuesday evening, we are having a barbecue, outside the Zeeman Building (in case of inclement weather, we will move inside).
- On Wednesday evening, the formal conference dinner will take place in the **Chancellor's Suite** on the second floor of the **Rootes Social Building** (see the campus map for directions).

YRM Common Room

The YRM Common Room, accessible from the street (and known to Warwick students as the undergraduate workroom), is available for all YRM delegates to use. In particular, please feel free to use the tables and chairs while eating lunch. Inside the YRM Common Room will be a number of display stands from sponsors and other companies, which will change every day; we encourage you to take a look and check them out.

On Campus Accommodation

Check-in: If you have booked on-campus accommodation through us, you will be able to check-in from 15:00 until 23:00 on your day of arrival; for your convenience there is a one-hour break after the last talk before the wine reception on Monday evening. Check-in is at the Conference Reception which is located in the **Students' Union Building** (see the campus map for directions).

Check-out: You must check out by 09:30 on your day of departure.

Left luggage: Left luggage facilities are available at Conference Reception. Alternatively, you may leave your luggage in Room A1.01 in the Zeeman Building on Monday and Thursday; the room will be locked or manned until 19:00 on Monday and from 09:00 on Thursday.

Breakfast: Breakfast is served in Rootes Restaurant, located on the first floor of the Rootes Social Building.

Sport facilities: Delegates have use of some of the comprehensive sports facilities including swimming and fitness suite free of charge; please ask at Conference Reception in the Students' Union Building for further information.

Parking

You can park on campus for free in car parks **7, 8, 8a** and **15**.

- If parking in car parks 8 or 8a, just park in a free space. There is no need to pay and display (please ignore the warnings, which only apply during term time).
- If parking in car parks 7 or 15: on entering the car park, take the token from the machine. Please ensure you validate your token at Conference Reception before leaving the car park.

Please note that due to ongoing roadworks on campus, those wishing to access the car parks on central campus **must** access campus from the north-west end via Kirby Corner Road / Westwood Way / Washwood Heath Road. There is **no** access to central campus from the south end of campus via Gibbet Hill Road. You may wish to allow extra time for your journey to campus.

Public transport

There are frequent bus services from Warwick campus to Coventry (number 12) and Leamington Spa (number U1). The number 11 bus runs between Coventry and Leamington Spa via campus; check which way the bus is going before getting on. Note that Warwick campus is **not** in the town of Warwick, but there is an hourly bus (number X16) to Warwick during the day.

Wireless Internet Access

Wireless internet is available for free in the Zeeman Building using the Eduroam system, which we recommend you set up with your home institution before you arrive.

Health and Safety

In an emergency, call University Security on **22222** (from a University phone) or **024 765 22222**, who will put you through to the emergency services.

All information is correct at the time of print. Any changes will be announced through notices on the pillars in the Street.

This page has been intentionally left almost blank. Please feel free to use it for your own notes.

Monday 30th June			
09:30–12:30	***Arrivals & Registration*** in the Street, Zeeman Building		
12:30–13:00	***Introduction and Welcome***, Room MS.02		
13:00–14:00	***Lunch*** in the Street		
14:00–15:00	Analysis & PDEs Keynote: **Prof. John Ball** (**Oxford**) *Mathematics of Interfaces in Solids* Room MS.02		
15:00–15:30	***Tea & Coffee*** in the Street		
	Algebra Room MS.01	Analysis & PDEs Room MS.03	Topology Room MS.04
15:30–16:00	Oliver King (City, London) *The modular representation theory of diagram algebras*	Pravin Madhavan (Warwick) *Adaptive Refinement for Partial Differential Equations on Surfaces*	Samuel Evington (Glasgow) *Classification of C*-algebras*
16:00–16:30	Wenqing Tao (QMUL) *Deformation of differential graded algebra and pre-Lie algebra*	Katharina Schade (TU Darmstadt) *Strong Dynamics of Nematic Liquid Crystal Flows: The Quasilinear approach*	Robert Kropholler (Oxford) *CAT(0) structures for Free-by-Cyclic Groups*
16:30–17:00	Christopher Fish (Sheffield) *Quantized connected Weyl algebras*	Andrew Lam (Warwick) *Modelling surfactants in two phase flow*	Bei Liu (Göttingen) *Uniqueness of T-duality isomorphism*
17:00–18:00	Probability & Statistics Keynote: **Dr. Hugo Duminil-Copin** (**Geneva**) *The self-avoiding walk on the hexagonal lattice: from combinatorics to Conformal Field Theory* Room MS.02		
19:00–	***Poster Presentation*** in the Street including *Wine Reception & Hot Buffet* sponsored by the Heilbronn Institute		

Tuesday 1st July					
09:30–10:30	Plenary Lecture: **Prof. Jeremy Gray (Open/Warwick)** *It's too late now! What you might have done starting out a long time ago* Room MS.02				
10:30–11:00	***Tea & Coffee*** in the Street				
	Algebra Room MS.01	Analysis & PDEs Room MS.03	Number Theory Room MS.04	Fluid Mechanics / Maths & Physics Room MS.05	
11:00–11:30	Emilio Pierro (Birkbeck) *Beauville Surfaces and Beauville Groups*	Daniel Seco (Warwick) *Cyclic functions in the bidisk*	Coline Wiatrowski (Lyon 1) *Some algebraic properties of Stark units*	Leonor Garcia Gutierrez (Warwick) *Multi-particle collision dynamics modelling of microflows*	Dr. Julia Collins (Edinburgh) *How to talk maths (and have people listen)* Room A1.01
11:30–12:00	Anna Schroeder (St Andrews) *The Building Blocks of Group Theory and the Structure of Classical Groups*	Richard Awonusika (Sussex) *The Selberg Zeta Function and Determinant of the Laplacian on Compact Hyperbolic Surfaces*	Yukako Kezuka (Cambridge) *On the p-part of the Birch–Swinnerton-Dyer conjecture for elliptic curves with CM by the ring of integers of* $\mathbb{Q}(\sqrt{-3})$	Gary Willis (Imperial) *Correlation functions and the wave-vector dependent surface tension in a toy density functional model of the liquid-vapour interface*	
12:00–12:30	Tom Harris (Southampton) *Binary complexes and algebraic K-theory*	Javed Hussain (York) *Non-linear Heat equation on Hilbert Manifold*	Yuchao Wang (Bristol) *Almost prime points on certain cubic surfaces*	Emilio Zappa (York) *An introduction to the mathematics of quasicrystals*	
12:30–13:00	***Group Photograph*** Outside the Zeeman Building				
13:00–14:00	***Lunch*** in the Street				

14:00–15:00	Maths & Biology Keynote: **Prof. Rebecca Hoyle** (**Surrey**) *Maternal effects and environmental change* Room MS.01			Algebra Keynote: **Dr. Colva Roney-Dougal** (**St Andrews**) *Groups, diagrams and geometries* Room MS.02	
15:00–15:30	***Tea & Coffee*** in the Street				
	Algebra Room MS.01	Analysis & PDEs Room MS.03	Number Theory Room MS.04	Maths & Biology Room MS.05	
15:30–16:00	Dandan Yang (York) *Maximal subgroups of free idempotent generated semigroups*	Katie Gittins (Bristol) *Heat Flow Problems in $\mathbb{R}^m$, $m \geq 2$.*	Chris Williams (Warwick) *Overconvergent modular symbols over imaginary quadratic fields*	Laila Alsharief (York) *Bioconvection as a Mechanism to Promote Biodiversity*	Dr. Julia Collins (Edinburgh) *How to talk maths (and have people listen)* Room A1.01
16:00–16:30	James Hyde (St Andrews) *Sierpinski Rank*	Matthew Thorpe (Warwick) *Convergence of the k-Means Method Using Gamma-Convergence*	Simon Myerson (Oxford) *"Moat lemmas" and mean values of exponential sums*	Rudianto Artiono (York) *A Simple Transmission Model of Leptospirosis in Rodent Populations*	
16:30–17:00	Rida-e Zenab (York) *λ-Zappa-Szép products*	Michael Tsardakas (Heriot-Watt) *Mathematics of Crime*			
17:00–18:00	Maths & Physics Keynote: **Prof. Robert Mackay** (**Warwick**) *A kinematic explanation for gamma-ray bursts* Room MS.01			Set Theory & Logic Keynote: **Dr. Thomas Forster** (**Cambridge**) *The Axiom of Choice: what it means and what it does* Room MS.02	
19:00–	***Barbecue*** Outside the Zeeman Building				

