Edinburgh Mathematical Society - Societat Catalana de Matemàtiques joint meeting

Edinburgh Mathematical Society

Barcelona, 28-30 May 2015

Contents

1 Welcome

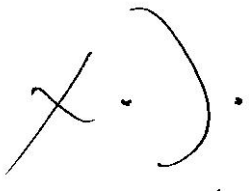
As president of the Catalan Mathematical Society I want to welcome all of you, with especial emphasize to the members of the Edinburgh Mathematical Society, to this first joint meeting between the two societies which is held in Barcelona.

I hope that the meeting will be a great opportunity to move forward in our research and that we will take the opportunity to consolidate our joint mathematical collaborations in the near future.

I want to thank the plenary speakers, from both societies, to accept our invitation, the members of the organizing and scientific committees for they effort to make the conference possible, and the organizers of the special sessions for all the work they have been doing during the last months.

I hope this will be the first of a series of joint meetings among the two societies which enforced our mathematical collaborations.

Sincerely,



Xavier Jarque
President of the SCM

2 Committees

2.1 Scientific Committee

- Àngel Calsina (Universitat Autònoma de Barcelona)
- Jose Figueroa O'Farrill (University of Edinburgh)
- Jim Howie (Heriot-Watt University)
- Marta Sanz-Solé (Universitat de Barcelona)

Jozsef Farkas (General Secretary of the EMS), Joan Solà-Morales (former President of the SCM) and Xavier Jarque Ribera (President of the SCM) have taken part in the discussions of the SC in order to help the organization.

2.2 Organizing Committee

- Xavier Jarque i Ribera (Universitat de Barcelona)
- Àngel Calsina (Universitat Autònoma de Barcelona)
- Jozsef Farkas (University of Stirling)
- Joan Mateu (Universitat Autònoma de Barcelona)
- Albert Ruiz (Universitat Autònoma de Barcelona)

2.3 Thematic Session organizers

- **Analysis:** Martin Dindos (The University of Edinburgh) and Joan Mateu (Universitat Autònoma de Barcelona).
- **Geometric Group Theory:** Jim Howie (Heriot-Watt University, Edinburgh) and Enric Ventura (Universitat Politècnica de Catalunya).
- **Geometry and Mathematical Physics:** Ignasi Mundet (Universitat de Barcelona) and Joan Simon (The University of Edinburgh).
- **Mathematical Biology:** Silvia Cuadrado (Universitat Autònoma de Barcelona) and Jozsef Farkas (University of Stirling).
- **Stochastics:** Istvan Gyongy (The University of Edinburgh) and Marta Sanz-Solé (Universitat de Barcelona).
- **Topology:** Andrew Baker (University of Glasgow) and Albert Ruiz (Universitat Autònoma de Barcelona).

3 Practical information

Meeting venue: The meeting will take place in the main building of the Institut d'Estudis Catalans (Carrer del Carme, 47, Barcelona).

Dinner: A meeting dinner has been organized for Friday, May 29 at 8 pm in the Cloister of the meeting venue.

Picture: A group picture will be taken on Friday, May 29, before the afternoon coffee break.

Local emergency numbers: General emergency (police, ambulance, firefighters) call 112.

4 Schedule

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<tr><td>10:30</td><td colspan="3">Coffee</td></tr>
<tr><td rowspan="2">11:00</td><td>Geometry and Mathematical Physics
11:00 J.I. Burgos

12:00 E. Miranda</td><td>Analysis

11:00 J. Pau
11:30 S. Hwang
12:00 J. Martin
12:30 J. Bosa</td><td>Geometry and Mathematical Physics
11:00 A. Winter

12:00 J.I. Latorre</td></tr>
<tr><td>Mathematical Biology
11:00 M. Casanellas
11:40 N. Popovic
12:20 J. Ripoll</td><td>Geometric Group Theory
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11:00 A. Korobeinikov
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12:20 T. Antal</td></tr>
<tr><td>13:00</td><td colspan="3">Lunch</td></tr>
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15:00 E. Nualart
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16:25 S. Sabanis</td></tr>
<tr><td>16:00</td><td colspan="2">Coffee</td></tr>
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17:15 S. Foss
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<tr><td>Geometric Group Theory
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17:50 P. Burillo</td><td>Topology
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17:50 C. Broto</td><td>Topology
15:00 L. Watson
15:40 I. Gálvez
16:20 R. Hepworth</td></tr>
<tr><td>18:30</td><td rowspan="2"></td><td>Poster session</td><td rowspan="2"></td></tr>
<tr><td>20:00</td><td>Meeting dinner</td></tr>
</table>

Lecture room Sala Prat de la Riba: located on the 1st floor, for *Plenary Lectures* and Thematic sessions on *Analysis*, *Geometry and Mathematical Physics* and *Stochastics*.

Lecture room Sala Nicolau d'Olwer: located on the ground floor, for Thematic sessions on *Geometric Group Theory*, *Mathematical Biology* and *Topology*.

