



# VII Congreso de Jóvenes Investigadores de la RSME

en Bilbao,  
del 13 al 17  
de enero del  
2025



## gazteak RSME 2025



## RSMERen Ikertzaile Gazteen VII. Kongresua

Bilbon,  
2025ko  
urtarrilaren  
13tik 17ra

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Parallels'  
Space-Time

Espacio-Tiempo  
de Paralelas

Paraleloen  
Espazio-Denbora

|       | 1.A  | 1.B  | 1.C  | 2.A  | 2.B  | 2.C  |
|-------|------|------|------|------|------|------|
| 0.1   | AL01 | AL01 |      | AL02 | AL02 | AL02 |
| 0.2   | AL06 | AL06 | AL06 | AL04 | AL04 | AL04 |
| 0.3   | AM01 | AM01 | AL03 | AL03 | AL03 |      |
| 0.5   |      | AL08 | AL08 | AL05 | AL05 | AL05 |
| 0.6   | AL09 | AL09 | AL09 | AL07 | AL07 | AL07 |
| 0.7   | AM02 | AM02 | AM02 | AL10 | AL10 | AL10 |
| 0.8   | MA01 | MA01 |      | AM04 | AM04 | AM04 |
| 0.12  | AM07 | AM07 | AM07 | AM03 | AM08 | AM08 |
| 0.13  | AM06 | AM06 | AM06 | CD02 | CD02 | CD02 |
| 0.15  | AM05 | AM05 | AM05 |      |      | MA01 |
| 0.16  |      | CD01 | CD01 | CD01 | CD03 | CD03 |
| 0.17  | CD06 | CD06 | CD04 | CD04 |      | CD06 |
| 0.18  |      | CD05 | CD05 |      | CD05 |      |
| 0.19  | GT04 | GT01 | GT01 | GT01 |      | GT04 |
| 0.19S | GT03 | GT03 | GT03 | GT02 | GT02 | GT02 |
| 0.20  | GT05 | GT05 | GT05 | GT06 | GT06 | GT06 |
| 0.20S |      | MA02 | MA02 | MA03 | MA03 |      |
| 0.27  | MA04 | MA04 | MA04 | MA05 | MA05 | MA05 |
| 1.12  | OT01 | OT01 | OT02 | OT02 | OT02 |      |
| 1.4   |      | OT03 | OT03 |      |      |      |

- 1.A:

L13|

17:30-19:30
- 1.B:

M14|

15:00-17:00
- 1.C:

M14|

17:30-19:30
- 2.A:

J16|

11:00-13:00
- 2.B:

J16|

16:30-18:30
- 2.C:

V17|

9:00-11:00

**AL01*****Finite and Profinite Groups*****Grupos Finitos y Profinitos****Talde Finitu eta Profinituak****Organizers****Cristina Acciarri**

(Università di Modena e Reggio Emilia)

**Organizadores****Matteo Vannacci**

(UPV/EHU)

**Antolatzaileak****Andoni Zozaya**

(Universidad de Liubliana)

**Description****Descripción****Deskribapena**

*This session will bring together researchers in various areas of Group Theory. It will explore aspects of finite group theory, such as characters, cohomology, and associated rings. Additionally, it will address profinite topological groups as well—specifically, topological groups that are projective limits of finite groups.*

Esta sesión reunirá a investigadores en distintas áreas de la Teoría de Grupos. Se explorarán aspectos de la teoría de grupos finitos, como los caracteres, la cohomología o los anillos asociados. También se tratarán grupos topológicos profinitos —a saber, grupos topológicos que son límites proyectivos de grupos finitos.

Sesio honek Talde Teoriaren hainbat eremutako adituak bilduko ditu. Talde finituetako alde ugari eztabaidatuko dira; adibidez, karaktereak, koomologia eta talde eraztunak. Horiez gain, talde topologiko profinituez arituko da; hau da, talde finituen alderantzizko limiteak diren talde topologikoak.

**MSC Codes****Códigos MSC****MSC Kodeak**

20-XX

(primary)

20C15; 20J06; 16S34; 22D05

(secondary)

**Slots****Bloques****Blokeak**

1.A (Aula 0.1); 1.B (Aula 0.1)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

L13 | 17:30-17:50 | 0.1

*Beyond BHZ: Exploring New "Heights"***Mandi A. Schaeffer Fry** (University of Denver)

L13 | 18:00-18:20 | 0.1

*Characters and normal Sylow subgroups***J. Miquel Martínez** (Universitat de València)

L13 | 18:30-18:50 | 0.1

*Decomposition numbers and Sylow normalisers***Noelia Rizo** (Universitat de València)

L13 | 19:00-19:20 | 0.1

*Tensor factorisations of group algebras***Diego García Lucas** (Universidad Rey Juan Carlos)

M14 | 15:00-15:20 | 0.1

*Lie algebraic methods in Galois theory***Simone Blumer** (University of Vienna)

M14 | 15:30-15:50 | 0.1

*Representation growth of compact  $p$ -adic analytic groups***Margherita Piccolo** (Heinrich-Heine-Universität Düsseldorf)

M14 | 16:00-16:20 | 0.1

*A Stallings-Swan-Dunwoody theorem for t.d.l.c. groups***Bianca Marchionna** (Heidelberg University)

M14 | 16:30-16:50 | 0.1

*The multiplicities of class sizes recognise hypercentral Hall subgroups*

**Víctor Sotomayor** (Universitat Politècnica de València)



Monday 13  
17:30-17:50  
[Room 0.1]

Lunes 13  
17:30-17:50  
[Aula 0.1]

Astelehena 13  
17:30-17:50  
[Gela 0.1]

*Beyond BHZ: Exploring New "Heights"*

**Mandi A. Schaeffer Fry**

(University of Denver)

In joint work with Navarro, Malle, and Tiep, we completed the proof of Brauer's Height Zero Conjecture (BHZ), one of the longest-standing conjectures in the representation theory of finite groups. This now-theorem says that all characters in a block of a finite group have height zero if and only if the block has abelian defect groups. In this talk, I'll discuss several extensions of the BHZ. This includes joint work with G. Malle, A. Moret , N. Rizo, and various combinations of the four of us.

Joint work with G. Malle, A. Moret , and N. Rizo.

[arXiv:2406.06428](#)

[arXiv:2402.08361](#)

[arXiv:2209.04736](#)

Monday 13  
18:00-18:20  
[Room 0.1]

Lunes 13  
18:00-18:20  
[Aula 0.1]

Astelehena 13  
18:00-18:20  
[Gela 0.1]

*Characters and normal Sylow subgroups*

**J. Miquel Mart nez**

(Universitat de Val ncia)

Let  $G$  be a finite group, let  $p$  a prime dividing the order of  $G$  and let  $P$  be a Sylow  $p$ -subgroup of  $G$ . Recently, G. Malle, G. Navarro and P. H. Tiep have proposed a new way of determining the normality of  $P$  in  $G$  in terms of the  $p$ -Brauer characters, different in nature from the previously known characterizations of normal Sylow subgroups in character-theoretical terms. In this talk, we report on the progress on this conjecture.

Joint work with Z. Feng, A. A. Schaeffer Fry and D. Rossi.

**Monday 13****18:30-18:50****[Room 0.1]****Lunes 13****18:30-18:50****[Aula 0.1]****Astelehena 13****18:30-18:50****[Gela 0.1]*****Decomposition numbers and Sylow normalisers*****Noelia Rizo**

(Universitat de València)

Let  $G$  be a finite group and  $p$  a prime. We can write the restriction of any irreducible character of  $G$  to the set of elements of  $G$  of order not divisible by  $p$  as a non-negative integer combination of irreducible  $p$ -Brauer characters. These non-negative integers are called  $p$ -decomposition numbers, and they are fundamental in linking characteristic 0 and positive characteristic representations. We explore their relation to the  $p$ -local structure of  $G$  for height-zero characters in the principal block.

Joint work with Gunter Malle.

[arXiv:2405.08723](https://arxiv.org/abs/2405.08723)**Monday 13****19:00-19:20****[Room 0.1]****Lunes 13****19:00-19:20****[Aula 0.1]****Astelehena 13****19:00-19:20****[Gela 0.1]*****Tensor factorisations of group algebras*****Diego García Lucas**

(Universidad Rey Juan Carlos)

We study the problem of whether every factorisation as a tensor product of a group algebra comes from a factorisation as a direct product of the underlying group basis, and, consequently, it is unique up to isomorphism and reordering. For the case when the group basis is a finite  $p$ -group and the ring of coefficients is a field of characteristic  $p$ , this problem was already studied by Carlson and Kovacs in 1995 in the commutative case. We extend their result to some non-commutative cases.

Joint work with Taro Sakurai and Ángel del Río.

[arXiv:2408.09036](https://arxiv.org/abs/2408.09036)

**Tuesday 14****15:00-15:20****[Room 0.1]****Martes 14****15:00-15:20****[Aula 0.1]****Asteartea 14****15:00-15:20****[Gela 0.1]*****Lie algebraic methods in Galois theory*****Simone Blumer**

(University of Vienna)

An aim of modern Galois theory is to determine which profinite groups can occur as absolute Galois groups. Since the 2011 proof of the Bloch-Kato conjecture, which confirmed the quadratic nature of the cohomology of certain maximal pro- $p$  Galois groups, new conjectures have emerged, refining our understanding of these cohomology rings. By linearizing pro- $p$  groups, one defines Lie algebras, enabling the exploration of Lie algebraic approaches to Galois theoretic conjectures.

**Tuesday 14****15:30-15:50****[Room 0.1]****Martes 14****15:30-15:50****[Aula 0.1]****Asteartea 14****15:30-15:50****[Gela 0.1]*****Representation growth of compact  $p$ -adic analytic groups*****Margherita Piccolo**

(Heinrich-Heine-Universität Düsseldorf)

The representation growth of a group measures the asymptotic distribution of its irreducible representations. When the growth is polynomial, a key invariant in this context is the "minimal" degree of growth. In the realm of compact  $p$ -adic analytic groups, explicit results have been achieved only for groups of small dimensions. I will provide an overview of the main concepts in this area and report on recent work aimed at expanding the class of groups for which we have explicit results.

