

Mathematical Physics Seminars 2009 - 2010

22 September 2009 - room M/2.30

Speaker: Dr Pinhas Grossman (Cardiff).

Title: Operator Algebras Seminar - Subfactor Planar Algebras I

1 October 2009

Speaker: Professor Gary Gibbons FRS (Cambridge).

Title: Two Problems in General Relativity

Abstract: I will describe two recent papers

1) Gravitating Opposites Attract.

Robert Beig, Gary W. Gibbons, Richard M. Schoen, . Jul 2009. 13pp.
arXiv:0907.1193 [gr-qc]

Generalizing previous work by two of us, we prove the non-existence of certain stationary configurations in General Relativity having a spatial reflection symmetry across a non-compact surface disjoint from the matter region. Our results cover cases such that of two symmetrically arranged rotating bodies with anti-aligned spins in $n+1$ ($n \geq 3$) dimensions, or two symmetrically arranged static bodies with opposite charges in $3+1$ dimensions. They also cover certain symmetric configurations in $(3+1)$ -dimensional gravity coupled to a collection of scalars and abelian vector fields, such as arise in supergravity and Kaluza-Klein models. We also treat the bosonic sector of simple supergravity in $4+1$ dimensions.

2) Birkhoff's invariant and Thorne's Hoop Conjecture.

G.W. Gibbons, arXiv:0903.1580 [gr-qc]

I propose a sharp form of Thorne's hoop conjecture which relates Birkhoff's invariant β for an outermost apparent horizon to its ADM mass, $\beta \leq 4\pi M_{ADM}$. I prove the conjecture in the case of collapsing null shells and provide further evidence from exact rotating black hole solutions. Since β is bounded below by the length l of the shortest non-trivial geodesic lying in the apparent horizon, the conjecture implies $l \leq 4\pi M_{ADM}$. The Penrose conjecture, $\sqrt{\pi A} \leq 4\pi M_{ADM}$, and Pu's theorem imply this latter consequence for horizons admitting an antipodal isometry. Quite generally, Penrose's inequality and Berger's isoperimetric inequality, $\sqrt{\pi A} \geq \frac{2}{\sqrt{\pi}} i$, where i is the injectivity radius, imply $4c \leq 2i \leq 4\pi M_{ADM}$, where c is the convexity radius.

6 October 2009 - room M/2.30

Speaker: Dr Pinhas Grossman (Cardiff).

Title: Operator Algebras Seminar - Subfactor Planar Algebras II

8 October 2009 - room M/0.34

Speaker: Professor Nigel Hitchin FRS (Oxford).

Title: Twisted tangent bundles

The talk concerns the role of the B-field as a mathematical object in the context of generalized geometry. A number of mathematical structures which admit a formulation in generalized terms don't fundamentally involve the symmetries defined by B-fields, but we investigate one, involving holomorphic vector bundles with an extra structure, where the action on the moduli space is nontrivial and relates to spectral curves and varieties. The twisted tangent bundles of the title involve the corresponding structures for local B-field actions, relating to degree three cohomology and the notion of a gerbe.

19 October 2009 - 2pm

Operator Algebras Seminar

Speaker: 2.00 pm Pinhas Grossman (Cardiff).

Title: "Subfactor Planar Algebras III"

Speaker: 4.00 pm [Hervé Oyono-Oyono](#) (Clermont)

Title "On non commutative principal torus bundles" (Oyono-Oyono)

NCPT-bundles form a class of continuous fields of noncommutative tori that generalises principal torus bundles. As we shall see, these bundles are quite irregular in any topological sense. This is a special class of C^* -bundles, we called K-fibrations, which satisfies a property generalising to the C^* -algebras setting the lifting property of Serre fibrations. We introduce K-theoretical invariants for this K-fibrations in order to obtain classification results for NCPT -bundles. (joint work with S. Echterhoff and R. Nest)

22 October 2009

Speaker: Volker Braun (DIAS, Dublin).

Title: Computing Heterotic String Compactifications

Using Donaldson's algorithm and its generalization, I will present a numerical computation of Calabi-Yau metrics on K3s and threefolds as well as Hermitian Yang-Mills connections on holomorphic vector bundles. We will see how the computation detects slope stability. The metric and connection defines Laplace operators which can be solved numerically, as well. The goal is to explicitly find the 4-d effective action.

