

EU-NCG: Focused Semester on Mathematical Physics and NCG

LMS Regional Meeting

and

Workshop on Operator Algebras and Physics

21-25 June 2010

School of Mathematics, Cardiff University

Speakers:

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| Constantin Teleman (UCB): | <i>Two Dimensional Topological Quantum Field Theories and Gauge theories</i> |
| Werner Nahm (DIAS): | <i>The present status of quantum field theory</i> |
| Marta Asaeda (Riverside): | <i>The classification of finite depth subfactors- an overview and the recent developments</i> |
| Edwin Beggs (Swansea): | <i>Line modules in noncommutative geometry</i> |
| Terry Gannon (Alberta): | <i>Twisted equivariant K-theory and modular invariants</i> |
| Johannes Kellendonk (Lyon): | <i>Spectral triples, aperiodic tilings and their maximal equicontinuous factors</i> |
| Michael Müger (Nijmegen): | <i>Superselection theory in low dimensions, modular invariants and categorical ramifications</i> |
| Andreas Recknagel (Kings): | <i>Matrix Factorisations and Topological Branes</i> |
| Karl-Henning Rehren (Göttingen): | <i>Geometric modular action in conformal field theory</i> |
| Richard Szabo (Heriot-Watt): | <i>Instantons on noncommutative toric varieties</i> |
| Jean-Louis Tu (Metz): | <i>Twisted equivariant K-theory, groupoids and cohomology</i> |
| Gerard Watts (Kings): | <i>Defects and boundaries in conformal field theory</i> |

Abstracts:**Constantin Teleman (UCB)***Two Dimensional Topological Quantum Field Theories and Gauge theories*

Abstract: In the introductory lecture I will give a general overview. This will be followed by a talk on curved algebras and Landau-Ginzburg models including their appearance in topology, a more detailed lecture on the case of equivariant cohomology and K-theory in relation to principal bundles on surfaces, and a fourth lecture on my work on Chern-Simons with Freed Hopkins and Lurie (for the torus, but seems to connect to the 2d story). Finally I will give a summation and outline of future directions.

Werner Nahm (DIAS)*The present status of quantum field theory*

Abstract: More than 80 years after its discovery, quantum field theory still has no stable place in mathematics, though many ideas from this area have been used by mathematicians. The situation is improving, however. Various axiomatic systems are converging and there are many precise analytical or numerical results. Conformally invariant theories in two dimensions have become a legitimate field of mathematical research and hopefully integrable theories will soon follow. One can expect great benefits for both mathematics and physics.

Marta Asaeda (Riverside)*The classification of finite depth subfactors- an overview and the recent developments*

Abstract: The classification of subfactors was started by Jones, and it developed dramatically, involving various other fields of mathematics. Existence of subfactors that do not come directly from other objects such as quantum groups was raised as question, and Haagerup gave the list of the candidates of graphs that might be invariants for such subfactors with index a little above 4. I would like to give an overview on the topic in this direction, including the most recent results by various people.

Edwin Beggs (Swansea)*Line modules in noncommutative geometry*

Abstract: Line bundles are of considerable importance in differential geometry, algebraic geometry and topology. A possible definition of a 'line module' in noncommutative geometry is related to the idea of Morita contexts and equivalence of categories of modules. I will show how this definition, together with a Hilbert module structure on the line module, gives rise to a special case of the Thom isomorphism in a very explicit form - a construction of the algebra of 'functions' on the corresponding circle bundle. The Hilbert module structure mentioned above is one of two special cases of a star structure on line bundles, and the one above is the one likely to be of interest in algebraic geometry. The definition is also related to principal Hopf bundles and Hopf-Galois extensions. I hope to conclude by discussing the differential geometry of the line modules.

Terry Gannon (Alberta)*Twisted equivariant K-theory and modular invariants*

Abstract: In seminal work, Freed-Hopkins-Teleman interpreted the Verlinde algebra of the CFTs associated to loop groups, using twisted equivariant K-theory. In my talk I will explain certain extensions of this work, to other algebraic combinatorial structures associated to those CFTs. This is joint work with David Evans.

Johannes Kellendonk (Lyon)*Spectral triples, aperiodic tilings and their maximal equicontinuous factors*

Abstract: Spectral triples have been constructed for a variety of different systems, including recently for ultra-metric Cantor sets. They ought to capture information about the system such as distance, dimension, etc. in a spectral way. Quite generally we would like to know what spectral triples can tell us about aperiodic order, a phenomenon which is usually described by aperiodic tilings. In this talk we first provide an overview on the common approaches to quantify order in aperiodic systems, in particular we will explain the role of complexity and repetitivity. We then describe constructions of spectral triples for aperiodic tilings. We will for example see that complexity is related to their spectral dimension. Looking further we find that a certain spectral triple characterizes the maximal equicontinuous factor of the tiling dynamical system.

Michael Müger (Nijmegen)

Superselection theory in low dimensions, modular invariants and categorical ramifications

Abstract: I will review the representation theory of QFTs in low dimensions from the point of algebraic quantum field theory, in particular the study of local extensions and applications to the classification of modular invariants. I will conclude with connections to the problem of classifying modular categories, in particular joint work with Davydov, Nikshych and Ostrik on the Witt group of modular categories.

Andreas Recknagel (Kings)

Matrix Factorisations and Topological Branes

Abstract:

Karl-Henning Rehren (Göttingen)

Geometric modular action in conformal field theory

Abstract: In conformal QFT, the modular groups of local algebras in the vacuum state generate spacetime symmetries. When the localization regions are disconnected, surprising new features called "modular teleportation" and "modular charge separation" occur. A semidirect product with one-parameter groups associated with these new features "fixes" the failure of diffeomorphism invariance of the vacuum state.

Richard Szabo (Heriot-Watt)

Instantons on noncommutative toric varieties

Abstract: We construct new noncommutative deformations of toric varieties by combining methods from toric geometry, isospectral deformation theory, and noncommutative geometry in braided monoidal categories. We apply these techniques to the construction of a certain class of noncommutative instantons, and describe the interrelationships between their descriptions in terms of deformed ADHM data, framed torsion-free modules, and a twistor correspondence.

Jean-Louis Tu (Metz)

Twisted equivariant K-theory, groupoids and cohomology

Abstract: We start by reviewing how an equivariant gerbe can be realized by central extensions of groupoids, and how a connection and curvature can be used to construct the equivariant 3-form associated to it. We define twisted cohomology as the periodic cyclic homology of a certain $*$ -algebra, and show how it can be realized as the cohomology of a certain complex involving differential forms.

Gerard Watts (Kings)

Defects and boundaries in conformal field theory

Abstract: