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BOOK OF ABSTRACTS

SS16 - Algebras with Polynomial Identities

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Algebras with Hopf action and almost polynomial growth

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In recent years, considerable progress has been made in describing varieties with almost polynomial growth of algebras with additional structure. Hopf algebra actions can be used to provide a unified treatment of several cases, in particular graded algebras, differential algebras and algebras with group action by automorphisms. In this talk, we will discuss the latest progress in this direction along with some interesting open problems.

New examples of fundamental algebras

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Fundamental algebras play an important role in the theory of algebras with polynomial identities in characteristic zero. More specifically, fundamental algebras are the building blocks used to generate any variety of finite basic rank of associative algebras over a field of characteristic zero. Recently, Giambruno, Polcino Milies and Zaicev have given a characterization of fundamental algebras in the language of cocharacters combined with other techniques from the theory of PI-algebras. In this talk, we will describe some new examples of fundamental algebras.

Outer Automorphisms of the Category of Free Non-Associative Algebras with Unit

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Let Θ be an arbitrary variety of algebras and Θ^0 the category of all free finitely generated algebras in Θ . The group $\text{Aut}(\Theta^0)$ of automorphisms of the category Θ^0 plays an important role in Universal Algebraic Geometry (see [3]). It turns out that for a wide class of varieties, the group $\text{Aut}(\Theta^0)$ can be decomposed into a product of the normal subgroup $\text{Inn}(\Theta^0)$ of inner automorphisms and the subgroup $\text{St}(\Theta^0)$ of strongly stable automorphisms. The method of verbal operations provides a machinery to calculate the group $\text{St}(\Theta^0)$ of strongly stable automorphism (see [4-6]).

In this talk we give some clarifying remarks describing the place of Θ^0 and $\text{Aut}(\Theta^0)$ in the general set up of the Universal Algebraic Geometry and discuss some new results concerning the group of outer automorphisms $\text{Out}(\Theta^0) = \text{Aut}(\Theta^0)/\text{Inn}(\Theta^0)$ for varieties of non-associative algebras with unit (see [1-2]).

References

- [1] E. Aladova Chestakov, *Outer Automorphisms of the Category of Free Non-Associative Algebras with Unit*, Int. J. Algebra Comput., (2025), accepted.
- [2] E. Aladova, *Automorphisms of categories of free algebras with unit for classical varieties of non-associative algebras*. Comm. Algebra, 52 (2024), 3826–3842.
- [3] B. Plotkin, *Some results and problems related to universal algebraic geometry*. Int. J. Algebra Comput., 17 (2007), 1133–1164.
- [4] B. Plotkin, G. Zhitomirski, *Automorphisms of categories of free algebras of some varieties*, Journal of Algebra, 306 (2006), 344–367.
- [5] A. Tsurkov, *Automorphic equivalence of algebras*, Int. J. Alg. Comput., 17 (2007), 1263–1271.
- [6] G. Zhitomirski, *On automorphisms of categories with applications to universal algebraic geometry*. Algebra Univers., 84 (2023) 24 pp.

On Polynomial Identities of Finite Algebras

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An interesting question in PI-theory is whether a finite-dimensional algebra can be determined by the polynomial identities it satisfies. In general, the answer is negative. However, under suitable assumptions, positive results are known over algebraically closed fields. The strongest result in this direction by Yu. Razmyslov who proved that finite-dimensional prime Ω -algebras over an algebraically closed field are uniquely determined by their polynomial identities. In this talk, we present a positive answer to this question for finite prime Ω -algebras over a unital commutative ring. This is a joint work with Felipe Yasumura (IME-USP) and Diogo Diniz (UFCG).

Finally, we discuss the Specht Problem for graded finite associative algebras over finite fields. Extending classical results of R. Kruse and I. L'vov for finite associative algebras, we prove that if G is a finite group then any G -graded finite associative algebra admits a finite basis for its identities. This is a joint work with Diogo Diniz (UFCG).