27 October 2009 - room M/2.30

Speaker: Dr Pinhas Grossman (Cardiff).

Title: Operator Algebras Seminar - Subfactor Planar Algebras IV

29 October 2009

Speaker: Professor Ulrike Tillmann FRS (Oxford).

Title: Manifolds, cobordism categories, and topological field theory

Following Atiyah, invariants of manifolds can be constructed by topological field theories. Recall that such a TFT is a functor from a certain cobordism category to the category of vector spaces. I will describe the topology of the classifying space of the (enriched) cobordism category and its higher dimensional analogues. These results shed new light on classical cobordism theory of Thom. At the same time they have fed into recent work of Jacob Lurie which classifies TFTs in any dimension.

3 November 2009 - room M/2.30

Speaker: Dr Pinhas Grossman (Cardiff).

Title: Operator Algebras Seminar - Subfactor Planar Algebras V

5 November 2009

Speaker: Dr Raf Bocklandt (Newcastle)

Title: Calabi Yau algebras and Quiver polyhedra

Dimer models have been used in string theory to construct path algebras with relations that are 3-dimensional Calabi Yau Algebras. These constructions result in algebras that share some specific properties: they are

finitely generated modules over their centers and their representation spaces are toric varieties. In order to describe these algebras we introduce the notion of a toric order and show that all toric orders 3-dimensional Calabi Yau algebras can be constructed from dimer models on a torus.

Toric orders are examples of a much broader class of algebras: positively graded category algebras with cancellation. For this broader class the CY-3 condition also implies the existence of a weighted quiver polyhedron, which is an extension of dimer models obtained by replacing the torus with any two-dimensional compact orientable orbifold. We discuss which of these quiver polyhedra give rise to Calabi Yau algebras.

10 November 2009 - room M/2.30

Speaker: Dr Pinhas Grossman (Cardiff).

Title: Operator Algebras Seminar - Subfactor Planar Algebras VI

12 November 2009

Speaker: Dr Gerard Watts (King's College, London)

Title: Defects in two-dimensional conformal field theory

Conformal Defects can be used to describe both branes in string theory and interfaces or lines of discontinuity in statistical systems. I shall review the description and classification of the simplest sort of defects, topological defects, and explain the physical and mathematical differences when the topological condition is removed. I shall then present recent work on exploring the space of defects through their perturbations, which combines exact, perturbative and numerical methods. (Reference [here](#).)

17 November 2009 - room M/0.40

Speaker: Claus Koestler (Aberystwyth).

Title: An application of exchangeability to characters of the group of finite permutations

Thoma's theorem characterizes the extremal characters of the group of finite permutations. Aside of the original result by Thoma from 1964, alternative proofs have been given by Kerov & Vershik in 1981, and more recently by Okounkov in 1997. We provide a new proof based on exchangeability in the framework of noncommutative probability. Quite surprisingly, our operator algebraic approach reveals that Thoma's theorem can be thought of as a noncommutative de Finetti theorem. This is joint work with Rolf Gohm.

19 November 2009

Speaker: Simon Brain (SISSA, Trieste and Oxford)

Title: Geometry of the Yang-Mills Gauge Fields

26 November 2009- 5:15pm

Speaker: Eugene Lytvynov (Swansea).

Title: Meixner class of non-commutative generalized stochastic processes with freely independent values

10 December 2009

Speaker: Andrew Bruce (Manchester).

Title: Higher Poisson structures and Higher Kozsul-Schouten brackets

In this talk we recall the basic constructions of higher Poisson structures as inhomogeneous even multivector fields on a supermanifold that Schouten-Nijenhuis self-commute. This generalises the notion of classical Poisson geometry. We will then proceed to describe how to generalise the Koszul-Schouten bracket on differential forms over a Poisson manifold to the higher case. We do this by constructing a homotopy BV-algebra generated by the Lie derivative along the higher Poisson structure. The audience are not expected to be experts in supergeometry or Poisson geometry.

28 January 2010

Speaker: Oliver Gray (Bristol).

Title: On the classification of the unitary minimal $N=2$ superconformal field theories.

Abstract: I will give an introduction to (super) conformal field theories from a more mathematical point of view, explain why the $N=2$ minimal models are in fact not yet classified, and suggest how a classification might be achieved through a mixture of orbifolding and folklore.

4 February 2010

Speaker: Liza Jones (Bristol).

Title: Non-Colliding Brownian Motions, Weyl Chambers and Symmetric Spaces.

Abstract: I will discuss how naturally occurring diffusions possessing the "non-colliding" property arise in the context of symmetric spaces. This framework has been particularly useful in studying and generalizing models from random matrix theory.

15 February - 5 March 2010

[Period on Planar Algebras and Physics](#)

Speakers: Julien Bichon (Clermont), Stephen Bigelow (UCSB), Richard Burstein (Vanderbilt), Ben Davison (Oxford), Jürgen Fuchs (Karlstad), Shamindra Ghosh (KU Leuven), Pinhas Grossman (Cardiff), Ved Gupta (Leuven), Amihay Hanany (Imperial), Yang-Hui He (Oxford), Paweł Kasprzak (Copenhagen), Alastair King (Bath), Mathew Pugh (Cardiff), Alex Quintero-Velez (Glasgow), Sven Raum (Leuven), Peter West (King's College, London)

15 February 2010- 2:30pm

Speaker: Yang-Hui He (Oxford).

Title: Quivers, gauge theories and Calabi-Yau singularities

Abstract: We discuss some recent progress on how quiver theories inevitably arise within string theory as world-volume theory of branes in various spacetime dimensions. We discuss intimate relations between the gauge theory, encoded by the quiver representations, the algebraic geometry of affine Calabi-Yau varieties, and auxiliary combinatorics involving dimers, tilings and plethystics.

24 February 2010 - 4pm

Speaker: Peter West FRS (King's College, London).

Title: E Theory

Abstract: I will review the current status of string theory and explain the evidence for a very large Kac-Moody symmetry of an underlying theory of strings and branes.

26 February 2010

[WIMCS Mathematical Physics Colloquium](#) [117KB] (Robert Recorde Room, Swansea University)

Speakers: Marco Marino (Geneva) and Richard Thomas (Imperial)

2pm - Thomas. Title: Curves on K3 surfaces and modular forms

Abstract: The Katz-Klemm-Vafa formula is a conjecture expressing Gromov-Witten invariants of K3 surfaces in terms of modular forms. In genus 0 it reduces to the (proved) Yau-Zaslow formula. I will explain how a correspondence between "stable pairs" and Gromov-Witten theory for toric 3-folds (proved by Maulik-Oblomkov-Okounkov-Pandharipande), some calculations with stable pairs (due to Kawai-Yoshioka) and some deformation theory lead to a proof of the KKV formula.

3:30pm - Marino. Title: Quantum theory and enumerative problems

Abstract: Many problems in mathematics involve counting objects. For example, in combinatorics, one is often interested in counting graphs with certain conditions. Another example is enumerative algebraic geometry, where one counts curves in algebraic varieties. Many of these problems turn out to be deeply related to quantum theories. In this talk I will explore this relation in three important examples: the enumeration of maps, the enumeration of Hurwitz coverings, and the LMO invariant of rational homology spheres. I will show how ideas of quantum theory lead to new insights in these problems, and in particular I will also explain the connection between non-perturbative effects in quantum theory and the asymptotic behavior of these enumerative problems.

5 March 2010 - 4pm

Speaker: Amihay Hanany (Imperial).

Title: On the classification of brane tilings

Abstract: Brane tilings give a large class of SCFT's in 3+1 and 2+1 dimensions. In this talk I will discuss several attempts to classify all such models. Statistical properties of these models can be derived using some techniques in crystallography and in number theory.

12 March 2010

Speaker: Jeffrey Giansiracusa (Swansea).

Title: Operads and Topological Field Theory

18 March 2010

Speaker: Kristian Evans (Swansea).

Title: Variable Order Subordination

15 April 2010

[COW](#) Seminar

Speakers: Katrin Wendland (Augsburg) and Sven Meinhardt (Oxford)

2.30 Sven Meinhardt (Oxford)
Integrality in Donaldson-Thomas theory

3.00 Tea

4.00 Katrin Wendland (Augsburg)
TQFT & singularities from a conformal field theorist's point of view

22 April 2010

Speaker: Boris Zilber (Oxford)

Title: On Model Theory, noncommutative geometry and physics.

