

Number Theory and Physics

Talks with abstracts for

the period March 16 - March 20, 2009

Organizers: A. Carey, H. Grosse, D. Kreimer, S. Paycha, S. Rosenberg, N. Yui

Monday March 16

Louise Nyssen, Université Montpellier 2

Title: Test vectors for trilinear forms

Abstract : Let F be a finite extension of \mathbb{Q}_p and $G=GL_2(F)$. If V is the tensor product of three infinite dimensional, admissible, irreducible representations of G , the space of G -invariant linear forms on V has dimension at most one. When a non zero linear form exists, one wants to find a test vector which is not in its kernel. It is called a test vector. Test vector are sometimes used to get estimates of the behaviour of L-functions of triple products of automorphic forms on $GL(2)$ along the critical line $\text{Re}(z)=1/2$. The point is to give an explicit description of test vectors. In joint work with Mladen Dimitrov, we describe test vectors when at least two of the representations are principal series, thus generalising results of Gross and Prasad.

Marcelo Laca, University Wollongong

Title: Phase transition on the Toeplitz algebra of the affine semigroup over the natural numbers.(joint work with I. Raeburn)

Abstract: We show that the group of orientation-preserving affine transformations over the rational numbers, is quasi-lattice ordered by the subsemigroup of affine transformations over the natural numbers. We then use this to give a presentation of the associated Toeplitz C^* -algebra in terms of generators and relations and show that the C^* -algebra Q_N recently introduced by Cuntz is the boundary quotient of this Toeplitz algebra, providing another proof that Q_N is purely infinite simple. There is a natural dynamics on the Toeplitz algebra, which induces the one considered by Cuntz; our main result is a phase transition theorem that fully describes the KMS state structure for this dynamics and highlights the interplay between equilibrium and symmetries of the Toeplitz system.

Jorge Plazas, IHES

Title: From Artin Motives to Endomotives

Abstract: Artin motives furnish the simplest examples of motives defined over a number field. Projective families of Artin motives endowed with the action of a semigroup of endomorphisms give rise in a natural way to dynamical systems with nice arithmetic properties. The recently developed theory of endomotives, based on the systematic study of these type of structures, provides a unified framework in which the tools of quantum statistical mechanics can be applied to the study of number fields. After recalling some basic facts about Artin motives we introduce endomotives. We discuss the main examples as well as some further perspectives of the theory.

Marie Françoise Ouedraogo, University of Ouaga

Title: The multiplicative anomaly for regularised determinants

Tuesday March 17

Ryszard Nest, University of Copenhagen

Title: Applications of triangulated categories in operator algebras

Harald Grosse, Universität Wien

Title: Renormalizable Noncommutative Quantum Field Theory

Abstract: We discuss models on 4 dimensional deformed space-time. Renormalizability is achieved by identifying relevant/marginal operators. For scalars and fermions a number of models have been identified. For a special scalar field theory the beta function vanishes in perturbation theory up to all orders. Gauge models are formulated.

A general mechanism to introduce noncommutativity shows that locality is violated, but wedge locality still holds.

Raimar Wulkenhaar, Universität Münster

Title: Non-compact spectral triples with finite volume

Abstract: In order to extend the spectral action principle to non-compact spaces, we propose a framework for spectral triples where the algebra may be non-unital but the resolvent of the Dirac operator remains compact. An example is given by the supersymmetric harmonic oscillator. The two different Dirac operators provide two representations of the volume form in the Hilbert space, and only their product is the grading operator. We also compute the spectral action for the corresponding Connes-Lott two-point model. There is an additional harmonic oscillator potential for the Higgs field, whereas the Yang-Mills part is unchanged. The total Higgs potential shows a two-phase structure with smooth transition between them: In the spontaneously broken phase below a critical radius, all fields are massive, with the Higgs mass slightly smaller than the NCG prediction. In the unbroken phase above the critical radius, gauge fields and fermions are massless, whereas the Higgs field remains massive.

Wednesday March 18

Noriko Yui, Queen's University

Title: K3 surfaces with non-symplectic group actions, and their modularity

Abstract: This is a joint work with Ron Livné (Jerusalem) and Matthias Schütt (Copenhagen). We consider complex K3 surfaces with a non-symplectic group acting trivially on the algebraic cycles. Vorontsov and Kondo classified those K3 surfaces with transcendental lattice of minimal rank. The purpose of this talk is to study the Galois representations associated to these K3 surfaces. The rank of transcendental lattices is even and varies from 2 to 20, excluding 8 and 14. We show that these K3 surfaces are dominated by Fermat surfaces and hence they are all of CM type. We establish the modularity of the Galois representations associated to the transcendental parts of these K3 surfaces. Time permitting, we briefly discuss mirror symmetry for these K3 surfaces.

Steve Rosenberg, Boston University

Title: Chern-Simons classes on loop spaces

Abstract: The loop space LM of a Riemannian manifold M has a family of Riemannian metrics indexed by a Sobolev parameter. We can construct characteristic classes for LM by using the Wodzicki residue instead of the usual matrix trace. The Pontrjagin classes of LM vanish, but the secondary or Chern-Simons classes may be nonzero.

Satoshi Kondo, University of Tokyo

Title: Two higher Chow groups of a scheme over a finite field

Abstract: This is a joint work with Seidai Yasuda (Kyoto University). For a separated scheme X of finite type over a finite field, we compute explicitly the two higher Chow groups $CH_{-1}(X, 1)$ and $CH_{-2}(X, 3)$.

Thursday March 19

Louis Boutet de Monvel, Paris 6

Title: Asymptotic equivariant trace and index

Abstract: In 1974 M.F. Atiyah developed the theory of the equivariant index of transversally elliptic pseudodifferential operators on manifolds with a compact group action. The asymptotic index is an avatar of this theory, which works for equivariant Toeplitz operators (as defined in my book with V. Guillemin). With E. Leichtnam, X. Tang and A. Weinstein we have used it to give a new "natural" proof of the Atiyah-Weinstein conjecture.

Gabriel Baditoiu, MPI Bonn

Title: Lax pair equations and Feynman diagrams

Abstract: We construct a Lax pair equation corresponding to the Connes-Kreimer Birkhoff factorization of the character group of the Hopf algebra of Feynman diagrams. In particular, we obtain a flow for the character given by Feynman rules. This is a joint work with Steven Rosenberg.

Christoph Bergbauer, Freie Universität Berlin

Title: Remarks on renormalization in position space

Abstract: I discuss renormalization in the sense of Epstein-Glaser using a resolution of singularities. This brings up some connections to recent work of Bloch and Kreimer.

Friday March 20

Matthew Szczesny, Boston University

Title: Feynman graphs and Hall algebras

Abstract: The Hall algebra of a (finitary) category is an associative algebra which records the structure of Ext^1 between objects. In some cases this algebra is the enveloping algebra of a Lie algebra, called the Hall Lie algebra of the category. We construct "nearly abelian" categories of Feynman graphs and rooted trees, whose Hall algebras are the Connes-Kreimer Lie algebras. This is joint work with Kobi Kremnizer.

Martin Schlichenmaier, University of Luxembourg

Title: Almost-graded central extensions of Lax operator algebras

Abstract: Lax operator algebras constitute a new class of infinite dimensional Lie algebras of geometric origin. More precisely, they are algebras of matrices whose entries are meromorphic functions on a compact Riemann surface. They generalize classical current algebras and current algebras of Krichever-Novikov type. Lax operators for $\mathfrak{gl}(n)$ were introduced by Krichever. In joint works of Krichever and Sheinman their algebraic structures was revealed and extended to more general groups. These algebras are almost-graded. In this talk we recall their definition and present classification and uniqueness results for almost-graded central extensions for this new class of algebras. The presented results are joint work with Oleg Sheinman.

Carolina Neira, ESI Junior Research Fellow

Title: Traces on pseudo-differential operators of negative order and related determinants

Abstract: In this talk we address the question whether we can classify traces on classical pseudo-differential operators of negative order on a closed manifold. We infer that those traces can be expressed as linear combinations of the residue trace, the leading symbol trace and the canonical trace. We also consider the determinants related to those traces.