<table>
<tr><th colspan="5">Wednesday 2nd July</th></tr>
<tr><td>09:30–10:30</td><td colspan="2">Differential Geometry Keynote:
Prof. Peter Topping (Warwick)
An introduction to Differential Harnack Inequalities
Room MS.01</td><td colspan="2">Number Theory Keynote:
Prof. Roger Heath-Brown (Oxford)
Diophantine equations: Algebra, Geometry, Analysis & Logic
Room MS.02</td></tr>
<tr><td>10:30–11:00</td><td colspan="4">Tea & Coffee in the Street</td></tr>
<tr><td></td><td>Algebraic Geometry / Algebra
Room MS.01</td><td>Analysis & PDEs / Differential Geometry
Room MS.03</td><td>Dynamical Systems / Number Theory
Room MS.04</td><td></td></tr>
<tr><td>11:00–11:30</td><td>Ian Vincent (Warwick)
Bounding lines on K3 Surfaces</td><td>Evangelos Papoutsellis (Cambridge)
Total Variation Regularisation in Measurement and Image space for PET reconstruction</td><td>Luke Adamson (Portsmouth)
Renormalisation of correlations in a barrier billiard: Quadratic irrational trajectories</td><td rowspan="4">Dr. Julia Collins (Edinburgh)
How to talk maths (and have people listen)
Room A1.01</td></tr>
<tr><td>11:30–12:00</td><td>Lore Kesteloot (KU Leuven)
The specialization index</td><td>Giovanni Alberti (Oxford)
Elliptic regularity theory applied to time harmonic Maxwell's equations</td><td>Sascha Troscheit (St Andrews)
Have I been here before? — Recurrence in dynamical systems</td></tr>
<tr><td>12:00–12:30</td><td>Jenni Awang (St Andrews)
Semigroups: Spot The Difference</td><td>Judith Campos Cordero (Oxford)
Sufficient conditions for regularity of extremals in the Calculus of Variations</td><td>Christopher White (Bristol)
Primes in an arithmetic progression in short intervals</td></tr>
<tr><td>12:30–13:00</td><td>Josephine French (Oxford)
Loop spaces, ind-schemes and other stuff</td><td>Michela Egidi (Durham)
Lifted Pestov's identity for principle bundles and dynamical applications</td><td>Mairi Walker (Open)
Even integer continued fractions: A geometric approach</td></tr>
<tr><td>13:00–14:00</td><td colspan="4">Lunch in the Street</td></tr>
</table>

14:00–15:00	Dynamical Systems Keynote: **Prof. Gwynneth Stallard** (**Open**) *The role of the escaping set in complex dynamics* Room MS.01		Algebraic Geometry Keynote: **Dr. Tom Coates** (**Imperial**) *Mirror Symmetry* Room MS.02	
15:00–15:30	***Tea & Coffee*** in the Street			
	Algebra / Set Theory Room MS.01	Probability / Financial Maths Room MS.03	Number Theory Room MS.04	
15:30–16:00	Rachael Carey (St Andrews) *Graph Automatic Semigroups*	MingJie Hao (Kent) *Multiple Equilibria, Adverse Selection and Loss Coverage in Insurance*	Christophe Debry (KU Leuven) *Special L-values in positive characteristic*	Dr. Julia Collins (Edinburgh) *How to talk maths (and have people listen)* Room A1.01
16:00–16:30	Alex McLeman (St Andrews) *Cayley Automaton Semigroups*	Stefan Walter (TU Darmstadt) *Mean curvature motion for a model of spatial random permutations*	Alejandro Argaez-Garcia (Warwick) *Galois Representations*	
16:30–17:00	Anja Komatar (Leeds) *Classification of Ramsey classes of coloured partial orders*		Francesca Balestrieri (Oxford) *Methods to solve Diophantine equations*	
17:00–18:00	Financial Maths & Stochastic Analysis Keynote: **Prof. Saul Jacka** (**Warwick**) *An introduction to math finance with transaction costs* Room MS.01		Topology Keynote: **Dr. Saul Schleimer** (**Warwick**) *Algorithmic topology* Room MS.02	
19:00–	***Conference Dinner*** Chancellor's Suite, Rootes Social Building			

Thursday 3rd July			
09:30–10:30	Fluid Mechanics Keynote: **Prof. John Gibbon** (**Imperial**) *The incompressible 3D Euler and Navier-Stokes equations: how much do we know?* Room MS.01	Combinatorics Keynote: **Dr. David Conlon** (**Oxford**) *On the grid Ramsey problem and related questions* Room MS.02	
10:30–11:00	***Tea & Coffee*** in the Street		
	Algebra Room MS.01	Probability Room MS.03	Combinatorics Room MS.04
11:00–11:30	Charles Cox (Southampton) *Automorphisms and The Conjugacy Problem for Houghton's Groups*	Owen Daniel (Warwick) *Loops, Soups, and Bosons*	Balázs Udvari (Warwick) *On the minimum number of convex quadrilaterals*
11:30–12:00	Louise Sutton (QMUL) *The graded dimension of Specht modules*	Martine Barons (Warwick) *Algebraic Statistics for Bayesian Networks*	Andrew Collins (Warwick) *The speed of hereditary properties of graphs*
12:00–12:30	Careers Talk by Dr. Ben Cox (*Tessella*) Room MS.02		
12:30–14:00	***Lunch*** in the Street		
14:00–15:00	Plenary Lecture: **Prof. Ian Stewart** (**Warwick**) *Network Models of Visual Illusions and Rivalry* Room MS.02		
15:00	***Closing & Departure***		

Abstracts

After the plenary talks, the abstracts for each track are listed, starting with the keynote; the rest of the talks appear in alphabetical order of the speaker's surname.

Plenary Lectures

Prof. Jeremy Gray (Open/Warwick) Tuesday, 09:30–10:30, Room MS.02

It's too late now! What you might have done starting out a long time ago

Where are the problems in mathematics, and what can you do to solve them as you start out? The study of algebraic curves in the 19th century suggests some ways in which all sorts of good ideas were there to be found and used, and some remarkable ones were there for those with eyes to see. Changing attitudes to mathematical objects threw up novel problems, highlighted what the old guys missed, and created opportunities that in the end revitalised geometry.

Prof. Ian Stewart (Warwick) Thursday, 14:00–15:00, Room MS.02

Network Models of Visual Illusions and Rivalry

The talk is about some of my current research, focusing on ways to model real-world phenomena and analyse the resulting models. The main aim is to understand some intriguing features of the human visual system.

In binocular rivalry, conflicting images are presented to the two eyes, and the visual system interprets this combination in sometimes surprising ways. Visual illusions involve ambiguous or incomplete information, presented simultaneously to both eyes. Well-known illusions include the Necker cube, the rabbit/duck illusion, the cartoonist William Ely Hill's 'my wife and my mother-in-law', and the spinning dancer, in which a moving image of a dancer appears to spin in either the clockwise or anticlockwise direction.

In 2009 Hugh Wilson proposed a neural network model for high-level decision-making in the brain, based on the phenomenon of binocular rivalry. Diekman, Golubitksy and Wang observed that Wilson networks are useful for understanding rivalry itself. The talk describes ongoing work with Golubitsky and Diekman in which we generalise Wilson networks, and model illusions as well as rivalry. The model corresponds well to several experiments in the literature, and in some cases leads to new predictions.

Public Speaking Workshops

Dr. Julia Collins (Edinburgh) Tuesday & Wednesday, 11:00–12:30 & 15:30–17:00, Room A1.01

How to talk maths (and have people listen)

Are you giving a talk at YRM? Do you want to improve your public speaking skills in a sympathetic and friendly environment? If the answer to either of these questions is 'yes' then you should sign up for our public speaking workshop!

In our workshop you will:

- Hear tips and advice on giving academic talks, from how to structure your material to how to deliver your talk;
- Receive a blueprint for designing the perfect presentation;
- Have a chance to give a short talk and get feedback from both experts and your peers;
- Share ideas on what you think makes a good talk and learn how to give constructive feedback to others.

The workshop lasts $1\frac{1}{2}$ hours and will run four times throughout YRM. Each workshop will have about 12 places; sign-up sheets will be available throughout Monday.

Algebra

KEYNOTE: **Dr. Colva Roney-Dougal (St Andrews)** Tuesday, 14:00–15:00, Room MS.02

Groups, diagrams and geometries

The study of finitely-presented groups has been ongoing since the work of Hamilton in the 1850s - almost as long as group theory itself! This talk will be a gentle introduction to combinatorial and geometric group theory, with an emphasis on algorithms. I'll describe some finite diagrams, and some potentially infinite geometries, that are naturally associated with any finitely-presented group, and show how results about the diagrams and geometries prove structural results about the group, and vice versa.

Jenni Awang (St Andrews) Wednesday, 12:00–12:30, Room MS.01

Semigroups: Spot The Difference

Semigroups are structures with very few rules governing them, and so lots of crazy things can happen. If we draw a picture (a Cayley graph, perhaps!) to represent a semigroup, does that picture uniquely represent a semigroup? Can we deduce any information about the semigroup just by looking at the picture? If the pictures of two semigroups look similar, does that mean that they share properties? And is there a prettiest semigroup?

Rachael Carey (St Andrews) Wednesday, 15:30–16:00, Room MS.01

Graph Automatic Semigroups

I will introduce the concept of graph automatic semigroups, a generalisation of automatic semigroups. Broadly speaking, a finitely generated semigroup is automatic if we can map a regular language onto the semigroup via a homomorphism, and check that equality and multiplication by generators can be recognised by a two-tape finite state automaton. For graph automatic semigroups we no longer require the map to be a homomorphism, merely a surjection. I will discuss some properties and constructions of graph automatic semigroups, and how these relate to the parallel results for automatic semigroups.

