Titles and abstracts of the talks of the conference

Noncommutative Geometry and Mathematical Physics

Scalea. Italy — June 16–20, 2014

Alberto Cattaneo
Universität Zürich

Minicourse: Classical and quantum Lagrangian field theories with boundaries

Abstract: Classical and quantum field theories may be thought of as appropriate functors from (some version of) the cobordism category. At the quantum level this was proposed by Segal as an axiomatization. Incarnations of this exist for nonperturbative topological field theory (by Witten following Atiyah's version of the axioms for TFTs) as well as in one and two dimensional field theories. This talk (based on joint work with Mnev and Reshetikhin) will give an introduction to the classical version and to the Batalin-Vilkovisky version, which forms the starting point for the perturbative quantization. The possibility of including boundaries of boundaries (and so on) naturally yields to a Lurie-type description. Eventually, one might be able to reconstruct perturbative quantum theories on manifolds by gluing simple pieces together. Work in progress on this will be presented.

Jørgen Ellegaard Andersen
Aarhus Universitet

Representations of mapping class groups arising from Quantum Chern-Simons theory

Abstract: In the talk we recall the geometric quantization of moduli spaces approach to the quantum representations of mapping class groups, which are part of the Witten-Reshetikhin-Turaev construction of quantum Chern-Simons theory for compact gauge groups. If time permits it, we will also discuss the new representations arising from quantum Chern-Simons theory for complex gauge groups.

Paolo Aschieri
Universitá degli Studi del Piemonte Orientale

Deformation Quantization of Principal Bundles

Abstract: Drinfeld twist deformation theory of modules and algebras that carry a representation of a Hopf Algebra H can be extended to deform also morphisms and connections that are not H-equivariant. In this talk I present how similar techniques allow to canonically deform principal G-bundles, and in general how Hopf-Galois extensions are canonically deformed to new Hopf-Galois extensions.

Twisting the structure group we obtain principal bundles with noncommutative fiber and where the structure group is a quantum group. Twisting the automorphism group of the principal bundle we further obtain a noncommutative base space.

Panagiotis Batakidis
The Pennsylvania State University

Weight homogeneous Poisson structures and deformation quantization

Abstract: The talk will be about the way deformation quantization behaves when applied to weight homogeneous Poisson structures, e.g. quadratic and transverse Poisson structures with applications to Lie representation theory.

Simon Brain
Radboud Universiteit Nijmegen

The Gysin Sequence for Quantum Lens Spaces

Abstract: We define quantum lens spaces as 'direct sums of line bundles' and exhibit them as 'total spaces' of certain principal bundles over quantum projective spaces. For each of these quantum lens spaces we construct an analogue of the classical Gysin sequence in K-theory. We prove exactness of our sequence using techniques in unbounded bivariant KK-theory.

Özgür Ceyhan
Université du Luxembourg

Feynman integrals, motives and periods of configuration spaces

Abstract: Mid 90's, Broadhurst and Kreimer observed that multiple zeta values persist to appear in Feynman integral computations. Following this observation, Kontsevich proposed a conceptual explanation, that is, the loci of divergence of these integrands, which are also known as graph hypersurfaces, must be mixed Tate motives. However, Belkale and Brosnan disproved this conjecture by showing that the classes of graph hypersurfaces in the Grothendieck group of varieties can be arbitrarily complicated. Since then, Aluffi, Bloch, Brown, Doryn, Esnault, Kreimer, Marcolli, Schnetz and many others collected further and counter evidences around the problem.

In this talk, I will describe a way to rectify Kontsevich's proposal and show that the regularized Feynman integrals in position space setting as well as their ambiguities are given in terms of periods of suitable configuration spaces, which are mixed Tate. This talk will be based on a joint work with M. Marcolli.

Nicola Ciccoli
Universitá degli Studi di Perugia

Groupoid quantization of hermitian symmetric spaces

Abstract: Integrable Poisson manifold can be quantized by performing geometric quantization on the symplectic groupoid integrating them. A possible way to carry through the whole quantization procedure is to try and build the quantized algebra as a twisted convolution algebra, from a suitable multiplicative Lagrangian distribution. However strong topological obstruction often appear. We will show how on complex projective spaces, seen as Poisson homogeneous spaces of standard Poisson $SU(n)$ it is possible to relax the requirement on the distribution and use a natural bihamiltonian structure to obtain a non commutative groupoid C^* algebra, where the cocycle integrating the modular class plays a distinct role as KMS operator on an etale groupoid. We will also show how, to a certain extent, such construction is functorial allowing for easy quantizations of some distinct Poisson submanifolds.