Abstract: Studying possible relations between a mathematical structure and its description in a formal language Model Theory developed a hierarchy of a 'logical perfection'. On the very top of this hierarchy we discovered a new class of structures called Zariski geometries. A joint theorem by Hrushovski and the speaker (1993) indicated that the general Zariski geometry looks very much like an algebraic variety over an algebraically closed field, but in general is not reducible to an algebro-geometric object. Later the present speaker established that a typical Zariski geometry can be explained in terms of a possibly noncommutative 'co-ordinate' algebra. Moreover, conversely, many quantum algebras give rise to Zariski geometries and the correspondence 'Co-ordinate algebra - Zariski geometry' for a wide class of algebras is of the same type as that between commutative affine algebras and affine varieties.

General quantum Zariski geometries can be approximated (in a certain model-theoretic sense) by quantum Zariski geometries at roots of unity. The latter are of a finitary type, where Dirac calculus has a well-defined meaning. We use this to give a mathematically rigorous calculation of the Feynman propagator in a few simple cases.

29 April 2010

Speaker: Elizabeth Gasparim (Edinburgh)

Title: New isomorphisms of moduli spaces

Abstract: I will describe some new isomorphisms between moduli spaces of rank 2 bundles over surfaces and over threefolds. I will speculate about the possible physics interpretations of those.

14 May 2010 - room M/0.34

Speaker: Frances Kirwan FRS (Oxford)

Title: Geometric invariant theory for non-reductive group actions and jet differentials.

Abstract: Geometric invariant theory (GIT) was developed by Mumford in the 1960s in order to construct and study quotients of algebraic varieties by actions of reductive linear algebraic groups. His main motivation was that many interesting moduli spaces in algebraic geometry can be constructed in this way. This talk will discuss a generalisation of GIT to non-reductive group actions, and if time permits a potential application to global singularity theory via jet differentials.

17-21 May 2010

Speaker: Nigel Higson (Penn State)

Title: [The Baum-Connes Conjecture and Group Representations](#)

This includes a [Spitalfields Day](#) on 17 May with speakers [Terry Gannon \(Alberta\)](#) and [Nigel Higson](#)

21-25 June 2010

[LMS Regional Meeting and Workshop on Operator Algebras and Physics](#)

Principal Speaker: Constantin Teleman (Berkeley) who is giving a series of talks on Two Dimensional Topological Quantum Field Theories and Gauge Theories.

The first talk by Constantin Teleman will be in the LMS regional meeting on the first afternoon, Monday 21 June

which is embedded in the five-day workshop. The other speaker in the regional meeting on the Monday afternoon will be Werner Nahm (Dublin).

Confirmed speakers for the week include Teodor Banica (Paris), Terry Gannon (Alberta), Johannes Kellendonk (Lyon), Michael Mürger (Nijmegen), Andreas Recknagel (King's), Karl-Henning Rehren (Göttingen), Richard Szabo (Heriot-Watt), Jean-Louis Tu (Metz), Gerard Watts (King's)

28 June 2010 - 5pm in Wallace Lecture Theatre, Main Building

Speaker: Dan-Virgil Voiculescu

[LSW Frontiers Distinguished Lecture](#)

28 June - 2 July 2010

[EU-NCG 3rd Annual Meeting](#)

Confirmed speakers include: Iakovos Androulidakis (Göttingen), Dorothea Bahns (Göttingen), Moulay-Tahar Benameur (Metz), Sebastiano Carpi (Rome), Kenny De Commer (Rome), Bergfinnur Durhuus (Copenhagen), Robin Hillier (Rome), Stefan Hollands (Cardiff), Tommaso Isola (Rome), Yasuyuki Kawahigashi (Tokyo), Amin Malik (Oslo), Jouko Mickelsson (Helsinki), Denjoe O'Connor (DIAS), Thomas Schucker (Provence), Wojciech Szymanski (Odense), Otgonbayar Uuye (Copenhagen), André Verbeure (K.U. Leuven), Dan Voiculescu (Berkeley), Mihaly Weiner (Rome), Jakob Yngvason (ESI, Vienna), Laszlo Zsido (Rome)