Program of the Poster Session

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Homogeneous G-structures

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Abstract

The theory of G-structures provides us with a unified framework for a large class of geometric structures, including symplectic, complex and Riemannian structures, as well as foliations and many others. Surprisingly, contact geometry —the "odd-dimensional counterpart" of symplectic geometry— does not fit naturally into this picture. In this work, we introduce the notion of a homogeneous G-structure, which encompasses contact structures, as well as some other interesting examples that appear in the literature.

Quasi-Hamiltonian Spaces and Complexification

Anastasia Matveeva

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Abstract

The poster describes our joint work with Eva Miranda and Anton Alekseev regarding complex version of quasi-Hamiltonian spaces. It contains definition and some examples of q-Hamiltonian G-spaces that are generalization of Hamiltonian G-spaces admitting moment map that takes values in the Lie group G. We show how to obtain "complex q-Hamiltonian S^1-space" from q-Hamiltonian $SU(2)$-space, provide an example and definition of such spaces.

Reduction of Equivariant Polyvector Fields and Ideas for Polydifferential Operators

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Abstract

In order to investigate the compatibility of deformation quantization with a symmetry reduction of the underlying Poisson manifold we want to reduce the corresponding differential graded Lie algebras that encode the deformation problem: On the classical side one has the equivariant polyvector fields, where a reduction to the polyvector fields on the reduced space is well understood. On the quantum side there are the equivariant polydifferential operators, where we want to present some ideas on a possible reduction procedure. This is joint work with Chiara Esposito and Jonas Schnitzer.

Real Calculus Homomorphisms and minimal Embeddings of noncommutative Manifolds

Axel Tiger Norkvist

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Abstract

In noncommutative geometry, one may use real calculi instead of spectral triples to encode information about noncommutative manifolds. We introduce the concept of homomorphisms of real calculi, which can be used to give a general definition of embeddings in noncommutative geometry. Several classical results in differential geometry can then be shown to have analogues in the noncommutative context —including Gauss' equations for the curvature of an embedding— and we define the notion of mean curvature and minimal embeddings in noncommutative geometry. Using this, we go on to show that the noncommutative torus can be minimally embedded into the noncommutative 3-sphere.

Compactness in Jacobi Geometry

Camilo Angulo

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Abstract

A Poisson manifold of compact type is an integrable Poisson manifold, whose symplectic groupoid is compact, s-proper or proper. These were introduced and studied by Crainic, Fernandes and Martinez Torres fairly recently and have many nice properties. In this poster, we will define the analogous concept in Jacobi geometry, motivate how such manifolds could be useful in Poisson geometry and present some of their properties.

Submanifolds in stable generalized complex geometry

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Abstract

Generalized complex geometry (introduced by Hitchin and Gualtieri in the early 2000's) interpolates between ordinary complex and symplectic geometry. Stable generalized complex manifolds (first introduced by Cavalcanti and Gualtieri in 2015) provide examples of generalized complex manifolds which admit neither a symplectic nor a complex structure. Their generalized complex structure is, up to gauge equivalence, fully determined by a Poisson structure which is symplectic everywhere except on a real codimension 2 submanifold, a so-called elliptic symplectic form. Like log symplectic structures, these are examples of Poisson structures which can be described in terms of symplectic forms for a Lie algebroid not isomorphic to the tangent bundle; Poisson structures of this type have been widely studied in recent years. The poster describes some of their natural classes of submanifolds, in particular a new type called Lagrangian brane with boundary, and some of their deformations.

Rigidity of Lie groupoid morphisms from a cohomological perspective

Cristian Cárdenas

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Abstract

We introduce the deformation cohomology of Lie groupoid morphisms, which offers a framework to study deformations of morphisms of Lie groupoids. Several properties of this cohomology can be remarked such as its Morita invariance and its interpretation in terms of the adjoint representation of Lie groupoids. We study how the deformation cohomology governs the deformations of morphisms, and we apply that to obtain rigidity properties of morphisms. Our theorems generalize the existing results of Cárdenas and Struchiner on Lie group homomorphisms.

Real index one Dirac structures

Dan Agüero

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Abstract

Generalized complex structures generalize both symplectic and com- plex structures. They are defined just in even dimensional manifolds. We note that by changing the real index we obtain structures that generalize both presymplectic and CR structures. We focus on the case of real index one. We note that in this case a new invariant appears, the subtype, which determines strongly the geometry of these structures. Moreover, we prove a splitting theorem for the case of subtype one.