Charles Cox (Southampton) Thursday, 11:00–11:30, Room MS.01

Automorphisms and The Conjugacy Problem for Houghton's Groups

Houghton's Groups are a family of groups H_n which are easily defined and accessible to those who have not seen them before. They have been the subject of much study due to relations with ends and each H_n being FP_{n-1} but not FP_n. In this talk we will introduce the groups, discuss the word and conjugacy problems (which will be introduced for those who are not familiar) and finally look at the structure of $\mathrm{Aut}(H_n)$, possibly seeing the differences for this finite extension of H_n and the conjugacy problem for it.

Christopher Fish (Sheffield) Monday, 16:30–17:00, Room MS.01

Quantized connected Weyl algebras

Quantized connected Weyl algebras are a family of algebras over a field with a simple presentation: each pair of generators satisfy either a quantized Weyl algebra-like relation, or a quantum plane-like relation, and there are 'sufficiently many' quantized Weyl algebra-like relations. I will give a classification of these algebras, and some ring-theoretic properties.

Josephine French (Oxford) Wednesday, 12:30–13:00, Room MS.01

Loop spaces, ind-schemes and other stuff

We will discuss (and make less scary) aspects of geometric representation theory, including (algebro-geometric) loop spaces, ind-schemes, and possibly factorisation monoids or D-modules.

Tom Harris (Southampton) Tuesday, 12:00–12:30, Room MS.01

Binary complexes and algebraic K-theory

Higher algebraic K-groups have traditionally been inaccessible by purely algebraic methods: they are usually defined as the homotopy groups of some K-theory space. Grayson (2012) has recently given an explicit presentation of the higher algebraic K-groups by generators and relations. The generators are new objects known as *acyclic binary multicomplexes*. We will give a short introduction to Grayson's presentation and describe how it can be used to give algebraic proofs of some classical theorems in algebraic K-theory. We will go on to describe some methods for manipulating binary complexes and outline some work in progress on their applications.

James Hyde (St Andrews) Tuesday, 16:00–16:30, Room MS.01

Sierpinski Rank

The Sierpinski Rank of a semigroup S is the least n such that every countable subset of S is contained in an n generated subsemigroup of S. I will talk about Sierpinski rank and then move onto universal sequences. This is a joint work with Julius Jonusas, James Mitchell and Yann Peresse.

Oliver King (City, London) Monday, 15:30–16:00, Room MS.01

The modular representation theory of diagram algebras

The Brauer and partition algebras, introduced by Brauer and Martin respectively, are examples of diagram algebras. The representation theory of both of these over a field of characteristic zero is well understood. In this talk, I will recall the block structure of the Brauer and partition algebras in characteristic zero in terms of the action of a reflection group on the set of simple modules. I will then give a description of the blocks in positive characteristic by using the corresponding affine reflection group (for the partition algebra, this is joint work with C. Bowman and M. De Visscher).

Alex McLeman (St Andrews) Wednesday, 16:00–16:30, Room MS.01

Cayley Automaton Semigroups

Automaton semigroups are the natural generalisation of automaton groups. They are semigroups generated by actions of automata on words over a finite alphabet. I will introduce automaton semigroups before discussing those which arise from so-called Cayley automata, where the automaton is constructed from the Cayley graph of a finite semigroup. We will look at some of the properties of these semigroups and explore the connections between the original semigroup and the arising Cayley automaton semigroup.

Emilio Pierro (Birkbeck) Tuesday, 11:00–11:30, Room MS.01

Beauville Surfaces and Beauville Groups

We give an introduction to the study of Beauville surfaces and Beauville groups with an eye toward generation of finite simple groups.

Anna Schroeder (St Andrews) Tuesday, 11:30–12:00, Room MS.01

The Building Blocks of Group Theory
and the Structure of Classical Groups

Finite simple groups are the building blocks of all finite groups and so understanding their structure greatly enhances our knowledge of group theory. In my talk I will give a short introduction to finite simple groups and their classification before focusing on a special class of matrix groups, namely simple classical groups. In particular, I am going to talk about how to find their maximal subgroups using Aschbacher's Theorem.

Louise Sutton (QMUL) Thursday, 11:30–12:00, Room MS.01

The graded dimension of Specht modules

Representation theory of the symmetric groups has been an area of interest and extensively studied for many years. The problem of fully understanding the symmetric groups over a field of positive characteristic remains at the forefront of representation theory. In 1954, the hook length formula determining the dimension of Specht modules was proven. Until the symmetric group algebra was shown to be isomorphic to a certain KLR algebra in 2009, it was unknown how to grade the symmetric group algebras. We can then define the graded dimensions of Specht modules by Laurent polynomials. Ambitiously, one can hope of obtaining a graded hook length formula. This talk gives an overview of the KLR algebra, together with my recent work on the graded dimensions of the Specht modules for the symmetric group.

Wenqing Tao (QMUL) Monday, 16:00–16:30, Room MS.01

Deformation of differential graded algebra and pre-Lie algebra

In this talk, I will present a fairly natural and easy introduction to deform a (commutative) associative algebra. Given an associative noncommutative algebra, we analysis the classical structures (like Poisson bracket, connection, etc) of which is quantisation. This approach is very different from the algebraic deformation theory of associative algebras introduced by Gerstenhaber (1964). In my case, I will focus on deformation of classical differential graded algebras (a super-commutative super Hopf algebra) over Poisson-Lie group. A large class of examples of such noncommutative deformation will be given by pre-Lie algebra, an (not necessarily associative) algebra with product such that $(ab)c - (ba)c = a(bc) - b(ac)$.

Dandan Yang (York) Tuesday, 15:30–16:00, Room MS.01

Maximal subgroups of free idempotent generated semigroups

The study of the free idempotent generated semigroup $IG(E)$ over a biordered set E began with the seminal work of Nambooripad in the 1970s and has seen a recent revival with a number of new approaches, both geometric and combinatorial. Here we study $IG(E)$ in the case E is the biordered set of a wreath product $G \wr \mathcal{T}_n$, where G is a group and $\mathcal{T}_n$ is the full transformation monoid on n elements. This wreath product is isomorphic to the endomorphism monoid of the free G-act $\operatorname{End} F_n(G)$ on n generators, and this provides us with a convenient approach.

We say that the *rank* of an element of $\operatorname{End} F_n(G)$ is the minimal number of (free) generators in its image. Let $\varepsilon = \varepsilon^2 \in \operatorname{End} F_n(G)$. For rather straightforward reasons it is known that if $\operatorname{rank} \epsilon = n - 1$ (respectively, n), then the maximal subgroup of $IG(E)$ containing ε is free (respectively, trivial). We show that if $\operatorname{rank} \epsilon = r$ where $1 \leq r \leq n - 2$, then the maximal subgroup of $IG(E)$ containing ε is isomorphic to that in $\operatorname{End} F_n(G)$ and hence to $G \wr \mathcal{S}_r$, where $\mathcal{S}_r$ is the symmetric group on r elements. We have previously shown this result in the case $r = 1$; however, for higher rank, a more sophisticated approach is needed. Our current proof subsumes the case $r = 1$ and thus provides another approach to showing that *any* group occurs as the maximal subgroup of some $IG(E)$. On the other hand, varying r again and taking G to be trivial, we obtain an alternative proof of the recent result of Gray and Ruškuc for the biordered set of idempotents of $\mathcal{T}_n$.

This is joint work with Igor Dolinka and Victoria Gould.

Rida-e Zenab (York) Tuesday, 16:30–17:00, Room MS.01

λ-Zappa-Szép products

I will address the Zappa-Szép products of restriction semigroups. Zappa-Szép products are generalisations of semidirect products. The Zappa-Szép product of two inverse semigroups is not inverse in general. But by picking up a special subset of this Zappa-Szép product, called λ-Zappa-Szép product, it is possible to get an inverse semigroup. The construction works via inductive groupoids and result is proved by Nick Gilbirt and Suha Wazzan.

We consider the λ- Zappa-Szép product of two restriction semigroups and see that this becomes a category. We wish to obtain an inductive category for this λ- Zappa-Szép product. For this we need to consider the λ- Zappa-Szép product of a monoid and a semilattice and in this special case, we obtain an inductive category and by defining a pseudo product on it we get restriction semigroup.

Algebraic Geometry

KEYNOTE: **Dr. Tom Coates (Imperial)** Wednesday, 14:00–15:00, Room MS.02

Mirror Symmetry

Mirror symmetry is a circle of ideas, originally coming from string theory in theoretical physics, which links many different aspects of geometry. I will sketch out some of these ideas and describe some of the research going on in the field, with an emphasis on the work of researchers based in the UK.

Lore Kesteloot (KU Leuven) Wednesday, 11:30–12:00, Room MS.01

The specialization index

In arithmetic geometry, one of the central questions is to find geometric conditions on a variety that will imply the existence of a rational point. Let X be a variety over the quotient field K of a henselian discrete valuation ring. If X has a rational point, the index $\iota(X)$ is equal to one, but the converse is not necessarily true.