5 Abstracts

5.1 Plenary talks

Roberto Emparan (Universitat de Barcelona)
Title: ***Black holes in the limit of very many dimensions.***
Abstract: One-hundred years after Einstein formulated General Relativity, the pivotal role of its most fundamental and fascinating objects – the black holes – is nowadays recognized in many areas of physics, even beyond astrophysics and cosmology. Still, solving the theory that governs their dynamics remains a formidable challenge that continues to demand new ideas. I will argue that, from many points of view, it is natural to consider the number of spacetime dimensions, D, as an adjustable parameter in the theory. Then we can use it for a perturbative expansion of the theory around the limit of very many dimensions, that is, considering 1/D as a small number. We will see that in this limit the gravitational field of a black hole simplifies greatly and its equations often turn out to be analytically tractable. A simple picture emerges in which, among other things, the shape of the black hole is determined by the same equations that describe soap bubbles.

Istvan Gyongy (The University of Edinburgh)
Title: ***On stochastic partial differential equations of parabolic type.***
Abstract: A brief introduction to the theory of stochastic partial differential equations will be presented. Applications to nonlinear filtering problems will be discussed. In particular, new results in the innovation problem will be given. This part of the talk is based on joint work with Nick Krylov.

Carles Simó (Universitat de Barcelona)
Title: ***Splitting, return maps and confined motion in the planar RTBP: Theory and praxis.***
Abstract: Return maps to a given domain close to a broken separatrix are useful to understand many dynamical properties. The talk will concentrate on symplectic 2D maps and related problems. The main ingredients are the return time to the domain and the splitting of separatrices. Different models are obtained, depending on the problem at hand. They allow to produce realistic quantitative estimates on the boundaries of confined motion.
The methodology is applied to the planar restricted three-body problem. Comparing the theoretical predictions with a careful numerical study one has deeper understanding and a source of new problems.
This is a joint work with Regina Martínez.

Enric Ventura (Universitat Politècnica Catalunya)
Title: ***The Conjugacy Problem and other algorithmically related questions.***
Abstract: A 1911 paper by Max Dehn iniciated a very fruitful line of research, which is in our days extremely dynamic and active: Algorithmic Group Theory. He introduced

the famous Word, Conjugacy and Isomorphism Problems for discrete groups; against the original intuition, during the 1950's, the three of them were showed to be unsolvable in general.
In this talk I will present a 2006 solution to the Conjugacy Problem for free-by-cyclic groups (an intriguing open question at that moment), and the further interesting development started when trying to extend this same result to the wilder class of free-by-free groups. This project is still going on, has proved to be very fruitful, and connects with a more primitive notion in algorithmic algebra: the so-called orbit decidability. We will end the talk proving that a very easy-to-estate linear algebra problem about matrices over the integers, happens to be algorithmically unsolvable.

Jim Wright (The University of Edinburgh)
Title: ***Lebesgue Constants: connections with pointwise ergodic theorems.***
Abstract: The classical Lebesgue constant for continuous periodic functions is useful in the study of pointwise and uniformly convergent Fourier series. We examine variants for functions with a sparse spectrum and in particular we look at extensions to functions of several variables. Interestingly there are some connections with extensions and generalisations of Bourgain's work on pointwise ergodic theorems along sparse subsets of integers.

5.2 Analysis

Joan Bosa (Glasgow University)
Title: ***Covering dimension of C*-algebras and 2-coloured classification.***
Abstract: We introduce the concept of finitely coloured equivalence for *-homomorphisms of C*-algebras, for which unitary equivalence of unital *-homomorphisms is the 1-coloured case. We use this concept to classify *-homomorphisms from separable, unital, nuclear C*-algebras into ultrapowers of simple, unital, nuclear Z-stable C*-algebras with compact extreme tracial-state space up to 2-coloured equivalence by their behaviour on traces (Joint work with N. Brown, Y. Sato, A. Tikuisis, S. White and W. Winter).

Martin Dindos (The University of Edinburgh)
Title: ***The equivalence of BMO solvability of the Dirichlet problem for parabolic equation with A_∞ condition for the parabolic measure.***
Abstract: We define a class of admissible parabolic domains on which we consider the Dirichlet problem for variable coefficient scalar parabolic PDE. We establish that the (natural) parabolic measure associated with the PDE belongs to the A_∞ class with respect to the surface measure if and only if the Dirichlet problem for this parabolic equation with BMO data is solvable.
The A_∞ class is significant, since if a parabolic measure belongs to it then the Dirichlet problem for the associated PDE is solvable in Lp for some $p > p_0$.
The presented proof significantly simplifies a recent result of Kenig, Kircheim, Pipher and

Toro for the elliptic PDEs that has improved an analogous equivalence result in the elliptic case of Kenig, Pipher and myself. Since our approach also applies to the elliptic case, we also re-prove the Kenig, Kircheim, Pipher and Toro result.
This is a joint work with J. Pipher and S. Petermichl.

