XI Workshop on Poisson Geometry

Manaus, Amazonas

A. Alexeev

Title: Multiple Horn problems

Abstract: The Horn problem is a Linear Algebra problem asking to determine the range of eigenvalues of the sum (a+b) of two Hermitian matrices with given spectra. The solution was conjectured by Horn, and it is given by a set of linear inequalities on eigenvalues. The proof of the conjecture is due to Klyachko and Knutson-Tao. It is interesting that exactly the same set of inequalities describes singular values of matrix products, maximal weights of multipaths in the concatenation of a pair of planar networks, and non-vanishing of Littlewood-Richardson coefficients for representations of GL(N).

In this talk, we consider the multiple Horn problem which is asking to determine the range of eigenvalues of Hermitian matrices (a+b), (b+c) and (a+b+c) for a, b and c with given spectra. Now the four different problems described above no longer have the same solution. We will present some results for the maximal multipaths problem, and for the singular value problem. In particular, it turns out that under the Gelfand-Zeitlin inequalities on the weights the multipaths problem is related to the octahedron recurrence from the theory of GL(N) crystals.

The talk is based on a joint work in progress with A. Berenstein, A. Gurenkova, and Y. Li.

D. Álvarez

Title: Manin triples at the global level: integration, prequantization and T-duality
Abstract: I will explain recent developments in the theory of Manin triples inside transitive Courant algebroids that concern their integration to symplectic double groupoids and corresponding prequantizations. Also, I will explain the link with T-duality. These results shall be illustrated with examples coming from generalized Kahler geometry (as in the work with M. Gualtieri and Y. Jiang) and Lie theory (configuration groupoids of flags).

C. Arias Abad

Title: Singular Chains on Lie groups, the Cartan relations and Lie theory: Part I
Abstract: The Lie algebra of vector fields on a manifold acts on differential forms by Lie derivatives and contractions, and these operations are related by the Cartan relations. We will explain an interpretation of these relations from the point of view of Lie theory, and describe how this leads to a categorification of the Chern-Weil homomorphism.

For a Lie group G, we consider the space of smooth singular chains C(G), which is a differential graded Hopf algebra. We show that the category of sufficiently local modules over C(G) can be described infinitesimally, as the category of representations of a dg-

Lie algebra which is universal for the Cartan relations. If G is compact and simply connected, the equivalence of categories can be promoted to an A-infinity equivalence of dg-categories, which are also A-infinity equivalent to the category of infinity local systems on the classifying space BG. The equivalence can be realized explicitly to provide a categorification of the Chern-Weil homomorphism.

The talk is based on joint work with A. Quintero and S. Pineda.

A. Balibanu

Title: Reduction along strong Dirac maps
Abstract: We develop a general procedure for reduction along strong Dirac maps, which are a broad generalization of Poisson moment maps. The reduction level in this setting is a submanifold of the target, and the symmetries are given by the action of a groupoid. When applied to quasi-Poisson moment maps, this framework produces new multiplicative versions of many Poisson varieties that are important to geometric representation theory. This is joint work with Maxence Mayrand.

P. Balseiro

Title: Nonholonomic systems and the hamiltonization problem
Abstract: Non-holonomic systems are classical mechanical systems characterized by velocity constraints, which prevent them from being treated as Hamiltonian systems. Consequently, the intrinsic

geometric structures that describe these systems do not satisfy the usual integrability conditions (i.e., where before we had a symplectic or Poisson structure, we now have a non-closed 2-form, or a bracket that lacks the Jacobi identity).

In this talk, I will address key questions driving my research: Can a non-holonomic system be transformed into a Hamiltonian system, perhaps through symmetry reduction or reparametrization of time? How far are these systems from being Hamiltonian? We will explore how tools from symplectic and Poisson geometry can help frame these questions and guide us toward potential answers.

F. Bonechi

Title: Towards Equivariant Yang Mills Theory

Abstract: The BV formalism can be extended to the equivariant setting. The AKSZ construction gives very natural examples of solutions of the equivariant Classical Master Equation. In this talk I discuss the case of four dimensional Yang Mills theory whose extension is studied by means of the BV pushforward of Donaldson Witten (AKSZ) solution of the equivariant CME. This example highlights also an intriguing relation between a topological and a physical theory.

A. Cabrera

Title: Differentiating higher Lie groupoids and generalized van Est theory

Abstract: This talk is based on joint work with Matias del Hoyo. The idea is to explain an explicit, direct, and rigorous construction of the higher Lie algebroid underlying any higher Lie groupoid. Instead of being based on supergeometric considerations, we identify a key ideal of cochains which has the information of what differentiation means in simplicial and geometric terms. This part of the results entails two main theorems: a normal form one and one characterizing the quotient by the ideal. At the same time, we obtain a novel generalization of the van Est map from groups and groupoids to higher Lie groupoids. Finally, we describe our third theorem which is a generalization to the higher context of the classical "van Est theorem": when a certain connectedness assumption is met, the van Est map induces isomorphisms in suitable cohomology groups.

M. Cueca

Title: Lie algebroids over differentiable stacks

Abstract: Many geometric structures on differentiable stacks have been defined in recent years. Nevertheless, the concept of a Lie algebroid remained unclear. In this talk I will introduce them, show some of their basic properties and construct many relevant examples. This is joint work with Daniel Alvarez.

M. del Hoyo

Title: Higher Lie Groupoids, Hypercovers, and Cohomology
Abstract: In recent years, higher Lie groupoids have gained significant attention for their essential role in derived differential geometry, particularly in relation to shifted structures in Poisson geometry. In this talk, based on collaborations with C. Ortiz, F. Studzinski, and A. Cabrera, I will review the foundations of higher Lie groupoids with a focus on hypercovers. I will clarify and simplify aspects of the theory, building on the work of Behrend, Getzler, Henriques, Wolfson, and Zhu, among others. I will present a geometric proof of cohomological descent, which is novel even in the classical case of Lie groupoids. Applications to representations up to homotopy and higher Lie theory will also be discussed.

M. de Melo

Title: Equivariant Basic Cohomology
Abstract: The leaf closure of a Riemannian foliation is generated by a sheaf of transverse vector fields, known as the Molino sheaf. If this sheaf is trivial, Goertsches and Töben developed an equivariant basic cohomology theory, which has been explored in both Riemannian and Poisson geometry. In this talk, based on the closure of the holonomy groupoid, we present a model for equivariant basic cohomology in the case where the Molino sheaf is not trivial. We discuss the properties of our model and how it recovers previously known invariants. This is joint work with Dirk Töben (UFSCar).

M. Gualtieri

Title: Double Groupoids and Generalized Kahler Metrics
Abstract: In 1984, physicists Gates, Hull and Roček discovered a generalization of Kähler geometry in their study of the supersymmetric 2d sigma model. I will describe recent work with D. Álvarez and Y. Jiang which describes the global structure behind this geometry: a square of Morita equivalences of holomorphic double symplectic groupoids, equipped with a real Lagrangian trivialization. One of the implications of this work is a positive resolution of a conjecture dating back to the origin of the subject concerning the existence of a generalized Kähler potential for the metric.

R. Fernandes

Title: Hamiltonian spaces of proper symplectic groupoids
Abstract: I will describe a program to study Hamiltonian spaces of proper symplectic and contact groupoids. As part of this program, I will discuss several recent results we have obtained in the

abelian case, concerning the existence of extremal invariant Kähler metrics, which extend the Abreu-Guillemin-Donaldson theory for symplectic toric manifolds. This is ongoing joint work with Miguel Abreu, Maarten Mol, and Daniele Sepe.

D. Iglesias

Title: Mechanical presymplectic structures and Marsden-Weinstein reduction of time-dependent Hamiltonian systems

Abstract: In 1986, C. Albert proposed a Marsden-Weinstein reduction process for cosymplectic structures. In this paper, we present the limitations of this theory in the application of the reduction of symmetric time-dependent Hamiltonian systems. As a consequence, we conclude that cosymplectic geometry is not appropriate for this reduction. Motived for this fact, we replace cosymplectic structures by more general structures: mechanical presymplectic structures. Then, we develop Marsden-Weinstein reduction for this kind of structures and we apply this theory to interesting examples of time-dependent Hamiltonian systems for which Albert's reduction method doesn't work.

Joint work with I. Gutiérrez-Sagredo, J.C. Marrero and E. Padrón

---

A. Mandini

Title: Hyperpolygon spaces and moduli space of parabolic Higgs bundles.

Abstract: Hyperpolygon spaces are a family of hyperkähler quiver varieties that can be obtained by hyperkähler reduction of a finite number of $SU(2)$-coadjoint orbits. Jointly with L. Godinho, we showed that these spaces are symplectomorphic to moduli spaces of rank 2, holomorphically trivial parabolic Higgs bundles over P^1, with fixed determinant and trace-free Higgs field, when a suitable condition between the parabolic weights and the spectra of the coadjoint orbits is satisfied. In this talk I will describe this construction and some results that generalize it in several ways.

I. Mărcuț

Title: The Serre Spectral Sequence for Lie Subalgebroids and Applications

Abstract: I will discuss the construction of a spectral sequence to approximate Lie algebroid cohomology, which is a associated with a Lie subalgebroid. This generalizes several classical examples in differential geometry: Hochschild-Serre spectral sequence for Liealgebras, the Leray-Serre spectral sequence for de Rham cohomology, theMackenzie spectral sequence for Lie algebroid extensions. We'll discuss convergence, in the two complementary cases: wide Lie subalgebroids and Lie subalgebroids over proper submanifolds. Finally, we will discuss applications in Poisson geometry, where this construction naturally arose before in the literature.

This is joint work with Andreas Schüßler.

E. Meinrenken

Title: On the integration of Manin pairs

Abstract: A Poisson manifold M admits an integration to a symplectic groupoid G if and only if its cotangent Lie algebroid integrates to a Lie groupoid. That is, the integration of the Poisson structure to a symplectic 2-form on G is automatic, at least when G is source-simply connected. Similar results hold for the integration of Dirac structures to quasi-symplectic groupoids, and for the integration of (quasi-)Lie bialgebroids to (quasi-)Poisson Lie groupoids. In this talk, I will explain how to place these results into a general context of integration of Manin pairs. We will also clarify the case where G need not be source-simply connected. (Joint work with David Li-Bland.)

