Book of Abstracts
XXV Brazilian Algebra Meeting

State University Campinas, December 3 - 7, 2018

Session: Lie Algebras and Their Representations

Room 326 IMECC

	December 3rd		**December 4th**		**December 5th**
14h00 - 14h40:	Neher	14h00 - 14h40:	Greenstein	14h00 - 14h40:	Hernandez
14h45 - 15h25:	Dimitrov	14h45 - 15h25:	Bittmann	14h45 - 15h25:	Fourier
15h30 - 16h00:	Calixto	15h30 - 16h00:	Monsalve	15h30 - 16h00:	Brito
16h00 - 16h30:	Coffee Break	16h00 - 16h30:	Coffee Break	16h00 - 16h30:	Coffee Break
16h30 - 17h10:	van Ekeren	16h30 - 17h10:	Garcia	16h30 - 17h10:	Kus
17h15 - 17h55:	Hartwig	17h15 - 17h45:	Macedo	17h15 - 17h55:	Hubery
		17h50 - 18h20:	Pereira	18h00 - 18h30	Bianchi

Basis for certain (graded) local Weyl modules

Angelo Calil Bianchi (Universidade Federal de São Paulo - Brasil)

Abstract:
We construct linear bases for (graded) local Weyl modules defined for weights that are multiples of fundamental weights in the context of current algebras $\mathfrak{sl}_n \otimes_{\mathbb{C}} \mathbb{C}[t]$ $(n \geq 2)$. The construction is combinatorial and involves some ideas from computational Gröbner bases.

t-deformations of Grothendieck rings as quantum cluster algebras

Léa Bittmann (Université Paris-Diderot Paris 7 - France)

Abstract:
It is known that some Grothendieck rings of categories of representations of quantum affine algebras can be endowed with cluster algebras structures. This is true for example for certain categories $\mathcal{O}$ containing the category of finite-dimensional representations. On the other hand, certain Grothendieck rings of categories of finite dimensional representations admit remarkable t-deformations, which are linked to quiver varieties and are useful to compute characters. The aim of this work is to obtain such t-deformations in the context of categories $\mathcal{O}$. Our approach is based on quantum cluster algebras.

A Weyl character formula for cluster algebras of type A

Matheus Batagini Brito (Universidade Federal do Paraná - Brasil)

Abstract:
We study the family of prime representations of quantum affine algebras of type A introduced in the work of Hernandez and Leclerc which are defined by using a quiver of type A. We show that such representations admit a BGG-type resolution where the role of the Verma module is played by the local Weyl module. This leads to a closed formula (the Weyl character formula) for the character of some prime irreducible representations as an alternating sum of characters of local Weyl modules.

Verma type modules for Lie superalgebras

Lucas Henrique Calixto (Universidade Federal de Minas Gerais - Brasil)

Abstract:
We describe parabolic sets for root systems of affine Lie superalgebras and corresponding Borel and parabolic subalgebras associated to these sets. We give necessary and sufficient conditions under which the Verma type modules associated to such subalgebras are simple.

Left symmetric superalgebras

Ivan Dimitrov (Queen's University - Canada)

Abstract:
Left symmetric algebras (LSA's) are the algebraic counterpart of flat left-invariant connections on differentiable manifolds. Similar to associative algebras, LSA's give rise to

Lie algebras and it is a natural question to ask whether a given Lie algebra arises from a LSA. It turns out that the answer is rarely positive - it is negative for semisimple Lie algebras; a full classification of the LSA-structures on gl_n was provided by O. Baues.

In my talk I will explain the necessary background and Baues' result. Then I will state the classification result about basic classical Lie superalgebras. As a teaser, only the superalgebras $sl(m+1|m)$ admit LSSA-structure.

This is a joint work with Runxuan Zhang.

Linear degenerations of flag varieties

Ghislain Fourier (RWTH Aachen University - Germany)

Abstract:
In 2011, Evgeny Feigin introduced the degenerate flag variety, which is a flat degeneration of the flag variety inspired by the representation theory of SL_n. In the years to follow, several desription of this variety have been provided, similarly to the classical case of the flag variety: as highest weight orbit using a Kodaira embedding, as Schubert variety, as quiver Grassmannian, as 'degenerate' flags, and as vanishing locus of degenerate Plücker relations.
In a joint work with G. Cerulli-Irelli, X.Fang, E.Feigin, M.Reineke, we generalized this notion of degenerate flags and introduced the universal linear degenerate flag variety. We studied the fibres over the space of degeneration parameters, e.g. a product of endomorphism rings, and provided a finite set (rank sequences) parametrizing their isomorphism classes. These fibres a quiver Grassmannians for the equioriented quiver of type A_{n-1} and a fixed dimension vector.
We classified the rank sequences such that the fibre is a) irreducible, b) a Schubert variety, c) a PBW degeneration, d) a flat degeneration of the flag variety. Moreover, we identify two special fibres, namely the degenerate flag variety and the mf-degenerate flag variety, and I will explain why these two might be the most interesting ones to study. I will finish with an outlook on how to generalize and degenerate the other descriptions of the flag variety.

Multiparameter quantum groups at roots of unity

Gastón Andrés García (Universidad Nacional de La Plata - Argentina)

Abstract:
The goal of this talk is to present recent advances on the study of multiparameter deformations of universal enveloping algebras of simple Lie algebras $\mathfrak{g}$ at roots of unity, that is, the so-called multiparameter quantum groups $U_{\mathbf{q}}(\mathfrak{g})$ depending on a matrix of parameters $\mathbf{q} = \left(q_{ij}\right)_{i,j\in I}$. This is performed via the construction of quantum root vec-

tors and suitable integral forms of $U_{\mathbf{q}}(\mathfrak{g})$: a *restricted* one (*à la Lusztig*) — generated by quantum divided powers and quantum binomial coefficients — and an *unrestricted* one — where quantum root vectors are suitably renormalized. The specializations at roots of unity of either form are the "multiparameter quantum groups at roots of unity" we are investigating. In particular, we study special subalgebras and quotients — namely, the multiparameter version of small quantum groups — and suitable associated quantum Frobenius morphisms, that link the (specializations of) multiparameter quantum groups at roots of 1 with multiparameter quantum groups at 1, the latter being classical Hopf algebras bearing a well precise Poisson-geometrical content.

Based in a joint work with Fabio Gavarini (Universitá di Roma "Tor Vergata"). Preprint: arxiv.org/abs/1708.05760.

On cacti and crystals

Jacob Greenstein (University of California Riverside - USA)

Abstract:
I will discuss the action of various groups generated by involutions on the category of integrable highest weight $U_q(\mathfrak{g})$-modules and their crystal bases for any symmetrizable Kac-Moody algebra $\mathfrak{g}$. The most notable of them are the cactus group and (yet conjectural) Weyl group action on every integrable module and its lower and upper crystal bases. Surprisingly, some of these involutions are closely related to the quantum twists studied by Kimura and Oya (joint with Arkady Berenstein and Jian-Rong Li).

Gelfand-Tsetlin modules over Galois orders

Jonas Torbjoern Hartwig (Iowa State University - USA)

Abstract:
Galois orders form a class of noncommutative algebras introduced by Futorny and Ovsienko in 2010. Examples include enveloping algebras, truncated Yangians, finite W-algebras, and orthogonal Gelfand-Tsetlin algebras of type A. In this talk we present new techniques which allows us to prove that quantum analogs as well as parabolic generalizations of the mentioned examples are also Galois orders. In addition, the new approach provides a natural way to construct canonical simple Gelfand-Tsetlin modules over these algebras, generalizing recent results by several different authors.