References

- [1] Bahturin, Y.; Diniz, D.; Martinez Correa, D.; Yasumura, F., *Polynomial identities of finite prime universal algebras*. Serdica Math. J. **51**(2025), 283–298.
- [2] Kruse, R.L., *Identities satisfied by a finite ring*, J. Algebra **26**(1973), 298–318.
- [3] L'vov, I.V., *Varieties of associative rings. I*. Algebra and Logic **12**(1973), 150–167.
- [4] Razmyslov, Yu.P., *Identities of algebras and their representations*. Transl. Math. Monogr., vol. **138**. Providence, RI, American Mathematical Society, 1994.

Asymptotic behavior of the codimension sequence in G-graded algebras with involution

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In recent years, the theory of algebras with polynomial identities has undergone significant development, with particular attention devoted to numerical invariants associated with a given algebra A . Among these invariants, the codimension sequence

$$c_n(A), \quad n = 1, 2, \dots,$$

plays a central role. Over a field of characteristic zero, every polynomial identity follows from multilinear ones. Thus, the codimension sequence provides a natural and powerful tool for studying the asymptotic behavior of the identities satisfied by A .

In this talk, we explore this theme in the setting of group-graded algebras endowed with a compatible involution. We focus on the classification of varieties according to the behavior of their codimension sequence. More precisely, we discuss classification results concerning varieties of almost polynomial growth, minimal varieties, and unitary varieties with polynomial codimension growth.

The results presented were obtained in collaboration with F. Yasumura, A. Vieira and L. H. Matos.

Varieties of $(C_p, *)$ -algebras of exponent 2

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In this talk, we consider F a field of characteristic zero, C_p the finite cyclic group of odd prime order p and A a finite dimensional $(C_p, *)$ -algebra over F . If A satisfies a non-trivial polynomial identity, then the sequence of $(C_p, *)$ -codimensions $\{c_n^{(C_p, *)}(A)\}_{n \geq 1}$ is exponentially bounded and we study the $(C_p, *)$ -exponent $\exp^{(C_p, *)}(A) = \lim_{n \rightarrow \infty} \sqrt[n]{c_n^{(C_p, *)}(A)}$. We provide a characterization of $(C_p, *)$ -varieties generated by finite dimensional algebras with $(C_p, *)$ -exponent greater than 2 by excluding a finite number of families of $(C_p, *)$ -algebras from the variety. As a consequence, we characterize $(C_p, *)$ -varieties generated by finite dimensional $(C_p, *)$ -algebras with $(C_p, *)$ -exponent equal to 2. This is a joint work with D. V. Avelar.

References

- [1] D. V. Avelar, R. B. dos Santos. $(C_p, *)$ -algebras of exponent two, *Preprint*

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Identities with superinvolution for 4×4 upper triangular matrices

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The superinvolutions on the upper triangular matrix algebra with entries on a field of zero characteristic were classified by Ioppolo and Martino in 2018. They also described the identities with superinvolution for $UT_n(F)$ when $n = 2$ and $n = 3$. In this talk we will present a finite set of generators for the T_2^* -ideal of superidentities of the algebra $UT_4(F)$ endowed with the $\mathbb{Z}_2$ -grading induced by the sequence $(0, 1, 0, 1)$ and super-symplectic superinvolution.

References

- [1] E. Campedel, P. Fagundes, A. Ioppolo, *Upper triangular matrices with superinvolution: identities and images of multilinear polynomials*, 2026, preprint.
- [2] A. Ioppolo, F. Martino, *Superinvolutions on upper-triangular matrix algebras*, J. Pure Appl. Algebra 222 (2018), no. 8, 2022–2039.

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Recent developments in algebras with trace

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Let F be a field of characteristic zero. In this talk we shall consider finite dimensional unitary associative algebras over F endowed with a trace, that is a linear map from A to F that assigns the same value to the trace of a product and its reverse. The objective is to present results on the trace polynomial identities satisfied by this type of algebras and to examine the growth of the corresponding trace codimension sequence.

References

- [1] A. Berele, *Exponential bounds on trace codimensions*, Comm. Algebra, 49 (2021), 1829–1835.
- [2] A. Giambruno, A. Ioppolo, D. La Mattina, *Trace codimensions of algebras and their exponential growth*, Isr. J. Math., 254 (2023), 431–459.
- [3] A. Ioppolo, P. Koshlukov, D. La Mattina, *Trace identities and almost polynomial growth*, Journal of Pure and Applied Algebra, 225 (2021), 106501.
- [4] A. Ioppolo, P. Koshlukov, D. La Mattina, *Matrix algebras with degenerate traces and trace identities*, J. Algebra. 592 (2022), 36–63.
- [5] A. Ioppolo, E. Pascucci, *Trace identities and structural properties of upper triangular matrix algebras*, submitted.
- [6] C. Procesi, *The invariant theory of $n \times n$ matrices*, Advances in Math., 19 (1976), 306–381.
- [7] Ju. P. Razmyslov, *Identities with trace in full matrix algebras over a field of characteristic zero*, Izv. Akad. Nauk SSSR Ser. Mat., 38 (1974), 723–756.

Growth of Codimension Sequences

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Let A be an associative algebra over a field of characteristic zero. One associates to A , in a natural way, a numerical sequence $c_n(A)$, $n = 1, 2, \dots$, called the sequence of codimensions of A , which is one of the main tools for the quantitative investigation of polynomial identities of the algebra. When A satisfies a polynomial identity, the sequence $c_n(A)$ is exponentially bounded and its asymptotic behaviour provides fundamental invariants of the corresponding variety of algebras.

Related asymptotic invariants also arise in the study of central polynomials and of associative algebras endowed with additional algebraic structures.

In this talk I will present some recent developments on asymptotic invariants associated with polynomial identities.

Color involution on upper triangular matrices and almost polynomial growth of $*$ -varieties

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Let G be a finite abelian group, let F be a field of characteristic zero and let $A = \bigoplus_{g \in G} A_g$ be a G -graded F -algebra. If ε is bicharacter of G , an ε -color involution $*$ on A is a graded linear map $*$: $A \rightarrow A$ of order ≤ 2 such that

$$(ab)^* = \varepsilon(g, h)b^*a^*$$

for all homogeneous elements $a \in A_g$ and $b \in A_h$. In this talk we present the recent results in this setting. In particular, we classify all color involutions on the algebra of $n \times n$ upper triangular matrices and describe the $*$ -varieties of almost polynomial growth generated by finitely generated $*$ -algebras.

References

- [1] F. Cerniglia, F. Martino, L.H. de Souza Matos, *Color involution on upper triangular matrices and almost polynomial growth of $*$ -varieties*, submitted, 2026.
- [2] A. Ioppolo, D. La Mattina, F. Martino, *Color involutions in graded algebras: Representability theorems and Specht property*, submitted, 2026.

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PI-Quivers via Incidence Algebras

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A quiver, i.e., a directed graph, gives rise to a path algebra generated by all its paths, with multiplication defined by concatenation. In this talk, we provide a topological characterization of quivers whose path algebras satisfy a polynomial identity. In particular, we show that the path algebra of a quiver satisfies exactly the same polynomial identities as a certain incidence algebra associated with a transitive order, whenever such identities exist.

This talk is based on joint works with A. Berele, G. Cerulli Irelli and J. De Loera Chávez.

References

- [1] G. Cerulli Irelli, J. De Loera Chávez, E. Pascucci, “Quivers with Polynomial Identities”, Ann. Repr. Theory, in press.
- [2] A. Berele, G. Cerulli Irelli, J. De Loera Chávez, E. Pascucci, “Polynomial identities for quivers via incidence algebras”, Bull. Lond. Math. Soc., **58** (2026), e70369.

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Simple Jordan superalgebras

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It is proved that a simple Jordan superalgebra of arbitrary dimension either belongs to the list of known examples of simple superalgebras or lies in a specific subvariety defined by a certain polynomial identity.

It is a joint work with Efim Zelmanov