Lie Algebras, Representations and Cohomological Invariants
Algèbres de Lie, représentations et invariants cohomologiques
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ZSUZSANNA DANCSO, University of Toronto
A categorical realization of the cut and flow lattices of graphs

A lattice is a free Abelian group equipped with a symmetric bilinear form. When a lattice L comes with a distinguished basis, we can ask for a categorical realization of the lattice: an algebra A such that the Grothendieck group of the category of (projective) A-modules with its Hom pairing is isomorphic to L, with the isomorphism classes of indecomposable projective modules descending to the given basis. We will discuss how to find such an algebra for an interesting class of lattices coming from graph theory, and why this construction is likely to have other applications. Joint work with Anthony Licata.

IVAN DIMITROV, Queen's University
Integrable weight modules of $gl(\infty)$

I will present a theorem classifying the irreducible integrable weight modules with finite dimensional weight spaces over the Lie algebra $gl(\infty)$ consisting of finitary infinite matrices. Every such module belongs to one of the following three classes: highest weight modules, infinite symmetric powers of the natural representations, and modules which are not highest weight but whose weights are dominated by a single weight. For the modules in the new third class I will present different realizations and will provide explicit parametrization. I will define all necessary terms and will state the problem and the main result.

YUN GAO, York University
Finite dimensional irreducible representations of some elementary unitary Lie algebras

We classify all finite dimensional irreducible representations of the elementary unitary Lie algebras $\mathfrak{eu}_n(\mathbb{C}_q, ^-)$ over the quantum torus with anti-involution $(\mathbb{C}_q, ^-)$ for $n \geqslant 5$. This is a joint work with Zhihua Chang and Yelong Zheng.

CAROLINE JUNKINS, University of Ottawa
Torsion in the gamma-filtration for groups of inner type Dn

For a linear algebraic group G, the twisted gamma-filtration provides a tool for constructing torsion elements in the gamma-filtration on the Grothendieck group of a projective G-homogeneous variety. The existence and behaviour of such an element is primarily determined by the indices of the Tits algebras of G. In this talk, we provide a torsion element for groups of inner type Dn, and discuss the relationship to algebras with orthogonal involution.

JOEL KAMNITZER, University of Toronto
Webs and quantum skew Howe duality

We give a diagrammatic presentation of the representation category of SL_n (and its quantum version). Our main tool is an application of quantum skew Howe duality.

KALLE KARU, University of British Columbia
Operational algebraic cobordism

Bivariant theories of Fulton and MacPherson generalize covariant homology and contravariant cohomology theories. Fulton and MacPherson also showed how to associate an "operational" bivariant theory to a given homology theory. The operational cohomology theory constructed this way is ring-valued and hence suitable for intersection theory.

In this talk I will explain these constructions applied to the theory of algebraic cobordism of Levine and Morel. I will discuss equivariant versions of these theories and describe the operational cobordism rings of toric varieties.

This talk is based on joint work with Jose Gonzalez.

MICHAEL LAU, Université Laval

Representations of twisted current algebras

A number of recent papers have used evaluation modules to describe the finite-dimensional representation theory of various generalizations of affine Lie algebras (derived algebras modulo their centres). We explain how these ideas can be combined with techniques from descent theory to give a unified treatment of these representations.

JOEL LEMAY, University of Ottawa

A Geometric Realization of the Basic Representation of Affine sl(n)

In their 1990 paper, ten Kroode and van de Leur gave explicit realizations of the basic representation of affine gl(n) and sl(n). In particular, there exists one realization for each partition of n (with the two extreme cases being the well-known principal and homogeneous realizations). In this talk, we will give a geometric interpretation of the principal realization. Our construction is given in terms of the equivariant cohomology of the Hilbert scheme of points in the plane and Nakajima quiver varieties.