In this talk, we introduce a new invariant $\iota_{\mathrm{sp}}(X)$, *the specialization index*, such that $\iota(X) \leq \iota_{\mathrm{sp}}(X)$. If K has equal characteristic zero and the residue field is algebraically closed, we provide an explicit formula for the specialization index in terms of an *sncd*-model. We use this to construct examples of curves C with $\iota(C) < \iota_{\mathrm{sp}}(C)$.

If moreover X has trivial coherent cohomology, Colliot-Thélène and Voisin, Esnault and Wittenberg, and Nicaise have independently proven that $\iota(X) = 1$. We generalize this result by also proving that $\iota_{\mathrm{sp}}(X) = 1$.

Ian Vincent (Warwick) Wednesday, 11:00–11:30, Room MS.01

Bounding lines on K3 Surfaces

Given a smooth algebraic surface, studying the number and configuration of its lines answers important questions about its geometry. I will show how studying and playing with the Intersection Form Lattice of Del Pezzo surfaces yields upper bounds on the number of its lines and hint towards extending this method to tackle K3 surfaces obtained as a nonsingular intersection of 3 Quadrics in P^5. If time permits, I will explain how examples of K3 surfaces can be constructed that contain 32 lines and that these are likely to be the maximal examples.

Analysis & PDEs

KEYNOTE: **Prof. John Ball (Oxford)** Monday, 14:00–15:00, Room MS.02

Mathematics of Interfaces in Solids

Solid phase transformations give rise to a variety of unusual kinds of interfaces between different phases, some only observed in recent experiments. The lecture will discuss ways of describing and predicting these, and related questions of nonlinear analysis.

Giovanni Alberti (Oxford) Wednesday, 11:30–12:00, Room MS.03

Elliptic regularity theory applied to time harmonic Maxwell's equations

In this talk I will show how the L^p theory for elliptic equations can be applied to study the regularity of solutions to time harmonic Maxwell's equations with anisotropic complex coefficients. In particular, the solutions are Hölder continuous provided that the coefficients are $W^{1,p}$ for some $p > 3$. This improves existing regularity estimates, where the minimum assumption was the Lipschitz continuity of the coefficients. Moreover, I shall show that this approach can be easily extended to the case with bi-anisotropic materials. This is joint work with Yves Capdeboscq.

Richard Awonusika (Sussex) Tuesday, 11:30–12:00, Room MS.03

The Selberg Zeta Function and Determinant of the Laplacian on Compact Hyperbolic Surfaces

The determinant of the Laplacian on a compact finite-area hyperbolic surfaces is explicitly computed in terms of the Selberg zeta function and the Barnes double gamma function.

Judith Campos Cordero (Oxford) Wednesday, 12:00–12:30, Room MS.03

Sufficient conditions for regularity of extremals in the Calculus of Variations

An outstanding question in the Calculus of Variations is that of finding sufficient conditions for extremals to be strong local minimizers. It is known that the answer to this question is strongly related to the a priori regularity of the extremals. In this talk we discuss some of the conditions that can be impossed on an extremal to ensure its regularity and, hence, that it furnishes a strong local minimizer.

Katie Gittins (Bristol) Tuesday, 15:30–16:00, Room MS.03

Heat Flow Problems in $\mathbb{R}^m$, $m \geq 2$.

We will discuss some Heat Flow Problems in $\mathbb{R}^m$ for $m \geq 2$.

The *Heat Content* is an interesting quantity which is related to the solution of the heat equation on $\mathbb{R}^m$. Let $\emptyset \neq D \subset \mathbb{R}^m$. If the initial temperature distribution is uniformly 1 on D and 0 on $\mathbb{R}^m - D$, then the Heat Content of D in $\mathbb{R}^m$ at time t represents the amount of heat in D at time t. For sufficiently small t, the Heat Content of D in $\mathbb{R}^m$ can be written as a polynomial in $t^{1/2}$ where the coefficients encode information about the geometry of D. We will explore how the geometry of D affects the Heat Content of D in $\mathbb{R}^m$ for small t.

Javed Hussain (York) Tuesday, 12:00–12:30, Room MS.03

Non-linear Heat equation on Hilbert Manifold

The objective of this study twofold. Firstly we will prove the existence and uniqueness of local and global solutions of non linear heat equation projected on a Hilbert manifold in $L^2(D)$, where D is a bounded domain in $\mathbb{R}^d$. Secondly we will prove, by the means of Lojasiewicz inequality, that that solution to our problem converges to some steady state solution as t goes to infinity.

Andrew Lam (Warwick) Monday, 16:30–17:00, Room MS.03

Modelling surfactants in two phase flow

Surfactants are molecules that influence the surface tension of the fluid interfaces within a mixture. This property is essential in the stabilisation of emulsions such as milk, hand cream and fire extinguishers. Thus, there is great interest in understanding the influence of surfactants in fluid mixtures.

In this talk I will present two models of soluble surfactants in two phase flow. The first is a sharp interface model and the second is a phase field model. These models are thermodynamically consistent and satisfy an energy inequality, which makes them potentially amenable to further analysis. I will outline the relationship between two models and present some 1D and 2D numerics.

Pravin Madhavan (Warwick) Monday, 15:30–16:00, Room MS.03

Adaptive Refinement for Partial Differential Equations on Surfaces

Partial differential equations (PDEs) on manifolds have become an active area of research in recent years due to the fact that, in many applications, models have to be formulated not on a flat Euclidean domain but on a curved surface. For example, they arise naturally in fluid dynamics and material science but have also emerged in areas as diverse as image processing and cell biology.

In this talk, we will discuss issues arising when performing adaptive refinement on surfaces and present a new "geometric" adaptive refinement strategy which makes use of information about the surface.

Evangelos Papoutsellis (Cambridge) Wednesday, 11:00–11:30, Room MS.03

Total Variation Regularisation in Measurement and Image space for PET reconstruction

The aim of this talk is to present a novel technique for image reconstruction in positron emission tomography, which is based on (total variation)regularization on both the image space and the projection space. We formulate our variational problem considering both total variation penalty terms on the image and on an idealized sinogram to be reconstructed from a given Poisson distributed noisy sinogram. We prove existence, uniqueness and stability results for the proposed model and provide some analytical insight into the structures favoured by joint regularization.

Katharina Schade (TU Darmstadt) Monday, 16:00–16:30, Room MS.03

Strong Dynamics of Nematic Liquid Crystal Flows: The Quasilinear approach

(joint work with M. Hieber, M. Nesensohn and J. Prüss)

We show the unique existence of strong solutions of the (simplified) Ericksen-Leslie model in bounded C^2-domains locally in time for arbitrary initial data and for initial data close to equilibria globally in time. The main tools are maximal regularity of the Stokes operator and the Neumann-Laplacian as well as quasilinear parabolic theory. The obtained solutions are shown to be real analytic both in time and space.

Daniel Seco (Warwick) Tuesday, 11:00–12:00, Room MS.03

Cyclic functions in the bidisk

Let H be a fixed Hilbert space of analytic functions over a domain. A function f is said to be cyclic in H if its polynomial multiplesare a dense subspace. Although the situation is well understood in many spaces of functions of 1 complex variable, the situation in 2 variables is rather complicated. We study the case when f is a polynomial of 2 variables.

Matthew Thorpe (Warwick) Tuesday, 16:00–16:30, Room MS.03

Convergence of the k-Means Method Using Gamma-Convergence

The k-means method is an iterative clustering algorithm which associates each observation with one of k clusters. It traditionally employs cluster centers in the same space as the observed data. By relaxing this requirement, it is possible to apply the k-means method to infinite dimensional problems, for example off-line multiple target tracking and smoothing problems in the presence of unknown data association. Via a Gamma-convergence argument, the associated optimisation problem is shown to converge in the sense that both the k-means minimum and minimizers converge in the large data limit to quantities which depend upon the observed data only through its distribution.

Michael Tsardakas (Heriot-Watt) Tuesday, 16:30–17:00, Room MS.03

Mathematics of Crime

Using mathematical methods to understand and model crime is a relatively recent idea that has drawn considerable attention from researchers during the last five years. From the plethora of models that have been proposed perhaps the most successful one has been a diffusion-type differential-equations model that describes how the number of criminals evolves in a specific area. We propose a more detailed form of this model that allows for two distinct criminal types representing major and minor crime. Additionally, we examine a stochastic variant of the model that represents more realistically the "generation" of new criminals. Numerical solutions from both models are presented and compared with actual crime data for the Greater Manchester area. Agreement between simulations and actual data is satisfactory. A preliminary statistical analysis of the data also supports the model's potential to describe crime. (joint work with Prof. Andrew Lacey)

Combinatorics

KEYNOTE: **Dr. David Conlon (Oxford)** Thursday, 09:30–10:30, Room MS.02

On the grid Ramsey problem and related questions

A well-known result of Shelah says that Hales-Jewett numbers are primitive recursive. A key lemma used in his proof, now known as Shelah's cube lemma, has become famous in its own right. In its simplest form, this lemma says that if we color the edges of the Cartesian product $K_n \times K_n$ in r colors then, for$n$ sufficiently large, there is a rectangle with both pairs of opposite edges receiving the same color. Shelah's proof shows that $n = r^{\binom{r+1}{2}} + 1$ suffices. Graham, Rothschild and Spencer asked whether this bound can be improved to a polynomial in r. We show that this is not possible by providing a superpolynomial lower bound in r. We also discuss a number of related problems.