BV-BFV description of General Relativity in three dimensions

Giovanni Canepa

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Abstract

The BV-BFV (Batalin-(Fradkin)-Vilkovisky) formalism is a tool to encode symmetries in gauge theories on manifolds with boundary. In this work, we compute the extension of the BV theory for three-dimensional General Relativity to all higher-codimension strata - boundaries, corners and vertices - in the BV-BFV framework. Moreover, we show that such extension is strongly equivalent to (nondegenerate) BF theory at all codimensions. This is a joint work with Michele Schiavina.

L_∞ algebra of Einstein-Cartan-Palatini gravity and its braided non-commutative deformation

Grigorios Giotopoulos

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Abstract

An L_∞ algebra encoding the field content, gauge transformations, equations of motions and Noether identities of the classical theory is presented. The algebra is deformed to a braided L_∞ algebra using Drinfel'd twists. The resulting structure encodes the (braided) non commutative deformation of Einstein-Cartan-Palatini gravity.

Quantization of Poisson Hopf algebras and beyond

Jan Pulmann

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Abstract

For any group, one can define its nerve, a collection of spaces $G^{\times n}$ with some operations. This object is equivalent to a *lax* monoidal functor from the prop of commutative algebras, satisfying a Segal-like condition. If we take the *braided* prop of commutative algebras, such functors give Hopf algebras. Moreover, there is an infinitesimal version of this braided prop, which gives Poisson Hopf algebras, of which Lie bialgebras are an example. Therefore, using the Drinfel'd associator, we produce Hopf algebras from Poisson Hopf algebras, quantizing e.g. Lie bialgebras. Moreover, the Segal condition on the nerve can be relaxed, which corresponds to higher groups and groupoids.

This is a joint work with Pavol Ševera.

The low-dimensional algebraic cohomology of the Witt and the Virasoro algebra

Jill Ecker and Martin Schlichenmaier

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Abstract

The aim of our work is to compute the low-dimensional algebraic cohomology of the Witt and the Virasoro algebra with values in the trivial, the adjoint, and general tensor-densities modules. We are interested in the full algebraic cohomology and not only the sub-complex of continuous cohomology, meaning we do not put any continuity constraints on the cochains. Therefore, our results are valid for any concrete realization of the Lie algebras under consideration, and independent of any choice of topology.

Deformations of symplectic groupoids

João Nuno Mestre

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Abstract

We study deformations of symplectic groupoids, and how the Bott-Shulman-Stasheff double complex shows up controlling infinitesimal deformations. The background on deformations of Lie groupoids is included. We also see a map relating the differentiable cohomology to the deformation cohomology of a symplectic groupoid. This Poster is based on joint work with Ivan Struchiner and Cristian Cárdenas

Towards a Floer homology for singular symplectic manifolds

Joaquim Brugués Mora

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Abstract

Floer homology has grown to become a fundamental tool in a wide variety of fields in geometry and topology. Since Floer introduced his theory in the late eighties to prove the Arnold conjecture on fixed points of Hamiltonian symplectomorphisms, it has been used to introduce invariants in symplectic and contact geometry, to study the space of connections on 3-dimensional manifolds, to study knots on the 3-sphere and to disprove the existence of triangulations for topological manifolds of dimension ≥ 5, and new applications to geometrical and topological problems still appear steadily. In our project, we intend to construct a homology akin to the Hamiltonian Floer homology in the context of b^m-symplectic geometry, a particular family of Poisson structures with controlled singularities in which we are often able to recover results from classical symplectic geometry. In this poster we present the setting of the problem, recalling the definition of Hamiltonian Floer homology and the basic characteristics of b^m-symplectic geometry.

Existence and classification of quantum moment maps via Formality

Jonas Schnitzer

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Abstract

Invariant Poisson structures (resp. star products) together with corresponding moment maps (resp. quantum moment maps) can be described as (curved) Maurer Cartan elements of certain DGLA's. The aim of my poster is to relate these DGLA's via an L_∞-morphism and explain that, under mild assumptions on the group action, it is a quasi-isomorphism. This implies that we can identify the Maurer Cartan elements, up to gauge equivalence in both DGLA's and hence classify quantum moment maps.

On q-Deformed Levi-Civita Connection

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Abstract

In a derivation based calculus, a connection on a left A- module M is a map $\nabla_X : M \longrightarrow M$ satisfying $\nabla_X(am) = a\nabla_X(m) + X(a)m$ for $X \in \mathrm{Der}(A)$, $a \in A$ and $m \in M$. For quantum algebras, where the derivations are q-deformed, we want to introduce the notion of a q-deformed connection. To this end, we study the particular example of the quantum 3-sphere S_q^3 and find appropriate definitions of metric compatibility and torsion-freeness, and explicitly construct a Levi-Civita connection on the module of differential forms.

Two-dimensional Yang-Mills theory and its deformations

Lorant Szegedy

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Abstract

Two-dimensional Yang-Mills theory can be phrased as an area-dependent quantum field theory: a symmetric monoidal functor from the category of two-dimensional bordisms to the category of Hilbert spaces, constructed from a compact semisimple Lie group. In the past decades several deformations of two-dimensional Yang-Mills theory have been considered in the physics literature, some of these related to defomation quantisation, which are constructed by considering a quantum group associated to the Lie group of the undeformed theory. The aim of this project is to understand these theories as deformations in the mathematical sense.

Deformation theory of Lie groupoids and differentiable stacks

Lory Kadiyan

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Abstract

It is a known philosophy that *every deformation problem is governed by a differential graded Lie algebra (dgLa).* Prototypical examples of this principle are deformations of associative algebras as studied by Gerstenhaber and deformations of complex structures as studied by Kodaira and Spencer. This conjecture has been proved by Lurie and Pridham using the modern language of higher category theory.

We are primarily interested in the deformation theory of so-called *Lie groupoids*, which are geometric objects that model a large class of geometric structures, such as representations, foliations, orbifolds, differentiable stacks, convolution C^*-algebras, etc. In particular, we would like to construct (a computable model of) the dgLa which controls deformations of Lie groupoids. This turns out to be an extremely hard problem. Crainic, Mestre and Struchiner have recently constructed the deformation complex of a Lie groupoid, which has many desirable results on the rigidity of Lie groupoids. However, the existence and construction of a Lie bracket for this complex making it into a dgLa is still unknown.

Morita Theory for Locally Convex Algebras

Mahdi Hamdan

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Abstract

We have analyzed the Eilenberg Watts theorem for equivalence functors on module categories and have given a sufficient condition for Morita equivalence in the setting of Fréchet algebras with bounded approximate identities and essential Fréchet modules as representations. For this purpose, we have constructed a bicategory with those algebras as 0-cells, bimodules as 1-cells and module morphisms as 2-cells, ultimately allowing us to call two algebras Morita equivalent, if they are equivalent as objects in this constructed bicategory. Furthermore, we gave a weaker version of the Eilenberg Watts theorem in the setting of multiplicative Fréchet algebras with uniformly bounded approximate identities and complete locally convex essential multiplicative modules as representations. We have proven that a Morita equivalence functor on the category of all complete locally convex essential modules is, when restricted to the subcategory of multiplicative Fréchet modules, equivalent to a tensor functors.

Graph complexes

Marko Živković

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Abstract

Graph complexes are mathematical structures generated by some kind of graphs. Each of them plays a certain role in a subfield of homological algebra or algebraic topology. They have an elementary and simple combinatorial definition, yet we know very little about their homology. In the poster we explain what are graph complexes and their (co)homology, and the main problems and techniques concerning them.

Generalized Coisotropic Reduction

Marvin Dippell

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Abstract

Symmetry reduction plays an important role in classical and quantum physics. In symplectic or, more generally, Poisson geometry this can be modelled by reduction of coiosotropic submanifolds. We will give an algebraic generalization of these reduction schemes, so called *coisotropic algebras*, which also incorporate reduction procedures known from deformation quantization. In order to compare such non-commutative coisotropic algebras the notion of coisotropic Morita equivalence will be useful. For this we need to introduce coisotropic bimodules and their reduction. In deformation quantization the classical limit is always well-behaved, and we will see that reduction of coisotropic algebras and bimodules commutes with the classical limit.

Gelfand - Naimark Theorems for Ordered *-Algebras

Matthias Schötz

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Abstract

The Gelfand-Naimark theorems provide important insight into the structure of general and of commutative C^*-algebras. However, they can be generalized to certain ordered *-algebras and thus to algebras of unbounded operators. More precisely, for Archimedean ordered *-algebras dominated by a sequence of positive elements, a faithful representation as operators can be constructed. Similarly, for commutative such algebras, a faithful representation as complex-valued functions can be constructed if an additional necessary regularity condition is fulfilled.

The Cohomology of Courant algebroids and their characteristic classes

Miquel Cueca

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Abstract

Courant algebroids originated over 20 years ago motivated by constrained mechanics but now play an important role in Poisson geometry and related areas. Courant algebroids have an associated cohomology, which is hard to describe concretely. Building on work of Keller and Waldmann, I will show an explicit description of the complex of a Courant algebroid where the differential satisfies a Cartan-type formula. This leads to a new viewpoint on connections and representations of Courant algebroids and allows us to define new invariants as secondary charcateristic classes, analogous to what Crainic and Fernandes did for Lie algebroids. This is joint work with R. Mehta.