Alexander Getmanenko
I.H.E.S.

Microlocal properties of sheaves and the Schrödinger equation

Abstract: In a joint work with Tamarkin, we apply Kashiwara-Schapira style sheaf theory to mathematially justify certain aspects of exponential asymptotic solutions of the Schrödinger equation.

Axel de Goursac
Université catholique de Louvain

Quantum Supergroups and Noncommutative Supergeometry

Abstract: In this talk, we introduce topological quantum supergroups and their representations. Then, we expose the construction of the non-formal deformation quantization of some supergroups and their universal deformation formula. By using these deformations, we build concrete examples of Fréchet quantum supergroups and see how they can be interpreted in Noncommutative Supergeometry.

Simone Gutt
Université de Lorraine & Université libre de Bruxelles

Symplectic space forms

Abstract: The goal of the talk is to show that symplectic space forms yield a nice framework to study Radon-type transforms. A symplectic symmetric space whose canonical connection is of Ricci-type can be considered as a symplectic analogue of a space form in Riemannian geometry. There exist nice models of those spaces given by reduction procedures. Totally geodesic symplectic submanifolds of those space forms can be described and there is a natural symmetric space structure on subsets of the set of those totally geodesic submanifolds.

Stéphane Korvers
Université catholique de Louvain

Formal and non-formal deformation quantizations of the complex unit ball

Abstract: In the paper *The Deformation Quantizations of the Hyperbolic Plane* (see Comm. in math. phys., 289(2), 2009, pp. 529-559), Bieliavsky, Detournay and Spindel gave an explicit realization of the space of all both formal and non-formal deformation quantizations on the Poincaré disk in the complex plane. This construction relies on the evolution of a second order hyperbolic differential operator that emerges from a curvature contraction process on the Poincaré disk. Certain solutions of this evolution equation define convolution operators that intertwine the deformation theory at the contracted level with that of the Poincaré disk. This talk will be devoted to the study of a generalization of this construction in the case of the unit ball in $\mathbb{C}^n$. This is a joint work with Prof. Pierre Bieliavsky.

Jing-Hua Lu
The University of Hong Kong

On some mixed product Poisson structures

Abstract: We give a construction of mixed product Poisson structures associated to Poisson Lie groups and some examples from Lie theory. When the Poisson Lie group is factorizable, our mixed product construction is equivalent to that of fusion product of quasi-Poisson manifolds. This is joint work with V. Mouquin.

Franz Luef
Norwegian University of Science and Technology

On non-linear sigma models for noncommutative tori

Abstract: In this talk I am going to describe some results on non-linear sigma models for noncommutative tori. These results are based on the interpretation of vector bundles over noncommutative tori as Gabor frames. The latter are an important tool in many areas of mathematics and signal analysis. Part of these results are based on joint work with Dabrowski and Landi.

Sergei Merkulov
Université du Luxembourg

Formality theorem behind quantizations of Lie bialgebras and the Grothendieck-Teichmueller group

Abstract: We introduce new operads of graph complexes and use them to prove a formality theory behind theorem behind quantizations of Lie bialgebras. We also prove that the set of homotopy classes of universal formality maps is a torsor over the the Grothendieck-Teichmüller group GRT.

Bram Mesland
University of Warwick

Spectral triples with unbounded commutators

Abstract: When computing the Kasparov product of an unbounded module with a spectral tripe, the resulting operator often has unbounded commutators with the algebra. In case this unboundedness is "mild" the "spectral triple" still defines a Fredholm module and hence an element in K-homology. In this talk I will discuss the source of this unboundedness in terms of operator modules, and give examples of both well- and poorly behaved unbounded products, coming from Cuntz-Krieger algebras and quantum groups respectively.

Jean-Philippe Michel
Université de Liège

Higher symmetries of Laplace and Dirac operators

Abstract: The algebra of higher symmetries of Laplacian have been studied by Eastwood, after a question by Witten. Using quantization mehtods, I will discuss two results concerning higher symmetries of Laplace and Dirac operators. The first involves the unique invariant star-deformation of the minimal coadjoint orbit of the conformal Lie group and the second is concerned with conformal supersymmetries.