Joint work with Jacob Fox, Choongbum Lee and Benny Sudakov.

Andrew Collins (Warwick) Thursday, 11:30–12:00, Room MS.04

The speed of hereditary properties of graphs

A graph property is an infinite class of graphs closed under taking isomorphisms. Given a property X, we write X_n for the number of graphs in X with vertex set $\{1, 2, \ldots, n\}$. We call this X_n the speed of the property X. In this talk I will discuss hereditary properties of factorial speed and discuss methods to determine if a property has speed at most factorial or not.

Balázs Udvari (Warwick) Thursday, 11:00–11:30, Room MS.04

On the minimum number of convex quadrilaterals

In the talk, we use local sequences to generalize convexity of quadrilaterals determined by n points in general position, then we give bounds on the minimum number of convex quadrilaterals in a family of local sequences.

Differential Geometry

KEYNOTE: **Prof. Peter Topping (Warwick)** Wednesday, 09:30–10:30, Room MS.01

An introduction to Differential Harnack Inequalities

I'm hoping to give a talk appealing particularly to the Analysis and PDE participants as well as the Differential Geometers.

Differential Harnack Inequalities have been essential tools in some of the major breakthroughs in pure mathematics of recent times, including the proof of the Poincare conjecture, and are important in probability theory and in many branches of physics. My goal is first and foremost to explain what these inequalities are and what they do. The beginning part of the talk will do this without requiring any knowledge of differential geometry. I will then go on to explain how they arise in geometric flows. For this final part, it would help to know what mean curvature is, but I will explain the intuition behind it for those who don't.

Michela Egidi (Durham) Wednesday, 12:30–13:00, Room MS.03

Lifted Pestov's identity for principle bundles and dynamical applications

We consider a compact Riemannian manifold M of dimension n and $P_{SO(n)}$, its principle bundle of orthonormal frames under the group action of $SO(n)$. We will present a version of the Pestov's identity for smooth functions on $P_{SO(n)}$ under the action of frame flows and we will derive some invariance properties of these smooth functions under parallel transports.

Dynamical Systems

KEYNOTE: **Prof. Gwyneth Stallard (Open)** Wednesday, 14:00–15:00, Room MS.01

The role of the escaping set in complex dynamics

This talk concerns the iteration of entire functions, that is, differentiable functions of the complex plane. In recent years, it has become clear that when these functions are transcendental (that is, not polynomials then a key role is played by the escaping set (consisting of thosepoints that escape to infinity under iteration). Much of this work has been motivated by Eremenko's conjecture that all the components of the escaping set are unbounded. We will show how this has led to a deeper understanding of the possible structures of the escaping set and hence of the Julia set, which consists of those points which behave chaotically under iteration.

Luke Adamson (Portsmouth) Wednesday, 11:00–11:30, Room MS.04

Renormalisation of correlations in a barrier billiard: Quadratic irrational trajectories

We present an analysis of autocorrelation functions in symmetric barrier billiards using a renormalisation approach for quadratic irrational trajectories. Depending on the nature of the barrier, this leads to either self-similar or chaotic behaviour. In the self-similar case we give an analysis of the half barrier and present a detailed calculation of the locations, asymptotic heights and signs of the main peaks in the autocorrelation function. Then we consider arbitrary barriers, illustrating that typically these give rise to chaotic correlations which we further represent by showing the invariant sets on which they lie. Our main ingredient is a functional recurrence which has been previously derived and used in work on the Harper equation, strange non-chaotic attractors and a quasi-periodically forced two-level system.

Sascha Troscheit (St Andrews) Wednesday, 11:30–12:00, Room MS.04

Have I been here before? — Recurrence in dynamical systems

In this talk we introduce the notion of recurrence for dynamical systems and classify points according to their rate of return. For an ergodic measure in a dynamical system Birkhoff's ergodic theorem tells us that for almost all points the rate of return to a subset A is equal to the measure of that set. However investigating sets of points having a different rate of return, we find that they are of uncountably infinite cardinality and have a rich multifractal nature.

Financial Maths & Stochastic Analysis

KEYNOTE: **Prof. Saul Jacka (Warwick)** Wednesday, 17:00–18:00, Room MS.01

An introduction to math finance with transaction costs

Most of the influential developments in mathematical finance have been in the context of frictionless markets. Starting in the 90s, a few people have considered what happens when (proportional) transaction costs are taken into account. This talk will discuss the basics in this context and make a link to monetary measures of risk.

MingJie Hao (Kent) Wednesday, 15:30–16:00, Room MS.03

Multiple Equilibria, Adverse Selection and Loss Coverage in Insurance

Conventional wisdom suggests that the absence of risk classification in an insurance market is likely to create adverse selection, i.e. an insurance product with a pooled premium is over-subscribed by high-risk people. Ultimately, this could lead to a collapse of the whole insurance system. However, this concept is difficult to reconcile with the successful operation of many insurance markets, even in the presence of restrictions on risk classification by regulators. Moreover, arguably from society's viewpoint, the high risks are those who most need insurance. That is, if the social purpose of insurance is to compensate the population's losses — that is, to provide "loss coverage" — then insuring high risks contributes more to this purpose than insuring low risks. Thus, the traditional risk classification scheme is contradicted to this purpose. Therefore, a certain degree of adverse selection is not always bad if it can increase loss coverage. My research starts by modelling the outcome in an insurance market in the absence of risk classification by a pooled equilibrium premium from low and high-risk groups. Using iso-elastic and negative-exponential demand functions, I analyse how the demand elasticities and the population ratio of these two groups determine the equilibria; and how the loss coverage and adverse selection behave. We are able to prove that a moderate degree of adverse selection is desirable for the public as it can increase the loss coverage.

Fluid Mechanics

KEYNOTE: **Prof. John Gibbon (Imperial)** Thursday, 09:30–10:30, Room MS.01

The incompressible 3D Euler and Navier-Stokes equations: how much do we know?

Two of the most enduring open questions in modern applied mathematics are: (i) Do solutions of the incompressible 3D Euler equations blow up in a finite time?; (ii) Do the incompressible 3D Navier-Stokes equations have regular (strong) solutions that evolve for arbitrarily long times from large initial data? This talk will review the history of the many approaches to these two questions in the last 50 years, including a review of more than 20 numerical experiments on the Euler singularity problem.

Leonor Garcia Gutierrez (Warwick) Tuesday, 11:00–11:30, Room MS.05

Multi-particle collision dynamics modelling of microflows

In this talk we will introduce a relatively new family of particle-based, off-lattice mesoscopic models known as Multi-Particle Collision Dynamics (also referred to as Stochastic Rotation Dynamics), and their applications to microfluidics modelling.

Maths & Biology

KEYNOTE: **Prof. Rebecca Hoyle (Surrey)** Tuesday, 14:00–15:00, Room MS.01

Maternal effects and environmental change

Maternal effects are a kind of inheritance that pass from mother to offspring through a pathway other than the genes. For example, if a mother is starving while she is pregnant, her baby may not get all the nutrition it needs and may be affected in later life. Or stress may cause methylation of parts of the mother's DNA and these so-called epigenetic marks can be transmitted to the child, affecting the way their genes are expressed and so how they develop. It is thought that maternal effects might be implicated in human obesity, boost the initial colonisation ability of plants, increase early survival in insects and in general provide a flexible way of maximising evolutionary fitness in a changing environment. I am going to describe insights from quantitative genetics into the role of maternal effects during environmental change.

Laila Alsharief (York) Tuesday, 15:30–16:00, Room MS.05

Bioconvection as a Mechanism to Promote Biodiversity

When algal species compete in the same environment and under the same limited resources, simple theory predicts competitive exclusion by the superior competitor. Here we show that bioconvection, the fluid motion caused by accumulation of upward swimming algal cells which are slightly denser than the fluid, can act as a mechanism for stable coexistence of competing species. By adding a non-linear term describing bioconvection to the simple Lotka-Volterra competition model for two competing species, motile and non-motile, we show that coexistence can arise in the form of stable fixed points or stable limit cycles. Theoretical consequences and practical applications of using these two phenomena in order to optimize biofuel production are discussed.

Rudianto Artiono (York) Tuesday, 16:00–16:30, Room MS.05

A Simple Transmission Model of Leptospirosis in Rodent Populations

Leptospirosis is considered as one of the major bacterial disease worldwide. It spreads not only in the animal populations but also in the humans. Rodents are well-known as the vector of this disease. The pathogens bacteria multiply in the kidneys of these animals and spread to the environment through the urine. In this paper, we propose a mathematical model of the transmission of leptospirosis in Rodent populations by considering standard dynamical modeling for epidemiology. The sensitivity analysis is presented to figure out which parameters have significant influence to the model. Therefore, it can be used as a control strategy. The analytical and numerical solutions are also shown to explore the behavior of the model.