Strict quantization of coadjoint orbits

Philipp Schmitt

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Abstract

We obtain a strict quantization of the holomorphic functions on any semisimple coadjoint orbit of a complex semisimple connected Lie group. By restricting this quantization, we also obtain strict star products on a subalgebra of analytic functions for any semisimple coadjoint orbit of a real semisimple connected Lie group. If this Lie group was also compact, the star product is of Wick type. The main tool to construct our quantization is a construction by Alekseev–Lachowska and an explicit formula for the canonical element of the Shapovalov pairing between generalized Verma modules.

Deformations of vector bundles over Lie groupoids

Pier Paolo La Pastina

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Abstract

VB-groupoids can be understood as vector bundles in the category of Lie groupoids. They encompass several classical objects, such as Lie group representations, 2-vector spaces, Lie group actions on vector bundles; moreover, they provide geometric pictures for 2-term representations up to homotopy of Lie groupoids, in particular the adjoint representation. Here I attach to every VB-groupoid a cochain complex controlling its deformations and discuss some of its features, such as Morita invariance, as well as some examples and applications. This is joint work with Luca Vitagliano.

A Globally Hyperbolic Derivation of the Virasoro Algebra

Sam Crawford

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Abstract

The commutation relations for the generators of the Virasoro algebra are derived from the free scalar field on a cylinder within the framework of pAQFT. This framework, developed by Brunetti, Dütsch and Fredenhagen around the late 1990's, has enabled mathematical physicists to formulate perturbative QFT, a theory which has been met with almost unrivalled phenomenological success, in terms which are entirely mathematically well-defined. Our derivation is achieved via a deformation of the Peierls bracket and as a result is manifestly Lorentzian; it does not require Wick rotations or any other 'complexification' of spacetime. We conclude by discussing how our results may be extended to the free scalar field on the plane and eventually to arbitrary (curved) 2D globally hyperbolic spacetimes.

Deformations of Singular Foliations

Sylvain Lavau

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Abstract

We study the deformation of singular foliations, from the point of view of Lie ∞-algebroids. A universal Lie infinity-algebroid associated to a singular foliation is in some sense the generalization of the foliation Lie algebroid associated to a regular foliation. Applying this setup to deformations of singular foliations gives interesting results : one may associate a universal Lie infinity-algebroid to the deformation of a singular foliation F over a base space B, that restricts to a (not necessarily universal) Lie infinity-algebroid of F at the origin. Also, this Lie infinity-algebroid is adapted to define the Maurer-Cartan elements that parametrize the deformation. Work in progress, in collaboration with C. Laurent-Gengoux.

Spectral approximation of the torus

Tey Berendschot

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Abstract

Noncommutative geometry starts with the observation that we can capture the geometry of a geometric object in a so-called spectral triple $(\mathcal{A}, \mathcal{H}, D)$. If we impose certain conditions on this triple, but not commutativity of the algebra $\mathcal{A}$, we can think of the triple as describing a 'noncommutative space'. The notion of Gromov–Hausdorff distance measures the 'distance' between two metric spaces. Inspired by the notion of *Quantum Gromov–Hausdorff distance*, introduced by Marc Rieffel, we use this to develop a notion of distance between two noncommutative spaces. We then apply this framework to the 'rectangularly truncated torus' and show it converges to the torus in Gromov–Hausdorff distance.

Braided Cartan Calculi and Submanifold Algebras

Thomas Weber

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Abstract

We develop a noncommutative Cartan calculus on any braided commutative algebra, generalizing classical and twisted Cartan calculi. In contrast to derivation based Cartan calculi on noncommutative algebras we are not constrained to work with central bimodules but rather in the symmetric braided monoidal category of equivariant braided symmetric bimodules. In complete analogy to differential geometry we construct the Lie derivative, insertion and de Rham differential in this setting and relate them via graded braided commutators. Furthermore we study braided covariant derivatives and metrics, proving for instance the existence and uniqueness of a braided Levi-Civita covariant derivative. Twist deformation of the algebraic structures corresponds to a gauge equivalence on the categorical level. Finally, we discuss how the braided Cartan calculus projects to submanifold algebras if the Hopf algebra action respects the submanifold ideal and that this process commutes with twist deformation.

Generalised T-duality and para-Hermitian Manifolds

Vincenzo Emilio Marotta

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Abstract

We introduce generalised metrics on para-Hermitian manifolds and their relation to Born geometries. Born structures can be used to define sigma models on para-Hermitian manifolds. We discuss the Lie algebroid gauging of such models when the para-Hermitian manifold is foliated. This procedure shows how to recover a sigma model on the leaf space of a given foliated para-Hermitian manifold with a Born structure. The leaf space is interpreted as the actual physical space-time. We define a generalised T-duality as a vector bundle morphism mapping a Born structure into another. T-dual sigma models in the usual sense are those defined on the leaf spaces of two para-Hermitian manifolds whose Born structures are related by a generalised T-duality.