Geometry and Representation Theory
Géométrie et théorie des représentations

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DANIEL ALVAREZ, University of Toronto
Symplectic groupoids and moduli spaces of flat bundles over surfaces

I will explain how the theory of decorated moduli spaces of flat bundles over surfaces is the largest source of examples of symplectic (double) groupoids and I will give many examples of this. This is based on the paper "Poisson groupoids and moduli spaces of flat bundles over surfaces", Adv. Math. (2024)

CALEB ASHLEY, Boston College
An explicit relationship between the ghost and swapping algebras

The notion of an Anosov representation is based on dynamical properties of discrete and faithful representations of a surface group into a semi-simple Lie group G, up to conjugation. Anosov representations were developed by Labourie and have been used to investigate moduli spaces of higher rank geometric structures on manifolds, themselves open subsets known as Hitchin components, of associated character varieties. Just as trace functions are essential for low dimensional geometry and topology when G is $PSL(2, C)$, fundamental for studying moduli spaces of Anosov representations are natural classes of functions; for example, "length functions" associated to geodesic currents developed by Bonahon-Dreyer, "correlation functions" developed Bridgeman-Canary-Labourie and further generalized to "projectors" in the context of "uniformily hyperbolic bundles" by Bridgeman-Labourie.

In this talk we rapidly review the work of Bridgeman-Labourie which relates several major results, namely: the symplectic geometry of character varieties (Goldman), to the notions of positivity and cluster algebra coordinates (Fock-Goncharov and Bonahon-Dreyer), and also the "swapping algebra" (Labourie). The main result of our talk is a description of an explicit Lie algebra isomorphism between the "ghost algebra" (Bridgeman-Labourie) and the "swapping algebra" (Labourie) for projective-Anosov representations.

This is joint work with Ming Hong Tee.

RAPHAËL BELLIARD, University of Alberta
Casimir conformal blocks from meromorphic connections over curves.

Casimir W-algebras are associative extensions of the Virasoro infinite-dimensional algebra of conformal transformations of the plane at integer central charge, and associated to simply-laced simple Lie algebras. We will describe how to construct families of co-invariants of certain representations of those algebras, so-called conformal blocks, associated to configurations of points on compact Riemann surfaces, together with some Lie theoretic data. To do so, we will consider deformations of meromorphic connections in principal bundles over compact Riemann surfaces, and give a quantum flavour to their geometry.

ERIC BOULTER, University of Waterloo
Moduli Spaces of Sheaves on Kodaira Surfaces

Moduli spaces of stable sheaves on Kodaira surfaces are examples of compact holomorphic symplectic manifolds. The only other known examples of non-Kähler holomorphic symplectic manifolds are Bogomolov-Guan manifolds or Douady spaces of points on Kodaira surfaces. In this talk we show that there exist compact moduli spaces in each even dimension, and that in the rank-2 case they are non-Kähler but not deformation equivalent to Bogomolov-Guan manifolds. We also discuss some steps toward determining if these moduli spaces are deformation equivalent to Douady spaces of points on Kodaira surfaces.

JOSÉ CRUZ, University of Calgary
On the Fourier transform and Vogan's perspective on the Local Langlands Correspondence

Deligne's Fourier transform is an endofunctor defined on the derived category of l-adic sheaves on certain spaces, which maps sheaves with small support to sheaves with large support. It was first applied by Laumon to simplify Deligne's proof of the Weil conjectures, and it has proved to be a fundamental tool in geometric representation theory. In this talk, I am going to introduce the Fourier transform via Grothendieck's function-sheaf dictionary, and I am going to apply it on some small examples that appear in Vogan's persepective of the local Langlands correspondence, just as Cunningham et al. did in their work.

MATTHEW KOBAN, University of Toronto
Moduli of doubled quiver representations

A quiver is a finite directed graph. In the early 90's Nakajima used representations of doubled quivers to construct a large class of hyperkähler varieties now known as Nakajima Quiver varieties. These varieties have been the focus of much recent research due to their incredible structure, and their appearance in representation theory and mathematical physics. In this talk I will give a brief introduction to Nakajima quiver varieties and the properties they possess.

SZE HONG KWONG, University of Maryland
Conformal limit of Higgs bundles along singular upward flow

Motivated by supersymmetric gauge theory, Gaiotto introduced the notion 'conformal limit' and conjectured that the conformal limit of a Higgs bundle on the Hitchin section exists and is an oper. This conjecture was confirmed by Dumitrescu-Fredrickson-Kydonakis-Mazzeo-Mulase-Neitzke. Later, it was generalized and proved affirmatively by Collier-Wentworth to upward flow through a stable $\mathbb{C}^*$-fixed point in the moduli of Higgs bundles.

In this talk, we will review the definitions and these developments, and then explore various instances of extension to cases where the upward flow is singular. The latter part is based on my ongoing work.

AIDAN LINDBERG, University of Toronto
Picard Groups of Holomorphic Poisson Manifolds

Poisson manifolds are the infinitesimal objects associated to symplectic groupoids, which can be thought of as presentations of 1-shifted symplectic stacks. The symplectic automorphisms of this stack therefore give an invariant of the Poisson manifold, called its Picard group. In this talk I will introduce the Picard group of a holomorphic Poisson manifold and show how we can use tools from deformation theory to describe this group as a moduli space.

CHRISTOPHER MAHADEO, University of Illinois at Chicago
Quantization through the tautological section

I will discuss some current work related to the quantization of Hitchin systems and topological recursion, specifically, regarding the quantization as a procedure on the spectral curve and tautological section.