Maths & Physics

KEYNOTE: **Prof. Robert Mackay (Warwick)** Tuesday, 17:00–18:00, Room MS.01

A kinematic explanation for gamma-ray bursts

We show that a kinematic effect produces results similar to observed gamma-ray bursts. The kinematic effect is that when one enters the union of the forward light cones of a continuously emitting object, one sees it initially as infinitely blue-shifted and infinitely intense, the blue-shift and intensity dying off with subsequent time. Thus no cataclysmic event at the emitter is required. We illustrate this by an analysis of light rays between time-like geodesics in de Sitter space. In the two-parameter space of pairs of time-like geodesics, modulo isometries, we find regimes that give light curves of the same shapes as observations. We make remarks about generalization to other models of space-time and discuss the fit with other aspects of observations such as the non-thermal spectrum.

Gary Willis (Imperial) Tuesday, 11:30–12:00, Room MS.05

Correlation functions and the wave-vector dependent surface tension in a toy density functional model of the liquid-vapour interface

We study the density-density (or in magnetic language spin-spin) correlation function in the interfacial region of a fluid (or in Ising language up/down interface) using a square gradient density functional theory. We show that in the Double Parabola approximation (DP), the correlation function and structure factor separate nicely into bulk and interfacial contributions, which is not the case for the full Landau m^4 theory. We attempt to explain this by deriving an interfacial Hamiltonian characterised by a wavevector dependent surface tension, and then reconstructing density correlations from correlations in the interfacial position. We show that a crossing criterion definition of the interface does not explain the aforementioned splitting of the correlation function and structure factors. We then propose an alternate definition of the interface based on a floating interfacial correlation function.

Emilio Zappa (York) Tuesday, 12:00–12:30, Room MS.05

An introduction to the mathematics of quasicrystals

A crystal is a solid whose atoms are arranged to form a regular lattice in the space. The discovery in 1984 of quasicrystals, solids whose atomic structure displays symmetry but lacks translational invariance, have spurred the mathematical interest to develop new tools in order to study these structures. In this talk I will introduce the main properties of quasicrystals, and show how group theory and topology play a relevant role for this task.

Number Theory

KEYNOTE: **Prof. Roger Heath-Brown (Oxford)** Wednesday, 09:30–10:30, Room MS.02

Diophantine equations: Algebra, Geometry, Analysis & Logic

Diophantine equations are polynomial equations, in several variables, over the integers/rationals, for which one seeks integer/rational equations. The Fermat equation $x^n+y^n = z^n$ is perhaps the most famous example. We will look at considerations from various branches of mathematics, culminating in the conclusion that Diophantine equations encode all these other areas.

Alejandro Argaez-Garcia (Warwick) Wednesday, 16:00–16:30, Room MS.04

Galois Representations

We will talk about how we can attache Galois representations to modular forms, elliptic curves and show that they are the same, meaning that we prove the modularity of the elliptic curve.

Francesca Balestrieri (Oxford) Wednesday, 16:30–17:00, Room MS.04

Methods to solve Diophantine equations

In this talk I will outline the current approaches to solving Diophantine equations (for example modular approach, Chabauty techniques, Skolem's Method, etc). In this talk I will go over some examples.

Christophe Debry (KU Leuven) Wednesday, 15:30–16:00, Room MS.04

Special L-values in positive characteristic

The class number formula (CNF) expresses the residue at $s = 1$ of the Dedekind zeta function of a number field in terms of important arithmetic invariants of that field. The BSD conjecture predicts a similar formula, but in an elliptic curve setting. As has often been done in the past, one tries to translate hard problems in number fields to their analogues in function fields and expects these to be "easier". In this talk I will introduce a characteristic-p-valued function field analogue of CNF and BSD, proven by L. Taelman in the case of the affine line as base curve; the aim of my PhD is to generalize this result.

Yukako Kezuka (Cambridge) Tuesday, 11:30–12:00, Room MS.04

On the p-part of the Birch–Swinnerton-Dyer conjecture for elliptic curves with CM by the ring of integers of $\mathbb{Q}(\sqrt{-3})$

We study an infinite family of quadratic and cubic twists of the elliptic curve E parametrised by the modular curve $X_0(27)$. There are two main results, both of which support the validity of the famous Birch–Swinnerton-Dyer conjecture. One of them concerns the 2-adic valuation of the algebraic part of the L-series of quadratic twists of E evaluated at 1, and the other concerns the 3-adic valuations of the L-series of cubic twists of E at 1. We check that the bounds obtained in the main results are precisely the bounds predicted by the conjecture, with equality holding when the Tate–Shafarevich groups of the curves are trivial.

Simon Myerson (Oxford) Tuesday, 16:00–16:30, Room MS.04

"Moat lemmas" and mean values of exponential sums

In 1997 V. Bentkus and F. Götze introduced a technique for estimating L^p norms of certain exponential sums without needing an explicit estimate for the exponential sum itself. One uses insteada kind of estimate I call a "moat lemma". I explain this term, and discuss the implications for several kinds of point-counting problem which we all know and love.

Mairi Walker (Open) Wednesday, 12:30–13:00, Room MS.04

Even integer continued fractions: A geometric approach

Simple continued fractions (those whose partial numerators all equal one, and whose partial denominators are all positive integers) have appeared in mathematical writings dating back as far as the times of the ancient Greeks, and have been studied explicitly by mathematicians for hundreds of years. In contrast, however, there has been very little study of those continued fractions whose partial numerators all equal one, and whose partial denominators are all even integers. In this talk I will show that taking a geometric approach to the study of such 'even integer' continued fractions allows some surprisingly deep results to be obtained in a relatively simple manner.

Yuchao Wang (Bristol) Tuesday, 12:00–12:30, Room MS.04

Almost prime points on certain cubic surfaces

In this talk, we investigate the density of rational points on certain singular cubic surfaces whose coordinates have few prime factors. The key tools used are the circle method and universal torsors.

Christopher White (Bristol) Wednesday, 12:00–12:30, Room MS.04

Primes in an arithmetic progression in short intervals

Based on joint work with A.Haynes I will present a method to obtain an analogue of Linnik's theorem for "short intervals", $(x, (1+\varepsilon)x)$.

Coline Wiatrowski (Lyon 1) Tuesday, 11:00–11:30, Room MS.04

Some algebraic properties of Stark units

In an abelian extension, Stark conjecture predicts the existence of a certain unit related to the Hecke L-function of the extension, called a Stark unit. In this talk, we will assume the existence of Stark units and give some index properties that they satisfy.

Chris Williams (Warwick) Tuesday, 15:30–16:00, Room MS.04

Overconvergent modular symbols over imaginary quadratic fields

The theory of overconvergent modular symbols, developed by Rob Pollack and Glenn Stevens, gives a beautiful and effective construction of the p-adic L-function of a modular form. They define a 'specialisation map' from the space of overconvergent modular symbols to the space of classical symbols, and the crux of their theory is a 'control theorem' that says that this map is an isomorphism on the small slope subspace. This gives an analogue of Coleman's small slope theorem in the modular symbol setting. In this talk, I will describe their results, and then discuss an analogue of the theory for the case of modular forms over imaginary quadratic fields, for which similar results exist.

Probability & Statistics

KEYNOTE: **Dr. Hugo Duminil-Copin (Geneva)** Monday, 17:00–18:00, Room MS.02

The self-avoiding walk on the hexagonal lattice: from combinatorics to Conformal Field Theory

We will discuss the self-avoiding walk model on the hexagonal lattice. Starting with the combinatorial aspects of the model, and in particular the proof of a conjecture made by B. Nienhuis regarding the so-called connective constant of the hexagonal lattice, we will then explain how the scaling limit of the model is (conjecturally) described by conformally invariant objects.

More precisely, we will show that on the hexagonal lattice, the number a_n of self-avoiding walks of length n (starting at the origin) satisfies:

$$\lim_{n\to\infty} a_n^{\frac{1}{n}} = \sqrt{2+\sqrt{2}}.$$

The proof uses a parafermionic observable for the self-avoiding walk, which satisfies a half of the so-called discrete Cauchy-Riemann relations. Establishing the other half of the relations (which conjecturally holds in the scaling limit) would also imply convergence of the self avoiding walk to SLE(8/3), an object which also appears in different aspects of Conformal Field Theory.

The talk will be elementary and will not require any background. This is joint work with S. Smirnov.