Grothendieck ring isomorphims, mutations and Kazhdan-Lusztig polynomials

David Hernandez (Université Paris 7 - France)

Abstract:
Quantum Grothendieck rings are natural t-deformations of representations rings of quantum affine algebras. They are known to have a structure of a quantum cluster algebra. Using distinguished equivalences of corresponding quivers, we establish ring isomorphism between quantum Grothendieck rings in types A and B. Combining we recent results of Kashiwara-Kim-Oh, we prove for the corresponding categories in type B a conjecture formulated by the speaker in 2002 : the multiplicities of simple modules in standard modules are given by the evaluation of certain analogues of Kazhdan-Lusztig polynomials and the coefficients of these polynomials are positive (joint work with Hironori Oya).

Euler characteristics of quiver Grassmannians

Andrew Hubery (Bielefeld University - Germany)

Abstract:
To each acyclic quiver we can consider on the one hand the simplicial polytope formed by considering the summands of tilting modules, and on the hand the corresponding cluster algebra. Moreover, Caldero and Chapoton gave an amazing formula showing how to send each such summand to an element of the cluster algebra, a formula with coefficients given as Euler characteristics of quiver Grassmannians. Moreover, these Euler characteristics are all non-negative. If instead we start with a more general hereditary algebra, over non-algebraically closed field, then again there is a simplicial polytope coming from the tilting modules, and also a corresponding cluster algebra, but there is no obvious analogue of the Caldero-Chapoton formula. In this talk we show how to repair this situation for hereditary algebras over finite fields, using in part the theory of Ringel-Hall algebras and quantum groups, as well as some Galois descent on quiver Grassmannians. Moreover, we show the coefficients that we define are again all non-negative.

A combinatorial formula for graded multiplicities in excellent filtrations

Deniz Kus (Ruhr-University Bochum - Germany)

Abstract:
A filtration of a representation whose successive quotients are isomorphic to Demazure modules is called an excellent filtration. In this talk I will explain how one can compute graded multiplicities in excellent filtrations of fusion products for the current algebra

$\mathfrak{sl}_2[t]$. The combinatorial formula for the polynomials encoding these multiplicities is in terms of two dimensional lattice paths. Corollaries of our formula include a combinatorial interpretation of Ramanujan's fifth order mock theta functions, Kostka polynomials for hook partitions and quotients of Chebyshev polynomials.

Extensions of irreducible modules for map superalgebras

Tiago Rodrigues Macedo (Universidae Federal de São Paulo - Brasil)

Abstract:
A map superalgebra is a Lie superalgebra given as the tensor product of a finite-dimensional Lie superalgebra $\mathfrak{g}$ and a commutative algebra A. In this talk, we will explain how to compute the extension group of finite-dimensional irreducible modules for map superalgebras in terms of extensions between irreducible modules for finite-dimensional Lie superalgebras such as $\mathfrak{g}$. (Based on a joint work with L. Calixto.)

Fibers of partial Kostant-Wallach map

Germán Alonso Benitez Monsalve (Universidade Federal do Amazonas - Brasil)

Abstract:
S. Ovsienko proved that the Gelfand-Tsetlin variety for $\mathfrak{gl}(n)$ is equidimensional (i.e. all its irreducible components have the same dimension) with dimension equals $n(n-1)/2$. This result is called Ovsienko's Theorem and has important consequences in Representation Theory. In this lecture we will define Partial Gelfand-Tsetlin variety and we will connect it with the fibers in zero of partial Kostant-Wallach map. Using that conection we will prove the equidimensionality of the fibers of partial Kostant-Wallach map and partial Gelfand-Tsetlin variety, this last one result is a generalization of the Ovsienko's Theorem.

Integrable representations of weight-graded Lie algebras

Erhard Neher (University of Ottawa - Canada)

Abstract:
A weight-graded Lie algebra is a Lie algebra L, which is a weight module with respect to the adjoint action of a finite-dimensional semisimple subalgebra g. Several types of Lie algebras recently studied can be viewed as weight graded Lie algebras (current algebras, parabolic subalgebras of affine Lie algebras, some equivariant map algebras).

We will present results on the structure of integrable representations of L whose weights are bounded by a dominant weight of g, like the global Weyl module. We will link the category of such representations to the module category of an associative, not necessarily commutative algebra, which we will describe for some special cases of L. Time permitting,

I will discuss in detail the example of the Tits-Kantor-Koecher algebra of a Jordan algebra and some open problems.

The talk is partially based on my joint paper with Manning and Salmasian.

Tensor products of spin Kirillov-Reshetihin modules

Fernanda de Andrade Pereira (Instituto Tecnológico de Aeronáutica - Brasil)

Abstract:
For a quantum affine algebra of type D, we study the tensor product of two Kirillov-Rehetihin modules associated to distinct spin nodes, using the qcharacters as the main tool. More precisely, we give a precise characterization for when such tensor product is irreducible. Moreover, if it is not irreducible, we explicitly describe the second highest Drinfeld polynomial of its simple factors.

Arc spaces and associated schemes of vertex algebras

Jethro van Ekeren (Universidade Federal Fluminense - Brasil)

Abstract:
The arc space of a scheme is an important invariant, but one that is difficult to compute in general. The arc spaces of fat points have recently been computed by Bruschek, Mourtada and Schepers, already in this simple case they find that the associated Hilbert series are closely related to the Roger-Ramanujan modular form identities. I report on joint work with R. Heluani in which we interpret this as a freeness result for boundary Virasoro minimal model vertex algebras, and in which we generalise the result to simple affine vertex algebras for SL2. This is part of our broader program to derive semisimplicity results for vertex algebras by studying chiral homology of elliptic curves.

Posters Lie Algebras and Their Representations

Homological properties of restricted Lie algebras over perfect fields

Adriana Juzga León (University of Campinas - Brazil)

Abstract:
Lie algebras over fields of characteristic $p > 0$ often have an additional structure involving a special class of applications of given algebra in itself. Such structure was first studied by Jacobson in [6] and called by him restricted Lie algebras. The main objective of our research is to determine a criterion to study when a restricted metabelian Lie algebra is finitely presented. For this purpose, the results obtained by Bryant and Groves in [2] and [3] were used as a basis to establish when a metabelian Lie algebra is finitely presented using these results and some homology techniques defined now in the context of restricted Lie algebras give answer to our problem in the especific that the Lie algebra is defined over a perfect field of positive characteristic. Some additional homological properties are studied in this context.
References
[1] R. M. Bryant, J. R. J. Groves, Finite presentation of abelian-by-finite dimensional Lie Algebras, Journal of the London Mathematical Society (2) 60 (1999), 45–57.
[2] R. M. Bryant, J. R. J. Groves, Finitely presented Lie Algebras, Journal of Algebra 218 (1999), 01–25.
[3] R. M. Bryant, J. R. J. Groves, Finitely presented centre-by-metabelian Lie algebras, Bulletin Australian Mathematical Society 60 (1999), no. 2, 221–226.
[4] H. Cartan, S. Eilenberg, Homological algebra, Princeton University Press, 1956.
[5] G. Hochschild, Cohomology of Restricted Lie Algebras, American Journal of Mathematics, vol. 76 (1954), pp. 591–603.

Módulos de Wakimoto intermediários torcidos

André Silva de Oliveira (Universidade de São Paulo - Brasil)

Abstract:
Seja $\mathfrak{g}$ uma álgebra de Kac-Moody afim. Os módulos de Wakimoto são representações de álgebras de Kac-Moody afim sobre espaços de Fock. Para um inteiro n e um parâmetro $0 \leq r \leq n$, em "Intermediate Wakimoto modules for affine sl(n+1,C)", B. Cox e V. Futorny definiram uma realização do tipo bóson da álgebra de Lie afim $\widehat{\mathfrak{sl}}(n+1, \mathbb{C})$ no módulo de Fock $\mathbb{C}[x] \otimes \mathbb{C}[y]$, que depende do parâmetro r. O módulo de Fock $\mathbb{C}[x] \otimes \mathbb{C}[y]$ munido com essa estrutura é chamado de Módulo de Wakimoto intermediário. O meu

objetivo é estudar os módulos de Wakimoto intermediários torcidos por elementos w do grupo de Weyl afim.

Simple tensor products of finite-dimensional representations of quantum affine algebras

Clayton Cristiano da Silva (University of Campinas - Brazil)

Abstract:
We will discuss the problem of deciding when a tensor product of simple modules over a Hopf algebra is simple. In particular, we will present some results from Vyjayanthi Chari and David Hernandez for the case where the Hopf algebra is the quantum group $\mathcal{U}_q(\hat{\mathfrak{g}})$ associated to an affine Kac-Moody algebra.

Chari obtained a sufficient condition for a tensor product of simple modules to be a highest ℓ-weight modulue. From this condition and from a duality argument it is possible to determine when such products are simple. Hernandez's result, on the other hand, reduces the problem to studying tensor products with only two factors.

Galois orders and an alternating analogue of $U(\mathfrak{gl}_3)$

Erich Christian Jauch (Iowa State University - USA)

Abstract:
First defined by V. Futorny and S. Ovsienko in 2010, Galois rings and Galois orders form a class of algebras that contain many important examples in representation theory including: Generalized Weyl algebras, the (quantized) enveloping algebra of $\mathfrak{gl}_n$, type A restricted Yangians, and Finite W-algebras. We'll look at the construction of Galois ring and Galois orders as subalgebras of the skew monoid rings, a "simple" example of a Galois Order, and the titular Alternating Analogue of $U(\mathfrak{gl}_3)$.

Superelliptic affine Lie algebras

Felipe Albino dos Santos (University of São Paulo - Brazil)

Abstract:
We consider Lie algebras of the form $\mathfrak{g}\otimes R$ where $\mathfrak{g}$ is a simple complex (finite-dimensional) Lie algebra and R is a ring of the form $\mathbb{C}[t^{\pm 1}, u]$ where $u^3 \in \mathbb{C}[t]$. We determine a basis for the kernel of the universal central extension of $\mathfrak{g} \otimes R$. In the case $R = \mathbb{C}[t^{\pm 1}, u]/\langle u^m - t^n - 1\rangle$, we prove $\mathfrak{g} \otimes R$ is not an n-point loop algebra.

Uma sequência de Lyndon-Hochschild-Serre para certas representações de uma álgebra de Lie graduada de dimensão finita

Gilmar de Sousa Ferreira (Universidade Estadual dos Vales do Jequitinhonha e Mucuri - Brazil)

Abstract:
Para uma álgebra de Lie graduada de dimensão finita estudamos algumas propriedades homológicas da categoria das suas representações graduadas onde cada parte graduada tem dimensão finita. Em particular, quando olhamos para a parte graduada de mais alto grau conseguimos uma sequência espectral do tipo Lyndon-Hochschild-Serre nessa categoria que fornece, a princípio, um processo indutivo de se calcular o grupo de extensões para os truncamentos (certos quocientes) dessa álgebra.

Classificação dos módulos simples de peso sobre $\mathfrak{sl}_2(\mathbb{C})$

João Antonio Francisconi Lubanco Thomé (Universidade Federal do Paraná - Brazil)

Abstract:
In the study of abstract algebra it is often very important and efficient rather to work with their representations. For the particular case of finite dimensional semi-simple Lie algebras the representation theory of $\mathfrak{sl}_2(\mathbb{C})$ plays a crucial role. In this work we focus on the study of representations of the Lie algebra $\mathfrak{sl}_2(\mathbb{C})$ and survey the classification of all its irreducible weight modules.

The isomorphism problem for universal envelopings algebras of solvable Lie algebras

José Luis Vilca Rodrígues (Universidade Federal de Minas Gerais - Brazil)

Abstract:
The isomorphism problem for universal enveloping algebras of Lie algebras seeks to determine whether the universal enveloping algebra $U(L)$ of a Lie algebra L determines completely the structure of L. In other words

Let L, H be Lie algebras. Does the isomorphism $U(L) \cong U(K)$ imply the isomorphism $L \cong K$?

This problem is stated in the paper by Bergman, in 1978. There is an analogous problem in group theory, namely the Isomorphism Problem for Integral Group Rings. This problem asks, for a group G, if the isomorphism type of the integral group ring $\mathbb{Z}G$ determines the isomorphism type of G. Many results that are true for group rings are true for universal enveloping algebras of Lie algebras too, of course, each in its own

language. For example, the isomorphism type of a nilpotent group G of class at most two is determined by the isomorphism class of $\mathbb{Z}G$. Analogously, it is shown by Usefi that the isomorphism type of a nilpotent Lie algebra L of class at most two is determined by its universal enveloping algebra $U(L)$.

This poster is devoted to the study of The Isomorphism Problem for universal enveloping algebras of solvable Lie algebras in low dimension. Although our results are given in low dimension, in several of these statements we require only that L should be finite-dimensional. Further, many of our results hold for an arbitrary base field independently of the characteristic.

Localização da realização de campos livres de módulos de Verma φ-imaginários sobre $\widehat{\mathfrak{sl}}(2,\mathbb{C})$

Marcela Guerrini Alves (University of São Paulo - Brazil)

Abstract:
A proposta deste trabalho é investigar a existência de novos módulos irredutíveis sobre a álgebra de Lie afim $\widehat{\mathfrak{sl}}(2,\mathbb{C})$ através da aplicação dos funtores localização de Ore e localização torcida aos módulos de Verma φ-imaginários.

A simple method for obtaining right coideal subalgebras for some small quantum algebras

Priscila Nunes dos Santos (Universidade Federal do Rio Grande do Sul - Brazil)

Abstract:
In this work we calculate the lattice of right coideal subalgebras of the multiparameter quantum groups $U_q^+(\mathfrak{g})$, where $\mathfrak{g}$ is a simple Lie algebra of small dimension, while the main parameter of quantization q is not a root of 1. The method used here is similar to the one used for the case G_2 in [4] and much simpler to the previous existing ones (see [1], [2], [3]).

References

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[2] V. K. Kharchenko and A. V. Lara Sagahon, Right coideal subalgebras in $U_q(sl_{n+1})$, Journal of Algebra, 319(2008), 2571-2625.
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A simple method for obtaining PBW-basis for some small quantum algebras

Vanusa Moreira Dylewski (Universidade Federal do Rio Grande do Sul - Brazil)

Abstract:
In this work we explicitly describe the PBW-generators of the multiparameter quantum groups $U_q^+(\mathfrak{g})$, where $\mathfrak{g}$ is a simple Lie algebra of small dimension, while the main parameter of quantization q is not a root of 1. The method used here is similar to the one used for the case G_2 in [3] and much simpler to the previous existing ones (see [1,2]).
References
[1] I. Angiono, Nichols algebras with standard braiding, Alg. and Number Theory 3 Vol.1 (2009), 35–106.
[2] V. K. Kharchenko, *A combinatorial approach to the quantifications of Lie algebras*, Pacific Journal of Mathematics, 203, N1(2002), 191–233.
[3] B. Pogorelsky, *Right coideal subalgebras of the quantum Borel algebra of type* G_2, Journal of Algebra, 322(2009), 2335–2354.

On a conjecture about truncated Weyl modules

Victor do Nascimento Martins (Universidade Federal do Espírito Santo - Brazil)

Abstract:
The truncated Weyl modules are the universal finite-dimensional graded highest-weight modules for the truncated current algebras. We study structural properties of truncated Weyl modules. Chari-Fourier-Sagaki conjectured that on certain conditions, the truncated Weyl module should be isomorphic to the fusion product of certain irreducible modules. Our main result proves this conjecture when the dominant weight is a multiple of a minuscule weight and the Lie algebra is simply laced.