Reports of Sponsored Meetings

27th Automorphic Forms Workshop UCD

March 11–14, 2013

The study of automorphic forms is a central subject in pure mathematics with deep connections to number theory, representation theory, combinatorics and mathematical physics. It is a crucial part of the unifying conjectures, now commonly known as the Langlands program, that Robert Langlands articulated in a letter to André Weil in 1967. Two of the most spectacular scientific breakthroughs in the 20th and 21st century are the resolution of Fermat's Last Theorem in 1995 by Andrew Wiles (Oxford) and the proof of the Fundamental Lemma by Ngô Bao Châu (2010 Fields Medalist), both of which are automorphic in nature.

Dr. Robert Osburn (UCD, Workshop Chair), Professor Scott Ahlgren (University of Illinois at Urbana Champaign, USA) and Professor Jeremy Lovejoy (CNRS, Paris 7) were the organizers of the 27th Automorphic Forms Workshop (AFW) at University College Dublin from March 11-14, 2013. Over the past twenty-six years, the AFW has built a reputation as an internationally recognized and highly respected forum that is attended by leading experts in the field. This was the first time that this internationally renowned workshop was held outside of North America. In addition, the workshop was an official Gathering 2013 event.

In total, there were 56 participants from 10 different countries (USA, Germany, Japan, UK, Ireland, France, Croatia, South Korea, Turkey and Finland), 46 research talks and two panel discussions concerning differences in professional expectations around the world and the profession over the years.

The organizers were grateful for financial support from the National Science Foundation (USA), the Number Theory Foundation (USA), the UCD School of Mathematical Sciences, Science Foundation Ireland, Failte Ireland and the Irish Mathematical Society and

for technical support from the American Institute of Mathematics. For further information, see the workshop webpage

`http://automorphicformsworkshop.org/pastworkshops/2013/index.html`

Report by Robert Osburn, University College Dublin
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Representations and Finite Fields UCD
28 May 2013

A one-day conference, entitled *Representations and Finite Fields*, was held in UCD on May 28th 2013, in celebration of the 65th birthday of Professor Rod Gow. The conference, which had 50 participants, featured six talks by a representative sample of Rod's 26 co-authors. These highlighted some of his diverse and significant contributions in the areas of representation theory and character theory, linear algebra, and the theory of finite fields. The speakers and titles were:

- **Ryan Vinroot** (College of William and Mary)
  Real-valued characters of finite groups of Lie type
- **Wolfgang Willems** (Otto-von-Guericke-Universität Magdeburg)
  Metabolic symplectic G-spaces
- **Alexandre Zaleskii** (Università degli Studi di Milano-Bicocca)
  On the Steinberg characters of orthogonal groups
- **Rachel Quinlan** (NUI Galway)
  Partial matrices of constant rank over small finite fields
- **John Murray** (NUI Maynooth)
  Symplectic geometry and induction
- **Gary McGuire** (UCD)
  My favourite theorem of Rod Gow

These talks were followed by some insightful reflections by Rod Gow on the first forty years of his career in mathematical research. Further details of the programme, as well as some photographs from the event, can be found at

The organizers, K. Hutchinson, J. Murray, R. Quinlan and T. Unger are grateful to the UCD School of Mathematical Sciences and to the Irish Mathematical Society for financial support of the conference.

Report by Rachel Quinlan, NUI Galway.
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11th Irish Geometry Conference NUIM
21-22 June 2013

The Irish Geometry Conference was held at N.U.I. Maynooth on 20-21 June, and was organized by Stefan Bechtluft-Sachs, Stephen Buckley and David Wraith. This annual research meeting in now in its tenth year, and this is the third time it has been held at NUI Maynooth. As well as participants based in Ireland, this year's event included two speakers from the United States and two from Germany, with talks covering various aspects of Geometry, Topology and Mathematical Physics. The speakers, titles and abstracts were as follows:

John Burns, NUI Galway 'The geometry of Weyl groups and their maximal tori'
Motivated by a question from Theoretical Physics, we classify the conjugacy classes of maximal order Abelian subgroups of Weyl groups and establish a version of Cartan's theorem on the conjugacy of maximal tori in this context. The classification and applications will encounter many old friends and some new ones (Symmetric spaces, branching rules, Del Pezzo surfaces, Fano planes and qubits).

Diarmuid Crowley, Max Planck Institute for Mathematics, Germany 'A new invariant of G2 structures'
I will report on recent work where we define an invariant of diffeomorphisms and homotopies of a G2 structure on a closed 7-manifold M. The -invariant takes values in Z/48 and is defined via the Euler characteristic and signature of a Spin(7)-coboundary of the G2 structure. An important motivation for defining the -invariant is to investigate

the connectivity of moduli space of G2-metrics on M in the case where such metrics exist. I will discuss examples, calculations for the invariant to date and its relationship to the mapping class groups of spin 7-manifolds. This work is joint with Johannes Nordstrm.

Emily Dryden, Bucknell University, U.S.A. 'Beating and heating planar domains'
If you had perfect pitch and listened to a recording of the sounds a drum made when struck, could you determine the shape of the drum? Phrased more mathematically, do the eigenvalues of the Dirichlet Laplace operator acting on smooth functions on a piecewise smooth planar domain D determine D up to isometry? This question was answered in the negative in 1992 by Carolyn Gordon, David Webb, and Scott Wolpert. Their answer tells us that these eigenvalues are an incomplete set of geometric invariants, and it is natural to look for ways to distinguish such non-isometric sound-alike drums. After introducing some examples of drums that sound alike, we will examine what we can learn from heating these drums and studying the amount of heat in them over time. This is joint work with Michiel van den Berg and Thomas Kappeler.

