Mathematical Physics Seminars

2014-2015

All seminars are held in Room M/2.06 on Thursdays at 3:10pm unless otherwise stated. All are welcome.

Programme Organiser and Contact: Professor David E Evans

8 October 2014 at 14:00

Mathematical Colloquium
Speaker: Florin Boca (Urbana).

Title: Irregularities in the distribution of Euclidean and hyperbolic lattice angles.

Abstract: Spacing statistics measure the randomness of uniformly distributed sequences, or more generally increasing sequences of finite sets of real numbers. A familiar example of a uniformly distributed sequence of sets isgiven by the directions of vectors joining a fixed point in the Euclidean plane, with all (or only visible) points of integer coordinates inside balls of fixed center and increasing radius. However, these directions are not randomly distributed, and even the study of their most popular spacing statistics, limiting gap distribution and pair correlation function, turn out to pose challenges.

This talk will discuss recent progress in the study of the spacing statistics for this type of geometric configuration, comparing the Euclidean and the hyperbolic situations.

9 October 2014

Speaker: Sameer Murthy (King's College, London).

Title: K3 surfaces, Mathieu moonshine and string theory.

Abstract: I shall discuss a conjecture of Eguchi, Ooguri and Tachikawa from 2010 that relates the elliptic genus of K3 surfaces and representations of M24, the largest Mathieu group, and its extensions called Umbral moonshine. The generating functions of these representations are mock theta functions. I shall then present an ongoing attempt to understand these moonshine phenomena as arising in string theory that suggests a construction of a non-trivial infinite-dimensional M24-module. This is based on joint work with Jeff Harvey.

16 October 2014

Speaker: Karen Vogtmann (Warwick).

Title: Hairy graphs and automorphisms of free groups.

Abstract: The group Out(F_n) of outer automorphisms of a free group is a complicated group with connections to many different areas of mathematics. A profitable way of studying Out(F_n) is to study its action on a space of graphs known as Outer space. In this talk I will describe Outer space and then show how breaking graphs into "hairy" pieces can help to find new algebraic invariants for Out(F_n). Some of these invariants are related to classical modular forms for SL(n,Z).

23 October 2014

Speaker: Jan Spakula (Southampton).

Title: Operator theory and coarse geometry.

Abstract: (Some) operator theorists study Fredholmness of certain operators on l^2(Z^n) using the so-called operator spectrum. John Roe, in 2004, explained that the operators of interest are really just elements of the Translation C*-algebra (also called the uniform Roe algebra) of Z^n, the C*-algebra encoding the large scale (or coarse) structure of Z^n.

In this talk, I will explain how to generalise the limit operator theory framework not only to other discrete groups, but to general discrete metric spaces. Furthermore, I will show how to further exploit the inherent connections to coarse geometry to generalise a recent result of Lindner and Siedel, which significantly simplifies the Fredholmness criterion (they refer to the problem they solve as "The core issue on Limit Operators (on Zn)").

30 October 2014

Speaker: Ian Leary (Southampton).

Title: Right-angled Coxeter groups as a source of examples.

Abstract: Coxeter groups are groups generated by reflections; right-angled Coxeter groups are the simplest ones in which any two reflection planes are either parallel or perpendicular. I shall explain some of the ways in which these groups give rise to interesting examples in a range of areas, following the seminal work of Mike Davis.

13 November 2014

Speaker: John Hunton (Durham).

Title: Attractive Tilings.

Abstract: This talk outlines a close connection between the moduli spaces of aperiodic tilings and attractors of certain types of dynamical systems. It should be reasonably self-contained, and I will introduce the necessary elements of these topics, together with a bit of homological algebra and geometric group theory, on the way.

20 November 2014

Speaker: Shahn Majid (Queen Mary, London).

Title: Semiquantisation functor and Poisson-Riemannian geometry.

27 November 2014

Speaker: Andre Henriques (Oxford).

Title: Bott periodicity and beyond.

Abstract: I will review Bott's classical periodicity result about topological K-theory (with period 2 in the case of complex K-theory, and period 8 in the case of real K-theory), and provide an easy (sketch of) proof, based on the algebraic periodicity of Clifford algebras. I will then introduce the `higher real K-theory' of Hopkins and Miller, also known as TMF. I'll discuss its periodicity (with period 576), and present a conjecture about a corresponding algebraic periodicity of `higher Clifford algebras'.

5 February 2015

Speaker: Simon Willerton (Sheffield)

Title: Categorifying the magnitude of graphs.