Sergei Neshveyev
Universitetet i Oslo

Cocycle deformation of operator algebras

Abstract: Given a C*-algebra A with an action of a locally compact quantum group G on it and a unitary 2-cocycle Ω on $\hat{G}$, we define a deformation A_Ω of A. The construction is motivated by an old observation of Majid and a more recent work of Kasprzak on Rieffel's deformation, and we will explain an easy way how to incorporate Rieffel's deformation into this setup. We will present a number of general results on the structure of the algebras A_Ω, as well several more refined results obtained in particular examples, such as computations of K-theory and periodic cyclic cohomology. We will also discuss some open problems. (Based on a series of papers, including joint work with J. Bhowmick, A. Sangha and L. Tuset.)

Adrian Ocneanu
The Pennsylvania State University

Inside Permutations and Fermionic Feynman diagrams

Abstract: We show that permutations decompose into primitive and prime permutations, in a tree structure. The nodes of the tree give the first known encoding of indecomposable Feynman Fermionic line diagrams.

Chiara Pagani
Georg-August-Universität Göttingen

A quantum 4-sphere with non central radius and its instanton sheaf

Abstract: I will describe the construction of an SU(2)-Hopf bundle over a quantum toric 4-sphere whose radius is non central. The construction is carried out in terms of sheaves of Hopf-Galois extensions. I will also describe the associated instanton bundle and its anti-selfdual connection. Based on a joint work with L. Cirio.

Florin Radulescu
Universitá di Roma - Tor Vergata

A Theory of Gamma-invariant vectors

Abstract: In the presence of a unitary representation of a group G with almost normal subgroup Γ so that the representation restricted to the smaller subgroup is a multiple of the left regular representation we identify the candidate for "Gamma invariant vectors", we identify the action of the larger group and its action on this space This is related to the Hecke operators, and we study various representations and start a classification procedure.

Daniel Sternheimer
Rikkyo University & Université de Bourgogne

Generalized Quantum AdS, a basis for a (new) Standard Model in particle physics?

Abstract: We present a "model generating" multifaceted framework in which the "internal symmetries" on which was based the Standard Model (SM) of strongly interacting elementary particles, could "emerge" by deforming the Anti de Sitter (AdS) deformation of the Poincaré group, i.e. quantizing it, probably at root of unity and possibly in manner not yet mathematically developed (with multiple or noncommutative parameters). We start by reviewing a possible explanation of photons as composites of AdS singletons, and of leptons as similar composites (extending the electroweak model to 3 generations). The SM might be a colossus with clay feet!

Elizaveta Vishnyakova
Université du Luxembourg

On quadratic symmetric n-ary superalgebras

Abstract: An n-ary symmetric superalgebra is called quadratic if its multiplication is invariant with respect to a non-degenerate skew-symmetric form. Here one has to be careful with "skew-symmetric" since we work in superspace!

In superspace "skew-symmetric" means that our form is skew-symmetric on the even part and symmetric on the odd part. Therefore, this class contains for example all Lie algebras with non-degenerate symmetric form, their n-ary generalizations and all commutative algebras with non-degenerate skew-symmetric form. The main observation here is that we can obtain all these algebras using a "derived bracket" approach from Poisson geometry.

Our talk is devoted to a discussion of quadratic symmetric n-ary superalgebras and other applications of "derived brackets".

Yannick Voglaire
Université du Luxembourg

Rozansky–Witten-type invariants from symplectic Lie pairs

Abstract: In 1997, Rozansky and Witten built new finite-type invariants of 3-manifolds from hyperkahler manifolds. It was later shown by Kapranov that those invariants only depend on the holomorphic symplectic structure of the hyperkahler manifolds, and may be built from only two objects: the Atiyah class of the underlying complex manifold, and the holomorphic symplectic form.

With Ping Xu, we introduce symplectic structures on "Lie pairs" of (real or complex) algebroids as studied by Chen-Stiénon-Xu, encompassing homogeneous symplectic spaces, symplectic manifolds with a $\mathfrak{g}$-action and holomorphic symplectic manifolds.

We show that to each such symplectic Lie pair are associated Rozansky-Witten-type invariants of three-manifolds and knots, given respectively by weight systems on trivalent and chord diagrams. In this talk, I will review the necessary notions to state the result and explain the construction of the weight systems.