Heiko Gimperlein (Heriot-Watt University, Edinburgh)
Title: ***Nonclassical spectral asymptotics of commutators.***
Abstract: This talk considers the spectral properties of commutators $[P, f]$ between a pseudodifferential operator P and a Holder continuous function f. The mapping properties of such commutators have been of interest in harmonic analysis since work by Calderon in the 1960s. Much less is known about their spectral theory, which relates to the classical theory of Hankel operators and is motivated by applications.
We discuss sharp upper estimates for the asymptotic behavior of the singular values (weak-Schatten class properties) as well as explicit formulas for their Dixmier traces on closed Riemannian or sub-Riemannian manifolds. The commutators exhibit a rich spectral asymptotics beyond classical Weyl laws, dominated by the points where f is not differentiable.
A mix of ideas from harmonic analysis, spectral theory and operator algebras enters into the proofs. The results are applied to questions in noncommutative geometry and complex analysis of several variables. (joint work with M. Goffeng).

José González Llorente (Universitat Autònoma de Barcelona)
Title: ***Variations on the mean value property.***
Abstract: The interplay between classical potential theory and probability relies on the well known mean value property for harmonic functions. In the last years some efforts have been made to clarify the probabilistic framework associated to some remarkable nonlinear differential operators (such as the p-laplacian or the ∞-laplacian) by means of appropriate (nonlinear) mean value properties. In the talk we will review some classical facts about the converse mean value property and we will also introduce a nonlinear mean value property associated to the p-laplacian.

Sukjung Hwang (The University of Edinburgh)
Title: ***The Dirichlet boundary problem for second order parabolic operators satisfying Carleson condition.***
Abstract: We consider boundary value problems for a parabolic equation in the form of $u_t - \mathrm{div}(A\nabla u) - \boldsymbol{B} \cdot \nabla u = 0$ on time-varying domains Ω with L^p Dirichlet boundary data for $1 < p \leq \infty$. Many difficulties are caused by the fact that neither the operator nor the domain we consider are assumed to be smooth. When the coefficient matrices $A = [a_{ij}]$ and $B = [b_i]$ satisfy certain Carleson conditions with small norms, we establish the solvability of the Dirichlet boundary problems for second order parabolic equations by comparing L_p norm of the square and non-tangential maximal functions.

Joaquim Martín (Universitat Autònoma de Barcelona)
Title: ***Isoperimetric weights and generalized uncertainty inequalities in metric measure***

spaces.
Abstract: We extend the recent L_1 uncertainty inequalities obtained by G. M. Dall'ara and D. Trevisan to the metric setting. For this purpose we introduce a new class of weights, named isoperimetric weights, for which the growth of the measure of their level sets $\mu(wledr)$ can be controlled by $rI(r)$; where I is the isoperimetric profile of the ambient metric space. We use isoperimetric weights, new localized Poincaré inequalities, and interpolation, to prove L_p-uncertainty inequalities on metric measure spaces.

Jordi Pau (Universitat de Barcelona)
Title: ***Schatten class Hankel operators on Bergman spaces.***
Abstract: We completely characterize the simultaneous membership in the Schatten ideals S_p, $0 < p < \infty$ of the Hankel operators H_f and $H_{\overline{f}}$ on the Bergman space, in terms of the behaviour of a local mean oscillation function, proving a conjecture of Kehe Zhu from 1991.

5.3 Geometric Group Theory

Yago Antolín (Vanderbilt University, USA)
Title: ***Conjugacy and hyperbolicity.***
Abstract: I'll explain why the conjugacy growth series of a non-elementary hyperbolic group is transcendental and use this result to prove that in a finitely generated acylindrically hyperbolic group no language containing exactly one minimal length representative of each conjugacy class is regular. If time permits, I will discuss some results about conjugacy length functions. This will be based in joint works with Laura Ciobanu and Andrew Sale.

Collin Bleak (University of St Andrews)
Title: ***On the semi-decidability of the periodicity problem for elements of various groups.***
Abstract: We prove that both the Higman-Thompson group $2V$ and the rational group R_n of Grigorchuk, Nekrashevych, and Suschanskii have semi-decidable periodicity problems. That is, there are algorithms which can confirm, given an element of one of these groups, that the element has finite order. However, there is no algorithm which can confirm in finite time whether a general element of one of these groups has infinite order. The argument is based on studying the achievable dynamical systems under the action of $2V$ on a Cantor space. Joint with Jim Belk.

Josep Burillo (Universitat Politècnica de Catalunya)
Title: ***Metric estimates for finitely generated groups.***
Abstract: We will review the concept of metric estimate for a finitely generated group. The word metric for an element is usually quite difficult to find, and many times it is possible to replace it by an estimate which differs only in a multiplicative constant but which is much easier to compute. We will show some results finding estimates for groups, such as Baumslag-Solitar groups or wreath products.