NICOLE LEMIRE, Western Ontario

Equivariant Birational Aspects of Algebraic Tori

We examine the equivariant birational linearisation problem for algebraic tori equipped with a finite group action and the stable rationality problem for algebraic tori. In particular, we look at the case of algebraic tori of dimension 4. We connect these problems to the question of determining when an algebraic group is (stably) Cayley - that is (stably) equivariantly birationally isomorphic to its Lie algebra. We discuss joint work with Popov and Reichstein on the classification of the simple algebraic groups which are Cayley and on determining bounds on the Cayley degree of an algebraic group, a measure of the obstruction for an algebraic group to be Cayley. We also relate this to recent work with Borovoi, Kunyavskii and Reichstein extending the classification of stably Cayley simple groups from the algebraically closed characteristic zero case to arbitrary fields of characteristic zero.

NATHAN MANNING, University of Ottawa

Global Weyl modules

A family of infinite-dimensional modules called global Weyl modules was defined and studied by Chari and Pressley over loop algebras $\mathfrak{g} \otimes \mathbf{C}[t, t^{-1}]$, where $\mathfrak{g}$ is a simple complex finite-dimensional Lie algebra. This talk gives an overview of some recent results on generalizations of these modules.

ERHARD NEHER, University of Ottawa

Invariant bilinear forms of algebras given by descent

The existence of a nondegenerate invariant bilinear form on a Lie algebra has important structural consequences (example: arbitrary versus symmetrizable Kac-Moody algebras). In this talk I will describe the structure of invariant bilinear forms of algebras given by faithfully flat descent, like for example Azumaya algebras, twisted loop Lie algebras or, more generally, multiloop algebras. The talk is based on joint work with A. Pianzola, D. Prelat and C. Sepp.

ALEXANDER NESHITOV, University of Ottawa
Invariants of degree 3 and torsion in the Chow ring of a versal flag variety

In this talk we will discuss the connection between degree 3 cohomological invariants of a semisimple split group and the torsion in the Chow group of codimension two cycles of the corresponding versal flag variety. The talk is based on the joint project with Alexander Merkurjev and Kirill Zainoulline.

KHOA PHAM, University of Ottawa
On the Dynkin index of Lie algebras

In this talk, we define the notion of the Dynkin index for a representation of a simple finite-dimensional Lie algebra and discuss several known results of the theory. We will present new formulas for the Dynkin indices of exterior and symmetric powers of representations. As an application, we will explain how knowing the Dynkin indices for exterior powers of representations is nearly sufficient to determine the Dynkin indices for all finite-dimensional representations.

ARTURO PIANZOLA, University of Alberta
On the rationality of multiloop algebras (after B. Margaux)

The celebrated affine Kac-Moody Lie algebras, which a priori are defined by generators and relations, can be given a concrete and explicit realization in terms of loop algebras. Similarly results apply to Lie tori with the use of multiloop algebras. The "loop" realization imposes, out of necessity, the existence of enough roots of unity in the base field. The talk will explain, by descent consideration, why (and exactly when) this assumption is superfluous. The "trialitarian" affine algebra $G_2^{(3)}$ provides such an example (a known fact explicitly and constructively shown to hold by Y. Yoshii, and also E. Neher - Z. Chang, with the aid of octonion algebras).

ZINOVY REICHSTEIN, University of British Columbia
Essential dimension of pseudo-reflection groups

An $n \times n$ complex matrix is called pseudo-reflection if its eigenvalues are $1, \dots, 1, t$, where $t \neq 1$ is a root of unity. Finite groups generated by pseudo-reflections were classified by Shephard and Todd in the 1950s. This classification is one of the high points of invariant theory of finite groups. In this talk, based on joint work with A. Duncan, I will define the essential p-dimension of a finite group and present a simple formula for the essential p-dimension of a pseudo-reflection group.

DANIELE ROSSO, University of Ottawa
The mirabolic Hecke algebra

The Iwahori-Hecke algebra of the symmetric group is the convolution algebra arising from the variety of pairs of complete flags over a finite field. Considering convolution on the space of triples of two flags and a vector we obtain the mirabolic Hecke algebra, which had originally been described by Solomon. We will see a new presentation of this algebra which shows that it is a quotient of a cyclotomic Hecke algebra. This lets us recover Siegel's results about its representations, as well as proving new 'mirabolic' analogues of classical results about the Iwahori-Hecke algebra.