Martine Barons (Warwick) Thursday, 11:30–12:00, Room MS.03

Algebraic Statistics for Bayesian Networks

Bayesian networks are a powerful and proven class of models that have been shown to work well in a wide range of different complex domains since they are able to capture the dependencies and independences between variables. In a decision support context, panels of experts provide judgements on small subsets of the overall problem. Using Bayesian networks, such expert opinion can be networked together and combined with data in a rigorous fashion which allows for uncertainty in the inputs. Statistical models that can be specified by an algebraic variety with respect to some set of parameters with ideal are called algebraic statistical models. Implementation of fast algorithms for the computation of the outputs of such systems relies on algebraic descriptions for the expected utility message passing algorithms. In this talk I will introduce Bayesian networks and describe how the power of the algebraic description can be brought to bear in this context.

Owen Daniel (Warwick) Thursday, 11:00–11:30, Room MS.03

Loops, Soups, and Bosons

In this talk we provide an introduction to Le Jan's model for Markovian loop soups, and their associated local field. In particular we describe Le Jan's isomorphism relating the local field of a symmetric loop soup to the Gaussian free field. In the second part of the talk we describe a particular class of non-symmetric loop soups, which we relate to the ideal Bose gas, and discuss how the isomorphism theorem can be used to elicit geometrical descriptions of classical critical phenomena. Joint work with Stefan Adams.

Stefan Walter (TU Darmstadt) Wednesday, 16:00–16:30, Room MS.03

Mean curvature motion for a model of spatial random permutations

It is known that in the zero-temperature Ising model an initial convex droplet of "−" spins, surrounded by an all "+" environment, follows a mean curvature shrinking in the hydrodynamic limit [Spohn 1993; Lacoin, Simenhaus and Toninelli 2011]. We will study a similar model of spatial random permutations (SRP) under zero-temperature dynamics, in which a long cyclic permutation nearly corresponds to the interface between phases in the Ising model. Being distinct enough to pose interesting questions on its own, SRP are still close enough to the above model to expect a mean curvature shrinking again. We will map the permutations to a variant of the simple symmetric exclusion process having implications for certain cell-spreading models in biology and discuss the hydrodynamic limit in this more familiar setting.

Set Theory & Logic

KEYNOTE: **Dr. Thomas Forster (Cambridge)** Tuesday, 17:00–18:00, Room MS.02

The Axiom of Choice: what it means and what it does

The Axiom of Choice is probably the cause of more anxiety and unproductive disputation than any other proposition of pure mathematics. Even the minority of mathematicians who can state it correctly (and who profess to believe it) generally do not know when they are using it (or not using it) nor what purpose it serves nor what it means. In this talk I offer a non-partisan account for the working pure mathematician. It will not be heavily technical: I assume mathematical maturity but no specific skills.

Anja Komatar (Leeds) Wednesday, 16:30–17:00, Room MS.01

Classification of Ramsey classes of coloured partial orders

We will consider classification of Ramsey classes of coloured partial orders using the correspondence between Fraisse classes and Fraisse structures.

Topology

KEYNOTE: **Dr. Saul Schleimer (Warwick)** Wednesday, 17:00–18:00, Room MS.02

Algorithmic topology

Tying knots, and then trying to untie them, is far older than topology. Note that if a string has a loose end then, by doubling back and following along, any knot can theoretically be untied. However, as realized by Alexander the Great, when the two ends of the string are joined to form a loop the unknotting problem becomes more difficult!

Samuel Evington (Glasgow) Monday, 15:30–16:00, Room MS.04

Classification of C^*-algebras

A survey talk on the recent progress in the classification program for C^*-algebras - the non-commutative analogue of spaces of continuous functions.

Bei Liu (Göttingen) Monday, 16:30–17:00, Room MS.04

Uniqueness of T-duality isomorphism

In this talk we first review different approaches of topological T-duality, for example, algebraic topology approach(by Bunke and Schick), C^* algebra construction (by Mathai and Rosenberg) and groupoid (by Daenzer). Each of these approaches gives a T-duality transformation isomorphism for twisted K-groups. Then we show that the T-duality isomorphism is unique, which implies all of these T-duality isomorphisms are the same.

Robert Kropholler (Oxford) Monday, 16:00–16:30, Room MS.04

CAT(0) structures for Free-by-Cyclic Groups

I will prove that all free of rank 2-by-cyclic groups are the fundamental groups of CAT(0) spaces.

List of Posters

The poster presentation takes place on Monday from 19:00 onwards, during the Wine Reception sponsored by the Heilbronn Institute.

Lovkush Agarwal (Leeds)
Reducts and Thomas' Conjecture

Reem Almahmud (Glasgow)
Linear stability analysis of bioconvection of uniform suspension of two mixed species

Ameneh Asgari Targhi (Glasgow)
Instabilities in an asymptotic model of cardiac excitation

Francesca Balestrieri (Oxford)
Title TBC

Mark Bell (Warwick)
How many loops are on this surface?

Raphael Bennett-Tennenhaus (Leeds)
Classifying Indecomposable Modules as Strings and Bands using Functorial Filtration

Federico Botta (Warwick)
Community Structure in Graphs

Alonso Castillo Ramirez (Imperial)
Monstrous Associativity

Italo Cipriano (Warwick)
Some consequences of chaotic dynamics

MingJie Hao (Kent)
Multiple Equilibria, Adverse Selection and Loss Coverage in Insurance

Ma. Elena Hernandez-Hernandez (Warwick)
Controlled Fractional Dynamics and non-Markovian Interacting Particle Systems

Watthanan Jatuviriyapornchai (Warwick)
Condensation in population dynamics and the zero-range processes

Neil Jenkins (Warwick)
Crowding Effects in Intracellular Transport Networks

Jonathan Keelan (Open)
Growing Arterial Trees Using Optimality Principles

Anja Komatar (Leeds)
Ramsey classes

Bei Liu (Göttingen)
Topological T-duality

Simon Myerson (Oxford)
Arithmetic Geometry: The Simplest Example

Ana Victoria Ponce Bobadilla (Warwick)
Modelling calcium waves in different dendritic structures

Thomas Rafferty (Warwick)
Coupling particle systems and growth processes

Ana Rovi (Glasgow)
Lie-Rinehart algebras

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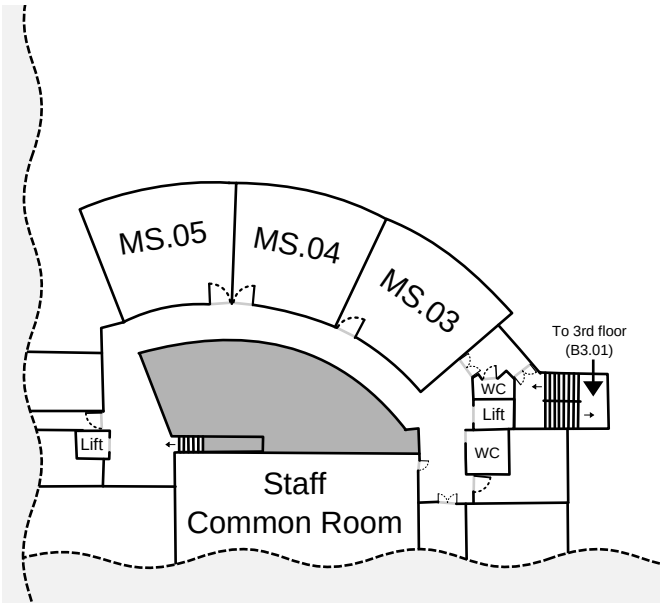

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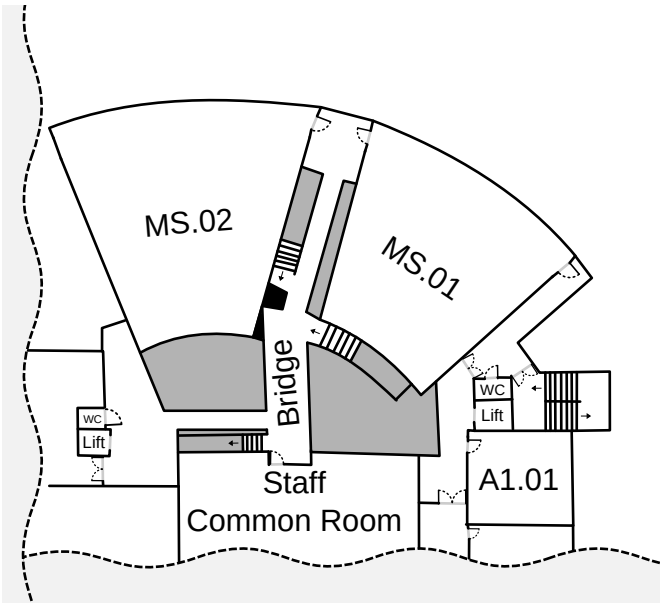