Ilya Kazachkov (Euskal Erriko Unibersitatea)
Title: ***On limit groups over partially commutative groups.***
Abstract: The class of limit groups can be linkened to the classical coordinate algebras in algebraic geometry. Limit groups admit extremely rich and diverse characterizations and this versatile nature makes them a fine example of the connection between Group Theory, Algebra, Geometry, and Model Theory. Its importance from each of the different perspectives has led to an intensive study of these groups in recent years.
The class of partially commutative groups is a prominent class of groups which is widely studied in different branches of mathematics and computer science. Most recently, partially commutative groups became key to solving some well-known problems in group theory and topology, like Baumslag's conjecture on residual finiteness of one-relator groups with torsion and the virtually fibred conjecture for 3-manifolds.
In this talk, I will describe a universe for the class of limit groups over partially commutative groups. I will then explain how this result can be used to study algorithmic problems. This is joint work in progress with A. Duncan and M. Casals-Ruiz

Adam Piggott (Bucknell University, USA)
Title: ***The Symmetries of McCullough-Miller Space.***
Abstract: We prove that if W is the free product of at least four groups of order 2, then the automorphism group of the McCullough-Miller space corresponding to W is isomorphic to the group of outer automorphisms of W. McCullough-Miller is therefore, in some sense, a best possible topological model for $\mathrm{Out}(W)$. We also prove that, for each integer n such that $n > 2$, the automorphism group of the hypertree complex of rank n is isomorphic to the symmetric group of rank n.

Anne Thomas (University of Glasgow)
Title: ***Palindromic automorphisms of right-angled Artin groups.***
Abstract: We introduce the palindromic automorphism group and palindromic Torelli group of a right-angled Artin group, generalising from the case of a free group. We find generating sets for these groups and consider their relationship with the centraliser of the hyperelliptic involution. This is joint work with Neil Fullarton.

5.4 Geometry and Mathematical Physics

José Ignacio Burgos (ICMAT, CSIC)
Title: ***Multiple zeta values and Feynman amplitudes.***
Abstract: The basic piece of most quantum field computations are Feynman amplitudes, that are integrals attached to Feynman diagrams. The accurate and fast computation of such integrals is of great importance in theoretical and experimental high energy physics. Many Feynman amplitudes can be interpreted as periods of algebraic varieties. Objects that have been extensively studied by algebraic geometers and number theorist. For instance low loop

order Feynman integrals of a massless phi-4 theory are periods of mixed Tate motives and therefore can be evaluated as multiple zeta values.
In recent years mathematicians and physicists have realized such connection and as a consequence, a wealth of new results and computational techniques have evolved. In this talk I will give a (biased and limited) survey of recent developments in this area.

José Ignacio Latorre (Universitat de Barcelona, associated with MIT in Boston and NUS in Singapur)
Title: ***Maximal Entanglement.***
Abstract: The holographic property of some quantum systems appears to be deeply related to error correction codes and combinatorial design. We present a simple example of such a relation that emerges from maximally entangled quantum states.

Eva Miranda (Universitat Politècnica de Catalunya)
Title: ***Poisson manifolds of "symplectic" type.***
Abstract: In this talk we focus on b^n-symplectic manifolds which are Poisson manifolds, symplectic away from a hypersurface and which satisfy some transversality conditions. These structures have been studied because of their connections to deformation quantization of manifolds with boundary and have recently proved to be useful as models for some classical systems such as the 3-body problem or integrable systems on manifolds with boundary.
We will introduce some motivating examples and we will present some recent developments which clarify the geometry, topology and dynamics of these manifolds. In particular, we can prove generalizations of classical results in the symplectic realm for these manifolds such as convexity for torus actions or a Delzant theorem but also answer some other questions concerning their dynamics.

Andreas Winter (Universitat Autònoma de Barcelona)
Title: ***Reading and hiding in quantum systems.***
Abstract: Quantum data hiding, originally invented as a limitation on local operations and classical communications (LOCC) in distinguishing globally orthogonal states, is actually a phenomenon arising generically in statistics whenever comparing a 'strong' set of measurements (i.e., decision rules) with a 'weak' one. The classical statistical analogue of this would be secret sharing, in which two perfectly distinguishable multi-partite hypotheses appear to be indistinguishable when accessing only a marginal. The quantum versions are richer in that for example LOCC allows for state tomography, so the states cannot become perfectly indistinguishable but only nearly so, and hence the question is one of efficiency. The issues covered in the talk are going to be the following:
1. Every restriction on the allowed measurements, but with arbitrary processing of the measurement data at the end, gives rise to a norm on density matrices, the "distinguishability norm"; we will review the general theory of these [Matthews/Wehner/AW, CMP 291:813-843, 2009].
2. LOCC is perhaps the most natural restriction in multi-partite systems, and we will revisit

LOCC data hiding and its efficiency.
3. Gaussian operations and classical computation (GOCC): Not very surprisingly, GOCC cannot distinguish optimally even two coherent states of a single mode [Takeoka & Sasaki, PRA 78:022320, 2008].
But we can find states, each a mixture of multi-mode coherent states, which are almost perfectly distinguishable by suitable measurements, but when restricted to GOCC, i.e. linear optics and postprocessing, the states appear almost identical. The construction is random and relies on coding arguments. Open questions include whether one can give a constructive version of the argument, and whether for instance even thermal states can be used, or how efficient the hiding is.