Abstract: Magnitude is a measure of the size of a metric space introduced by Tom Leinster. Whilst its origins lie in category theory, it has a very concrete definition and turns out to have connections with various aspects of mathematics, such as biodiversity measurement, integral geometry, potential theory and Minkowski dimension. A graph gives rise to a metric space by taking the shortest-path metric, thus a graph can be assigned a magnitude, and this, it transpires, can be considered as a formal power series with integer coefficients. Just as Khovanov homology has the Jones polynomial as its Euler characteristic, so it turns out that there is a homology theory of graphs that has graph magnitude as its Euler characteristic. I will explain the background and some properties of this magnitude homology of graphs. This is joint work with Richard Hepworth.

26 February 2015

Speaker: Raymond Vozzo (Adelaide).

Title: String structures on homogeneous spaces

Abstract: In many areas of geometry and physics we often require that the manifolds we work with carry a spin structure, that is a lift of the structure group of the tangent bundle from SO(n) to its simply connected cover Spin(n). In string theory and in higher geometry the analogue is to ask for a string structure; this is a further lift of the structure group to the 3-connected group String(n). Waldorf has given a way to describe string structures in terms of bundle gerbes (which are the abelian objects in higher geometry—a sort of categorification of a line bundle). Unfortunately, explicit examples are lacking. In this talk I will explain how all this works and give some examples of such structures. I will also explain some current work in progress on the geometry of string structures. This is joint work with David Roberts.

12 March 2015

Speaker: Tom Leinster (Edinburgh)

Title: The many faces of magnitude

Abstract: The magnitude of a square matrix is the sum of all the entries of its inverse. This strange definition, suitably used, produces a family of invariants in different contexts across mathematics. All of them can be loosely understood as "size". For example, the magnitude of a convex set is an invariant from which one can conjecturally recover many important geometric measures: volume, surface area, perimeter, and so on. The magnitude of a category is very closely related to the Euler characteristic of a topological space. Magnitude also appears in the difficult problem of quantifying biological diversity: under certain circumstances, the greatest possible diversity of an ecosystem is exactly its magnitude. I will give an aerial view of this landscape.

19 March 2015

Speaker: Moritz Weber (Saarbruecken)

Title: Quantum Groups meet Free Probability.

Abstract: It is a fundamental concept in operator algebras to pass from a (topological/measurable/...) space to the algebra of (continuous/measurable/...) functions over it and to study this algebra instead of the space itself. In a next step, the multiplication of such algebras is allowed to be noncommutative yielding a kind of ``noncommutative topology'' (C*-algebras) or ``noncommutative measure theory'' (von Neumann algebras) etc. Sending compact groups through this machinery, we obtain (C*-algebraic) compact quantum groups, as defined by Woronowicz in the 1980's. Starting with probability theory, we end up with free probability as developed by Voiculescu around the same time.

We will give brief introductions into compact quantum groups and free probability. The meeting point between these two theories are the so called easy quantum groups as introduced by Banica and Speicher in 2009. These objects are governed by the combinatorics of set theoretical partitions and it is amazing how several operator algebraic properties can be studied by purely combinatorial means. We will report on this particular class of quantum groups and their interplay with free probability.

23 April 2015

Speaker: Miles Reid FRS (Warwick)

Title: The G-Hilbert scheme for trihedral groups

Abstract: It is known that for a finite subgroup G in SL(n,C) for n = 2 or 3, the G-Hilbert scheme provides a crepant resolution Y -> X of the orbifold (or quotient singularity) X = CC^n/G. The McKay correspondence then provides an equivalence between the G-equivariant geometry of CC^n and the geometry of Y, so that (say), the topological Euler number of Y equals the number of irreducible representations of G. This talk describes the problem of calculating the G-Hilbert scheme explicitly in the case of a trihedral group, that is, an extension of an Abelian group such as the cyclic diagonal group 1/79 (1, 23, 55) by the cyclic permutation (x, y, z). Jigsaw puzzle games on the trihedral plane (the standard hexagonal honeycomb) play a prominent role in this study. This is joint work with Ben Wormleighton.

21 May 2015

Speaker: Neil J. A. Sloane FLSW (Rutgers and OEIS). **Venue:** M/0.40

Title: My Favourite Integer Sequences, or, Confessions of a Sequence Addict.

Abstract: The On-Line Encyclopedia of Integer Sequences (oeis.org) is a free web site that contains information about a quarter of a million number sequences. This talk will discuss some especially interesting examples from geometry, arithmetic, cellular automata, etc., including the Hofstadter, van Eck, Fredkin, EKG, Gijswijt, and Recaman sequences. There will be music, movies, and many unsolved problems. Warning: some of these may prevent you sleeping at night.