

# XXI CLA - Session S11

## Representations of Algebras

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S11 - July 25, 15:00 – 15:50

### PARTIAL RELATION EXTENSIONS

**Ibrahim Assem**

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It is well-known that cluster-tilted algebras introduced by Buan, Marsh and Reiten can equivalently be described as relation extensions, that is, trivial extensions of a tilted algebra  $C$  by its relation bimodule  $E$ . Also, any complete slice in  $\text{mod}C$  embeds as a local slice in the module category of the cluster tilted algebra.

The objective of this talk is to introduce an intermediate class of algebras, called partial relation extensions, where  $E$  is replaced by one of its direct summands  $E'$ . Our main results show how one can compute the bound quiver and the module category of a partial relation extension. We also prove that a complete slice in  $\text{mod}C$  embeds as local slice in the module category of its partial relation extensions.

*Joint work with Juan Carlos Bustamante (Université de Sherbrooke), Julie Dionne (Cégep de Sherbrooke), Patrick Le Meur (Université Paris-Diderot) and David Smith (Bishop's University).*

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S11 - July 25, 16:00 – 16:50

### SPLIT $t$ -STRUCTURES AND TORSION PAIRS IN HEREDITARY CATEGORIES

**Sonia Trepode**

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We give necessary and sufficient conditions for torsion pairs in a hereditary category to be in bijection with  $t$ -structures in the bounded derived category of that hereditary category. We prove that the existence of a split  $t$ -structure with nontrivial heart in a semiconnected Krull-Schmidt category implies that this category is equivalent to the derived category of a hereditary category. We construct a bijection between split torsion pairs in the module category of a tilted algebra having a complete slice in the preinjective component with corresponding  $t$ -structures. Finally, we classify split  $t$ -structures in the derived category of a hereditary algebra.

*Joint work with Ibrahim Assem (Universidad de Sherbrooke, Canadá) and María José Souto Salorio (Universidad de la Coruña, España).*

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S11 - July 25, 17:30 – 18:10

### ON THE REPRESENTATION THEORY OF THE PARTITION ALGEBRA

**Rosa Orellana**

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The partition algebra was defined independently by Martin and Jones in the mid 1990s. In this talk I will discuss the representation theory of this algebra and how it connects to the representation theory of the symmetric group. In particular, I will show how the representation theory of the partition algebra is connected to the problem of decomposing the tensor product of irreducible representations of the symmetric group into irreducibles.

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S11 - July 25, 18:15 – 18:55

GERSTENHABER BRACKET VIA ARBITRARY RESOLUTION

**Yury Volkov**

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Hochschild cohomology is an interesting derived invariant of an algebra. It is well known that it has a structure of a Gerstenhaber algebra, which includes the cup product and the Gerstenhaber bracket. There are some well known formulas for cup product via an arbitrary bimodule projective resolution of an algebra under consideration. One interesting formula for the Gerstenhaber bracket appeared recently in a work of C. Negron and S. Witherspoon. There the correctness of this formula is proved for a resolution with some restrictive properties. In the current talk we will see how to modify this formula in such a way that it becomes correct for any bimodule projective resolution. Also we represent some other interesting formulas and algorithms for computing the Gerstenhaber bracket on Hochschild cohomology of an algebra.

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S11 - July 26, 15:00 – 15:50

MAXIMAL GREEN SEQUENCES

**Kiyoshi Igusa**

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Recently a lot of progress has been made in the study of maximal green sequences. In this talk I will give an overview of, first the definition from many points of view using pictures and other figures, second what the major questions are, and third what progress has been made. I will also explain some of the key ideas of Brustle-Dupont-Perotin, Thomas-Todorov-Reiten, Garver-McConville that were used in my work with Gordana Todorov, Thomas Brustle and Steve Hermes on some of these problems.

*Joint work with Gordana Todorov, Thomas Brustle and Stephen Hermes.*

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S11 - July 26, 16:00 – 16:50

A LITTLE BIT OF EXTRA FUNCTORIALITY FOR EXT AND THE COMPUTATION OF THE GERSTENHABER BRACKET

**Mariano Suárez-Álvarez**

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We show that the action of the Lie algebra  $HH^1(A)$  of outer derivations of an associative algebra  $A$  on the Hochschild cohomology  $HH^\bullet(A)$  of  $A$  given by the Gerstenhaber bracket can be computed in terms of an arbitrary projective resolution of  $A$  as an  $A$ -bimodule, without having recourse to comparison maps between the resolution and the bar resolution.

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S11 - July 26, 17:30 – 17:50

THE BLOB ALGEBRA IN POSITIVE CHARACTERISTIC AND THE  $p$ -KAZHDAN-LUSZTIG  
POLYNOMIALS.

**David Plaza**

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In 2003, Martin and Woodcock observed that, over a field of characteristic zero, the decomposition numbers for the blob algebra are given by certain evaluations at 1 of the Kazhdan-Lusztig polynomials associated to the infinite dihedral group  $W_\infty$ .

In this talk, we prove that in characteristic  $p > 0$  the decomposition numbers for the blob algebra are given by evaluations at 1 of the  $p$ -Kazhdan-Lusztig polynomials associated to  $W_\infty$ . These polynomials arise as the entries of the change of basis matrix from the basis of the Hecke algebra  $\mathcal{H} = \mathcal{H}(W_\infty)$  of  $W_\infty$  obtained by decategorifying the corresponding indecomposable Soergel bimodules to the standard basis of  $\mathcal{H}$ .

In general, to calculate the  $p$ -Kazhdan-Lusztig polynomials is a very hard task. However, for  $W_\infty$ , we are able to provide an easy algorithm to compute them.

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S11 - July 26, 18:00 – 18:20

ABOUT SUMS OF COMPOSITIONS OF IRREDUCIBLE MORPHISMS

**Nicolás Llodra Schat**

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We consider  $A$  an artin algebra, and  $\text{mod } A$  the category of finitely generated right  $A$ -modules.

In this talk, we present some results about sums of compositions of irreducible morphisms between indecomposable  $A$ -modules in relation with the powers of the radical of its module category.

The notion of degree of an irreducible morphism, introduced by S. Liu [L], played a fundamental role to obtain such results.

In particular, we give a characterization of when the sums of compositions of irreducible morphisms of length exactly  $n$ , for  $n = 2, 3, 4$  and  $5$  belong to  $\mathfrak{R}^{n+1}$ .

**References**

[L] S. Liu, *Degree of irreducible maps and the shapes of Auslander-Reiten quivers*, Journal of London Math. Soc. 2, 45, (1992), 32-54.

*Joint work with Claudia Chaio (Universidad Nacional de Mar del Plata, Argentina).*

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S11 - Poster

## REPRESENTATION OF TWISTED TENSOR PRODUCTS

**Jack Arce Flores**

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We obtain a faithful representation of the twisted tensor product  $B \otimes_{\chi} A$  of unital associative algebras, when  $B$  is finite dimensional. This generalizes the representations of [C] where  $B = K[X]/\langle X^2 - X \rangle$ , [GGV] where  $B = K[X]/\langle X^n \rangle$  and [JLNS] where  $B = K^n$ . Furthermore, we establish conditions to extend twisted tensor products  $B \otimes_{\chi} A$  and  $C \otimes_{\psi} A$  to a twisted tensor product  $(B \times C) \otimes_{\varphi} A$ .

[A] J. Arce. Representation of twisted tensor Products. arXiv:1505.01232 [math.RA] 6 may 2015.

[C] C. Cibils. Non-commutative duplicates of finite sets. J. Algebra Appl , 5(3):361–377, 2006.

[GGV] A. Guccione, J. J. Guccione and C. Valqui, Non commutative truncated polynomial extensions.

[JLNS] Jara, J. López Peña, G. Navarro and D. Stefan, On the classification of twisting maps between  $K^n$  and  $K^m$ , arXiv : 0805.2874v3[math.RA]24Sep2009.

*Joint work with .*

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S11 - Poster

## ANÁLISIS DEL ESPECTRO DE GRAFOS JAHANGIR

**Wilsmar dos Santos**

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La energía de un grafo se define como la suma de los valores absolutos de los autovalores de su matriz de adyacencia. Por otro lado su espectro como el conjunto de los autovalores considerando sus multiplicidades. A partir de ello, matemáticos tales como McClelland, Koolen y Moulton entre otros, han definido expresiones algebraicas en función del número de aristas y vértices de un grafo para permitir estimar cotas inferiores y superiores de la energía de los mismos. Por otro lado, otros autores han definido con gran éxito la expresión algebraica de los autovalores de la matriz asociada a grafos tales como Caminos y Ciclos. El presente trabajo, refleja algunas de las conclusiones que se arribaron sobre la expresión algebraica de algunos de los autovalores en ciertos integrantes de la familia de los grafos Rueda, particularmente de Jahangir. Para ello se muestran algunos procedimientos, que se podrían extender para grafos Abanico, que involucran modelos generados por softwares, particiones equitativas de grafos hasta aplicaciones de teoremas de álgebra lineal en matrices vinculada a subgrafos inducidos y teorema de entrelazados de Cauchy.

*Joint work with Wilsmar dos Santos (CFE, CETP, CES, Uruguay).*

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S11 - Poster

## HOCHSCHILD HOMOLOGY AND COHOMOLOGY OF SUPER JORDAN PLANE

**Sebastián Gustavo Reza**

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We compute the Hochschild homology and cohomology of the algebra  $A = \mathbb{k}\langle x, y | x^2, y^2x - xy^2 - xyx \rangle$ , known as super Jordan plane. This algebra has Gelfand-Kirillov dimension equal to 2, and it is also known as the Nichols algebra  $B(V(-1, 2))$ . We also describe the algebra structure of the Hochschild cohomology.

*Joint work with Andrea Solotar (Universidad de Buenos Aires, Argentina).*

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