JAIMAL THIND, University of Toronto - Mississauga
Reconstruction of Lie Group Morphisms

Given a map of Lie groups $f : G \to H$, one gets a functor $f^* : Rep(H) \to Rep(G)$ pulling back a representation of H to G via the map f. This functor induces a map of semirings $f^* : \mathcal{K}^+(H) \to \mathcal{K}^+(G)$, where $\mathcal{K}^+$ denotes the semiring of isomorphism classes of representations, with direct sum and tensor product as addition and multiplication. It has been shown by Kazhdan, Larsen, and Varshavsky that when G is reductive, the semiring $\mathcal{K}^+(G)$ determines G up to isomorphism. Moreover, they show

that if a map of semirings preserves irreducibles, then it comes from a map of Lie Groups. They also showed that not all maps of semirings $\mathcal{K}^+(H) \to \mathcal{K}^+(G)$ come from maps of Lie groups $G \to H$. However, their examples do not preserve dimension, and few maps of Lie Groups preserve irreducibles.

A natural question then is to classify which maps of semirings do come from maps of Lie groups. We will discuss this problem and report on recent progress made for the case of simple Lie groups. In particular, when H is classical, it suffices to require that the map of semirings preserves the structure on $\mathcal{K}^+$ coming from the exterior power operation on representations. This is based on joint work in progress with J. Blasiak and J. Grochow.

PETER TINGLEY, Loyola University Chicago
Convex orders on roots, PBW bases, and polytopes.

Consider the integral form of a quantum group. One natural (if somewhat naive) question is to write down a basis. Early in the history of quantum groups Lusztig did this, and in fact he considered a number of bases: one for each reduced expression in the Weyl group, or equivalently one for each convex order on simple roots. He also considered the problem of how these different bases are related. This gives rise to some combinatorics, which has recently been re-understood using Mirkovic-Vilonen (MV) polytopes. That connection reveals various connections, for instance to geometry. I will discuss this story, along with some recent work on the affine situation.

LIAM WATSON, University of Glasgow
Dehn twists in Heegaard Floer homology

Bordered Floer homology replaces surfaces with differential algebras and manifolds-with-boundary with differential modules over these algebras. This gives a refinement of Heegaard Floer homology (due to Lipshitz, Ozsváth and Thurston) that is decidedly algebraic; this talk will introduce and focus on these algebraic objects by way of some simple examples. While bordered invariants are typically quite sensitive to a parametrization of the boundary, our interest will be in those instances where different choices of parametrization yield equivalent bordered invariants. We observe a Heegaard Floer homology Alexander trick, and this leads to the notion of a Heegaard Floer homology solid torus.

WANSHUN WONG, University of Ottawa
Periods of generic torsors of groups of multiplicative type

If G is a commutative linear algebraic group, the first Galois cohomology $H^1(K, G)$ is an abelian group, and the period of a G-torsor over K is defined to be the order of the corresponding element in $H^1(K, G)$. In this talk I will present a formula for the period of a generic G-torsor (also called versal torsor) in terms of coflasque resolutions of G, where G is a group of multiplicative type.

KAIMING ZHAO, Wilfrid Laurier University, Waterloo
Irreducible representations of the Virasoro algebra

Recently, there are several new methods to construct new irreducible modules over the Virasoro algebra. Some of these irreducible modules are weight modules with infinite dimensional weight spaces, while others are irreducible non-weight modules. I will show you most of these classes of irreducible Virasoro modules.

CHANGLONG ZHONG, University of Alberta
T-equivariant oriented cohomology of flag varieties

In this talk I will introduce a construction of T-equivariant oriented cohomology of flag varieties. This construction uses only the algebraic properties. More precisely, I will introduce the formal group algebra and the formal affine Demazure algebra. The latter is constructed by generators and relations, and its dual gives the $h_T(G/B)$, where h is an algebraic oriented cohomology in the sense of Levine-Morel. If time permits, I will also mention some result about $h_T(G/P)$.