5.5 Mathematical Biology

Tibor Antal (The University of Edinburgh)
Title: ***Multitype branching processes: from bacteria to cancer.***
Abstract: We'll review recent developments in the theory of two type birth-death branching processes. These studies were pioneered by Salvador Luria and Max Delbruck in 1943 to model genetic mutations arising in bacterial populations. More recent applications include the development of resistance to chemotherapy of cancer.

Marta Casanellas (Universitat Politècnica de Catalunya)
Title: ***Algebraic tools in the evolution of species.***
Abstract: Many statistical models of nucleotide substitution can be viewed as algebraic varieties. As a consequence, tools from algebra can add information on the phylogenetic reconstruction problem. We shall present methods of phylogenetic inference based on algebraic tools and, by comparison to other exiting methods, we shall discuss what are the advantages and disadvantages of these new methods.

Andrei Korobeinikov (Centre de Recerca Matemàtica)
Title: ***Mathematics of viral evolution.***
Abstract: Viral evolution is probably the most significant single factor accountable for emergence of new pathogens and drug-resistant strains and preventing a development of effective drugs and vaccines. Moreover, it is believed that the dynamics of HIV is also mostly determined by the ability of HIV to evolve. The most natural question arises about the driving force for this evolution. Other questions are about the role of immune pressure in this natural selection and about the links between evolution and the development of AIDS.
Viruses, and RNA viruses in particular, rapidly evolve, and HIV is known to be one of the fastest evolving human viruses. It is now commonly accepted that viral evolution is the cause of the intriguing dynamics exhibited during HIV infections and the ultimate success of the virus in its struggle with the immune system. An objective of this talk is to introduce a simple mathematical model of the within-host viral dynamics which incorporates

random mutations. This model assumes a continuous distribution of viral strains in a one-dimensional variant space where random mutations are modelled by diffusion. Numerical simulations show that random mutations combined with competition result in evolution towards higher Darwinian fitness: a stable traveling wave of evolution, moving towards higher levels of fitness, is formed in the phenotype space.

Nikola Popovic (The University of Edinburgh)
Title: ***A geometric analysis of fast-slow models for stochastic gene expression.***
Abstract: Stochastic models for gene expression frequently exhibit dynamics on different time-scales. One potential scale separation is due to significant differences in the lifetimes of mRNA and the protein it synthesises, which allows for the application of perturbation techniques.
Here, we develop a dynamical systems framework for the analysis of a family of "fast-slow" models for gene expression that is based on geometric singular perturbation theory. We illustrate our approach by giving a complete characterisation of a standard two-stage model which assumes transcription, translation, and degradation to be first-order reactions. In particular, we develop a systematic expansion procedure for the resulting propagator probabilities that can in principle be taken to any order in the perturbation parameter.
Finally, we verify our asymptotics by numerical simulation, and we explore its practical applicability, as well as the effects of a variation in the system parameters and the scale separation.

Mariya Ptashnyk (University of Dundee)
Title: ***Multiscale analysis of elastic-viscoleastic model for plant cell wall biomechanics.***
Abstract: Plant cell walls, consisting of cellulose microfibrils and wall matrix, composed of proteins, water and polysaccharides (hemicelluloses and pectins), have complex dynamical mechanical behaviour. This is necessitated by the fact that they must be strong to support a high internal (turgor) pressure, but at the right moment be able to yield to allow for cell growth. It was observed that changes in cell wall elasticity are strongly correlated with changes in the pectin matrix chemistry. In this talk I will present a microscopic model for plant cell wall biomechanics that takes into account both the microstructure coming from the cellulose microfibrils and the chemical reactions between the cell wall's constituents. The mathematical model constitutes a strongly coupled system of elastic-viscoelastic equations for deformations of plant cell walls and non-linear reaction-diffusion equations, describing chemical processes in cell wall matrix. To analyse the macroscopic behaviour of plant cell walls, as well as for effective numerical simulations, the macroscopic model for cell wall biomechanics is rigorously derived by applying homogenisation techniques.

Jordi Ripoll (Universitat de Girona)
Title: ***Impact of non-linear diffusion on epidemic outbreaks in heterogeneous metapopulations.***
Abstract: We investigate the role of migration/diffusion patterns on the spread of epidemics

in complex networks. We enhance the SIS-diffusion model on metapopulations to a non-linear diffusion. Specifically, individuals move randomly over the network but at a rate depending on the population of the departure patch. The migration-driven equilibrium is described by quantifying the total population living in heavily/lightly populated areas and the short-term outbreak situation is given by the linearisation of the system around the equilibrium. Our analytical approach reveals that strengthening the movement of individuals from populous areas to sparse ones contains the epidemic spreading. Moreover, depending on the exponent of the non-linear diffusion rate, epidemic outbreaks do not always occur in the most populated areas as one may expect.

5.6 Stochastics

Aureli Alabert (Universitat Autònoma de Barcelona)
Title: ***Uniqueness for some non-Lipchitz SDE.***
Abstract: We study the uniqueness in the "path-by-path" sense of solutions to stochastic differential equations with additive noise and non-Lipschitz autonomous drift. The notion of path-by-path solution involves considering a collection of ordinary differential equations and is, in principle, weaker than that of a strong solution, since no adaptability condition is required. We use results and ideas from the classical theory of ODE's, together with probabilistic tools like Girsanov's theorem. This is a joint work with Jorge A. León.

Sergey Foss (Heriot-Watt University, Edinburgh)
Title: ***Limit theorems for random directed graphs.***
Abstract: We consider a stochastic directed graph on the integers whereby a directed edge between i and a larger integer j exists with probability p that may depend on the distance $j-i$, and there is no edges from bigger to smaller integers. Edge lengths $L(i, j)$ may be constants or i.i.d. random variables. We introduce also a complementary "infinite bin" model. We study the asymptotics for the maximal path length in a long chunk of the graph. Under certain assumptions, the model has a regenerative structure that depends on the infinite future, and the SLLN and the CLT follow. Otherwise, we obtain scaling laws and asymptotic distributions expressed in terms of a "continuous last-passage percolation" model on $[0, 1]$. If time allows, we will introduce various and, in particular, multi-dimensional extensions of the models. We will also link this topic to contact processes.
The talk is partly based on joint papers with T Konstantopoulos (2003, MPRF), D Denisov and T Konstantopoulos (2012, AnnAP), J Martin and Ph. Schmidt (2014, AnnAP) and S Zachary (2013, AdvAP).

Gabriel Lord (Heriot-Watt University, Edinburgh)
Title: ***Stochastic travelling waves and computation.***
Abstract: We examine a new numerical method for solving Stratonovich SDEs. In particular we are interested in computing stochastic travelling waves. Travelling waves are often of

physical interest and we have applications from models of neural tissue that are both SPDEs and large SDE systems. We introduce a technique where we move to a travelling wave frame and stop the wave from moving. This has some computational advantages as a small domain can be used but we will also discuss some potential pitfalls.

Eulàlia Nualart (Universitat Pompeu Fabra, Barcelona)
Title: ***A truncated two-scale realized variance estimator robust to price jumps and small noises.***
Abstract: In this work we propose an estimator that combines the truncation method with the two-scale realized variance estimator to estimate the integrated variance of an asset return. The observed log price of the asset is assumed to be driven by a diffusion process with jumps, and we assume the presence of market microstructure noise, which is decreasing in the number of observations during a day. A concentration inequality is derived to show the precision of this estimator. In addition, we also prove that this estimator converges to the quadratic variation of the efficient price process, which is the integrated variance plus the sum of the squares of the price jumps. We finally perform some simulations which show that our estimator is more efficient than the bipower variation and the truncated realized variance, which are estimators on the integrated variance robust to the price jumps. This is a joint work with Christian Brownlees and Yucheng Sun from Universitat Pompeu Fabra.

Lluís Quer-Sardanyons (Universitat Autònoma de Barcelona)
Title: ***A fully discrete approximation of the one-dimensional stochastic wave equation.***
Abstract: In this talk, a fully discrete approximation of a one-dimensional nonlinear stochastic wave equations driven by multiplicative noise is presented. More precisely, we use a standard finite difference approximation in space and a stochastic trigonometric method for the temporal approximation. This explicit time integrator allows us to obtain error bounds in $L^p(\Omega)$, uniformly in time and space, in such a way that the time discretization does not suffer from any kind of CFL-type stepsize restriction. Moreover, uniform almost sure convergence of the numerical solution is also proved. We will present some numerical experiments which confirm the theoretical results. The talk is based on joint work with David Cohen (University of Umea).