MARIELLE ONG, University of Pennsylvania
Multiplicative global Springer Theory

Multiplicative affine Springer fibers are group-theoretic analogues of affine Springer fibers. They can be seen as affine Deligne-Lusztig varieties without the Frobenius twist. They were studied by Frenkel and Ngo in 2011 to give a geometric interpretation of orbital integrals of spherical Hecke functions. Since then, there is an on-going program by Bouthier, Chi and Wang to establish their connections to multiplicative Higgs bundles and the multiplicative Hitchin fibration. In this talk, I will introduce parabolic multiplicative affine Springer fibers and use them to develop a multiplicative version of Yun's global Springer theory from 2011.

JONATHAN SEJR PEDERSEN, University of Toronto
Splitting Madsen-Tillmann Spectra

We prove that the Madsen-Tillmann spectrum $MT\theta_n := \mathrm{Th}(-\theta_n^*\gamma_{2n} \to BO(2n)\langle n\rangle)$ splits into the sum of spectra $\Sigma^{-2n}MO\langle n\rangle \oplus \Sigma^{\infty-2n}\mathbb{R}P_{2n}^{\infty}$ after Postnikov tunctation $\tau_{\leq \ell}$ for $\ell = \frac{n}{2} - c$. This is achieved by showing the connecting homomorphism $\tau_{\leq \ell}MO\langle n\rangle \to \tau_{\leq \ell}\Sigma^{\infty+1}\mathbb{R}P_{2n}^{\infty}$ is nullhomotopic in this range by applying Adams spectral sequence arguments.

We discuss a number of applications, most prominently the computation of $H_2(B\,\mathrm{Diff}(W_g^{2n}, D^{2n}); \mathbb{Z})$ which is connected to moduli spaces of high dimensional manifolds. This is joint work with Andy Senger.

MISHTY RAY, University of Calgary
Geometric analogues of local Arthur packets for p-adic GL_n

Local Arthur packets are sets of representations of p-adic groups that help us realize important classes of automorphic forms. They have geometric analogues, called ABV-packets. This was first proposed for p-adic groups by David Vogan following his joint work with Adams and Barbasch for real groups. This theory was then adapted by Cunningham et al. for the non-archimedean case. They defined ABV-packets and formulated the conjecture that ABV-packets generalize local Arthur packets. They called it "Vogan's conjecture" to honour the work that led to it, in addition to providing a wealth of examples as evidence. In this talk, I will introduce ABV-packets and present a proof of Vogan's conjecture for p-adic GL_n .

DENI SALJA, Dalhousie University
Internal Category of Elements + Fractions

The pseudocolimit of a small filtered diagram of categories can be computed by localizing the cartesian arrows of the (domain of the) corresponding fibration [Expose 6, SGA IV]. In this talk I'll share a framework for constructing internal analogues of these along with some settings this could take place and examples I'm interested in.

FLORIAN SCHWARZ, University of Calgary
The Lie Algebra of a group object

The tangent space of a Lie Group is a Lie Algebra. This is one of the most important basic results of differential geometry, sparking the entire field of Lie theory with its extensive applications to Physics.

Using group objects we will investigate the generalisation of this theorem in the broader setting of Cartesian tangent categories, encompassing among other things classical differential geometry, algebraic geometry and synthetic differential geometry. Tangent categories have been used to generalize various constructions from differential geomtetry, like connections, De Rham cohomology and differential equations.

We will see that (if a certain pullback exists) various results about Lie groups hold for group objects in Cartesian tangent categories. In particular the tangent bundle is trivial and a negation exist for the addition of tangent vectors, even if it was not a priori required to exist. This then allows us to define an external Lie-Algebra structure on the tangent space, generalizing a Lie group's Lie Algebra.

JAMES STEELE, University of Calgary
Cohomological Duality in the Local Langlands Correspondence for p-adic Groups

The Langlands Programme seeks to classify the irreducible representations of a connected, reductive algebraic group G over a field k, roughly in correspondence with the representations of Gal $\left(\bar{k}/k\right)$, deemed L-parameters. For local fields, this classification has largely been a successful, and a natural next step is to classify the extensions between these irreducible representations of G. In this talk, we show that, for G split semisimple over a p-adic field, certain classes of extensions can be classified according to the extensions of perverse sheaves on a moduli space built from the L-parameters.

EVAN SUNDBO, University of Toronto
Twisted Quiver Varieties and Higgs Bundles

Quivers have a rich history of being used to construct algebraic varieties via their representations in the category of vector spaces. We consider representations in a different category, namely that of vector bundles on some complex variety equipped with a fixed locally free sheaf which twists the morphisms. In this way we construct interesting subvarieties of Hitchin's moduli space of Higgs bundles, finding especially nice descriptions when the quivers are "argyle", cyclic, or when the underlying variety is the Riemann sphere.

GRISHA TAROYAN, University of Toronto
Equivalent models of derived stacks

Derived differential geometry is an emergent field that uses the ideas of derived algebraic geometry applied to classically "analytic" settings. In our talk, we want to explore one instance of such application: the Dold−Kan correspondence for Fermat theories and the resulting equivalence of various models of derived differentiable stacks. Time permitting, we will also talk about connections with the conjecture of Behrend−Liao−Xu on the homotopy theory of derived manifolds formulated in arXiv:2006.01376.

The talk is based on our paper "Equivalent models of derived stacks," arXiv:2303.12699.