A. Quintero

Title: Singular Chains on Lie Groups, the Cartan Relations, and Lie Theory: Part II.

Abstract: The Lie algebra of vector fields on a manifold acts on differential forms by Lie derivatives and contractions, and these operations are related by the Cartan relations. We will explain an interpretation of these relations from the point of view of Lie theory, and describe how this leads to a categorification of the Chern-Weil homomorphism.

For a Lie group G, we consider the space of smooth singular chains C(G), which is a differential graded Hopf algebra. We show that the category of sufficiently local modules over C(G) can be described infinitesimally, as the category of representations of a dg-

Lie algebra which is universal for the Cartan relations. If G is compact and simply connected, the equivalence of categories can be promoted to an A-infinity equivalence of dg-categories, which are also A-infinity equivalent to the category of infinity local systems on the classifying space BG. The equivalence can be realized explicitly to provide a categorification of the Chern-Weil homomorphism.

E. Shemyakova

Title: On Differential Operators Generating Higher Brackets

Abstract: On supermanifolds, a Poisson structure can be either even, corresponding to a Poisson bivector, or odd, corresponding to an odd Hamiltonian quadratic in momenta. An odd Poisson bracket can also be defined by an odd second-order differential operator that squares to zero, known as a "BV-type" operator. A higher analog, P_∞ or S_∞, is a series of brackets of alternating parities or all odd, respectively, that satisfy relations that are higher homotopy analogs of the Jacobi identity. These brackets are generated by arbitrary multivector fields or Hamiltonians. However, generating an S_∞-structure by a higher-order differential operator is not straightforward, as this would violate the Leibniz identities. Kravchenko and others studied these structures, and Voronov addressed the Leibniz identity issue by introducing formal $\hbar$-differential operators.

In this talk, we revisit the construction of an $\hbar$-differential operator that generates higher Koszul brackets on differential forms on a P_∞-manifold. It is well known that a chain map between the de Rham and Poisson complexes on a Poisson manifold at the same time maps the Koszul bracket of differential forms to the Schouten bracket of multivector fields. In the P_∞-case, however, the chain map is also known, but it does not connect the corresponding bracket structures. An L_∞-morphism from the higher Koszul brackets to the Schouten bracket has been constructed recently, using Voronov's thick morphism technique. In this talk, we will show how to lift this morphism to the level of operators.

The talk is partly based on joint work with Yagmur Yilmaz.

I. Struchiner

Title: Deformations of Symplectic Groupoids

Abstract: I will describe the complex controlling deformations of symplectic groupoids up to isomorphisms and gauge transformations. As an application I will discuss the Moser argument in this setting. The talk is based on joint work with Cristián Camilo Cárdenas and João Nuno Mestre.

E. Vishnyakova

Title: About graded coverings

Abstract: In geometry there is a well-known notion of a covering space. A classical example is the following universal covering: $p : \mathbb{R} \to S^1$, $t \mapsto \exp(it)$. Another example we can find in algebra: a flat covering or torsion-free covering in the theory of modules over rings. All these coverings satisfy some common universal properties.

In the paper "Super Atiyah classes and obstructions to splitting of supermoduli space", Donagi and Witten suggested a construction of a first obstruction class for splitting a supermanifold. It appeared that an infinite prolongation of the Donagi-Witten construction satisfies universal properties of a covering. In other words this is a covering of a supermanifold in the category of graded manifolds corresponding to the non-trivial homomorphism $\mathbb{Z} \to \mathbb{Z}_2$. Further the space of infinite jets can also be regarded as a covering of a (super)manifold in the category of graded manifolds corresponding to the homomorphism $\mathbb{Z} \times \mathbb{Z}_2 \to \mathbb{Z}_2$, $(m, \bar{n}) \mapsto \bar{n}$. (For usual manifolds this homomorphism is trivial $\mathbb{Z} \to 0$.) Another example is a multiplicity free covering of a graded manifold. In fact, similar constructions have appeared before in Poisson geometry. Summing up, coverings in the category of graded manifolds we call graded. Our talk is devoted to the current state of the theory of graded coverings: general idea, particular examples, notion of a fundamental group.

M. Zambon

Title: Lie 2-algebras of functions of quasi-Poisson and quasi-symplectic groupoids

Abstract: The functions on symplectic and Poisson manifolds, together with the Poisson bracket, form a Lie algebra. In this talk we consider Lie groupoids endowed with weak versions of symplectic and Poisson structures, respectively. On quasi-Poisson groupoids there is a well-behaved Lie 2-algebra of functions. By contrast, on quasi-symplectic groupoids we are only able to either associate 1) a Lie 2-algebra of functions which is not Morita invariant, and 2) a graded Lie algebra structure on the truncated differentiable cohomology, which turns out to arise from the "inverse" quasi-Poisson groupoid structure. This talk is based on ongoing work with Cristian Ortiz and Gabriele Sevestre.