Sotirios Sabanis (The University of Edinburgh)
Title: ***Explicit numerical schemes for SDEs driven by Levy noise and for Stochastic Evolution Equations.***
Abstract: The idea of 'tamed' Euler schemes, which was pioneered by Hutzenthaler, Jentzen and Kloeden [1] and Sabanis [2], led to the development of a new generation of explicit numerical schemes
– for SDEs driven by Levy noise with superlinear coefficients and,
– for stochastic evolutions equations with super-linearly growing operators appearing in the drift.
Moreover, high order schemes (such as Milstein) are established (with optimal rates of

convergence) by the natural extension of the aforementioned ideas. Theoretical results on this topic along with relevant simulation outputs will be presented during this talk.
[1] M. Hutzenthaler, A. Jentzen, P.E. Kloeden, Strong convergence of an explicit numerical method for SDEs with non-globally Lipschitz continuous coefficients. Ann. Appl. Probab. 22 (2012) 1611–1641.
[2] S. Sabanis, A note on tamed Euler approximations, Electron. Commun. Probab. 18 (2013), no. 47, 1–10.
Joint work with Istvan Gyongy, David Siska, Chaman Kumar and Konstantinos Dareiotis.

5.7 Topology

Spiros Adams-Florou (Glasgow University)
Title: ***Simplicially graded algebraic topology.***
Abstract: In algebraic topology there are many examples of local to global theorems where a global consequence is drawn from imposing strong local conditions. When working with simplicial complexes it is often possible to fragment a global geometric obstruction into a local obstruction over each simplex with a problem being soluble if and only if all the local obstructions vanish. An important example of this is the total surgery obstruction of Ranicki. In this talk I will discuss the approach of fragmenting over a simplicial complex, give some examples of problems that can be solved with this approach and explain some potential applications to the algebraic theory of surgery.

Carles Broto (Universitat Autònoma de Barcelona)
Title: ***Automorphisms of fusion systems of finite groups of Lie type.***
Abstract: Fix a prime p. Given a finite group G and a Sylow p-subgroup S of G, there are natural homomorphisms between Out(G), the group of homotopy classes of self-equivalences of the p-complete classifying space of G, and the fusion preserving automorphisms of S. We compare these groups in case of finite groups of Lie type. This is joint work with J. M. Møller and B. Oliver.

Imma Gálvez (Universat Politècnica de Catalunya)
Title: ***Decomposition spaces for homotopy algebraic combinatorics.***
Abstract: Joint work with J Kock (UAB), A Tonks (Leicester).
In this talk I will explain the use of (infinity-)groupoids instead of sets in enumerative combinatorics, and homotopy equivalence instead of bijective correspondence between equinumerous objects. Groupoid slices, or equivalently presheaves (of groupoids) on a groupoid G, take the place of numerical functions from $\pi_0(G) \to \mathbb{Q}$. In particular, the process of taking the incidence coalgebra of a poset or monoid can be lifted: starting with a simplicial groupoid satisfying certain coassociativity conditions (in our terminology, a 'decomposition space') one can define an incidence coalgebra in the category of groupoids. Examples include generalisations of Hall (co)algebras, the Butcher–Connes–Kreimer coalgebra of trees, and a new

notion of directed restriction species, generalising the restriction species of Schmitt.

Richard Hepworth (University of Aberdeen)
Title: ***Homological Stability for Families of Coxeter Groups.***
Abstract: A series of groups and homomorphisms

$$G_0 \to G_1 \to G_2 \to \cdots$$

is said to satisfy homological stability if in any fixed degree d the sequence of homology groups

$$H_d(BG_0) \to H_d(BG_1) \to H_d(BG_2) \to \cdots$$

eventually consists of isomorphisms. Homological stability holds for symmetric groups, general linear groups, mapping class groups, and many many more. In almost all cases we do not know the homology groups themselves. In this talk I will explain a stability result for certain families of Coxeter groups. Examples include the A_n, B_n, C_n and D_n families (all finite), the superideal simplex reflection groups (all hyperbolic), and many others.

Joan Porti (Universitat Autònoma de Barcelona)
Title: ***Coarse geometry of discrete subgroups of isometries of symmetric spaces.***
Abstract: Among the discrete subgroups of isometries of hyperbolic space, convex cocompact groups play an important role, in particular in Thurston's geometrization. Those subgroups are characterized in many ways. In this talk I discuss joint work with M Kapovich and B Leeb about generalizing this notion to higher rank symmetric spaces of non compact type.

Liam Watson (Glasgow University)
Title: ***Loops, L-spaces, and left-orderabiliy.***
Abstract: I'll give an overview of a project-in-progress with Jonathan Hanselman. We develop a calculus for studying the (bordered) Heegaard Floer homology of a particular class of orientable three-manifolds with torus boundary. This allows us to give a complete understanding of when gluing two such manifolds (to form a closed three-manifold) has simplest-possible Heegaard Floer homology — that is, when the resulting closed manifold is an L-space. As an application, we prove the following: For a graph manifold Y which decomposes along a torus into two Seifert fibred pieces, Y is an L-space if and only if $\pi_1(Y)$ is not a left-orderable group. This equivalence between L-spaces and non-left-orderable fundamental groups is conjectured to hold in general.

