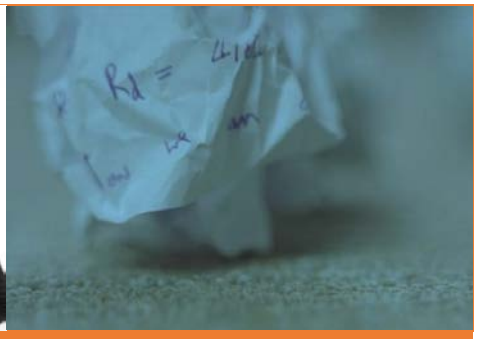
Heilbronn Institute for Mathematical Research





# Annual Review

## October 2015 – September 2016

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## Appendices

# 1. Overview

The period under review has seen considerable further development and expansion of the Heilbronn Institute's external programme, and highly encouraging performance on a number of fronts.

HIMR is in excellent health: there is currently an impressive group of Heilbronn Research Fellows doing first-rate research, recruitment of new Fellows has been strong, and those departing have gone on to attractive positions. Recruitment of other members has also gone extremely well. This is the case in both Bristol and London.

Last year HIMR recruited more Fellows than in any year in the past decade. The new Fellows came from some of the leading mathematics departments and have excellent academic credentials. HIMR now has 33 Fellows, a significant increase compared to previous years. The Fellows are hosted in 9 universities.

The Institute is taking a leading role in addressing the underrepresentation of women in UK mathematics through a number of schemes that are proving effective, including a scheme for supporting female PhD students that has been particularly successful.

Members of the Institute produced over 50 papers on their external research during the review period. Many of these papers are of a highly impressive quality and were published in leading international journals.

The research culture at the Institute is excellent. Members have expressed a high level of satisfaction with their experience at HIMR. This is especially the case with the Fellows, many of whom have chosen to continue their relationships with the Institute.

Our new Fellows come from leading mathematics departments and have excellent academic credentials. Those who left have moved to high-profile groups, including to permanent academic positions. This is contributing to the development of HIMR as a national research institute that is increasingly influential in UK mathematics.

The external events organized by the Institute have been exceptionally successful. Last year HIMR supported 26 events, each attracting, on average, 80 participants; this is a considerable increase on previous years. HIMR has started to develop partnerships with other major mathematics research institutes, including the the Alan Turing Institute, the American Institute of Mathematics, the Clay Mathematics Institute, and the International Centre for Mathematical Sciences.

HIMR is playing an increasingly important role in supporting UK Mathematics and Early-Career Mathematicians. This is becoming a distinctive and highly regarded feature of the HIMR brand.

The team based at the University of Bristol that is responsible for HIMR's external activities continues to make an outstanding contribution to the Institute's success.

## 2. Profile

HIMR enjoys a high reputation in the academic mathematical community. The Institute's successes, its role as a national facility supporting a broad spectrum of mathematics, and the Fellows' achievements are widely understood.

Last year we advertised 10th Anniversary Focused Research Grants. This was an experimental call for highly adventurous and ambitious ideas to address major mathematical problems. Each grant was for up to £10K, to bring a group of people together to discuss new lines of research. Any university could apply, with a maximum of one application per university. We were pleased by the response: applications from most of the leading mathematics departments in the UK. The outcome was that we funded six proposals, which were of an extremely high quality.

This year we repeated that call, lowering the limit on the budget to £7.5K and allowing two applications per university. We received roughly the same number of applications and again funded some excellent proposals, which are listed in Appendix E3. The reports we have received suggest that the events were highly successful. This is rapidly becoming a flagship scheme for HIMR and is viewed very positively in the academic mathematics community.

Discussions have been held with the American Institute of Mathematics, the Clay Mathematics Institute, the International Centre for Mathematical Sciences, the Isaac Newton Institute, and the Alan Turing Institute. These have resulted in plans to collaborate with all of these Institutes, jointly running or co-funding events (see Section 4 for further details).

We hosted a visit from representatives of the Mathematical Sciences section of EPSRC, during which we apprised them of recent developments at HIMR and discussed areas of cooperation.

We are increasingly involved in advocacy for UK Mathematics and have a unique vantage point from which to comment.

The website designed last year (heilbronn.ac.uk) has proved highly successful. It has considerably improved access to information about HIMR.

## 3. Research

One of the primary purposes of the Heilbronn Institute is to support the external research of its members by providing a stimulating environment and appropriate opportunities. We attract excellent mathematicians and aim to enable them to carry out excellent research. A natural measure of the Institute's performance in relation to this goal is therefore the quality of the papers produced by its members.

Members of the Institute produced 56 papers last year. These are listed in Appendix R2. The 26 papers identified by their authors as being their best are listed in Appendix R1. They are of a very high quality indeed.

The current portfolio of 'best' publications compares favourably with last year's.

Citations do not represent a reliable method for assessing research in Pure Mathematics, but they can be said to correlate (crudely) with visibility. Citations in 2015 to papers listing HIMR as the address of one or more authors (and some members do not use this address, so inevitably a number of papers are missed) were 83% higher than in 2014. Similarly, citations in 2016 were 33% up on 2015. Again, we remark that the numbers are relatively small and one should not read too much into their actual size, but the trend continues to be encouraging.

The inclusion of Impact in the 2014 REF, in which context work at the Institute made a significant contribution, and the likelihood that it will be a component of next REF play to HIMR's strengths. This is a significant advantage in recruitment and in the career progression opportunities of our Fellows. Arrangements have been made to monitor Impact accruing from work at the Institute, in readiness for the next REF.

## 4. Events

The Heilbronn Institute organises a number of research events throughout the year. These include a two-day annual conference and several workshops, meetings and working groups. They are of a high quality, attracting leading mathematicians and contributing significantly to the research environment and the Institute's reputation.

The annual conference is central to the programme and in 2016 continued the tradition of having excellent and distinguished speakers: Graham Cormode (Warwick), Amir Dembo (Stanford), Alex Kontorovich (Rutgers), Bryna Kra (Northwestern), James

McKernan (UCSD), Kavita Ramanan (Brown), Martin Wainwright (Berkeley) and Anton Zorich (Jussieu).

The Institute ran two major workshops in 2016. The first of these – organised by two of the Heilbronn Fellows, Robert Kurinczuk and Tom Oliver – was on the Langlands Programme, and the second was on Extreme Value Statistics in Number Theory and Random Matrix Theory. Both were considerable successes, attracting leading mathematicians in their respective areas. In particular, the Extreme Values Workshop was the first major meeting on connections with Number Theory and its participants included all of the most prominent researchers. It has made a significant contribution to establishing a new area of research that is currently flourishing.

The Heilbronn Distinguished Lecture Series in 2016 was given by Professor Peter Sarnak (Princeton). In 2015 the Heilbronn Lecturer was Professor Scott Sheffield (MIT), and in 2017 it will be Professor Maciej Zworski (Berkeley). The 2016 Heilbronn Colloquium was given by Professor László Babai (Chicago). These events are organised by the University of Bristol in collaboration with HIMR.

Last year we again offered Focused Research Grants. This has become a distinctive and highly successful scheme, leading to a number of interesting and adventurous events that we see as promoting the Institute's ethos. Our ability to move quickly has enabled us to support several important Focused Research Events that have played a key role in developing new avenues of research. This is coming to be viewed as a highly attractive and popular component of our portfolio. We now advertise the scheme in the LMS Newsletter. There is still more work to be done to ensure that our advertising reaches all departments and research areas, but we believe we are making good progress in this direction.

We have started to partner with other major mathematics research institutes, co-sponsoring workshops and other research events. We have for several years provided funding to the LMS for Postgraduate Schools. Over the summer we partnered with the American Institute of Mathematics, proving support for UK Mathematicians to participate in a workshop on moments of *L*-functions (subsequently leading to a major joint UK-USA FRG proposal to the NSF), and with the Clay Mathematics Institute, providing support for two UK participants on the PROMYS Europe programme for highly gifted pre-university mathematicians. In December 2016 we will run a workshop jointly sponsored with the Alan Turing Institute, on large-scale structures in random graphs. In the coming year we are providing support for two workshops organised by the ICMS in Edinburgh.

HIMR also co-sponsors many events run throughout the UK, including the BMC, the Young Researchers in Mathematics conference, and various summer schools and

smaller conferences. This support is increasingly popular, helped by our reputation for light-touch applications and quick decisions.

The increase in HIMR's ability to support UK Mathematics is illustrated by the fact that between 2006 and 2015, HIMR supported around 35 events, i.e. roughly four per year; in 2015-16, we supported 26 events. The average attendance at the events supported last year was roughly 80.

We have a policy that at least 20% of the speakers at HIMR-run events should, wherever possible, be women, and we press organisers on this matter. In fact, most events now do better than this.

For events run by HIMR, we offer to cover the costs of childcare for children up to 14 years of age. This is proving to be an important component of the support we offer.

More information and a complete list of HIMR run and co-sponsored events are given in Appendices E1-E4.

The feedback we have received from the community about the events we run and support has been extremely encouraging. As other funders and Institutes increasingly prioritise interdisciplinary and applied research in mathematics, HIMR is seen more and more as a partner of choice for activities in Pure Mathematics and Probability.

Our current focus is on advertising HIMR events and opportunities for funding more effectively. It is clear from the increasing number of applications we receive that the message is spreading, but there are still some universities where awareness of the Institute's external activities can be improved. All funding calls are listed on our website.

## 5. Personnel

A research institute's main resource is its researchers. The goals at HIMR are: to attract leading mathematicians to work as senior Consultants and Secondees, and to ensure that their experience of the research environment is a good one; to appoint the best possible postdoctoral researchers to Fellowships and to ensure that they benefit from excellent opportunities and mentoring that will enhance their career development.

Recruitment went exceptionally well last year. The number of people now working in London exceeds the initial target. The quality of the mathematicians engaged was high. Recruitment was similarly strong in Bristol.

Current Secondees report that they are enjoying the experience of working at the Institute; several have expressed a wish to continue.

Typical application pools for Fellowships have been strong and there has been a good record of the top applicants accepting offers. In the last round we received over 150 applications. We now emphasize in our advertisements that we recruit Fellows from essentially all areas of Pure Mathematics, Probability and Statistics, and from areas involving theoretical Quantum Mechanics.

Details of current Fellows can be found on the Institute's website. A list of new Fellows is given in Appendix P1, and a list of Fellows who have finished in the past year is given in Appendix P2.

At present we have Fellows in 9 Universities: Bath, Bristol, Cambridge, City, Imperial, King's College London, Leicester, Oxford, and University College London. Most are based in Bristol. Having Fellows based in a larger number of institutions has the advantage of emphasizing HIMR's role as a national institute, demonstrating the quality of the external research programme to a wider audience, and providing a broader experience base for the Fellows.

HIMR offers the opportunity for Fellows coming to the end of their first three years to extend their Fellowships, for either one year or three. A one-year extension is normally held at the same host university, and a three-year extension normally involves a move. Extending Fellowships in this way brings the benefit to HIMR of continuity of expertise; one concern is that it will diffuse the Fellows' focus on their career development. All Fellows are invited to apply for an extension. Applications are assessed by a committee that includes the Chair and the Head of HIMR. A list of Fellows extending in this way is given in Appendix P3.

The quality of the Fellows appointed this past year is very good indeed, especially given that HIMR only appoints from a small subset of mathematicians. Our Fellows are comparable with typical Junior Research Fellows and their equivalents at leading universities. (This is evidenced, for example, by explicit comparisons made by referees.) Their performance and their career trajectories are also comparable with typical Junior Research Fellows. The new website is helping to raise the Fellows' visibility.

Fellows leaving HIMR continue to move on to good academic positions elsewhere, or to good positions outside academia. Over the past 10 years, most Fellows have stayed in academia, and the majority of those continuing now have permanent or tenure-track appointments. Former Fellows have in recent years gained permanent appointments in the mathematics departments at Durham, Exeter, Heriot Watt, Lancaster, Leeds, the Open University, Royal Holloway, Sheffield, and York.

We created a strategic fund to which members of HIMR could apply for support for specific research projects. A number were funded and we believe that this helped accelerate promising lines of research. The intention is to continue this scheme.

We have introduced a scheme to support PhD study for women mathematicians who want to work at HIMR. This currently supports four women. It has proved highly successful and we plan to expand the programme.

HIMR funds students involved in two EPSRC Centres for Doctoral Training: the London CDT in Geometry and Number Theory (currently two students) and the Bristol CDT in Quantum Engineering (currently one student). These students spend the summer working at the Institute.

## 6. Mentoring Programme

Last year we redesigned the mentoring arrangements for Fellows. A significant component of the new arrangements is that we have developed a programme of training events focusing on generic skills, led by Dr. Julia Wolf, the Heilbronn Associate Chair in Bristol. There is one event per month. Those that have taken place during the Review period are listed in Appendix M1. All Fellows are invited (i.e. not just those in Bristol). Feedback has been most encouraging.

Each Fellow also has an individual mentor with subject-specific expertise. We have substantially refreshed the pairing of mentors and Fellows in Bristol, and have met with mentors to ensure they know which general areas we feel merit particular attention. We are now confident that we have a better mentoring team in place. Julia Wolf leads on mentoring in Bristol.

The geographical spread of the Fellows has necessitated devolution of the monitoring of the quality of mentoring provided to the Fellows. We have set out expectations and responsibilities concerning mentoring in a letter to the Heads of all Departments hosting Fellows. Heads are expected to monitor mentoring locally and send a brief annual report confirming that this has been done to their satisfaction. General guidance has been prepared on the points we feel would benefit from greater attention.

We believe that the mentoring provision now in place is providing considerably better support for the Fellows.

## 7. Structures

The Heilbronn Institute has, over a short period of time, transformed itself from a research centre based almost entirely in Bristol (but drawing members from across the UK), to an institute with premises in both Bristol and London, and staff employed by 9 universities across the South of England.

The rapid expansion, along with the change in the leadership arrangements associated with the introduction of the role of Chair, continues to necessitate rethinking the structures and processes supporting the running of the Institute's external programme.

In order to refine future strategy, we established an External Advisory Board to support HIMR's external research activities. The following are members: Professors Keith Ball FRS (Warwick), Nathanael Berestycki (Cambridge), Joe Chuang (City), Andrew Granville (UCL/Université de Montréal), Ben Green FRS (Oxford), Frances Kirwan FRS DBE (Oxford), Daniela Kuhn (Birmingham), Jens Marklof FRS (Bristol), Colin Sparrow (Warwick), and John Toland FRS (Bath/INI).

The External Advisory Board had its first meeting in September 2016.

The admin team supporting the external programme, based at the University of Bristol and led by Chrystal Cherniwchan and Liz Wainwright, makes an outstanding and important contribution to the Institute's success. The impact on this team of the growth of the Institute's activities and the transfer of support associated with Chair's business is considerable, and a modest further expansion may be necessary if we are to maintain the quality of the increased number of external events.

The Associate Chair, Julia Wolf, has also made an excellent contribution to further enhancing the relationship with the University of Bristol, in particular through her remodelling of the Mentoring Programme. Her work with HIMR was recognised in the award of the Anne Bennett Prize by the London Mathematical Society this year.

A close working relationship between the internal and the external programmes is essential to the success of both, and this continues to be achieved.

## Appendix R1: Highlighted Papers

Continuous monitoring for changepoints in data streams using adaptive estimation. Bodenham, D.A.; **Adams, N.M.** Stats. Comput., (2016), in press.

The capacity of nonadaptive group testing. **Aldridge, M**. arXiv:1511.05201

Clique decompositions of multipartite graphs and completion of Latin squares. **Barber, B**.; Kühn, Daniela; Lo, Allan; Osthus, Deryk; Taylor, Amelia. arXiv:1603.01043

Nonnoetherian homotopy dimer algebras and noncommutative crepant resolutions. **Beil, Charlie**. arXiv:1609.08112

A plectic Taniyama group. **Blake, C**. arXiv:1606.03320

New computations of the Riemann zeta function on the critical line. **Bober, Jonathan**; Hiary, Ghaith. Preprint at arXiv:1607.00709. To appear in Experimental Mathematics. Eprint http://dx.doi.org/10.1080/10586458.2016.1233083.

Convex separation from convex optimization for large-scale problems. **Brierley, Steve**; Navascues, Miguel; Vertesi, Tamas. arXiv:1609.05011

Mating Quadratic Maps with the Modular Group II. **Bullett, Shaun**; Lomonaco, Luna.

Cluster growth in the dynamical Erdős-Rényi process with forest fires. **Crane, Edward**; Freeman, Nic; Toth, Balint. Electron. J. Probab. Volume 20 (2015), paper no. 101, 33 pp. https://projecteuclid.org/euclid.ejp/1465067207

Serre weights and wild ramification in two-dimensional Galois representations. **Diamond, Fred**; Dembélé, L.; Roberts, D. arXiv:1603.07708

Bayesian uncertainty quantification for transmissibility of influenza, norovirus and Ebola using information geometry**.** House, Thomas; **Ford, Ashley**; Lan, Shiwei; Bilson, Samuel; Buckingham-Jeffery, Elizabeth;

Girolami, Mark.
http://rsif.royalsocietypublishing.org/cgi/content/abstract/rsif.2016.0279

Genus 2 paramodular Eisenstein congruences. **Fretwell, Dan**.
arXiv: 1603.07088

Increasing the minimum distance of codes by twisting. **Gillespie, N.I.**; Praeger, C.E.; Akbari, M. arXiv 1511.07154

Adaptive sequential Monte Carlo for multiple changepoint analysis. **Heard, Nicholas**; Turcotte, Melissa. Journal of Computational and Graphical Statistics. doi: 10. 1080/10618600.2016.1190281

Discrete restriction estimates of epsilon-removal type for kth-powers and k-paraboloids. Henriot, Kevin; **Hughes, Kevin**. arXiv: 1610.03984

Endo-classes for p-adic classical groups. **Kurinczuk, Robert**; Skodlerack, Daniel; Stevens, Shaun. arXiv:1611.02667

An Euler system for characters over an imaginary biquadratic field**.** **Lamplugh, Jack**.

A stochastic McKean—Vlasov equation for absorbing diffusions on the half-line. **Ledger, Sean**; Hambly, B. Accepted to Annals of Applied Probability, 2016. arXiv:1605.00669

Notes on Low Degree L-Data. **Oliver, Tom**. To appear in RIMS Kokyuroko. arXiv:1601.05009

Rational Mixed Tate Motivic Graphs. Agarwala, Susama; **Patashnick, Owen**. arXiv: 1602.01478

A Bayesian cluster analysis method for single-molecule localization microscopy data, to appear in Nature Protocols, 2016. Griffié, Juliette; Shannon, Michael; Bromley, Claire L.; Boelen, Lies; Burn, Garth L.; Williamson, David J.; Heard, Nicholas A.; Cope, Andrew P.; Owen, Dylan M.; **Rubin-Delanchy, Patrick**.

Modular curves and Néron models of generalized jacobians. **Scholl, Tony**; Jordan, Bruce W.; Ribet, Kenneth.

Reduced fusion systems over p-groups with abelian subgroup of index p: II. **Semeraro, Jason**; Craven, David; Oliver, Bob. arXiv:1606.05133

Modularity of tree-like and random regular graphs. **Skerman, Fiona**; Colin McDiarmid. arXiv:1606.09101

Hasse Principle Violations for Atkin-Lehner Twists of Shimura Curves. Clark, Pete L.; **Stankewicz, James.**

The Irreducible Subgroups of Exceptional Algebraic Groups. **Thomas, Adam**. (preprint at arXiv:1608.05103 [math.GR], 137 pages.

## Appendix R2: All Papers

Identification of Credit Risk Based on Cluster Analysis of Account Behaviours. Bakoben, M., **Adams, N.** and Bellotti, A. Journal of the Operational Research Society, Submitted.

Handling delayed labels in temporally evolving data streams. Plasse, J. and **Adams, N.M.** IEEE Conference on Big Data, 2016, Submitted.

Estimating optimal active learning via model retraining improvement. Evans, L.P.G.E, Anagnostoupoulos, C. and **Adams, N.M.** Statistical Analysis and Data Mining, Submitted. arXiv:1502.01664

An anomaly detection framework based on predicting NETFLOW data. Evangelou, M. and **Adams, N.M.** Technometrics. Submitted.

The capacity of nonadaptive group testing. **Aldridge, M**. arXiv:1511.05201

Improved group testing rates with constant column weight designs. **Aldridge, M;** Johnson, O; Scarlett, J. 2016 IEEE International Symposium on Information Theory, 1381–1385, 2016. arXiv:1602.03471

Clique decompositions of multipartite graphs and completion of Latin squares. **Barber, B**.; Kühn, Daniela; Lo, Allan; Osthus, Deryk; Taylor, Amelia. https://arxiv.org/abs/1603.01043

Nonnoetherian homotopy dimer algebras and noncommutative crepant resolutions. **Beil, Charlie**. arXiv:1609.08112

Nonnoetherian coordinate rings with unique maximal depictions. **Beil, Charlie** arXiv:1608.00926

Nonnoetherian coordinate rings with multiple positive dimensional points. **Beil, Charlie**. arXiv:1607.07778

A plectic Taniyama group. **Blake, C**. arXiv:1606.03320

New computations of the Riemann zeta function on the critical line. **Bober, Jonathan**; Hiary, Ghaith. Preprint at arXiv: 1607.00709. To appear in Experimental Mathematics. Eprint http://dx.doi.org/10.1080/10586458.2016.1233083.

Convex separation from convex optimization for large-scale problems. **Brierley, Steve**; Navascues, Miguel; Vertesi, Tamas. arXiv:1609.05011

Entanglement Detection with Fewer Measurements based on the Geometric Criterion. Wang, Bingjie; **Brierley, Stephen**. arXiv:1602.02099

Mating Quadratic Maps with the Modular Group II. **Bullett, Shaun**; Lomonaco, Luna.

Cluster growth in the dynamical Erdős-Rényi process with forest fires. Crane, Edward; Freeman, Nic; Toth, Balint. Electron. J. Probab. Volume 20 (2015), paper no. 101, 33 pp. https://projecteuclid.org/euclid.ejp/1465067207

Circle Packing with Generalized Branching. **Crane, Edward**; Stephenson, Ken; Ashe, James. To appear in the Journal of Analysis, special issue for the retirement conference of David Minda. Submitted version: arXiv:1607.03404.

Serre weights and wild ramification in two-dimensional Galois representations. **Diamond, Fred**; Dembélé, L.; Roberts, D. arXiv:1603.07708

Bayesian uncertainty quantification for transmissibility of influenza, norovirus and Ebola using information geometry**.** House, Thomas; **Ford, Ashley**; Lan, Shiwei; Bilson, Samuel; Buckingham-Jeffery, Elizabeth; Girolami, Mark. http://rsif.royalsocietypublishing.org/cgi/content/abstract/rsif.2016.0279.

Genus 2 paramodular Eisenstein congruences. **Fretwell, Dan**. arXiv: 1603.07088

On representations attached to generic level p Harder congruences. **Fretwell, Dan**. arXiv: 1605.03450

Increasing the minimum distance of codes by twisting. **Gillespie, N.I.**; Praeger, C.E.; Akbari, M. arXiv:1511.07154

Conway's groupoid and its relatives. Gill, N.; **Gillespie, N.I.**; Praeger, C.E.; Semeraro, J. arXiv:1604.04429

Alphabet almost simple 2-neighbour transitive codes. **Gillespie N.I.**; Hawtin, D.R. arXiv: 1609.01886

Adaptive sequential Monte Carlo for multiple changepoint analysis. **Heard, Nicholas**; Turcotte, Melissa. Journal of Computational and Graphical Statistics. doi: 10. 1080/10618600.2016.1190281

Topic modelling of authentication events in an enterprise computer network. **Heard, Nick**; Palla, Konstantina; Skoularidou, Maria. IEEE Intelligence and Security Informatics Conference (ISI2016), Cybersecurity and Big Data. IEEE.

Network-wide anomaly detection via the Dirichlet process. **Heard, Nick**; Patrick Rubin-Delanchy, Patrick. IEEE Big Data Analytics for Cybersecurity Computing (BDAC2016). IEEE.

Model-Based Clustering and New Edge Modelling in Large Computer Networks. Metelli, Silvia; **Heard, Nick**. IEEE Intelligence and Security Informatics Conference (ISI2016), Cybersecurity and Big Data. IEEE.

Disassortativity of computer networks. Rubin-Delanchy, Patrick; Adams, Niall; **Heard, Nick.** IEEE Big Data Analytics for Cybersecurity Computing (BDAC2016). IEEE.

Poisson Factorization for Peer-Based Anomaly Detection. Turcotte, Melissa; Moore, juston; **Heard, Nick**; McPhall, Aaron. IEEE Intelligence and Security Informatics Conference (ISI2016), Cybersecurity and Big Data. IEEE.

Malware Family Discovery Using Reversible Jump MCMC Sampling of Regimes. Bolton, Alexander; **Heard, Nick**.

Discrete restriction estimates of epsilon-removal type for kth-powers and k-paraboloids. Henriot, Kevin; **Hughes, Kevin**. arXiv:1610.03984

On restriction estimates for discrete quadratic surfaces. Henriot, Kevin; **Hughes, Kevin**. arXiv: 1611.00720

The Pointillist principle for variation operators and jump functions. **Hughes, Kevin**. arXiv: 610:00322

Endo-classes for p-adic classical groups. **Kurinczuk, Robert**; Skodlerack, Daniel; Stevens, Shaun. arXiv:1611.02667

An Euler system for characters over an imaginary biquadratic field**.** **Lamplugh, Jack**.

Skorokhod's M1 topology for tempered-distribution-valued processes. **Ledger, Sean.** Electronic Communications in Probability, 21(34):1-11, 2016. arXiv:1509.02855

A stochastic McKean—Vlasov equation for absorbing diffusions on the half-line. **Ledger, Sean;** Hambly, B. Accepted to Annals of Applied Probability, 2016. arXiv:1605.00669

Notes on Low Degree L-Data. **Oliver,Tom**. To appear in RIMS Kokyuroko. arXiv:1601.05009

Rational Mixed Tate Motivic Graphs. Agarwala, Susama; **Patashnick, Owen**. arXiv: 1602.01478

A Bayesian cluster analysis method for single-molecule localization microscopy data, to appear in Nature Protocols, 2016. Griffié, Juliette; Shannon, Michael; Bromley, Claire L.; Boelen, Lies; Burn, Garth L.; Williamson, David J.; Heard, Nicholas A.; Cope, Andrew P.; Owen, Dylan M.; **Rubin-Delanchy**, **Patrick**.

Disassortivity of computer networks. To appear in the Proceedings of the IEEE workshop on Big Data Analytics for Cyber-security Computing, 2016. **Rubin-Delanchy, Patrick;** Adams, Niall M.; Heard, Nicholas A.

Network-wide anomaly detection via the Dirichlet process. To appear in the Proceedings of the IEEE workshop on Big Data Analytics for Cyber-security Computing, 2016. Heard, Nicholas A.; **Rubin-Delanchy**, **Patrick.**

3D Bayesian cluster analysis of super-resolution iPALM data reveals the recruitment of LAT vesicles to the T cell immunological synapse. Griffié, Juliette; Shlomovich, Leigh; Williamson, David J.; Shannon, Michael; Aarons, Jesse; Khuon, Satya; Burn, Garth; Boelen, Lies; Peters, Ruby; Cope, Andrew P.; Cohen, Edward A.K.; **Rubin-Delanchy, Patrick**; Owen, Dylan M.

Posterior predictive p-values and the convex order. **Rubin-Delanchy, Patrick**; Lawson, Daniel J. arXiv:1412.3442, 2015 (revised).

On the mid-p-value of a test statistic with arbitrary real support. **Rubin-Delanchy, Patrick**; Heard, Nicholas A. arXiv:1505.05068, 2016 (revised).

A test for dependence between two point processes on the real line. **Rubin-Delanchy, Patrick**; Heard, Nicholas A. arXiv:1408.3845, 2014 (revised).

Modular curves and Néron models of generalized jacobians. **Scholl, Tony**; Jordan, Bruce W.; Ribet, Kenneth.

Conway's groupoid and its relatives. **Semeraro, Jason**; Gill, Nick; Gillespie, Neil; Praeger, Cheryl. arXiv: 1604.04429

Fusion systems over a Sylow p-subgroup of G2(p). **Semeraro, Jason**; Chris Parker. arXiv:1608.08399

Reduced fusion systems over p-groups with abelian subgroup of index p: II. **Semeraro, Jason**; Craven, David; Oliver, Bob. arXiv:1606.05133

Modularity of tree-like and random regular graphs. **Skerman, Fiona**; Colin McDiarmid. arXiv:1606.09101

Guessing Numbers of Odd Cycles. **Skerman, Fiona**; Atkins, Ross; Rombach, Puck. arXiv:1602.03586

Hasse Principle Violations for Atkin-Lehner Twists of Shimura Curves. Clark, Pete L.; **Stankewicz, James.**

The Irreducible Subgroups of Exceptional Algebraic Groups. **Thomas, Adam**. (preprint at arXiv:1608.05103 [math.GR], 137 pages.

Finite subgroups of simple algebraic groups with irreducible centralizers. **Thomas, Adam**. (preprint at arXiv:1606.03064 [math.GR], 24 pages.

## Appendix E1: HIMR-Run Events

| | |
|---|---|
| 9 November 2015<br>**France**<br><br>**48 attendees** | **The London-Paris Number Theory Seminar, Paris 13**<br><br>**Speakers:**<br>P. Colmez (CNRS), G.Faltings (HCM), A. Yafaev (UCL)<br>F. Andreatta (University of Milan) |
| 8-25 February 2016<br>**Bristol**<br><br>**72 attendees** | **Invariants and Indeterminate Equations (6 lectures)**<br><br>**Speaker:**<br>Christopher Hooley (University of Bristol) |
| 15-17 March 2016<br>**Bristol**<br><br>**230 attendees** | **Distinguished Lecture Series 2016**<br><br>**Speaker**: Peter Sarnak (Institute for Advanced Study, School of Mathematics, Princeton).<br><br>[Organised in cooperation with the School of Mathematics, University of Bristol]. |
| 29 March–1st April 2016<br>**Bristol**<br><br>**62 attendees** | **Algebraisation and Geometrisation in the Langlands Programme**<br><br>**Speakers**:<br>Ramla Abdellatif (Lyon), Noriyuki Abe (Hokkaido)<br>Anne-Marie Aubert (Jussieu), Colin Bushnell (London)<br>Jean-François Dat (Jussieu), David Helm (Imperial)<br>Guy Henniart, (Orsay), Kobi Kremnitzer (Oxford)<br>Nadir Matringe (Poitiers), Sergey Oblezin (Nottingham)<br>Gopal Prasad (Michigan), Dmitriy Rumynin (Warwick)<br>Peter Schneider (Muenster), Vincent Secherre (Versailles)<br>Alexander Stasinski (Durham), Shaun Stevens (East Anglia)<br>Marie-France Vigneras (Paris VII). |
| 11 April 2016<br>**Bristol**<br><br>**80 attendees** | **Heilbronn Colloquium: Group Theory and Algorithms: The Graph Isomorphism Problem**<br><br>**Speaker**: Laszlo Babai, University of Chicago<br><br>[Organised in cooperation with the School of Mathematics, University of Bristol]. |

14-17 April 2016
**Cambridge**

**100 attendees**

**Heilbronn and QALGO Quantum Algorithms Meeting**
**Speakers:**
Andris Ambainis (University of Latvia)
Laszlo Babai (Chicago)
Alexander Belov (CWI, Amsterdam)
Shalev Ben David (MIT)
Johannes Bausch (Cambridge)
Anne Broadbent (Ottawa)
Harry Buhrman (CWI, Amsterdam)
Levon Chakhmakhchyan (Université libre de Bruxelles)
Bill Fefferman (University of Maryland/NIST)
Alex Grilo (Université Paris-Diderot)
Robin Kothari (MIT)
Sophie Laplante (Université Paris-Diderot)
Laura Mančinska (University of Bristol)
Miklos Santha (CNRS, Paris)
Ronald de Wolf (CWI, Amsterdam)

9-13 May 2016
**Bristol**

**38 attendees**

**Extrema of Logarithmically Correlated Processes, Characteristic Polynomials, and the Riemann zeta function**

**Speakers/Participants**: Louis-Pierre Arguin (Montreal, Canada), David Belius, Courant (US), Nathanael Berestycki (Cambridge, UK), Jonathan Bober (Bristol, UK) Paul Bourgade (Courant, US), Pierre Le Doussal (ENS, France), Yan Fyodorov (QMUL, UK), Adam Harper (Cambridge, UK), Christopher Hughes (York, UK) Jon Keating (Bristol, UK) Boris Khoruzhenko (QMUL, UK), Francesco Mezzadri (Bristol, UK) Ashkan Nikeghbali (Zurich, Switzerland) Neil O'Connell (Warwick, UK), Dmitry Ostrovsky (US) Elliot Paquette (Weizmann Inst, Israel), Remi Rhodes (Univ. of Paris, France), Alberto Rosso (Paris Sud, France), Eero Saksman (Helsinki, Finland), Marius Schmidt (Frankfurt, Germany), Nick Simm (Warwick, UK), Nina Snaith (Bristol, UK), Christian Webb (Helsinki, Finland) , Ofer Zeitouni (Weizmann Inst, Israel).

**Report:** The aim of the workshop was to bring together experts in fields of log-correlated fields, random matrix theory and number theory to collectively improve our understanding of extreme values of logarithmically correlated random fields and their applications, and to map possible directions for future progress in this area. This aim was achieved by (a) giving strong guidance to the speakers as to the subject of

their talk (this enabled each day to consist of mutually cognate talks), and (b) we left large blocks of free time in the afternoon for work (hoping to enable new collaborations to form, or to strengthen existing ones), in particular by organising an open question session. We felt that the time set aside for participants to do new mathematics was used well.

**Feedback**: The feedback we have received from the participants has been very positive. There was much praise for the high quality of the talks. We believe that the conference achieved the goal of bringing together mathematicians from around the world and we also believe that some new collaborations will evolve from the workshop.

15-16 September 2016
**Bristol**

**83 Attendees**

**Heilbronn Annual Conference**

**Speakers**:
Graham Cormode (University of Warwick)
Amir Dembo (Stanford University)
Alex Kontorovich (Rutgers University)
Bryna Kra (Northwestern University)
James McKernan (UCSD)
Kavita Ramanan (Brown University)
Martin Wainwright (Berkeley)
Anton Zorich (Institut de Mathematiques de Jussieu-Paris Rive Gauche)

## Appendix E2: HIMR-Sponsored Events

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| 10 March 2016<br>**Imperial College London** | **Statistical Aspects of Cyber-Security**<br>**Speakers**: Nicholas Heard (Imperial College London)<br>Patrick Rubin-Delanchy, (Heilbronn Institute for Mathematical Research, University of Oxford), Joshua Neil, (Ersnt& Young, USA),<br>http://www.darktrace.com/executive-team/ (Darktrace) and<br>https://uk.linkedin.com/in/matthew-rapier-683a40a(SELEX ES). |
| 21-24 March 2016<br>**Bristol**<br><br>**249 attendees** | **British Mathematical Colloquium (BMC 2016)**<br>**Special lectures:** Kristin Lauter and Hendrik Lenstra.<br>**Invited speakers**: Robert Adler, Luigi Ambrosio, Nalini Anantharaman, Nathanaël Berestycki, Maria Chudnovsky, Radha Kessar, Emmanuel Kowalski, Alex Lubotzky, Andrea Malchiodi, László Pyber, Omri Sarig, Peter Sarnak, Benny Sudakov, Balázs Szegedy, Benedek Valkó, Stefan Wenger, Amie Wilkinson and Sarah Zerbes.<br><br>**Workshops Organisers:**<br>Tim Burness, Jeremy Rickard **(Algebra)**<br>Michiel van den Berg, John Mackay **(Analysis)**<br>Thomas Bloom, Julia Wolf **(Combinatorics)**<br>Thomas Jordan, Corinna Ulcigrai **(Ergodic Theory)**<br>Andrew Booker, Tim Browning **(Number Theory)**<br>Marton Balazs, Balint Toth **(Probability)** |
| 22 -24 March 2016<br>**Belfast** | **The 32nd British Colloquium of Theoretical Computer Science (BCTCS 2016)**<br>**Speakers**: Valerie King (University of Victoria, Canada)<br>The LMS **Keynote Speaker** in Discrete Maths<br>Michael J Butler (University of Southampton).<br>Rob Gilles (Queen's University Belfast).<br>Magnús Halldórsson (Reykjavik University).<br>Matthew Hennessy (Trinity College Dublin).<br>**Sponsored by**: Heilbronn Institute for Mathematical Research and the London Mathematical Society. |

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| 1 April 2016<br>**Bristol**<br><br>**120 attendees** | **Conference In Honour of Sir Michael Berry's 75th Birthday**<br>**Speakers**:<br>Sir Michael Atiyah, FRS (Edinburgh), Sir Phillip Campbell, Editor in Chief (Nature), Felice Frankel (MIT)<br>Eric Heller (Harvard), Jon Keating, FRS (Bristol), Ivo Souza (San Sebastian). |
| 4 -8 April 2016<br>**Warwick**<br><br>**120 attendees** | **Explicit Methods in Number Theory: Conference in Honour of Cremona's 60th Birthday**<br>**Speakers**:<br>Barinder Banwait (Essen), Manjul Bhargava (Princeton)<br>Bryan Birch (Oxford), Henri Cohen (Bordeaux)<br>Tom Fisher (Cambridge), Hendrik Lenstra (Leiden)<br>Ariel Pacetti (Buenos Aires), Soma Purkait (Kyushu)<br>Haluk Sengun (Sheffield), Denis Simon (Caen)<br>Michael Stoll (Bayreuth), Drew Sutherland (MIT)<br>Lynne Walling (Bristol), Don Zagier (MPIM Bonn) |
| 20-24 June 2016<br>**Glasgow** | **Developments in Contact and Symplectic Topology** [LMS-CMI Research Schools]<br>**Organisers:** Brendan Owens (Glasgow), Andy Wand (Glasgow) and Liam Watson (Glasgow)<br>**Lecturers:** Vincent Colin (Université de Nantes)<br>Emmy Murphy (Massachusetts Institute of Technology)<br>András Stipscz (Alfréd Rényi Institute of Mathematics) |
| 22 June 2016<br>**Bristol**<br><br>**42 attendees** | **Central Limit Theorem Workshop**<br>**Speakers:**<br>Friedrich Götze (Bielefeld)<br>Giovanni Peccati (Luxembourg)<br>Irina Shevtsova (MSU)<br>Christopher Hughes (York)<br><br>Supported by the Heilbronn Institute and EPSRC. |

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| 28 June -1 July 2016<br>**Imperial College London**<br><br>**43 attendees** | **Postgraduate Group Theory Conference (PGTC)**<br>**Organisers:**<br>Carlisle King (Imperial College London), Sheng Lim (Imperial College London), Alex Malcolm (Imperial College London), Atiqa Sheikh (Imperial College London), Madeleine Whybrow (Imperial College London)<br>**Speakers**:<br>Tim Burness (University of Bristol)<br>Rowena Paget (University of Kent) |
| 1- July – 20 August 2016<br>**Oxford** | **PROMYS Europe 2016: Program in Mathematics for Young Scientists**<br>Two participants were sponsored by the Heilbronn Institute. |
| 4-8 July 2016<br>**Reading**<br><br>**50 attendees** | **Modern Topics in Nonlinear PDE and Geometric Analysis**<br>[LMS-CMI Research School]<br>**Organisers:** Stefanos Aretakis (Princeton) and Nikos Katzourakis (Reading) |
| 11-15 July 2016<br>**Herstmonceux**<br><br>**83 Attendees** | **Algebraic Combinatorics and Group Actions**<br><br>**Keynote Speakers**: Bob Guralnick (USC), Vic Reiner (University of Minnesota).<br><br>**Speakers**: Steven Sam (University of Wisconsin, Madison), Tim Burness (University of Bristol), Martin Liebeck (Imperial College London), Christine Berkesch-Zamaere (University of Minnesota), Christophe Hohlweb (UQAM), Neil Gillespie (University of Bristol), Mark Wildon (University of London, Royal Holloway), Michael Giudici (The University of Western Australia), Sara Billey (University of Washington), Vic Reiner (University of Minneapolis), Bob Guralnick (University of Southern California), François Bergeron (UQAM), Nick Gill (University of South Wales), Sara Faridi (Dalhousie University), Jochen Kuttler (University of Alberta), Nicole Lemire (University of Western Ontario), Anne Shepler (University of North Texas), Corneliu Hoffman (University of Birmingham), Attila Maróti (Alfréd Rényi Institute of Mathematics), Criel Merino, (Instituto de Matematicas UNAM), Owen Patashnick (University of Bristol), Vivien Ripoll (Universitat Wien, Austria), Joel Lewis, Jason Semeraro (University of Bristol), Michael Kinyon (University of Denver), Aram Dermenjian (UQAM), Anna Felikson (Durham University), Russ Woodroofe |

(Mississippi State University) Zinovy Reichstein (The University of British Columbia, Canada), Barbara Baumeister (Universität Bielefeld), Ezra Miller (Duke University), Nathan Reading (North Carolina State University), Arkady Berenstein (University of Oregon), Hugh Thomas (University of Quebec at Montréal), Venkatramani Lakshmibai (Northeastern University, USA), Nick Kuhn (University of Virginia), Thomas Brüstle (University of Sherbrooke, Canada), Marston Conder, Nantel Bergeron (York University, Canada), Ugur Madran (Izmir University of Economics), Christian Stump (Freie Universität Berlin), Dan Frohardt (Wayne State University), William Slofstra (IQC, University of Waterloo), Kalman Cziszler (Renyi Institute of Mathematics, Budapest), Theo Douvropoulos (Univeristy of Minnesota), Atiqa Sheikh (Imperial College London), Mushtaq Baht (Department of Mathematics, Indian Institute of Technology Bombay, India), Julia Heller (Karlsruhe Institute of Technology), Thomas Gobert (TU Kaiserslautern).

**Report**: There were 83 registered participants from 12 countries and 4 continents, including 49 invited speakers. The 49 talks were spread over the five days. The feedback we have received from the participants has been uniformly positive. Herstmonceux Castle is an attractive and effective conference site; the relative isolation of the site encouraged participants to discuss and interact. We believe that the conference achieved the goal of bringing together mathematicians from around the world working in algebraic combinatorics and its interaction with the study of group actions; many participants commented that the conference included mathematicians they did not routinely see at the conferences they usually attended and we believe that some new collaborations will evolve from the conference. The conference was funded by the London Mathematical Society, the Heilbronn Institute, the Fields Institute and the Tutte Institute. Tuesday was designated as “Heilbronn Day”; Owen Patashnick gave a short presentation on the activities of the Heilbronn Institute and there were four hour long presentations, including talks by the two keynote speakers.

11-22 July 2016
**Sarajevo**

**100 Attendees:**

**Building Bridges: 3rd EU/US Summer School + Workshop on Automorphic Forms and Related Topics (University of Sarajevo)**
**Organisers**: Jay Jorgenson (New York), Lejla Smajlovic (Sarajevo), Lynne Walling (Bristol).
**Speakers**: Mike Bennett, Andrew Booker, Kamal Khuri Makdisi and Samir Siksek, Min Lee, Fredrik Stromberg, Samuele Anni.

**Report**: Overall, from all accounts, the summer school and the workshop were great successes. The instructors were all very pleased with the event and with how hard the students worked on the problems they set. The TA for the first course (Samuele Anni) organised the students into 9 problem-solving groups, with no group containing 2 students from the same country, and with each group containing students with a variety of backgrounds and seniority.
**Workshop (18-22 July):** Everyone attending the workshop was encouraged to give a talk, and everyone who registered to do so was scheduled. In addition to the 2-minute “speed-talks”, the talks varied in length: 20, 30, and 40 minutes. There were 40 of these longer talks, 16 of which were given by summer school students. (Also, 17 of these longer talks were given by women.) For the speed-talks, we had some of our experienced speed-talkers from Bristol and Warwick give demonstration speed-talks during the summer school; this helped us recruit speed-talkers. In the end, we had 15 speed-talks during the workshop. These were great fun and extremely well-received, with prizes for the 2 people who ended almost exactly on time, and a special prize (invented on the spot) for the most creative (and amusing) speed-talk (which was Holger Then's talk about using computers to compute Maass wave forms, presented on a paper flip chart). We tried to persuade all students who weren't giving longer talks to give speed-talks; 7 of them did.

**Feedback**: There was much praise for the different lengths of talks; the chance for lots of people to present;  the speed-talks; the variety of topics and perspectives; the high quality of the talks; the balance between younger" and more experienced researchers; the high number of female mathematicians; the friendly, relaxed, and encouraging atmosphere, creating an environment conducive to learning.
The school was also described as “inspiring" and “awesome". The students particularly appreciated the session on open

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| | problems at the end of Mini-course 3, and we plan to incorporate more such sessions in future events.<br><br>**Resulting publication**: AMS is interested in publishing a volume in the Contemporary Mathematics series based on this summer school and workshop. The lectures and exercises from the school will be included, as well as papers of the talks from each speaker who would like to contribute. |
| 13-15 July 2016<br>**York** | **Representations of Algebraic Groups, York**<br>**Speakers**: Henning Haahr Andersen (Aarhus), Anton Cox (City), William Crawley-Boevey (Leeds), Maud De Visscher (City), Richard Dipper (Stuttgart), Stephen Doty (Loyola), Karin Erdmann (Oxford), Jens Carsten Jantzen (Aarhus), Alison Parker (Leeds), Ana Paula Santana (Coimbra), Donna Testerman (EPFL), Wilberd van der Kallen (Utrecht). |
| 1-4 August 2016<br>**St Andrews** | **Young Researchers in Mathematics 2016**<br>**Plenary Speakers**: Peter Cameron (University of St Andrews/Queen Mary University), Clément Mouhot (University of Cambridge).<br>**Keynote Speakers**: Victoria Gould (University of York), Jim Wright (University of Edinburgh), Maarit Järvenpää (University of Oulo), Kousha Etessami (University of Glasgow), Michael McIntyre (University of Cambridge), Philip Welch (University of Bristol), Stephen Coombes (University of Nottingham), Jan Gutowski (University of Surrey), Samir Siksek (University of Warwick), Philippa Browning (University of Manchester), Adrian Bowman (University of Glasgow), Sarah Whitehouse (University of Sheffield). |
| 28 Aug – 2 Sept 2016<br>**San Jose, California**<br><br>**36 attendees** | **American Institute of Mathematics: Moments of Zeta and Correlations of Divisor Sums**<br>**Organisers:** Siegfred Baluyot, Steve Gonek (Rochester), and Jon Keating (Bristol)<br>**Speakers:** Alexandra Florea (Stanford University),Trevor Wooley (Bristol), Kannan Soundararajan (Stanford), Olga Balkanova (ICERM ), Ritabrata Munshi (Tata Institute of Fundamental Research), Sandro Bettin (Genova) |

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| 5-9 September 2016<br>**Belfast** | **Combinatorics and Operators in Quantum Information Theory** [LMS Research School]<br>**Organisers:** Ivan Todorov (QUB) and Simone Severini (UCL)<br>**Lecture Courses by**: Andreas Winter (Barcelona) Vern Paulsen (Waterloo), Monique Laurent (Amsterdam/Tilburg) and Jop Briët (Amsterdam)<br>**Tutorials**: Sabine Burgdorf (Amsterdam), Laura Mančinska (Bristol), Teresa Piovesan (Amsterdam), David Roberson (London), Giannicola Scarpa (Madrid). |
| 25-30 September 2016<br>**Leiden, Netherlands** | **WIN-E2: Women in Numbers Europe**<br>**Organisers**: Irene Bouw (Ulm University)<br>Rachel Newton (University of Reading)<br>Ekin Özman (Boğaziçi University) |

## Appendix E3: Focused Research Events

14-18 Dec 2015
**Bristol**

**20 attendees**

**Mini Meeting in Quantum Chaos**
PI: Suresh Eswarathasan (Cardiff)
**Speakers/ Participants**: Stéphane Nonnenmacher (Université de Paris-Sud, Orsay), Par Kurlberg (Royal Institute of Technology, Stockholm), Jens Marklof (University of Bristol), Jon Keating, (University of Bristol), Sir Michael Berry (University of Bristol), Gabriel Rivière (Université de Lille), Roman Schubert (University of Bristol), Étienne Lemasson (University of Bristol), Igor Wigman, (King's College London), Nadav Yesha (University of Bristol), Fabricio Macia (Universidad Politécnia de Madrid), Zeev Rudnick (Tel-Aviv University), Henrik Uberschar (Université de Lille), Semyon Dyatlov (Massachusetts Institute of Technology), Marco Marletta (Cardiff University), Nicolas Burq (Université de Paris-Sud, Orsay), Luc Hillairet (Université d'Orléans), Francesco Mezzadri (University of Bristol), Kevin Hughes (University of Edinburgh), Tobias Weich (Universität Paderborn).

**Report:** The 'Mini-meeting in Quantum Chaos' was a success in many ways. In terms of collaborations, there were quite a few which began: 1) Jens Marklof formulated a problem motivated by his work on quantum ergodicity with Zeev Rudnick and made progress with some members of the meeting, 2) Pär Kurlberg, Igor Wigman, and Stéphane Nonnenmacher began considering new questions involving random waves, 3) Gabriel Rivière and Fabricio Macia continued their work on semiclassical measures on Zoll manifolds, 4) Semyon Dyatlov and Jens Marklof began discussing some open problems in dynamical systems. This list is not meant to be exhaustive. There was a very strong energy throughout the two days as all the members were actively engaged during the lectures with many of the Q&A sessions going overtime because of the enthusiasm! It was also quite a sight to see prominent mathematicians like Stéphane Nonnenmacher, Nicolas Burq, and Pär Kurlberg interact passionately with well-known physicist Sir Michael Berry. The feedback from the participants was only positive as many of them sent me emails afterwards regarding the conducive atmosphere towards collaboration and interaction, amongst other things.

4-8 January 2016
**East Anglia**

**Categorification for p-Adic Groups**
**PI**: Shaun Stevens (UEA), Vanessa Miemietz (UEA)
**Speakers/Participants**: Joseph Chuang (City Univesity), Jean-François Dat (Institut de Mathématiques deJussieu), David Helm (Imperial College London) , Robert Kurinczuk (University of Bristol), Vincent Sécherre (Université de Versailles), Catharina Stroppel (Bonn Univesity) and Justin Trias (Université Pierre et Marie Curie). Daniel Skodlerack (UEA), Peter Latham (UEA), Michael Arnold (UEA).

6-8 January 2016
**Bristol**

**41 attendees**

**Geometry of Fano 3-Folds Recent Developments and Future Challenges**

**PI**: Miles Reid (Warwick) and Hamid Ahmadinezhad (Bristol).

**Speakers**: Tim Browning (Bristol), Ivan Cheltsov (Edinburgh), Alessio Corti (London), Stephane Lamy (Toulouse), Emmanuel Peyre (Grenoble), Marta Pieropan (Berlin), Yuri Prokhorov (Moscow), Evgeny Shinder (Sheffield), Konstantin Shramov (Moscow), Zhiyu Tian (Grenoble), Claire Voisin (Paris), Trevor Wooley (Bristol).

**Participants**: Marta Pieropan (Berlin), Evgeny Shinder (Sheffield), Konstantin Shramov (Moscow), Zhiyu Tian (Grenoble).

**Report**: The workshop was generously supported by a "10th Anniversary HIMR Focused Research Grant", joint application by Bristol and Warwick, and it was part I (of II) workshops proposed initially. Part II is due to take place at the University of Warwick, during 10th – 12th February 2016.

The aim of the workshop was to discuss a significant new development around rationality questions, in algebraic geometry. In fact rationality questions have been central in algebraic geometry throughout the history. However, several fundamental problems remain unsolved. A recent breakthrough of Claire Voisin (Collège de France and CNRS) has been instrumental in this branch, resulting in several great achievements since 2013. Yet, the challenging problem of rationality for smooth cubic fourfolds remains unsolved, serving as a motivational target.

Several techniques have been deployed to address rationality questions, notably the "decomposition of the diagonal" by Voisin, "dynamical degree" by Cantat and Lamy, "Cremona transformations" by Prokhorov and "Birational Rigidity" by Cheltsov, among other techniques.

There are several overlaps between algebraic and arithmetic geometry in this discipline. Hence the workshop had a successful mix of speakers, as well as participants.

Because of the popularity of this domain we decided to make it public and attract several (junior) participants. For this reason we had generous financial help volunteered by the senior speakers to cover parts of their own expenses. Besides this, some Japanese mathematicians attended the workshop with their own fund. In total we had 41 participants, including 13 PhD students (12 UK, 1 Chinese visiting Warwick).

Several discussions took place around the workshop, making it a bigger success. I am aware of a few projects that were initiated during the workshop, and at least one problem that I solved together with Igor Krylov (Edinburgh), which proves irrationality of general del Pezzo fibrations of degree 2, settling a long standing conjecture in algebraic geometry.

20-22 January 2016
**Exeter**

**Number Theory and Function Fields at the Crossroads**
**PI**: Julio Andrade (Oxford/Exeter).
**Speakers/Participants**: Ardavan Afshar (University College London), Julio Andrade (University of Exeter and University of Oxford), Lior Bary-Soroker (Tel-Aviv University), Tim Browning (University of Bristol), Hung Bui (University of Manchester), Nigel Byott (University of Exeter), Dan Carmon (Tel-Aviv University), Brian Conrey (AIM), Chantal David (Concordia University), Alexei Entin (Stanford University), Alexandra Florea (Stanford University), Andrew Granville (University College London and Université de Montréal), Adam Harper (University of Cambridge), Chris Hughes (University of York), Henri Johnston (University of Exeter), Jon Keating (University of Bristol), Oleksiy Klurman (University College London), Min Lee (University of Bristol), Adelina Manzateanu (University of Bristol), Brad Rodgers (University of Michigan), Edva Roditty-Gershon (University of Bristol), Igor Wigman (King's College).

**Report**: The analogies between function fields and number fields are fundamental in Number Theory. In the past few years there has been an explosion of activity in function fields related to number theory, specifically in arithmetic statistics, analytic number theory and additive number theory.

The upsurge of activity in function fields has attracted some of the leading mathematicians and number theorists to think and revisit questions related to function fields and number theory.

The goal of this research workshop was to explore some of the new advances in number theory and investigate further the interplay between number fields and function fields and its connections with mathematical physics and random matrix theory.

The main aim of the workshop was to discuss new ideas and recent trends in the subject and to formulate some new and ambitious problems, as well as brainstorm various ideas for solving them. A small number of main lectures were delivered by more senior and established mathematicians, a number of short talks given by postdocs followed by discussion sessions. The expectation is that a number of new and exciting collaborations will be initiated due to the meeting.

31 Jan – 6 Feb 2016
**Bristol**

**New Developments in Processes with Reinforcement**
**PI**: Codina Cotar (UCL)

**Speakers**: Omer Angel (UBC, Canada), Erwin Bolthausen (Zürich, Switzerland), Ed Crane (Bristol, UK), Margherita Disertori (Bonn, Germany), Jonathan Jordan (Sheffield, UK), Gady Kozma (Weizmann, Israel), Daniel Kious (EPFL, Switzerland), Peter Mörters (Bath, UK), Olivier Raimond (Paris-Sud, France), Silke Rolles (TU München, Germany), Cristophe Sabot (Lyon 1, France), Pierre Tarrres (Paris Dauphine, France), Debleena Thacker (Lund, Sweden)
Bálint Tóth (Bristol, UK & Budapest, Hungary), Bruno Schapira (Aix Marseille, France), Andrew Wade (Durham, UK)

**Other non-local participants include**: Marcello Costa (Durham), Carl-Erik Gauthier (Neuchâtel, Switzerland), Chak Hei Lo (Durham), Cecile Mailler (Bath, UK), Minh Nguyen (Lund, Sweden), Richard Pymar (UCL, UK), Xiaolin Zeng (Lyon 1, France).

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| | **Report:** A team of experts on different aspects of processes with reinforcement met in Heilbronn between the 1-5 February for an intensive week of research. During the meeting there were 16 talks on the latest developments in the area. The rest of the time was spent in discussions in groups on key open problems. A number of new projects were started by various members of the team. |
| 10-12 February 2016<br>**Warwick** | **Birational Geometry Part 2**<br>**Speakers**: Jeremy Blanc (Basel), Christian Boehning (Warwick), Mark Gross (Cambridge), Anne-Sophie Kaloghiros (Brunel), Alexander Kasprzyk (Nottingham), Johannes Nicaise (London), Takuzo Okada (Saga), Artie Prendergast-Smith (Loughborough), Joe Waldron (Cambridge), Jakub Witaszek (London), Francesco Zucconi (Udine). |
| 19-23 September 2016<br>**Bristol** | **Recent Breakthroughs Using the Polynomial Method**<br><br>**Organisers:** Julia Wolf (University of Bristol) and Thomas Bloom (University of Bristol)<br><br>**Report**: In May 2016, a new technique in the field of additive combinatorics appeared in the work of Croot, Lev, and Pach, startling in both its simplicity and the strength of the results obtained. In the next few months the method was successfully brought to bear on a variety of problems; most notably the cap set problem, the sunflower conjecture, and the arithmetic removal lemma.<br><br>After the initial flurry of results, we held a focused research workshop on this new polynomial method in September 2016, in Bristol, funded by the Heilbronn Institute. Almost all of the world experts in this method attended. Talks were given on the results achieved so far, and everyone was able to share their own individual insights on the strengths and weaknesses of the new method.<br><br>This workshop afforded an invaluable opportunity for consolidation, and by the end of the workshop we had a much deeper understanding of the wider conceptual framework into which the new method fit, particularly the formalisation using the notion of slice rank. |

All participants were generous with ideas, sharing both partial progress on applications they had considered, and new open problems that the method seemed to hold promise for. The free exchange of ideas and problems that the workshop enabled will lead to further advances, both in the method itself, and in its interaction with other problems and techniques.

## Appendix E4: Future Events

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| 24-28 October 2016<br>**Nottingham** | **Kac-Moody Groups and *L*-functions**<br>**Organisers:** Sergey Oblezin and Tom Oliver (University of Bristol)<br><br>A Heilbronn Focused Research Workshop. |
| 3-7 October 2016<br>**Belfast** | **Non-commutative Graphs in Quantum Information Theory**<br>**Organisers**: Ivan G. Todorov (Queen's University, Belfast) |
| 14-15 November 2016<br>**Paris** | **The London Paris Number Theory**<br>[The theme is Perfectoid spaces/Espaces perfectoïdes]<br><br>**London organisers**: David Burns (KCL), Kevin Buzzard (Imperial) Fred Diamond, Yiannis Petridis (UCL), Alexei Skorobogatov, Andrei Yafaev, Sarah Zerbes.<br><br>**Paris organisers**: Pierre Charollois, Olivier Fouquet, Michael Harris, Marc Hindry, Benjamin Schraen, Jacques Tilouine. |
| 18-27 November 2016<br>**Edinburgh** | **Good Birational Models Through Moduli Theory**<br>**Organiser:** Igor Krylov<br><br>A Heilbronn Focused Research Workshop. |
| 12-16 December 2016<br>**Alan Turing Institute, London** | **Large-scale Structures in Random Graphs**<br>**Organisers:** Peter Allen, Julia Böttcher, Jozef Skokan<br><br>A joint ATI-HIMR Focused Research Workshop. |
| 11-13 January 2017<br>**Bristol** | **New Results and Challenges with Random Walks in Dynamic Random Environment**<br>**Organisers**: Luca Avena, Márton Balázs, Frank den Hollander, Frank Redig<br><br>A Focused Research Workshop.<br><br>[Organised in cooperation with the School of Mathematics, University of Bristol]. |

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| 16-20 January 2017<br>**Bristol** | **The Sarnak Rigidity Conjecture**<br>**Organisers**: Andrew Booker, Min Lee<br><br>A Heilbronn Focused Research Workshop. |
| 13-17 February 2017<br>**Imperial College London** | **Homotopy Theory and Arithmetic: Around Galois Groups**<br>**Organisers**: A. Pal, C. Lazda, and T. Schlank<br><br>A Heilbronn Focused Research Workshop. |
| 27-29 March 2017<br>**Bristol** | **Distinguished Lecture Series 2017**<br><br>**Speaker:** Maciej Zworski, University of California, Berkeley<br><br>[Organised in cooperation with the School of Mathematics, University of Bristol]. |
| March 2017<br>**Oxford** | **Young Geometric Group Theory VI**<br>**Organisers:** Aditi Kar (Oxford), John Mackay (Bristol), Anne Thomas (Sydney)<br>**Speakers**: Goulnara Arzhantseva (Vienna), Emmanuel Breuillard (Orsay), Marc Burger (ETH Zurich), Benson Farb (Chicago), and Alan Reid (Texas), along with eight outstanding young mathematicians. |
| 18-21 April 2017<br>**Durham** | **Research Students' Conference in Probability and Statistics (RSC 2017)** |
| 22-26 May 2017<br>**ICM, Edinburgh** | **Braids in Algebra, Geometry and Topology**<br><br>**Organisers:**<br>Tara Brendle (University of Glasgow), Jordan Ellenberg (University of Wisconsin), Andrew Putman (Rice University) Andrew Ranicki (University of Edinburgh). |
| 19-30 June 2017<br>**Leicester** | **New Trends in Representation Theory** [LMS-CMI Summer School] |

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| 26-30 June 2017<br>**Bath** | **GAeL XXV, Géométrie Algébrique en Liberté**<br>The 25th edition of GAeL will take place in Bath, and information about speakers will be confirmed soon. |
| 27-30 June 2017<br>**Cambridge** | **Postgraduate Group Theory Conference (PGTC)**<br>**Speakers**:<br>Tim Burness (University of Bristol)<br>Rowena Paget (University of Kent) |
| 17-21 July 2017<br>**ICMS, Edinburgh** | **Harmonic analysis and its interactions: in honour of Tony Carbery**<br>**Organisers:** Juan Antonio Barcelo (Universidad Politecnica de Madrid), Jonathan Bennett (University of Birmingham), Philip Gressman (University of Pennsylvania), Jim Wright (University of Edinburgh) |
| September 2017<br>**Bristol** | **Artin Conjecture Workshop**<br>**Speaker:**<br>Christopher Hooley (University of Bristol) |
| September 2017<br>**Imperial Collee London** | **Data Science and Cyber-Security**<br>**Organisers:**<br>Niall Adams (Imperial College London)<br>Nick Heard (Imperial College London)<br>Melissa Turcotte (Los Alamos National Laboratory)<br>Patrick Rubin-Delanchy (Oxford University) |
| 11-15 September 2017<br>**Oxford** | **Algebraic Topology of Manifolds** [LMS-CMI Research Schools]<br><br>**Organiser:** Ulrike Tillmann, Oxford |

## Appendix P1: Fellows joining in 2015/2016

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|---|---|
| **Barber,** Ben | BA(Cantab), MMath(Cantab), PhD(Cantab)<br>Joined 1st October 2015 from a Research Fellowship at Birmingham<br>**Research Interests**: Combinatorics and Number Theory |
| **Blake,** Chris | PhD (Cantab)<br>Joined September 2015 in London, just finished PhD in Cambridge<br>**Research Interests:** Algebraic number theory |
| **Dogra,** Netan | PhD Oxford<br>Joined Imperial on the 1 October 2016 from a post-doc in Radboud University.<br>**Research Interest**: Arithmetic Geometry |
| **Ford,** Ashley | PhD Warwick<br>Joined 1st January 2016 from Warwick<br>**Research Interests:** Data Mining |
| **Fretwell,** Dan | MMath(Sheff), PhD(Sheff)<br>Joined 1st October 2015 – just finished PhD, Sheffield<br>**Research Interests:** Number Theory |
| **Hughes,** Kevin | PhD Princeton<br>Joined 1st December 2015 from Edinburgh<br>**Research Interests:** Harmonic analysis and number theory |
| **Kramer-Miller,** Joseph | PhD CUNY Graduate Centre, NY<br>Joined UCL on the 1 October 2016<br>**Research Interest**: Algebraic Number Theory and Arithmetic Geometry. |
| **Latham,** Peter | PhD East Anglia<br>Joined King's College London on the 1 October 2016,<br>**Research Interest**: Representation theory of reductive *p*-adic groups. |
| **Ledger,** Sean | MMath(Oxon), D.Phil. (Oxon)<br>Joined 1st October 2015 – just finished D.Phil., Oxford<br>**Research Interests:** Probability. |

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| **Martin,** Dan | PhD Bristol<br>Joined 1 October 2016<br>**Research Interest**: Statistics & Combinatorics |
| **Murphy,** Brendan | PhD Rochester<br>Joined 1 October 2016<br>**Research Interest**: Combinatorics and harmonic analysis |
| **Palmer,** Matthew | PhD Bristol,<br>Joined 1 October 2016<br>**Research Interest**: Diagonal diophantine approximation |
| **Peacock,** Simon | PhD Bristol,<br>Joined 1 October 2016<br>**Research Interest**: Modular representation theory of finite dimensional algebras |
| **Skerman,** Fiona | B.Phil. (ANU), D.Phil. (Oxon)<br>Joined 1st November 2015 (Initial 18 months), just finished D.Phil., Oxford<br>**Research Interests:** Combinatorics |
| **Thomas,** Adam | **MMath (Warwick), PhD(Imperial)**<br>Joined 1st October 2015 from an EPSRC post-doc Fellowship, held at Imperial<br>**Research Interests:** Algebra |
| **Tseng,** Jimmy | **BA(Harvard), MSc(Yale), PhD (Brandeis)**<br>Joined 3rd September 2015 from an RA position in Bristol<br>**Research Interests**: Dynamical systems, ergodic theory, and number theory (Diophantine approximation) |
| **Williams,** Christopher | PhD Warwick<br>Joined Imperial on the 1 October 2016<br>**Research Interest**: Automorphic Forms and Iwasawa Theory. |

## Appendix P2: Fellows leaving since September 2015

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| **Butler**, Lee | End date 30 Sept 2016 |
| **Freeman**, Nic | End date 02 Sept 2015<br>**Current Position**: Permanent Lectureship, School of Mathematics and Statistics, Sheffield University. |
| **Platt**, David | End date 30 September 2015<br>**Current Position**: Research Associate with Andy Booker, University of Bristol. |
| **Saunders**, Neil | End date 30 Sept 2015<br>**Current Position**: Post-doc Lausanne, then 3 yr. Heilbronn Fellowship, City, London. |
| **Solanki**, Vinesh | End date 30 Sept 2015 |

## Appendix P3: Fellows moving with 3 year extensions

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|---|---|
| **Gillespie**, Neil | Bristol -> Bristol<br>End date was 22 October 2016 |
| **Kurinczuk**, Robert | Bristol -> Imperial<br>End date at Bristol 30 September 2016 |
| **McInroy**, Justin | Bristol -> Bristol<br>End date was 30 September 2016 |
| **Rubin-Delanchy**, Patrick | Bristol -> Oxford<br>End date at Bristol 31 Oct 2015 |
| **Saunders**, Neil | Bristol > Lausanne > City University<br>End date at Bristol 30 Sept 2015<br>Post-doc Lausanne, then 3 yr. Heilbronn Fellowship, City University, London |
| **Semeraro**, Jason | Bristol -> Leicester<br>End date at Bristol 30 September 2016 |

## Appendix P4: Future Fellows

**New Starters October 2017**

**Topley,** Lewis

PhD 2013 (Manchester)
**Research Interest**: Algebra

## Appendix M1: Mentoring Programme

Led by: **Julia Wolf**
Associate Chair, Heilbronn Institute for Mathematical Research

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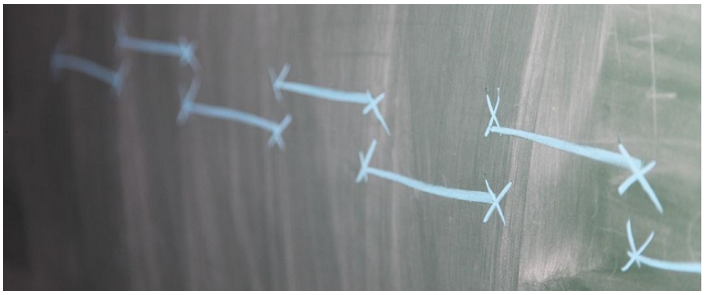
|---|---|
| 7 October 2015<br>**20 attendees** | **Explain Yourself**<br>Julia Wolf |
| 4 November 2015<br>**24 attendees** | **Getting your next job**<br>Julia Wolf, Noah Linden, Andrew Brooke-Taylor, Lynne Walling and Jon Keating |
| 2 December 2015<br>**3 attendees** | **Mock Interviews (for those with upcoming interviews)**<br>Jens Maklof, Guy Nason, Nina Snaith and Jon Keating |
| 3 February 2016<br>**19 attendees** | **Building Connections in Academia**<br>Tim Browning, Julia Wolf and Jon Keating |
| 28 April 2016<br>**40 attendees** | **Careers Outside Academia**<br>Peter Landrock (Cryptomathic) & others |
| 5 October 2016<br>**18 attendees** | **Exhausted Mathematician or Valiant Hero? Motivating Yourself on your Research Journey** |
| 16 November 2016<br>**25 attendees** | **Research Assessment and Open Access** |

Heilbronn Institute for Mathematical Research



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