Thomas Huettemann, Queen's University Belfast 'On Novikov cohomology of cochain complexes'
Informally, Novikov cohomology of a cochain complex is the cohomology of a "completion" of the cochain complex. I will discuss the case of a cochain complex over a Laurent polynomial ring in finitely many indeterminates, in which case Novikov cohomology detects certain finiteness properties of the original cochain complex. Concrete results proved in collaboration with David Quinn make heavy use of a toric re-interpretation of a known one-variable result due to Ranicki. I will explain the relevant constructions in some detail, concentrating on basic ideas and geometric input.

Ben McKay, University College Cork 'Holomorphic geometry on compact complex manifolds'
I will explain some of the techniques that went into the classification of various types of holomorphic geometric structure (2nd order ODEs in particular) on compact Kaehler manifolds.

Niall Murchadha, University College Cork 'Two scalar functions define all axi-symmetric transverse tracefree tensors on flat space'
A TT tensor is a symmetric 33 matrix for which each row is divergence-free and the tensor is also tracefree. This means that one has 6

independent components satisfying 4 equations. Therefore one expects 2 degrees of freedom per space point. Such TT tensors arise naturally in several areas in General Relativity. I will show that all axisymmetric TT tensors on flat space can be constructed from 2 axi-symmetric scalar potentials.

Wilderich Tuschmann, Karlsruhe Institute of Technology, Germany 'Manifolds with almost nonnegative curvature operator'
The curvature tensor of a Riemannian manifold also gives rise to a symmetric operator on two-forms, the curvature operator. Closed manifolds admitting metrics with almost nonnegative curvature operator play an important role in the emerging theory of collapsing under a lower bound on the curvature operator. I will discuss constructions of spaces with as well as global obstructions to this property.

Mark Walsh, Wichita State University, U.S.A. 'Loop Spaces and Positive Scalar Curvature'
Recently, there have been a number of interesting developments concerning the problem of understanding the space of metrics of positive scalar curvature on a smooth manifold. In this talk, I will first provide some background to this problem. I will then discuss a new result which shows that in the case when the underlying manifold is a sphere of dimension n, where n is at least three but not equal to four, the space of metrics of positive scalar curvature is weakly homotopy equivalent to an n-fold loop space. This result makes considerable use of a recent theorem of Botvinnik on concordance and isotopy in the space of metrics of positive scalar curvature.

Colum Watt, Dublin Institute of Technology, 'Milnor fibres and non-crossing partitions'
Each arrangement of hyperplanes in a complex vector space has an associated fibration whose base space is the once-punctured complex plane and whose fibre is called the Milnor fibre. In this talk, non-crossing partitions are used to describe a new triangulated space which can be used to shed new light on the Milnor fibre when the arrangement arises from a finite reflection group. This is joint work with Thomas Brady and Michael Falk (Northern Arizona University).

Report by David Wraith.
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Complex Analysis and Approximation
A conference in honour of Anthony G. O'Farrell
NUI Maynooth
June 17–19, 2013

The Department of Mathematics and Statistics, National University of Ireland Maynooth hosted a conference in honour of the recently retired Professor Anthony O'Farrell on 17–19 June, 2013. The fifteen speakers were from Ireland, Britain, Czech Republic, Israel, Spain, and the USA. There were 71 registered attendees from 11 countries, including 24 attendees who travelled from overseas. Full details of the conference can be found at the conference website

> `http://archive.maths.nuim.ie/staff/sbuckley/meetings/13CAA/`

The conference was supported by the Irish Mathematical Society, as well as the Department of Mathematics and Statistics, NUI Maynooth, and the Department of Computer Science, NUI Maynooth. Additionally, some of the expenses of one speaker were covered by the London Mathematical Society.

Although no formal conference proceedings were planned, we managed to get electronic copies of the presentations of all speakers, and these are all on the website.

Tony O'Farrell was Head of the Mathematic Department of NUI Maynooth from 1975 to 2007, as well as being simultaneously Head of the Computer Science Department for several years. The opening talk by David Walsh (NUI Maynooth) was entitled *Personal Reminiscences*, and it covered various stories about Tony from over the years. The subsequent talks were on a wide variety of topics in complex analysis, approximation theory, and related areas.

Talks ranged from broad surveys, such as Lawrence Zalcman's *Picard Theorems, 1879-2013*, to a couple of talks on narrow but important advances, such as Ian Short's *On a conjecture of Lorentzen and Ruscheweyh*. The talks covered various areas, including classical complex and conformal analysis (Hayman, Marshall, Short, Zalcman), several complex variables (Izzo), infinite dimensional holomorphy (Dineen), C*-algebras (Dales, Timoney), approximation theory (Feinstein, Netuka), and related areas of analysis (Khavinson, Lavicka, Perez-Gonzalez, Sanabria García). The areas covered in the talks reflected the various interests of Professor O'Farrell during the 37

years that he was employed at Maynooth. It gave him an opportunity to meet again his many collaborators and mathematical friends from various countries.

As well as the lectures, participants had an opportunity to talk each day over lunch in Pugin Hall. There was also a reception on 17 June, and a conference dinner on 18 June.

Report by Stephen M. Buckley, National University of Ireland Maynooth.

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