6 Participants

Spiros Adams-Florou	University of Glasgow
Aureli Alabert	Universitat Autònoma de Barcelona
Tibor Antal	University of Edinburgh
Ramon Antoine	Universitat Autònoma de Barcelona
Yago Antolín Pichel	Vanderbilt University
Albert Avinyó Andres	Universitat de Girona
Odysseas Bakas	University of Edinburgh
Andrew Baker	University of Glasgow
Xavier Bardina	Universitat Autònoma de Barcelona
Lali Barriere	Universitat Politècnica de Catalunya
Carles Barril Basil	Universitat Autònoma de Barcelona
Giulia Binotto	Universitat de Barcelona
Collin Bleak	University of Sant Andrews
Joan Bosa	University of Glasgow
Carles Broto	Universitat Autònoma de Barcelona
José Ignacio Burgos Gil	ICMAT (CSIC)
Jose Burillo	Universitat Politècnica de Catalunya
Àngel Calsina	Universitat Autònoma de Barcelona
Colin Campbell	University of St Andrews
Tony Carbery	University of Edinburgh
Marta Casanellas Rius	Universitat Politècnica de Catalunya
Natàlia Castellana	Universitat Autònoma de Barcelona
Sílvia Cuadrado Gavilán	Universitat Autònoma de Barcelona
Julià Cufí	Universitat Autònoma de Barcelona
Jordi Delgado	Universitat Politècnica de Catalunya
Martin Dindos	University of Edinburgh
Roberto Emparan	Universitat de Barcelona (ICREA)
Jozsef Zoltan Farkas	University of Stirling
Ramón Flores	Universidad Autónoma de Madrid
Carme Florit	Universitat de Barcelona
Sergey Foss	Heriot-Watt University, Edinburgh
José G. Llorente	Universitat Autònoma de Barcelona

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Teresa Garcia Gálvez	Universitat Autònoma de Barcelona
Heiko Gimperlein	Heriot-Watt University and University of Paderborn
Víctor Manuel González Moreno	Royal Holloway University of London
Xavier Gracia	Universitat Politècnica de Catalunya
Keith Grady	-
Allan Grady	University of Abertay
Eylem Güzel Karpuz	Karamanoglu Mehmetbey University
Istvan Gyongy	Edinburgh University
Richard Hepworth	University of Aberdeen
Jim Howie	Heriot Watt University
Sukjung Hwang	University of Edinburgh
Xavier Jarque i Ribera	Universitat de Barcelona
Delaram Kahrobaei	City University of New York
Ilya Kazachkov	IKERBASQUE - Basque Foundation for Science
Andrei Korobeinikov	Centre de Recerca Matemàtica
José Ignacio Latorre	Universitat de Barcelona (MIT)
Tom Leinster	University of Edinburgh
Eric Lopez	Universitat Politècnica de Catalunya
Gabriel Lord	Maxwell Institute, Heriot-Watt University
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Joaquim Martin	Universitat Autònoma de Barcelona
Regina Martínez Barchino	Universitat Autònoma de Barcelona
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Joan Mateu	Universitat Autònoma de Barcelona
Eva Miranda	Universitat Politècnica de Catalunya
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Ignasi Mundet i Riera	Universitat de Barcelona
Artur Nicolau	Universitat Autònoma de Barcelona
Eulalia Nualart	Universitat Pompeu Fabra
Joan Orobitg	Universitat Autònoma de Barcelona
Joaquim Ortega Cerdà	Universitat de Barcelona

Jordi Pau	Universitat de Barcelona
Adam Piggott	Bucknell University
Nikola Popovic	University of Edinburgh
Joan Porti	Universitat Autònoma de Barcelona
Mariya Ptashnyk	University of Dundee
Lluís Quer-Sardanyons	Universitat Autònoma de Barcelona
Lawrence Reeves	University of Melbourne
Jordi Ripoll	Universitat de Girona
Francesc Rosselló	Univ. Balearic Islands
Ana Rovi	University of Glasgow
Carles Rovira	Universitat de Barcelona
Albert Ruiz Cirera	Universitat Autònoma de Barcelona
Sotirios Sabanis	The University of Edinburgh
Carles Sáez Calvo	Centre de Recerca Matemàtica
Marta Sanz-Solé	Universitat de Barcelona
Xiaocheng Shang	University of Edinburgh
Carles Simó	Universitat de Barcelona
Joan Simon	University of Edinburgh
David Siska	University of Edinburgh
Joan Solà-Morales Rubió	Universitat Politècnica de Catalunya
Ian Strachan	Edinburgh Mathematical Society
Anne Thomas	University of Glasgow
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Andrew Tonks	University of Leicester
Michael Tsardakas	Heriot-Watt University
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Noèlia Viles Cuadros	Universitat de Barcelona
Josep Vives	Universitat de Barcelona
Liam Watson	Glasgow University
Andreas Winter	Universitat Autònoma de Barcelona
Jim Wright	University of Edinburgh
Jianchun Wu	Soochow University

Notes: