Booklet of abstracts

IICAA , Liberia 2025

0.1 Talks:

1. **Invitation to representation theory**

   Vyacheslav Futorni, Southern University of Science and Technology, China:

   Abstract

   Representation theory is the study of abstract algebraic structures (groups, rings, algebras), by the action of their elements on vector spaces. It provides powerful tools to study the symmetries of systems and geometric objects. Modern representation theory is intrinsically connected to many parts of mathematics and mathematical physics. The goal of the talk is to give an introduction to this vibrant field of research.

2. **Entangled polyomials and quasi-cyclic codes.**

   Sergio Lopes-Permouth, Ohio University, USA:

   Abstract

   The family of quasi-cyclic codes plays a central and significant role in contemporary coding theory. Sixty years after their inception, however, and unlike the case for other generalizations of cyclic codes, there is no single algebraic model

that describes all codes in the family. We will present the recently introduced algebras of m-nomials and entangled polynomials, as a context in which abundant and arbitrarily long quasi-cyclic codes may be constructed as left or right ideals or even as modules over smaller algebras. Part of the talk will be devoted to describe the origin of entangled polynomials in a context outside coding theory and to mention the basics of algebraic coding theory needed to appreciate the topic.

This talk is based on ongoing research with Thang Manh Vo.

3. **The symplectic singularities and vertex algebras.**

Tomoyuki Arakawa, Kyoto University RIMS, Japan.

Abstract

Symplectic singularities, introduced by Beauville, play significant roles in various aspects of representation theory. They also appear in quantum field theory, particularly in the Higgs and Coulomb branches of three-dimensional theories, and in the Higgs branches of four-dimensional theories. Moreover, the 4D/2D duality proposed by Beem et al. identifies vertex algebras as invariants of superconformal four-dimensional theories. Interestingly, in both 3D and 4D contexts, it has been suggested that the Higgs branch can be reconstructed as the associated variety of vertex algebras. Consequently, vertex algebras arising from 3D and 4D theories are believed to represent chiral quantizations of symplectic singularities. In this talk, we will explore these vertex algebras and their representation theory.

4. **Admisible varieties of algebras.**

Ivan Shestakov, Universidade de São Paulo, Brazil.

Abstract

We consider the subvarieties of the variety of noncommutative Jordan algebras that admit structure theories similar to those of alternative and Jordan algebras. In the case of finite dimensional algebras examples of such varieties were considered in 1960-70-s by R.Schafer, R.Block, A, Thedy and the author. Now we are trying to extend certain results on nilpotency and solvability of infinite dimensional algebras. A homogeneous variety V of noncommutative Jordan algebras we call "n-admissible" if any anticommutative algebra from V is nilpotent of index n. If any anticommutative algebra from V is locally nilpotent, we call V "locally admissible". For instance, the variety of Jordan algebras is 2-admissible, the variety of associative algebras is 3-admissible, the variety of alternative algebras is 4-admissible. We prove, in particular, that in a locally admissible variety any nil algebra A of bounded degree is locally nilpotent; If the algebra A in the previous statement belongs to an admissible variety over a field of characteristic 0, then A is solvable; The nil radical of a finitely generated PI-algebra A from an admissible variety is nilpotent; Any finitely generated coalgebra in an admissible variety is finite dimensional.

5. **An invitation to vertex oparator algebras.**

David Ridout, University of Melbourne, Australia.

Abstract

The notion of a vertex algebra first arose in Borcherds' Fields-medal work on monstrous moonshine. Vertex operator algebras were subsequently introduced by Frenkel–Lepowsky–Meurman and were immediately realised to be identical to the chiral algebras being studied by physicists working in conformal field theory.

I will construct a simple, but very important, example of a vertex operator algebra before outlining some of the magical properties of its representation category. If time permits, I will briefly discuss other examples and their applications.

6. **Equivalence of definitions of W-algebras and Poisson geometry.**

Naoki Genra, Tomaya University, Japan.

Abstract

Premet originally introduced finite W-algebras as generalizations of Kac and Lynch's works to study modular representations of Lie algebras. Later, Gan and Ginzburg showed that finite W-algebras have many different equivalent definitions by using the geometry of Slodowy slices. (Affine) W-algebras were originally defined by Feigin and Frenkel and generalized by Kac, Roan, and Wakimoto. We show that W-algebras also have many different equivalent definitions as analogs of finite cases.

This is joint work with Thibault Juillard.

7. **A Universal Kaluzhnin-Krasner Embedding theorem.**

Xabier García Martínez, Universidad de Vigo, España.

Abstract

Given two groups A and B, the Kaluzhnin–Krasner universal embedding theorem states that the wreath product $A \wr B$ acts as a universal receptacle for extensions from A to B. For a split extension, this embedding is compatible with the canonical splitting of the wreath product, which is further universal in a precise sense. This result was recently extended to Lie algebras and cocommutative Hopf algebras. In this talk we will explore the feasibility of adapting the theorem to other types of algebraic structures. By explaining the underlying unity of the three known cases, our analysis gives necessary and sufficient conditions for this to happen. We will also see that the theorem cannot be adapted to a wide range of categories, such as loops, associative algebras, commutative algebras or Jordan algebras. Working over an infinite field, we may prove that among non-associative algebras, only Lie algebras admit a Kaluzhnin–Krasner theorem.

8. **Braided commutative algebras.**

Martín Mombelli, Universidad Nacional de Córdoba, Argentina.

Abstract

In this talk I will present a new construction of braided commutative algebras in finite tensor categories. Some explicit examples will be shown in case the tensor category comes from finite dimensional Hopf algebras.

9. **The Graded Classification Conjectures Hold for Various Finite Leavitt Path Algebras.**

Wolfgang Bock, Linneaus University, Sweeden.

Abstract

The Graded Classification Conjecture states that for finite directed graphs E and F, the associated Leavitt path algebras $L(E)$ and $L(F)$ are graded Morita equivalent, i.e., $L(E) \simeq L(F)$, if and only if, their graded Grothendieck groups are isomorphic $K_0(L(E)) \cong K_0(L(F))$ as order-preserving $Z[x, x-1]$-modules. Furthermore, if under this isomorphism, the class $[L(E)]$ is sent to $[L(F)]$ then the algebras are graded isomorphic, i.e., $L(E) \cong L(F)$. In this talk we show that, for finite graphs E and F with no sinks and sources, an order-preserving $Z[x, x-1]$-module isomorphism $K_0(L(E)) \cong K_0(L(F))$ gives that the categories of locally finite dimensional graded modules of $L(E)$ and $L(F)$ are equivalent, i.e., $[Z]L(E) \simeq [Z]L(F)$. We further obtain that the category of finite dimensional (graded) modules are equivalent, i.e., $L(E) \simeq L(F)$.

10. **Extreme grouth in Lie algebras.**

Vyctor Pretrogradsky, Universidade de Brasilia, Brazil.

Abstract

Different versions of Burnside Problem ask what one can say about finitely generated periodic groups under additional assumptions. For associative algebras, Kurosh type problems ask similar questions about properties of finitely generated nil (more generally, algebraic) algebras. Similarly, one considers finitely generated restricted Lie algebras with a nil p-mapping. Now we study an oscillating intermediate growth in nil restricted Lie algebras. Namely, for any field of positive characteristic, we construct a family of 3-generated restricted Lie algebras of intermediate oscillating growth. We call them Phoenix algebras, because of the following. a) For infinitely many periods of time the algebra is "almost dying" by having a quasi-linear growth, namely the lower Gelfand-Kirillov dimension is one, more precisely, the growth is of type $nln \cdots lnn_k$, where $q \in \mathbb{N}$, $k > 0$ are constants. b) On the other hand, $|z_q$ times for infinitely many n the growth function has a rather fast intermediate behavior of type $\exp(n/(lnn\lambda))$, λ being a constant determined by characteristic, for such periods the algebra is "resuscitating". c) Moreover, the growth function is bounded and oscillating between these two types of behaviour. d) These restricted Lie algebras have a nil p-mapping. We also discuss related construction nil of nil Jordan superalgebras of similar oscillating intermediary growth over arbitrary field.

11. **The iquantum Brauer category.**

Alistair Savage, University of Ottawa, Canada.

Abstract

Symmetric pairs consist of a complex simple Lie algebra and a subalgebra fixed by an involution. Passing to enveloping algebras, the latter becomes a Hopf subalgebra. Hence, its category of representations is naturally a monoidal category. The quantum analogue of this concept is that of a quantum symmetric pair. In the quantum setting, the subalgebra, called an iquantum group, is not a Hopf subalgebra. Rather, it is a coideal subalgebra. This means that the category of representations of the iquantum group is not monoidal. Instead, it is a module category over the category of representations of the larger quantum group. In this talk, we will explore the representation theory of iquantum groups from the point of view of diagrammatic interpolating categories. We will see that one can obtain a presentation of the category of modules of the iquantum group from the framed HOMFLYPT skein category (a category that underpins the HOMFLYPT link invariant) by imposing a single relation. This is joint work with Hadi Salmasian and Yaolong Shen.

12. **Linear representations of finite geometries and associated LDPC codes.**

Qing Xiang, Southern University of Science and Technology, China

Abstract

The linear representation of a subset of a finite projective space is an incidence structure of affine points and lines determined by the subset. In this talk we use character theory

to show that the rank of the incidence matrix has a direct geometric interpretation in terms of certain hyperplanes. We consider the LDPC codes defined by taking the incidence matrix and its transpose as parity-check matrices, and in the former case prove a conjecture of Vandendriessche that the code is generated by words of minimum weight called plane words. In the latter case we compute the minimum weight in some cases and provide a few constructions of codewords.

13. **Realiztion of strongly tame Gelfand-Tselin modules: Non-standard case.**

Oscar Hernández Morales, Universidade de São Carlos, Brazil.

Abstract

In this presentation, we will discuss combinatorial methods (assuming that the Gelfand-Tsetlin subalgebra of $g = sl(n+1)$ acts diagonally) which allow constructing enumerable bases for modules called strongly tame Γ-Gelfand-Tsetlin g-modules, where Γ is a non-standard Gelfand-Tsetlin subalgebra. In particular, we will give criteria in terms of the highest weight λ to decide which highest weight g-modules (with respect to the standard Borel) $L(\lambda)$ are strongly tame Γ-Gelfand-Tsetlin g-modules. We will see that when $\#n = 2\#$, $L(\lambda)$ is always a strongly tame Γ-Gelfand-Tsetlin g-module. However, there does not exist a Gelfand-Tsetlin subalgebra Γ such that $L(\lambda)$ is a strongly tame Γ-Gelfand-Tsetlin g-module, for any $n > 2$. Finally, we construct non-highest weight modules using localization functors.

14. **Associated varieties of simple affine vertex algebras at non-admissible levels.**

Libor Krizka, Charles University, Prague, Czech Republic.

Abstract

In this talk, we introduce a method for determining the associated variety of a simple affine vertex algebra. We use it for describing the associated variety of the simple affine vertex algebra $\mathcal{V}_k(\mathfrak{sl}_{r+1})$ at the boundary non-admissible level $k + r + 1 = \frac{r}{q}$ with $\gcd(q, r) = 1$. Moreover, we also get a free field realization of the simple affine vertex algebra $\mathcal{V}_k(\mathfrak{sl}_{r+1})$ and the simple affine $\mathcal{W}$-algebra $\mathcal{W}_k(\mathfrak{sl}_{r+1}, f_{\min})$ at that level.

15. **To be announced.**

Dimitar Grantcharov, Texas University at Arlington, USA.

Abstract

To be announced.

16. **To be announced.**

Vladimir Dostenko, Strasbourg University, France

Abstract

To be announced.

0.2 Mini-Courses

1. **Representations of symmetric groups.**

   Iryna Kashuba, Southern University of Science and Technology, China.

   Abstract

   To be announced.

2. **To be announced.**

   Santiago Chaves, Universidad de Costa Rica, Costa Rica.

   Abstract

   To be announced.

3. **To be announced.**

   Samuel Lopes, Universidade do Porto, Portugal.

   Abstract

   To be announced.