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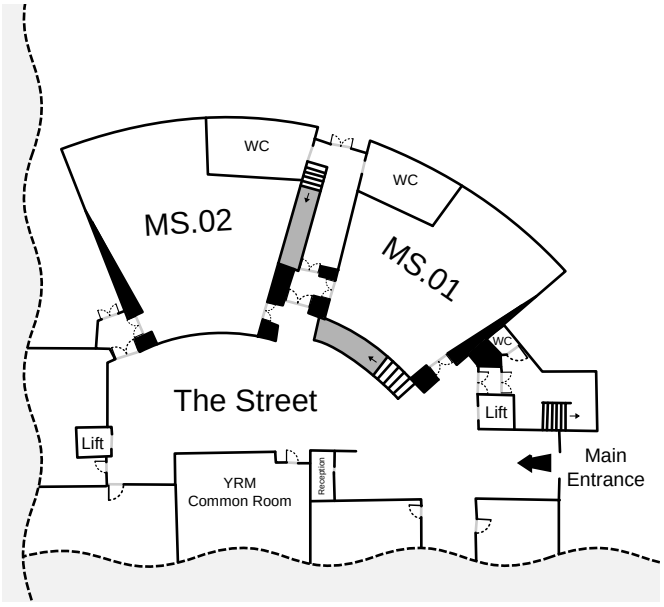

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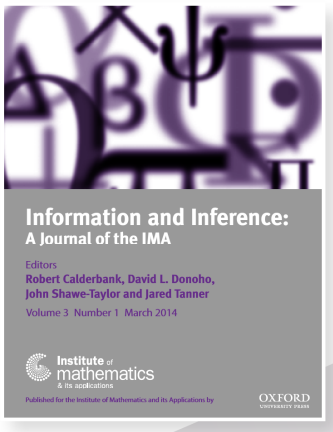

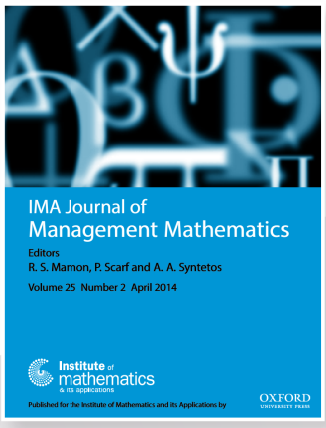

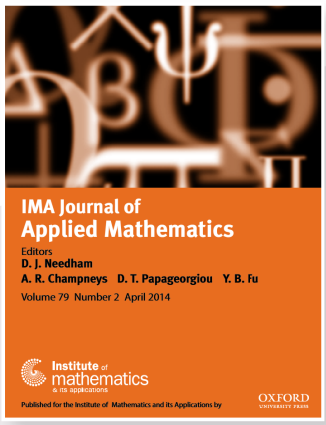

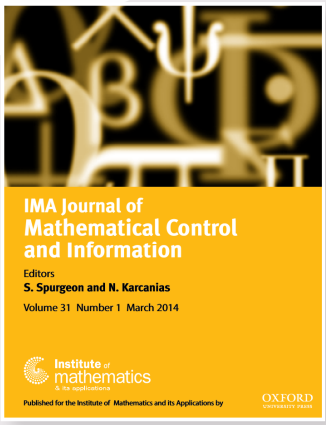

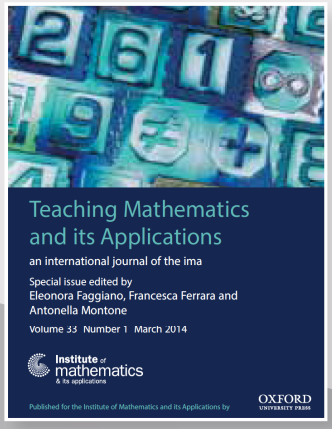

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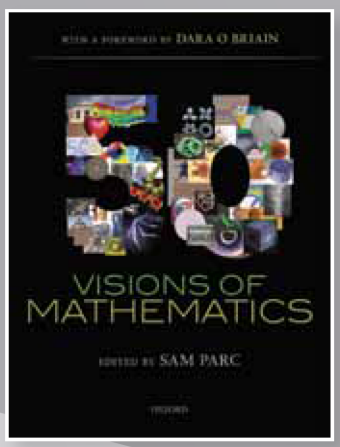

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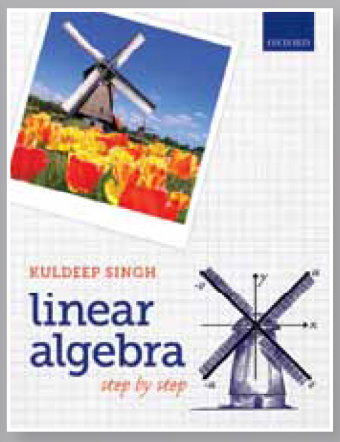

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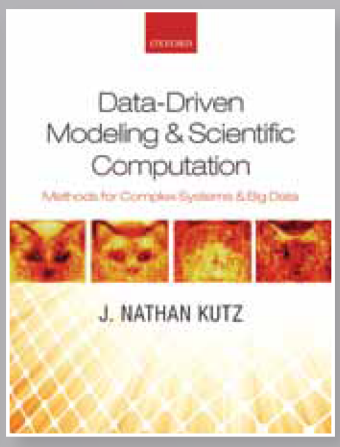

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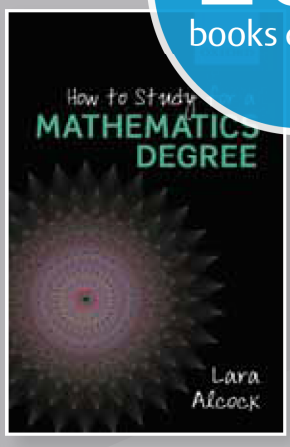

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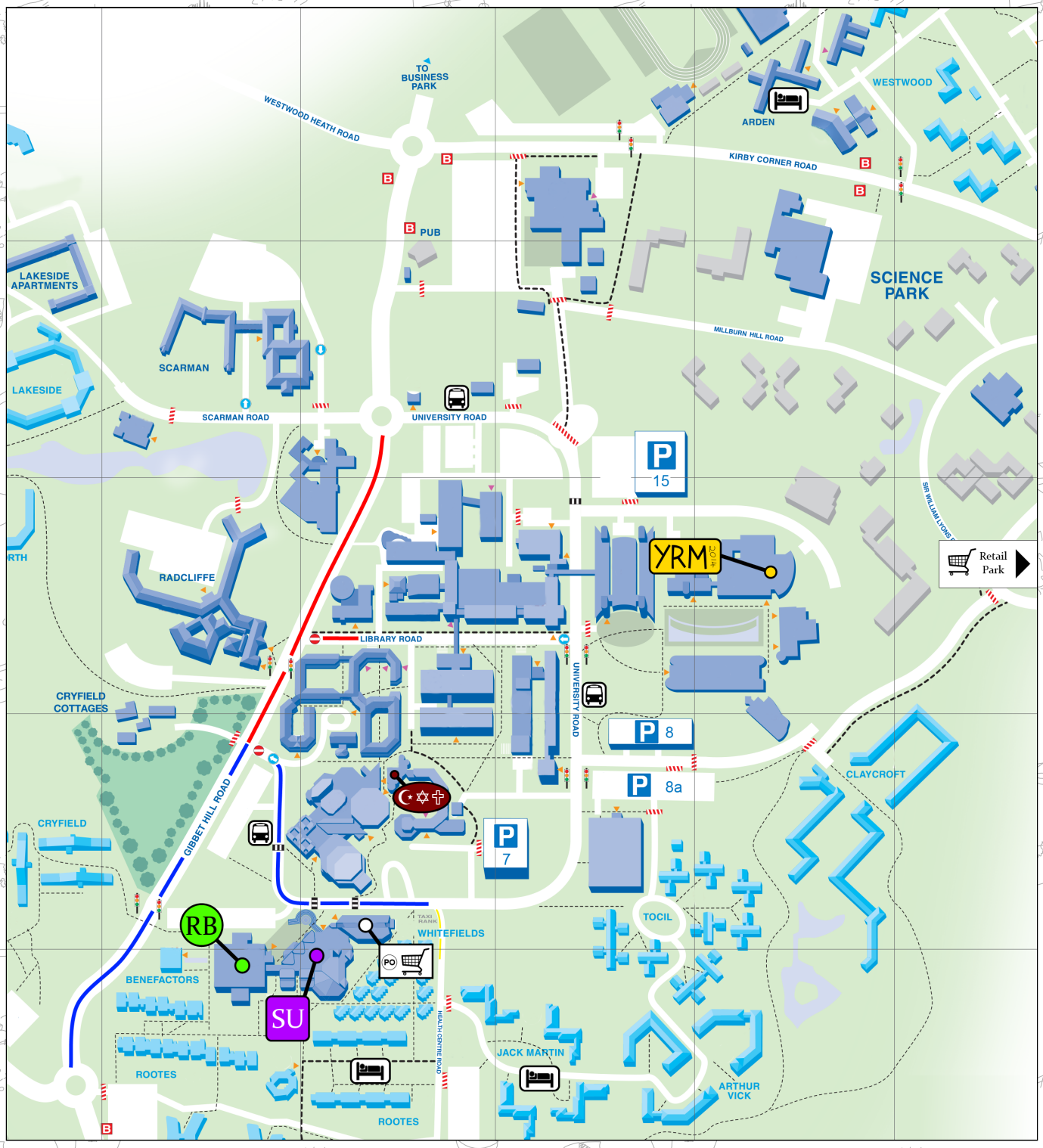

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