Joint work with Jan Moritz Petschick.

Tuesday 14

16:00-16:20

[Room 0.1]

Martes 14

16:00-16:20

[Aula 0.1]

Asteartea 14

16:00-16:20

[Gela 0.1]

*A Stallings-Swan-Dunwoody theorem for t.d.l.c. groups***Bianca Marchionna**

(Heidelberg University)

A famous theorem due to Stallings-Swan-Dunwoody asserts that finitely generated groups of rational cohomological dimension at most 1 are exactly the finitely generated groups that are virtually free or, equivalently, that act properly and cocompactly on a tree. We show that an analogous result holds within the more general class of unimodular t.d.l.c. groups. We then rephrase the result in terms of the notion of accessibility on the group, a key notion in geometric and profinite group theory.

Joint work with I. Castellano and T. Weigel.

[arXiv:2201.10847](https://arxiv.org/abs/2201.10847)

Tuesday 14

16:30-16:50

[Room 0.1]

Martes 14

16:30-16:50

[Aula 0.1]

Asteartea 14

16:30-16:50

[Gela 0.1]

*The multiplicities of class sizes recognise hypercentral Hall subgroups***Víctor Sotomayor**

(Universitat Politècnica de València)

The aim of this contribution is to survey some results concerning how much information about the algebraic structure of a group can be obtained from the sizes of its conjugacy classes and their frequencies. In particular, some recent progress in this research line will be shown, from a local point of view.

[doi:10.1007/s40840-024-01752-x](https://doi.org/10.1007/s40840-024-01752-x)

**AL02****Geometric Group Theory**  
Teoría Geométrica de Grupos**Organizers****Federico Berlai**

(UPV/EHU)

**Anne Lonjou**

(UPV/EHU)

**Organizadores****Marcos Escartín Ferrer**

(Universidad de Zaragoza)

**Marialaura Noce**

(Universidad de Salerno)

**Antolatzaileak****Description**

*Geometric group theory is a fairly new and active branch of mathematics that appeared at the end of last century, growing out of combinatorial group theory. The original focus of geometric group theory is the study of groups viewed as geometric objects, and nowadays it closely interacts with low-dimensional topology, differential geometry, ring theory, mathematical logic, dynamical systems, probability and K-theory, to mention a few.*

La teoría geométrica de grupos es una rama bastante nueva y activa de las matemáticas que nació a finales del siglo pasado y surgió de la teoría combinatoria de grupos. El enfoque original de la teoría geométrica de grupos es el estudio de grupos vistos como objetos geométricos, y hoy en día interactúa estrechamente con la topología geométrica, la geometría diferencial, la teoría de anillos, la lógica matemática, los sistemas dinámicos, la probabilidad y la K-teoría entre otras.

**Descripción****Deskribapena****MSC Codes****Códigos MSC****MSC Kodeak**

20F65

(primary)

05C25; 20F67; 20E26

(secondary)

**Slots****Bloques****Blokeak**

2.A (Aula 0.1); 2.B (Aula 0.1); 2.C (Aula 0.1)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

J16 | 11:00-11:20 | 0.1

*Narrow graphs and virtual fiber subgroups***Pénélope Azuelos** (University of Bristol)

J16 | 11:30-11:50 | 0.1

*Twisted right-angled Artin groups***Islam Foniqi** (University of East Anglia)

J16 | 12:00-12:20 | 0.1

*Folding quasiconvex semigroups of automatic groups***Lucía Asencio Martín** (Newcastle University)

J16 | 12:30-12:50 | 0.1

*Fixed points of automorphisms and  $L^2$ -homology***Ismael Morales** (University of Oxford)

J16 | 16:30-16:50 | 0.1

*Ribbon property conjecture for Artin groups***José Gálvez Mateos** (Universidad de Sevilla & UPV/EHU)

J16 | 17:00-17:20 | 0.1

*Universal localizations, Atiyah conjectures and graphs of groups.***Pablo Sánchez Peralta** (Universidad Autónoma de Madrid)

J16 | 17:30-17:50 | 0.1

*An Introduction to the Compressed Word Problem for Groups***Paloma López Larios** (Universidad Complutense de Madrid)

J16 | 18:00-18:20 | 0.1

*On the  $L^2$ -Betti numbers and algebraic fibering of the (outer) automorphism groups of a RAAG*

**Marcos Escartín-Ferrer** (Universidad de Zaragoza)

V17 | 9:00-9:20 | 0.1

*Around subgroups of Artin groups*

**Jone Lopez de Gamiz Zearra** (UPV/EHU)

V17 | 9:30-9:50 | 0.1

*Torsion subgroups of small cancellation groups*

**Karol Duda** (UPV/EHU)

V17 | 10:00-10:20 | 0.1

*McCullough-Miller space for RAAGs*

**Peio Ardaiz Gale** (Nafarroako Unibertsitate Publikoa)

V17 | 10:30-10:50 | 0.1

*The geometry of free-by-cyclic groups*

**Marco Linton** (ICMAT)

**Thursday 16**

11:00-11:20

[Room 0.1]

**Jueves 16**

11:00-11:20

[Aula 0.1]

**Osteguna 16**

11:00-11:20

[Gela 0.1]

***Narrow graphs and virtual fiber subgroups*****Pénélope Azuelos**

(University of Bristol)

A finitely generated subgroup  $H$  of a finitely generated group  $G$  is a virtual fiber subgroup if  $G$  admits a finite index subgroup which surjects onto the integers and the kernel has finite index in  $H$ . This condition is very strong; it implies a number of nice properties of the subgroup, such as separability, but also imposes a number of geometric properties on the quotient  $H \backslash G$ . In this talk, I will discuss the extent to which these geometric properties characterise virtual fiber subgroups.

[arXiv:2402.19000](https://arxiv.org/abs/2402.19000)**Thursday 16**

11:30-11:50

[Room 0.1]

**Jueves 16**

11:30-11:50

[Aula 0.1]

**Osteguna 16**

11:30-11:50

[Gela 0.1]

***Twisted right-angled Artin groups*****Islam Foniqi**

(University of East Anglia)

Right-angled Artin groups (RAAGs) play a central role in geometric group theory. In this talk, we introduce twisted right-angled Artin groups (T-RAAGs), a generalization of RAAGs. T-RAAGs are defined using a mixed graph: undirected edges  $[a - b]$  impose the relation  $ab = ba$ , while directed edges  $[a \rightarrow b]$  give the Klein relation  $aba = b$ . We present a normal form for elements of T-RAAGs and utilize it to explore the geometric and algebraic similarities and differences between T-RAAGs and RAAGs.

[arXiv:2407.06933](https://arxiv.org/abs/2407.06933)



**Thursday 16**

12:00-12:20

[Room 0.1]

**Jueves 16**

12:00-12:20

[Aula 0.1]

**Osteguna 16**

12:00-12:20

[Gela 0.1]

***Folding quasiconvex semigroups of automatic groups*****Lucía Asencio Martín**

(Newcastle University)

Stallings foldings were introduced in 1983 as a tool to understand f.g. subgroups of free groups through finite objects called Stallings automata. Since then several generalisations of the automata have been developed for e.g. RAAGs or automatic groups. In 2017 Kharlampovich, Miasnikov and Weil described a way to build Stallings automata for certain subgroups of automatic groups, we now present some work in progress that adapt these ideas to understand semigroups inside automatic groups.

Joint work with John Britnell, Andrew Duncan, Dominik Francoeur, and Sarah Rees.

**Thursday 16**

12:30-12:50

[Room 0.1]

**Jueves 16**

12:30-12:50

[Aula 0.1]

**Osteguna 16**

12:30-12:50

[Gela 0.1]

***Fixed points of automorphisms and  $L^2$ -homology*****Ismael Morales**

(University of Oxford)

Let  $F$  be the free group of finite rank  $n$  and let  $\Phi$  be an automorphism of  $F$ . A folkloric conjecture of Scott stated that the subgroup of elements of  $F$  fixed by  $\Phi$  has rank at most  $n$ . This was settled by Bestvina and Handel in 1992, for which they developed the analogous theory of Thurston's train-track maps in this context. We will discuss a new proof of Scott's conjecture based on  $L^2$ -homology.

Thursday 16

16:30-16:50

[Room 0.1]

Jueves 16

16:30-16:50

[Aula 0.1]

Osteguna 16

16:30-16:50

[Gela 0.1]

*Ribbon property conjecture for Artin groups***José Gálvez Mateos**

(Universidad de Sevilla &amp; UPV/EHU)

Artin groups are defined from a set of generators  $S$  and relations  $aba\dots = bab\dots$ , where the words are of the same length. Objects of great interest within the study of these groups are the standard parabolic subgroups. In this talk, we will present a problem related to the conjugation of these subgroups known as the ribbon conjecture. It asks whether two parabolic subgroups  $P, Q$ , we have that  $gPg^{-1} = Q$  if and only if  $g$  is the product of an element of  $P$  and some special elements called ribbons.

Thursday 16

17:00-17:20

[Room 0.1]

Jueves 16

17:00-17:20

[Aula 0.1]

Osteguna 16

17:00-17:20

[Gela 0.1]

*Universal localizations, Atiyah conjectures and graphs of groups.***Pablo Sánchez Peralta**

(Universidad Autónoma de Madrid)

The study of the rationality of  $L^2$ -Betti numbers has led to a rich theory in  $L^2$ -homology with deep implications in structural properties of groups. For decades it has been unclear if the strong Atiyah conjecture passes to free products. We will confirm that the strong and algebraic Atiyah conjectures are closed under the graph of groups construction provided that the edge groups are finite and show that the  $*$ -regular closure is a universal localization of the associated graph of rings

arXiv:2409.12268

**Thursday 16****17:30-17:50****[Room 0.1]****Jueves 16****17:30-17:50****[Aula 0.1]****Osteguna 16****17:30-17:50****[Gela 0.1]*****An Introduction to the Compressed Word Problem for Groups*****Paloma López Larios**

(Universidad Complutense de Madrid)

The compressed word problem is a variant of the classical word problem in which the input word is given as a context-free grammar that produces just one word. In this talk, we will introduce the basic notions of compression that are necessary to understand this problem and we will show the connection between the compressed word problem for a group and the classical word problem for its group of automorphisms. We will also discuss the strategy to solve the compressed word problem in an example.

**Thursday 16****18:00-18:20****[Room 0.1]****Jueves 16****18:00-18:20****[Aula 0.1]****Osteguna 16****18:00-18:20****[Gela 0.1]*****On the  $L^2$ -Betti numbers and algebraic fibering of the (outer) automorphism groups of a RAAG*****Marcos Escartín-Ferrer**

(Universidad de Zaragoza)

The family of right-angled Artin groups (RAAGs) interpolates between free groups and free abelian groups. A group is said to algebraically fiber if it surjects onto  $\mathbb{Z}$  with finitely generated kernel. This property is coarsely connected with the  $L^2$ -Betti numbers of the group, a powerful homological invariant.

In this talk we will present some partial results on the computation of the  $L^2$ -Betti numbers and the fibration properties of the (outer) automorphism group of a RAAG.

Friday 17  
9:00-9:20  
[Room 0.1]

Viernes 17  
9:00-9:20  
[Aula 0.1]

Ostirala 17  
9:00-9:20  
[Gela 0.1]

*Around subgroups of Artin groups*  
**Jone Lopez de Gamiz Zearra**  
(UPV/EHU)

In this talk, we will generalize to certain Artin groups some results previously known for right-angled Artin groups. Firstly, we will show that the derived subgroup of an Artin group is free if and only if the group is coherent. Secondly, we will discuss finitely generated normal subgroups of coherent Artin groups, by showing that they are (mostly) co-(virtually abelian). Finally, we will talk about acylindrical hyperbolicity of their subgroups.

Joint work with Conchita Martínez Pérez.

[arXiv:2405.16641](https://arxiv.org/abs/2405.16641)

Friday 17  
9:30-9:50  
[Room 0.1]

Viernes 17  
9:30-9:50  
[Aula 0.1]

Ostirala 17  
9:30-9:50  
[Gela 0.1]

*Torsion subgroups of small cancellation groups*  
**Karol Duda**  
(UPV/EHU)

We prove that torsion subgroups of groups defined by  $C(6)$ ,  $C(4)$ -T(4) or  $C(3)$ -T(6) small cancellation presentations are finite. This follows from more general results about locally elliptic action on small cancellation complexes.

[arXiv:2112.01912](https://arxiv.org/abs/2112.01912)

Friday 17  
10:00-10:20  
[Room 0.1]

Viernes 17  
10:00-10:20  
[Aula 0.1]

Ostirala 17  
10:00-10:20  
[Gela 0.1]

*McCullough-Miller space for RAAGs*  
**Peio Ardaiz Gale**  
(Nafarroako Unibertsitate Publikoa)

The McCullough-Miller space is a contractible simplicial complex that admits an action of the pure symmetric automorphisms of the free group, with stabilizers that are free abelian. It has been used to derive several cohomological properties of these groups, such as computing their cohomology ring and proving that they are duality groups. We will generalize the construction of McCullough-Miller to PSA of right-angled Artin groups, and use it to obtain some cohomological results about them.

Joint work with Conchita Martinez Perez and Richard Wade.

Friday 17  
10:30-10:50  
[Room 0.1]

Viernes 17  
10:30-10:50  
[Aula 0.1]

Ostirala 17  
10:30-10:50  
[Gela 0.1]

*The geometry of free-by-cyclic groups*  
**Marco Linton**  
(ICMAT)

The close connections between dynamical properties of automorphisms of finitely generated free groups and geometric and algebraic aspects of (finitely generated free)-by-cyclic groups has led to several decades of fruitful research. In this talk I will briefly summarise some of what is known about (finitely generated free)-by-cyclic groups, I will discuss generalisations to the much larger family of free-by-cyclic groups and present some applications to the theory of one-relator groups.

**AL03****Number Theory****Teoría de Números****Organizers****Organizadores****Antolatzaileak****Beatriz Barbero Lucas**

(University College Dublin)

**Daniel Gil Muñoz**

(Charles University in Prague)

**Álvaro González Hernández**

(University of Warwick)

**Javier Guillán Rial**

(Universidad de Barcelona)

**Description****Descripción****Deskribapena**

*In this parallel session, various topics related to number theory and other related areas will be explored. Attendees will enjoy short talks on abelian varieties, diophantine equations and modularity, elliptic curves and Galois representations, zeta functions, geometry in positive characteristic, and applications to coding theory, among others. The session will also encourage the exchange of ideas and collaboration, allowing mathematicians to discuss open problems in an informal setting.*

En esta sesión paralela se explorarán varios temas relacionados con la teoría de números y otras áreas afines. Los asistentes podrán disfrutar de charlas cortas sobre variedades abelianas, ecuaciones diofánticas y modularidad, curvas elípticas y representaciones de Galois, funciones zeta, geometría en característica positiva y aplicaciones a la teoría de códigos entre otros. También se fomentará el intercambio de ideas y la colaboración, permitiendo a los participantes discutir problemas abiertos en un ambiente informal.

**MSC Codes****Códigos MSC****MSC Kodeak**

11-02

(primary)

14G17; 11D61; 11G18; 11G10; 11G05; 14J28; 11G30; 11G50; 11T71; 11F80; 11M41

(secondary)

**Slots****Bloques****Blokeak**

1.C (Aula 0.3); 2.A (Aula 0.3); 2.B (Aula 0.3)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

M14 | 17:30-17:50 | 0.3

*Generalised Jacobians of modular curves and their rational torsion.***Mar Curcó Iranzo** (Utrecht University)

M14 | 18:00-18:20 | 0.3

*How to obtain new quantum codes from Generalized Monomial-Cartesian Codes***Beatriz Barbero Lucas** (University College Dublin)

M14 | 18:30-18:50 | 0.3

*"Safe chains" and their applications in Langlands' functoriality***Javier Guillán Rial** (Centre de Recerca Matemàtica)

M14 | 19:00-19:20 | 0.3

*Perfect codes over non-prime power alphabets: an approach based on Diophantine equations***Pedro José Cazorla García** (Universidad Pontificia Comillas)

J16 | 11:00-11:20 | 0.3

*Comparing Galois representations***Ignasi Sánchez Rodríguez** (Universitat de Barcelona)

J16 | 11:30-11:50 | 0.3

*The form of a quadratic form***Álvaro Serrano Holgado** (Universidad de Salamanca)

J16 | 12:00-12:20 | 0.3

*Galois module theory for degree  $p$  extensions of  $p$ -adic fields***Daniel Gil Muñoz** (Charles University & Università di Pisa)

J16 | 12:30-12:50 | 0.3

*Monodromy and equidistribution*

**Francisco García-Cortés** (Universidad de Sevilla)

J16 | 16:30-16:50 | 0.3

*Intersections of the automorphism and  $p$ -rank strata in the moduli space of genus two curves*

**Alvaro Gonzalez Hernandez** (University of Warwick)

J16 | 17:00-17:20 | 0.3

*Serre-Tate theory*

**Ines Borchers Arias** (Princeton University)

J16 | 17:30-17:50 | 0.3

*Abelian varieties that split modulo all but finitely many primes*

**Enric Florit** (Universitat de Barcelona)

J16 | 18:00-18:20 | 0.3

*$(r, \delta)$ -LRCs from evaluation codes*

**Helena Martín-Cruz** (Universitat Jaume I)



Tuesday 14

17:30-17:50

[Room 0.3]

Martes 14

17:30-17:50

[Aula 0.3]

Asteartea 14

17:30-17:50

[Gela 0.3]

*Generalised Jacobians of modular curves and their rational torsion.***Mar Curc3 Iranzo**

(Utrecht University)

Consider the generalised Jacobian  $J_0(N)_m$  of the modular curve  $X_0(N)$  with respect to a modulus  $m$ . This algebraic group also seems to be related to the arithmetic of  $X_0(N)$  through the theory of modular forms. In the talk we will present new results that compute the  $\mathbb{Q}$ -rational torsion of  $J_0(N)$  for  $N$  an odd integer with respect to a cuspidal modulus  $m$ . These generalise previous results of Yamazaki, Yang and Wei. We will also discuss how our results relate to generalised Ogg's conjecture.

[arXiv:2112.03741](https://arxiv.org/abs/2112.03741)

Tuesday 14

18:00-18:20

[Room 0.3]

Martes 14

18:00-18:20

[Aula 0.3]

Asteartea 14

18:00-18:20

[Gela 0.3]

*How to obtain new quantum codes from Generalized Monomial-Cartesian Codes***Beatriz Barbero Lucas**

(University College Dublin)

Quantum computers are a great tool to attack some intractable problems for classical computers, such as the prime factorization problem. However, quantum computer implementations have higher error rates than classical computers, making reliability a challenge. That is where Quantum Error correction codes come into play. In this talk I will give an overview of how to construct a certain kind of Generalized Monomial-Cartesian codes that allow us to obtain new quantum codes.

Joint work with Fernando Hernando, Helena Mart3n-Cruz, Gary McGuire.

[arXiv:2307.15488](https://arxiv.org/abs/2307.15488)

Tuesday 14

18:30-18:50

[Room 0.3]

Martes 14

18:30-18:50

[Aula 0.3]

Asteartea 14

18:30-18:50

[Gela 0.3]

*"Safe chains" and their applications in Langlands' functoriality***Javier Guillán Rial**

(Centre de Recerca Matemàtica)

In this talk we are going to introduce the concept of "safe chains" as a way to make use of congruence graphs of modular forms to prove some instances of Langlands' functoriality. In order to illustrate this method we are going to explain some examples of its applicability such as the proof of Serre's conjecture or base change, both over  $\mathbb{Q}$ .

Tuesday 14

19:00-19:20

[Room 0.3]

Martes 14

19:00-19:20

[Aula 0.3]

Asteartea 14

19:00-19:20

[Gela 0.3]

*Perfect codes over non-prime power alphabets: an approach based on Diophantine equations***Pedro José Cazorla García**

(Universidad Pontificia Comillas)

Perfect codes have been classical objects of study in both Pure and Applied Mathematics, but their existence has only been completely settled for alphabets of prime power size. In this talk, we will explore how the existence of certain perfect error correcting codes entails the existence of solutions to a class of Diophantine equations. In addition, we shall present techniques that allow to solve them, such as the resolution of S-unit equations and the determination of Heegner points.

[arXiv:2405.03347](https://arxiv.org/abs/2405.03347)

**Thursday 16****11:00-11:20****[Room 0.3]****Jueves 16****11:00-11:20****[Aula 0.3]****Osteguna 16****11:00-11:20****[Gela 0.3]*****Comparing Galois representations*****Ignasi Sánchez Rodríguez**

(Universitat de Barcelona)

How does one prove that a particular abelian variety corresponds to a specific modular form? How can we show that two abelian varieties belong to the same isogeny class? In this talk, we will introduce the well-established "Faltings-Serre approach," a powerful method for comparing Galois representations. We will explore why this approach works, why it is effective and highlight recent developments and current research.

Joint work with Nuno Freitas.

**Thursday 16****11:30-11:50****[Room 0.3]****Jueves 16****11:30-11:50****[Aula 0.3]****Osteguna 16****11:30-11:50****[Gela 0.3]*****The form of a quadratic form*****Álvaro Serrano Holgado**

(Universidad de Salamanca)

The theory of binary quadratic forms, as developed by Fermat, Legendre, Gauss and others, is one of the cornerstones of Elementary Number Theory, due to its connections to number fields, the class number, and so on. We will see a more visual approach to quadratic forms, by means of what Conway called the "graph" of a quadratic form. This gives us simple new ways of proving some of the most important results of the theory, such as the classification problem or the finiteness of the class numbers.

**Thursday 16**

12:00-12:20

[Room 0.3]

**Jueves 16**

12:00-12:20

[Aula 0.3]

**Osteguna 16**

12:00-12:20

[Gela 0.3]

***Galois module theory for degree  $p$  extensions of  $p$ -adic fields*****Daniel Gil Muñoz**

(Charles University &amp; Università di Pisa)

Galois module theory aims to describe the structure of the ring of integers of Galois extensions of local and global fields as module over a suitable ring depending on the Galois group of the extension. Whether such a module is free or not is a problem of long-standing interest. In this talk we shall study these questions for ramified degree  $p$  extensions of  $p$ -adic fields, where  $p$  is an odd prime. If time permits, we will explore non-Galois generalizations of this problem to Hopf-Galois theory.

**Thursday 16**

12:30-12:50

[Room 0.3]

**Jueves 16**

12:30-12:50

[Aula 0.3]

**Osteguna 16**

12:30-12:50

[Gela 0.3]

***Monodromy and equidistribution*****Francisco García-Cortés**

(Universidad de Sevilla)

We review the phenomenon of equidistribution for Frobenius traces of local systems over varieties defined over finite fields and the role played by the monodromy group. In doing so we look at actual computational data obtained in concrete examples and we present cases in which the distribution is discrete, i.e. the underlying monodromy group is finite. We finish by reporting new local systems with finite monodromy group that were obtained in joint work with Antonio Rojas-León.

Original results were obtained jointly with Antonio Rojas-León.

[arXiv:2406.10385](https://arxiv.org/abs/2406.10385)

**Thursday 16****16:30-16:50****[Room 0.3]****Jueves 16****16:30-16:50****[Aula 0.3]****Osteguna 16****16:30-16:50****[Gela 0.3]**

*Intersections of the automorphism and  $p$ -rank strata in the moduli space of genus two curves*

**Alvaro Gonzalez Hernandez**

(University of Warwick)

There are two key invariants of a curve over  $\overline{\mathbb{F}_p}$ : its automorphism group and its  $p$ -rank. Therefore, it is natural to ask ourselves, if we pick  $G$  and  $f$ , is there a curve with automorphism group  $G$  and  $p$ -rank  $f$ ?

In this talk, I will answer this question for genus two curves by studying the intersection of the loci of curves with prescribed  $p$ -rank and with prescribed automorphism group, inside of the coarse moduli space of genus two curves.

**Thursday 16****17:00-17:20****[Room 0.3]****Jueves 16****17:00-17:20****[Aula 0.3]****Osteguna 16****17:00-17:20****[Gela 0.3]*****Serre-Tate theory*****Ines Borchers Arias**

(Princeton University)

Serre-Tate theory proves that studying deformation theory of abelian varieties in positive characteristic is a semi-linear algebraic problem, and gives a description of the deformation space of such abelian varieties. I will introduce the objects required to rigorously state these theorems and sketch their proofs.

**Thursday 16**

17:30-17:50

[Room 0.3]

**Jueves 16**

17:30-17:50

[Aula 0.3]

**Osteguna 16**

17:30-17:50

[Gela 0.3]

*Abelian varieties that split modulo all but finitely many primes***Enric Florit**

(Universitat de Barcelona)

It is well-known that abelian surfaces with QM split modulo almost all primes. This has earned them the name of fake elliptic curves, and they cannot be differentiated from the square of an elliptic curve by looking at a single local factor.

In this talk we will show that this is a more general phenomenon: when  $\text{End}(A)$  is non-commutative,  $A$  splits modulo all but finitely many primes  $p$  of  $k$ . This will involve a study division algebras, after which the result follows by applying Honda-Tate theory.

[arXiv:2404.08496](https://arxiv.org/abs/2404.08496)**Thursday 16**

18:00-18:20

[Room 0.3]

**Jueves 16**

18:00-18:20

[Aula 0.3]

**Osteguna 16**

18:00-18:20

[Gela 0.3]

 *$(r, \delta)$ -LRCs from evaluation codes***Helena Martín-Cruz**

(Universitat Jaume I)

Locally recoverable codes arose to treat the repair problem for large scale distributed and cloud storage systems. An  $(r, \delta)$ -LRC,  $C$ , is an error-correcting code such that any position in  $C$  can be recovered from at most  $r$  positions but tolerating other  $\delta - 1$  erasures. In this talk we give several families of optimal  $(r, \delta)$ -LRCs which are certain evaluation codes obtained when evaluating multivariate polynomials in a prefixed set of points.

These results were obtained jointly with C. Galindo and F. Hernando.

[doi:10.1007/s10623-024-01403-z](https://doi.org/10.1007/s10623-024-01403-z)

**AL04****Non-Associative Algebras and Applications****Álgebras No Asociativas y Aplicaciones****Organizers****Organizadores****Antolatzaileak****Alberto Daza García**

(Universidad de Sevilla)

**Xabier García Martínez**

(Universidade de Vigo)

**Andrés Pérez Rodríguez**

(Universidade de Santiago de Compostela)

**Description****Descripción****Deskribapena**

*The study of non-associative algebras naturally appears in numerous areas of mathematics. Historically, it was mainly represented by Lie algebras and Jordan algebras, providing methods in differential geometry, differential equations, and physics. Currently, it encompasses a multitude of research lines, such as evolution algebras (aimed at modeling non-Mendelian genetics), operads and their connection with algebraic topology, superalgebras, and more.*

*In this session, we will bring together a group of pre- and post-doctoral researchers with the goal of fostering collaborations and introducing the mathematical community to the topics in this area and their interactions.*

El estudio de álgebras no asociativas aparece de manera natural en multitud de áreas de las matemáticas. Históricamente estaba representado principalmente por las álgebras de Lie y las álgebras de Jordan, proporcionando métodos en geometría diferencial, ecuaciones diferenciales y física. Actualmente, cuenta con multitud de líneas de estudio, como las álgebras de evolución (con el objetivo de modelar la genética no-Mendeliana), las opéradas y su conexión con la topología algebraica, las superálgebras, etc.

En esta sesión reuniremos a un grupo de investigadores pre y post doctorales con el objetivo de fomentar colaboraciones y dar a conocer a la comunidad matemática los temas de esta área y sus interacciones.

**MSC Codes****Códigos MSC****MSC Kodeak**

17-XX

(primary)

15B30; 17BXX; 18-XX

(secondary)

## Slots

## Bloques

## Blokeak

2.A (Aula 0.2); 2.B (Aula 0.2); 2.C (Aula 0.2)

## QR Code

## Código QR

## QR Kodea



## Session Schedule

## Horario de la Sesión

## Saioaren Ordutegia

J16 | 11:00-11:20 | 0.2

*Gradings on associative triple systems*

**Alberto Daza Garcia** (Universidad de Sevilla)

J16 | 11:30-11:50 | 0.2

*Short  $SL_2 \times SL_2$ -structures on Lie algebras*

**Alejandra Sarina Córdova Martínez** (Universidad de Málaga)

J16 | 12:00-12:20 | 0.2

*Some results on compatible Lie algebras*

**Bernardo Leite da Cunha** (Universidade de Santiago de Compostela)

J16 | 12:30-12:50 | 0.2

*Twisted Lie algebras*

**Francisco de Paula Cuenca Carrégalo** (Universidad de Málaga)

J16 | 16:30-16:50 | 0.2

*Quadratically defined Lie algebras and HNN-extensions*

**Simone Blumer** (University of Vienna)

J16 | 17:00-17:20 | 0.2

*Double-double extension of quadratic Lie algebras*

**Javier Rández Ibáñez** (Universidad de La Rioja)



J16 | 17:30-17:50 | 0.2

*Skew-adjoint endomorphisms and generalized oscillator Lie algebras*

**Jorge Roldán-López** (Universidad de La Rioja)

J16 | 18:00-18:20 | 0.2

*On Loday-Pirashvilli Category*

**Alejandro Fernández Fariña** (Universidade de A Coruña)

V17 | 9:00-9:20 | 0.2

*Centroid and algebraic properties of evolution algebras through graphs*

**Iván Ruiz Campos** (Universidad de Málaga)

V17 | 9:30-9:50 | 0.2

*Gonosomal algebras and operators*

**Andrés Pérez Rodríguez** (Universidade de Santiago de Compostela)

**Thursday 16****11:00-11:20****[Room 0.2]****Jueves 16****11:00-11:20****[Aula 0.2]****Osteguna 16****11:00-11:20****[Gela 0.2]*****Gradings on associative triple systems*****Alberto Daza Garcia**

(Universidad de Sevilla)

Associative triple systems of the second kind is a nonassociative structure which acts as a bridge between structurable algebras related to an hermitian form and some 3-graded associative algebras with an involution. In this talk we explain how do we classify all gradings on associative triple systems.

[arXiv:2403.13775](https://arxiv.org/abs/2403.13775)**Thursday 16****11:30-11:50****[Room 0.2]****Jueves 16****11:30-11:50****[Aula 0.2]****Osteguna 16****11:30-11:50****[Gela 0.2]*****Short  $SL_2 \times SL_2$ -structures on Lie algebras*****Alejandra Sarina Córdova Martínez**

(Universidad de Málaga)

To generalise the notion of gradings by abelian groups Vinberg introduced the S-structures, where the S stands for a reductive group. Some research has been made on such structures for simple reductive groups. In this talk short( $SL_2 \times SL_2$ )-structures are shown to be used to cover a situation where the reductive group is the simplest semisimple but not simple reductive group.

Joint work with Patricia D. Beites, Isabel Cunha and Alberto Elduque.

[arXiv:2303.17993](https://arxiv.org/abs/2303.17993)

**Thursday 16****12:00-12:20****[Room 0.2]****Jueves 16****12:00-12:20****[Aula 0.2]****Osteguna 16****12:00-12:20****[Gela 0.2]*****Some results on compatible Lie algebras*****Bernardo Leite da Cunha**

(Universidade de Santiago de Compostela)

Given two Lie products on a vector space, they are said to be compatible if any linear combination of them is also a Lie product. We start with some basic definitions and results which are analogous to those of Lie algebras. Then, we explore the more complex notions such as nilpotency, solvability, semisimplicity and cohomology of compatible Lie algebras, highlighting the results that are analogous to the non-compatible case and those that differ significantly.

Joint work with Manuel Ladra and Samuel Lopes.

[arXiv:2406.04036](https://arxiv.org/abs/2406.04036)**Thursday 16****12:30-12:50****[Room 0.2]****Jueves 16****12:30-12:50****[Aula 0.2]****Osteguna 16****12:30-12:50****[Gela 0.2]*****Twisted Lie algebras*****Francisco de Paula Cuenca Carrégalo**

(Universidad de Málaga)

The compact simple Lie algebra  $\mathfrak{g}_2$  admits a nice model as a "twisted ring group". We ask whether there are more Lie algebras that fit this structure or, on the contrary, the case of  $\mathfrak{g}_2$  is an isolated example. We will show that there is an interesting collection of unknown solvable and nilpotent Lie algebras, obtained by graded contractions on the orthogonal Lie algebras of dimension 7 and 8, that can be described in this way.

Joint work with Cristina Draper Fontanals.

Thursday 16

16:30-16:50

[Room 0.2]

Jueves 16

16:30-16:50

[Aula 0.2]

Osteguna 16

16:30-16:50

[Gela 0.2]

*Quadratically defined Lie algebras and HNN-extensions***Simone Blumer**

(University of Vienna)

In this talk, we will delve into the class of Lie algebras defined by quadratic relations, investigating how their cohomology rings can be explicitly computed in certain cases. The theory of HNN-extensions plays a crucial role in this context, providing a powerful tool for decomposing these Lie algebras into smaller components. Moreover, we will explore how HNN-extensions can be used to embed finitely presented positively graded Lie algebras into quadratic ones.

Thursday 16

17:00-17:20

[Room 0.2]

Jueves 16

17:00-17:20

[Aula 0.2]

Osteguna 16

17:00-17:20

[Gela 0.2]

*Double-double extension of quadratic Lie algebras***Javier Rández Ibáñez**

(Universidad de La Rioja)

The class of quadratic Lie algebras is broad and challenging to classify. Lorentzian algebras, those with Witt index equal to 1, can be classified using the double extension method (Medina and Revoy, 1985) starting from an orthogonal vector space (Benito et al., 2024). The next natural step involves quadratic Lie algebras with Witt index equal to 2. This class can be constructed by means of two double extensions, and we attempt to classify the algebras in the class from this perspective.

Joint work with Pilar Benito and Jorge Roldán-López.

[arXiv:2401.03100](https://arxiv.org/abs/2401.03100)

**Thursday 16****17:30-17:50****[Room 0.2]****Jueves 16****17:30-17:50****[Aula 0.2]****Osteguna 16****17:30-17:50****[Gela 0.2]*****Skew-adjoint endomorphisms and generalized oscillator Lie algebras*****Jorge Roldán-López**

(Universidad de La Rioja)

This talk focuses on skew-adjoint endomorphisms and their role in constructing quadratic Lie algebras. We are introducing generalized oscillator algebras, which arise from double extensions of abelian Lie algebras by skew-adjoint derivations. Later, we will proceed to the classification of oscillator nilpotent algebras and those with quadratic dimension 2 recovering the classification of real oscillator algebras, also known as Lorentzian algebras.

Joint work with Pilar Benito and Javier Rández-Ibáñez.

[arXiv:2401.03100](https://arxiv.org/abs/2401.03100)**Thursday 16****18:00-18:20****[Room 0.2]****Jueves 16****18:00-18:20****[Aula 0.2]****Osteguna 16****18:00-18:20****[Gela 0.2]*****On Loday-Pirashvili Category*****Alejandro Fernández Fariña**

(Universidade de A Coruña)

In 1998, Loday and Pirashvili they equipped the category  $\mathbf{LM}$  of linear maps of vector spaces with a tensor product, constructing the Loday-Pirashvili category. This tensor product allows them to do various constructions related to Leibniz algebras; in this monoidal category, a Leibniz algebra becomes a Lie object. In this talk we will introduce this category and show that its construction can be done for categories other than vector spaces asking for some conditions that are not very restrictive.

Friday 17  
9:00-9:20  
[Room 0.2]

Viernes 17  
9:00-9:20  
[Aula 0.2]

Ostirala 17  
9:00-9:20  
[Gela 0.2]

*Centroid and algebraic properties of evolution algebras through graphs*

**Iván Ruiz Campos**

(Universidad de Málaga)

The aim of this talk is linking algebraic properties of an evolution algebra with combinatorial properties of the graphs that one can associate. We also provide a description of the prime ideals and prove that certain algebraic properties, such as semiprimeness and perfection, can not be characterized in combinatorial terms. In addition, we describe the centroid of evolution algebras as constant functions along the connected components of its associated graph.

Joint work with Yolanda Cabrera Casado, Daniel Gonçalves, Maria Inez Gonçalves Cardoso, Dolores Martín Barquero, and Cándido Martín González.

[arXiv:2404.08752](https://arxiv.org/abs/2404.08752)

Friday 17  
9:30-9:50  
[Room 0.2]

Viernes 17  
9:30-9:50  
[Aula 0.2]

Ostirala 17  
9:30-9:50  
[Gela 0.2]

*Gonosomal algebras and operators*

**Andrés Pérez Rodríguez**

(Universidade de Santiago de Compostela)

The main objective of this talk is to make a brief approach to gonosomal algebra theory. Gonosomal algebras were introduced with the purpose of modelling a wide variety of sex determination systems observed in bisexual populations. We will comment on some of the numerous constructions and examples presented in R. Varro's *Gonosomal algebras* and study their dynamics by constructing the associated gonosomal operator.

Joint work with Yolanda Cabrera Casado and Manuel Ladra.

**AL05****Applied Nonlinear Algebra****Álgebra No Lineal Aplicada****Organizers****Organizadores****Antolatzaileak****Carles Checa**

(University of Copenhagen)

**Rodrigo Iglesias**

(Universidad de la Rioja)

**Pablo Mazón**

(Università di Trento)

**Elvira Pérez-Callejo**

(Universitat Jaume I)

**Description****Descripción****Deskribapena**

*Systems of polynomial equations model problems appearing in a wide range of applications. Understanding the algebraic structure and the geometry of their solution set is a widely known mathematical challenge, which can be addressed from the point of view of commutative algebra, algebraic geometry, combinatorics, tropical geometry, and other related areas. All these trends are captured under the term "nonlinear algebra".*

*The list of invited speakers includes 12 international young researchers, pre and post-doctoral, working in diverse areas lying on nonlinear algebra. We hope that this session brings positive synergies to the community, and helps researchers put in common different insights and perspectives in this field.*

Los sistemas de ecuaciones polinomiales modelan problemas que aparecen en una variedad de aplicaciones. Comprender la estructura algebraica y la geometría de sus soluciones es un reto matemático ampliamente reconocido, que puede abordarse desde los puntos de vista del álgebra conmutativa, la geometría algebraica, la combinatoria, la geometría tropical y otras áreas relacionadas. Todas éstas puede enmarcarse como "álgebra no lineal".

La lista de ponentes invitados incluye 12 jóvenes investigadores internacionales, pre y postdoctorales, que trabajan en diversos campos dentro del álgebra no lineal. Esperamos que esta sesión aporte sinergias positivas a la comunidad y ayude a los investigadores a poner en común ideas y perspectivas.

| MSC Codes | Códigos MSC  | MSC Kodeak |
|-----------|--|------------|
|           | 13P10<br>(primary)   |            |
|           | 13P15; 13P20; 13P25; 14Q05; 14Q20; 14Q30; 14T20; 14T90; 68W30<br>(secondary) |            |
| Slots     | Bloques  | Blokeak    |
|           | 2.A (Aula 0.5); 2.B (Aula 0.5); 2.C (Aula 0.5)                               |            |

| QR Code | Código QR  | QR Kodea |
|---------|--|----------|
|         |  |          |

| Session Schedule   | Horario de la Sesión | Saioaren Ordutegia |
|--|----------------------|--------------------|
| J16   11:00-11:20   0.5<br><i>A BBD-engine for computations on monomial ideals</i><br><b>Laura Moreno Resa</b> (Universidad de La Rioja)       |                      |                    |
| J16   11:30-11:50   0.5<br><i>Complexity measures of m-ary functions</i><br><b>Sara Asensio Ferrero</b> (Universidad de Valladolid)            |                      |                    |
| J16   12:00-12:20   0.5<br><i>Algebraic invariants associated to graph coloring</i><br><b>Raquel Melgar Fernández</b> (Université de Bordeaux) |                      |                    |
| J16   16:30-16:50   0.5<br><i>On strong Euler-homogeneity for free divisors</i><br><b>Abraham del Valle</b> (Universidad de Sevilla)           |                      |                    |



J16 | 17:00-17:20 | 0.5

*Hadamard products and where to find them*

**Dario Antolini** (Università di Trento)

J16 | 18:00-18:20 | 0.5

*Lower and Upper Bounds for the Riesz Energy on the Grassmannian*

**Pedro R. López-Gómez** (Universidad de Cantabria)

V17 | 9:00-9:20 | 0.5

*Computational aspects of the short resolution*

**Mario González-Sánchez** (Universidad de Valladolid)

V17 | 9:30-9:50 | 0.5

*Cox rings of blow-ups of the projective space*

**Luis José Santana Sánchez** (Universidad de La Laguna)

V17 | 10:00-10:20 | 0.5

*Algebraic geometry meets game theory: Spohn CI varieties*

**Javier Sendra Arranz** (CUNEF Universidad)

V17 | 10:30-10:50 | 0.5

*Proudfoot-Speyer degenerations of scattering equations*

**Barbara Betti** (MPI MiS Leipzig)

**Thursday 16****11:00-11:20****[Room 0.5]****Jueves 16****11:00-11:20****[Aula 0.5]****Osteguna 16****11:00-11:20****[Gela 0.5]*****A BDD-engine for computations on monomial ideals*****Laura Moreno Resa**

(Universidad de La Rioja)

Binary Decision Diagrams (BDDs) are efficient structures for solving logic-related problems. This talk covers BDD fundamentals and explores their use in fields like commutative algebra and reliability theory. We analyze the connection between different combinatorial objects, optimizing its computational efficiency. Practical applications of BDDs using C++ libraries CoCoALib and TeDDy show improvements for monomial ideal calculations, significantly enhancing performance in real-world problems.

Joint work with Eduardo Sáenz de Cabezón.

**Thursday 16****11:30-11:50****[Room 0.5]****Jueves 16****11:30-11:50****[Aula 0.5]****Osteguna 16****11:30-11:50****[Gela 0.5]*****Complexity measures of  $m$ -ary functions*****Sara Asensio Ferrero**

(Universidad de Valladolid)

The study of the relations between different complexity measures of boolean functions led Nisan and Szegedy to state the sensitivity conjecture in 1994. This problem was solved in 2019, when Huang proved the conjecture by means of an equivalent reformulation of the problem in graph theory. We wonder if the same type of results hold for functions defined on finite alphabets of cardinality  $m$  greater than two, which we call  $m$ -ary functions, and we extend most of the results for boolean functions.

Joint work with Ignacio García-Marco and Kolja Knauer.

**Thursday 16****12:00-12:20****[Room 0.5]****Jueves 16****12:00-12:20****[Aula 0.5]****Osteguna 16****12:00-12:20****[Gela 0.5]*****Algebraic invariants associated to graph coloring*****Raquel Melgar Fernández**

(Université de Bordeaux)

In 1995 Stanley defined  $X_G(\mathbf{x})$  the chromatic symmetric function of a graph  $G$ , which specializes to  $\chi_G(k)$ , the polynomial counting proper colorings of  $G$ . In 2017 Shareshian, Wachs and Ellzey defined a refinement of this function for a directed graph that happens to be in the algebra of quasisymmetric functions that is of great interest in combinatorics. Our aim is to extend this work to signed graphs taking into account the hyperplane arrangement viewpoint of this problem.

**Thursday 16****16:30-16:50****[Room 0.5]****Jueves 16****16:30-16:50****[Aula 0.5]****Osteguna 16****16:30-16:50****[Gela 0.5]*****On strong Euler-homogeneity for free divisors*****Abraham del Valle**

(Universidad de Sevilla)

In 2002, it was conjectured that a free divisor satisfying the so-called Logarithmic Comparison Theorem must be strongly Euler-homogeneous and it was proved for the two-dimensional case. In 2006, it was shown that the conjecture is also true in dimension three, but, today, the answer for the general case remains unknown. In this talk I will give a new characterization of strong Euler-homogeneity that will allow us to deduce some partial answers to this problem.

**Thursday 16**

17:00-17:20

[Room 0.5]

**Jueves 16**

17:00-17:20

[Aula 0.5]

**Osteguna 16**

17:00-17:20

[Gela 0.5]

***Hadamard products and where to find them*****Dario Antolini**

(Università di Trento)

The Hadamard product of two projective varieties  $X$  and  $Y$  is the Zariski closure of the set of all coordinate-wise products of an element in  $X$  and an element in  $Y$ , when this is defined. Although their definition is highly coordinate-dependent, they arise in different applications, such as the study of rigidity of plane graphs and of Restricted Boltzmann Machines. We focus on these applications and how they lead to interesting questions in Tropical Geometry and Matroid Theory.

Joint work with Nathaniel Vaduthala, Alessandro Oneto, and Guido Montúfar.

**Thursday 16**

18:00-18:20

[Room 0.5]

**Jueves 16**

18:00-18:20

[Aula 0.5]

**Osteguna 16**

18:00-18:20

[Gela 0.5]

***Lower and Upper Bounds for the Riesz Energy on the Grassmannian*****Pedro R. López-Gómez**

(Universidad de Cantabria)

In recent years, the problem of minimizing certain pairwise interaction energies on compact Riemannian manifolds has attracted the interest of both the pure and applied mathematical community. In this talk, I will introduce the problem of minimizing the Riesz energy on the Grassmann manifold and I will present for the first time lower and upper bounds for the minimal Riesz energy on this space.

Joint work with Ujué Etayo.

Friday 17  
9:00-9:20  
[Room 0.5]

Viernes 17  
9:00-9:20  
[Aula 0.5]

Ostirala 17  
9:00-9:20  
[Gela 0.5]

*Computational aspects of the short resolution*

**Mario González-Sánchez**

(Universidad de Valladolid)

Let  $I \subset R = k[x_1, \dots, x_n]$  be a homogeneous ideal of height  $n - d$ , and assume that  $A = k[x_{n-d+1}, \dots, x_n]$  is a Noether normalization of  $R/I$ . The minimal graded free resolution of  $R/I$  as  $A$ -module is called its short resolution. In this talk we will show how to compute the short resolution using Gröbner bases. Moreover, we will discuss its advantages over the usual resolution when computing invariants such as the Hilbert series or the Castelnuovo-Mumford regularity of  $R/I$ .

Joint work with Ignacio García-Marco and Philippe Gimenez.

Friday 17  
9:30-9:50  
[Room 0.5]

Viernes 17  
9:30-9:50  
[Aula 0.5]

Ostirala 17  
9:30-9:50  
[Gela 0.5]

*Cox rings of blow-ups of the projective space*

**Luis José Santana Sánchez**

(Universidad de La Laguna)

In this talk we will discuss Cox rings of point blow-ups of the projective space. In particular, from the work of Castravet and Tevelev on the Cox ring of the projective space blown-up at points on a rational normal curve, we will see how to establish a stable base locus theorem for divisors on such a space.

Friday 17  
10:00-10:20  
[Room 0.5]

Viernes 17  
10:00-10:20  
[Aula 0.5]

Ostirala 17  
10:00-10:20  
[Gela 0.5]

*Algebraic geometry meets game theory: Spohn CI varieties*

**Javier Sendra Arranz**

(CUNEF Universidad)

In recent years, algebraic geometry has been used to study Nash and dependency equilibria, which model scenarios where players behave independently and collectively, respectively. The gap between these opposite notions is filled by the CI equilibria of a graph, where complicated dependencies among players are modeled by the graph. We analyze the geometry of CI equilibria through the algebro-geometric study of the Spohn CI variety. This work is based on a joint effort with Irem Portakal.

Joint work with Irem Portakal.

Friday 17  
10:30-10:50  
[Room 0.5]

Viernes 17  
10:30-10:50  
[Aula 0.5]

Ostirala 17  
10:30-10:50  
[Gela 0.5]

*Proudfoot-Speyer degenerations of scattering equations*

**Barbara Betti**

(MPI MiS Leipzig)

We study scattering equations of hyperplane arrangements with techniques of nonlinear algebra. We restate the problem as linear equations on a reciprocal linear space and solve it with a homotopy algorithm. This is based on the Gröbner degeneration of the coordinate ring into the Stanley-Reisner ring of the broken circuit complex. We study the regularity of the ideal defined by the equations and apply our methods to scattering equations.

Joint work with Viktoriia Borovik and Simon Telen.

**AL06****Algebraic Geometry****Geometría Algebraica****Organizers****Alicia Tocino Sánchez**

(Universidad de Málaga)

**Organizadores****Alfonso Zamora Saiz**

(Universidad Politécnica de Madrid)

**Antolatzaileak****Erroxe Etxabarri Alberdi**

(University of Warwick)

**Description****Descripción****Deskribapena**

*In this parallel session we intend to have presentations by young researchers representing, as far as possible, the diversity of research areas that are either framed in the field of algebraic geometry or make use of its techniques: derived algebraic geometry, moduli spaces, homotopy theory, enumerative geometry, local cohomology of schemes, étale fundamental group, Brill-Noether theory, multilinear algebra and tensor product...*

En esta sesión paralela pretendemos contar con las ponencias de investigadores jóvenes representando, en la medida de lo posible, la diversidad de las áreas de investigación que, o bien están enmarcadas en el campo de la geometría algebraica, o bien hacen uso de sus técnicas: geometría algebraica derivada, espacios de moduli, teoría de homotopía, geometría enumerativa, cohomología local de esquemas, grupo fundamental étale, teoría de Brill-Noether, álgebra multilineal y producto tensorial...

**MSC Codes****Códigos MSC****MSC Kodeak**

14Dxx

(primary)

14D06; 14D07; 14D20; 14D22; 14D23; 14F08; 14A30; 15A69

(secondary)

**Slots****Bloques****Blokeak**

1.A (Aula 0.2); 1.B (Aula 0.2); 1.C (Aula 0.2)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

L13 | 17:30-17:50 | 0.2

*On the vanishing of the hyperdeterminant under certain symmetry conditions***Alicia Tocino** (Universidad de Málaga)

L13 | 18:00-18:20 | 0.2

*Local homology and cohomology on Thomason subsets***Raúl Alvite Pazó** (Universidade de Santiago de Compostela)

L13 | 18:30-18:50 | 0.2

*Cohomology of moduli spaces via stacks***Andres Fernandez Herrero** (University of Pennsylvania)

L13 | 19:00-19:20 | 0.2

*Blowing up sheaves to count curves***Alberto Cobos Rabano** (KU Leuven)

M14 | 16:00-16:20 | 0.2

*Brill-Noether Theory of stable bundles on ruled surfaces***Irene Macías Tarrío** (Universitat de Barcelona)

M14 | 16:30-16:50 | 0.2

*Automorphisms of Jacobians and a Generic Prym-Torelli Theorem***Irene Spelta** (HU Berlin)

M14 | 17:30-17:50 | 0.2

*Galois coverings of algebraic curves.***Diego Alba Alonso** (Universidad de Salamanca)



M14 | 18:00-18:20 | 0.2

*Character Varieties in Knot Theory*

**Alejandro Calleja** (UCM-ICMAT)

M14 | 18:30-18:50 | 0.2

*Ultrasolid Geometry and Deformation Theory*

**Sofia Marlasca Aparicio** (University of Oxford)

M14 | 19:00-19:20 | 0.2

*The  $p$ -adic Jaynes Cummings model*

**Luis Crespo** (Universidad de Cantabria)

**Monday 13****17:30-17:50****[Room 0.2]****Lunes 13****17:30-17:50****[Aula 0.2]****Astelehena 13****17:30-17:50****[Gela 0.2]*****On the vanishing of the hyperdeterminant under certain symmetry conditions*****Alicia Tocino**

(Universidad de Málaga)

Given a vector space  $V$  over a field  $K$  whose characteristic is coprime with  $d!$ , let us decompose the vector space of  $d$ -multilinear forms according to the different partitions of  $d$ , that is. the different representations of the symmetric group of order  $d$ . In this talk we first give a more refined decomposition of it into smaller pieces. We then prove the vanishing of the hyperdeterminant of multilinear forms belonging to some of these slices.

Joint with Enrique Arrondo.

[arXiv:2407.06603](https://arxiv.org/abs/2407.06603)

**Monday 13****18:00-18:20****[Room 0.2]****Lunes 13****18:00-18:20****[Aula 0.2]****Astelehena 13****18:00-18:20****[Gela 0.2]*****Local homology and cohomology on Thomason subsets*****Raúl Alvite Pazó**

(Universidade de Santiago de Compostela)

Local homology and cohomology supported in a closed subset  $Z$  of a quasi-compact and separated scheme were studied by Alonso, Jeremías and Lipman in 1997, where they introduced weakly proregular sequences as the key concept to relate them. In this talk we extend the results about local cohomology to Thomason subsets by considering suitable topological and algebraic torsion functors. We will also discuss the extension of the completion functor, local homology and duality in this context.

Joint work with Leo Alonso and Ana Jeremías.

**Monday 13****18:30-18:50****[Room 0.2]****Lunes 13****18:30-18:50****[Aula 0.2]****Astelehena 13****18:30-18:50****[Gela 0.2]*****Cohomology of moduli spaces via stacks*****Andres Fernandez Herrero**

(University of Pennsylvania)

If two varieties  $X$  and  $Y$  belong to a smooth projective family over a connected base, then they share many geometric properties. For example, they are homeomorphic and their Hodge numbers agree. Unfortunately, in moduli theory it is common to deal with moduli spaces that are singular, even when they come from GIT quotients of smooth varieties. I will explain how to use local structure theorems for stacks to relate the geometry of two such moduli spaces, even when neither  $X$  nor  $Y$  are smooth.

Joint work with Mark de Cataldo and Andres Ibanez Nunez.

**Monday 13****19:00-19:20****[Room 0.2]****Lunes 13****19:00-19:20****[Aula 0.2]****Astelehena 13****19:00-19:20****[Gela 0.2]*****Blowing up sheaves to count curves*****Alberto Cobos Rabano**

(KU Leuven)

The blow-up of a scheme along an ideal sheaf is a key tool in algebraic geometry due to Hironaka's resolution of singularities. Hugo Rossi introduced a more general construction: from a coherent sheaf on a scheme, it returns a new scheme where the torsion-free part of the sheaf is locally free. We apply this construction in enumerative geometry to define reduced Gromov–Witten invariants of complete intersections in any genus, extending the work of Li–Vakil–Zinger in genus one.

Joint work with Etienne Mann, Cristina Manolache and Renata Picciotto.

[arXiv:2310.06727](https://arxiv.org/abs/2310.06727)

**Tuesday 14**  
**16:00-16:20**  
**[Room 0.2]**

**Martes 14**  
**16:00-16:20**  
**[Aula 0.2]**

**Asteartea 14**  
**16:00-16:20**  
**[Gela 0.2]**

***Brill-Noether Theory of stable bundles on ruled surfaces***

**Irene Macías Tarrío**

(Universitat de Barcelona)

Let  $\mathcal{M}_X(r; c_1, \dots, c_s)$  be the moduli space of rank- $r$  stable vector bundles on  $X$  with respect to an ample divisor  $H$  on a projective variety  $X$ , and with fixed Chern classes  $c_i$ . To study the geometry of these moduli spaces, one examines their subvarieties called Brill-Noether loci, whose points correspond to stable vector bundles with at least  $k$  independent sections. The talk focus on new results concerning the non-emptiness of Brill-Noether loci for rank-2 vector bundles on ruled surfaces.

Joint work with Laura Costa Farras.

[arXiv:2401.11578](https://arxiv.org/abs/2401.11578)

**Tuesday 14**  
**16:30-16:50**  
**[Room 0.2]**

**Martes 14**  
**16:30-16:50**  
**[Aula 0.2]**

**Asteartea 14**  
**16:30-16:50**  
**[Gela 0.2]**

***Automorphisms of Jacobians and a Generic Prym-Torelli Theorem***

**Irene Spelta**

(HU Berlin)

In general, it is very hard to construct explicit families of Jacobian of curves with many (non-polarized) automorphisms. In this talk, we will show how they appear when considering cyclic, unramified, degree  $d$  coverings of hyperelliptic genus  $g$  curves. Via a monodromy argument, we will prove that the generic element  $J_C$  of the family is simple. This describes the endomorphism algebra of  $J_C$ , as well as its units. As a consequence, we prove that certain Prym maps are generically injective.

Joint work with J.C. Naranjo, A. Ortega, and P. Pirola.

**Tuesday 14**  
**17:30-17:50**  
**[Room 0.2]**

**Martes 14**  
**17:30-17:50**  
**[Aula 0.2]**

**Asteartea 14**  
**17:30-17:50**  
**[Gela 0.2]**

*Galois coverings of algebraic curves.*

**Diego Alba Alonso**

(Universidad de Salamanca)

A. Grothendieck, in the SGA I, presented the algebraic fundamental group of a connected scheme. This object classifies the finite étale covers of the scheme. Almost simultaneously, D.K. Harrison presented an object which classifies the Galois extensions of given group of a commutative ring, later named the Harrison group. The objective of this talk is to present explicitly the relationship between the algebraic fundamental group of a curve and the Harrison group of its function field.

**Tuesday 14**  
**18:00-18:20**  
**[Room 0.2]**

**Martes 14**  
**18:00-18:20**  
**[Aula 0.2]**

**Asteartea 14**  
**18:00-18:20**  
**[Gela 0.2]**

*Character Varieties in Knot Theory*

**Alejandro Calleja**

(UCM-ICMAT)

Given an algebraic group  $G$  and a knot  $K \subseteq \mathbb{R}^3$ , we define the  $G$ -character variety of  $K$  as the moduli of representations  $\rho : \pi_1(\mathbb{R}^3 - K) \rightarrow G$  of the knot group into  $G$ . The importance of these varieties lies in the fact that their study provides in a natural way many knot invariants. In this talk, we will introduce one of the most important of these invariants, the E-polynomial, exposing the techniques used to study them, as well as the main results known, focusing on the case of torus knots.

Joint work with Ángel González-Prieto.

Tuesday 14

18:30-18:50

[Room 0.2]

Martes 14

18:30-18:50

[Aula 0.2]

Asteartea 14

18:30-18:50

[Gela 0.2]

*Ultrasolid Geometry and Deformation Theory***Sofía Marlasca Aparicio**

(University of Oxford)

We present the theory of ultrasolid modules over a field (first proposed by Dustin Clausen), which generalises the solid modules over  $\mathbb{Q}$  or  $\mathbb{F}_p$  of Clausen and Scholze. Ultrasolid modules are a notion of complete modules over a discrete field. We build some basic results in ultrasolid commutative algebra, study its derived variants, and finally apply this to the deformation of algebraic varieties.

[arXiv:2406.04063](https://arxiv.org/abs/2406.04063)

Tuesday 14

19:00-19:20

[Room 0.2]

Martes 14

19:00-19:20

[Aula 0.2]

Asteartea 14

19:00-19:20

[Gela 0.2]

*The  $p$ -adic Jaynes Cummings model***Luis Crespo**

(Universidad de Cantabria)

The notion of classical  $p$ -adic integrable system on a  $p$ -adic symplectic manifold was proposed by Pelayo, Voevodsky and Warren a decade ago in analogy with the real case. In this talk we introduce, from the viewpoint of symplectic geometry and topology, the basic properties of the  $p$ -adic version of the classical Jaynes-Cummings model, which is a fundamental example of integrable system going back to the work of Jaynes and Cummings in the 1960s.

Joint work with Álvaro Pelayo.

[arXiv:2406.18415](https://arxiv.org/abs/2406.18415)

AL07

Singularity Theory

Teoría de Singularidades

Singularitateen Teoria

| Organizers  | Organizadores  | Antolatzaileak |
|---|--|----------------|
| <b>Irene Macías Tarrío</b><br>(Universidad de Barcelona)            | <b>Abraham del Valle Rodríguez</b><br>(Universidad de Sevilla) |                |
| <b>Joel Castillo Rey</b><br>(Basque Center for Applied Mathematics) |  |                |

| Description  | Descripción | Deskribapena |
|--|-------------|--------------|
| <i>This session is composed of nine talks concerning different aspects of the study of singularities, both in characteristic zero and positive. Concretely, we will cover topics such as singularities of plane curves, Higgs bundles, singularities of mappings, Hilbert-Kunz theory and Floer theory, among others.</i>  |             |              |
| Esta sesión está compuesta por nueve charlas que tratarán diversos aspectos relacionados con el estudio de las singularidades, tanto en característica cero como en característica positiva. En concreto, se abarcarán temas como singularidades de curvas planas, fibrados de Higgs, singularidades de aplicaciones, teoría de Hilbert-Kunz y teorías Floer, entre otros. |             |              |

| MSC Codes | Códigos MSC  | MSC Kodeak |
|-----------|--|------------|
|           | 14B05<br>(primary)   |            |
|           | 13D40; 57R45; 32S65; 14F10; 14C17; 14E18; 14D20<br>(secondary) |            |

| Slots | Bloques  | Blokeak |
|-------|--|---------|
|       | 2.A (Aula 0.6); 2.B (Aula 0.6); 2.C (Aula 0.6) |         |

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

J16 | 11:00-11:20 | 0.6

*Foliations with a given set of singular points***Elvira Pérez-Callejo** (Universitat Jaume I)

J16 | 11:30-11:50 | 0.6

*Weighted-homogeneity and substantiality***Ignacio Breva Ribes** (Universitat de València)

J16 | 12:00-12:20 | 0.6

*Vanishing homology of frontal map germs***Christian Muñoz-Cabello** (Universitat de València)

J16 | 12:30-12:50 | 0.6

*Good real pictures of complex maps***Roberto Giménez Conejero** (Mid Sweden University)

J16 | 16:30-16:50 | 0.6

*Arc spaces in algebraic geometry and Floer theories in symplectic topology. A mysterious relation***Javier de la Bodega** (Alfréd Rényi Institute of Mathematics)

J16 | 17:00-17:20 | 0.6

*New versions of Frobenius and integral closure of ideals***Kriti Goel** (BCAM)

J16 | 17:30-17:50 | 0.6

*Holomorphic structures and the Chern correspondence for bundles with non-reductive structure group.***Diego Ruiz-Cases** (ICMAT-UCM)



V17 | 9:30-9:50 | 0.6

*Line arrangements on smooth cubic surfaces*

**Juan Carlos Castro Rivera** (Universidad de Zaragoza)

V17 | 10:00-10:20 | 0.6

*Stratification of the moduli space of plane branches with a single characteristic exponent*

**María de Leyva Elola-Olaso** (Universitat Politècnica de Catalunya)

V17 | 10:30-10:50 | 0.6

*Stratification by the poles of the complex zeta function of  $\mu$ -constant plane branch deformations*

**Roger Gómez-López** (Universitat Politècnica de Catalunya)

**Thursday 16****11:00-11:20****[Room 0.6]****Jueves 16****11:00-11:20****[Aula 0.6]****Osteguna 16****11:00-11:20****[Gela 0.6]*****Foliations with a given set of singular points*****Elvira Pérez-Callejo**

(Universitat Jaume I)

Let  $C = \{p_i\}_{i=1}^n$  be the set of centers of a sequence of blowups. We pose the problem of finding a foliation with the points of  $C$  as singular points. We provide an answer in which the points are also dicritical for the foliation and the foliation is algebraically integrable. We apply this result to an approach to the bounded negativity conjecture.

Joint work with Carlos Galindo and Francisco Monserrat.

**Thursday 16****11:30-11:50****[Room 0.6]****Jueves 16****11:30-11:50****[Aula 0.6]****Osteguna 16****11:30-11:50****[Gela 0.6]*****Weighted-homogeneity and substantiality*****Ignacio Breva Ribes**

(Universitat de València)

Characterization of weighted-homogeneity is clear for functions with isolated singularity in terms of equality of Milnor and Tjurina number, thanks to Saito. The generalization to map-germs is still an open problem, Mond's conjecture. In this talk we relate the property of being weighted-homogeneous to that of being substantial, by studying the vector fields tangent to the image (or discriminant) of its stable unfolding.

Joint work with Raúl Oset Sinha.

Thursday 16

12:00-12:20

[Room 0.6]

Jueves 16

12:00-12:20

[Aula 0.6]

Osteguna 16

12:00-12:20

[Gela 0.6]

*Vanishing homology of frontal map germs***Christian Muñoz-Cabello**

(Universitat de València)

A holomorphic  $f : U \subseteq \mathbb{C}^n \rightarrow \mathbb{C}^{n+1}$  is frontal if its image admits a smooth field of tangent hyperplanes at every point. In this talk, we explore the vanishing homology of frontal map germs, defining an analogue of the image Milnor number and giving formulas for its computation in corank 1. We will also discuss the Mond conjecture in the context of frontal map germs, outlining the cases where it is known to be true and postulating a Mond-type conjecture.

Joint work with Juan José Nuño-Ballesteros and Raúl Oset Sinha.

[arXiv:2407.16635](https://arxiv.org/abs/2407.16635)

Thursday 16

12:30-12:50

[Room 0.6]

Jueves 16

12:30-12:50

[Aula 0.6]

Osteguna 16

12:30-12:50

[Gela 0.6]

*Good real pictures of complex maps***Roberto Giménez Conejero**

(Mid Sweden University)

For a holomorphic map germ  $f_{\mathbb{C}}(C^n, 0) \rightarrow (C^p, 0)$ , the problem we study is finding a real map germ  $f_{\mathbb{R}} : (R^n, 0) \rightarrow (R^p, 0)$  such that its complexification is equivalent to  $f_{\mathbb{C}}$  and all the topological data of  $f_{\mathbb{C}}$  can be found in  $f_{\mathbb{R}}$ . More precisely, one wants to find that the topology of the a generic perturbation of  $f_{\mathbb{C}}$  (equivalent of the Milnor fiber for maps) is realised as a real object.

Joint work with Ignacio Brevia Ribes.

**Thursday 16****16:30-16:50****[Room 0.6]****Jueves 16****16:30-16:50****[Aula 0.6]****Osteguna 16****16:30-16:50****[Gela 0.6]*****Arc spaces in algebraic geometry and Floer theories in symplectic topology. A mysterious relation*****Javier de la Bodega**

(Alfréd Rényi Institute of Mathematics)

Two invariants can be attached to a hypersurface singularity: contact loci, sets of arcs with a fixed intersection multiplicity, and the Milnor fibration. In 2019, Budur, Bobadilla et al. conjectured that the cohomology of contact loci equals the Floer homology of the iterates of a symplectic monodromy. In this talk, we will give an overview of the problem and explain how de Lorenzo Poza and the speaker solved the conjecture for plane curves. Also, we will present some related on-going projects.

Joint work with Eduardo de Lorenzo Poza.

[arXiv:2308.00051](#)

[arXiv:2408.01533](#)

**Thursday 16****17:00-17:20****[Room 0.6]****Jueves 16****17:00-17:20****[Aula 0.6]****Osteguna 16****17:00-17:20****[Gela 0.6]*****New versions of Frobenius and integral closure of ideals*****Kriti Goel**

(BCAM)

We define new versions of integral and Frobenius closures of ideals which incorporate an auxiliary ideal and a real parameter. In the case of tight closure, similar generalizations exist due to N. Hara and K.I. Yoshida, as well as A. Vraciu. We study their basic properties and give computationally effective calculations of the new tight, Frobenius, and integral closures in the case of affine semigroup rings in terms of the convex geometry of exponent sets.

Joint work with Kyle Maddox and William D. Taylor.

**Thursday 16****17:30-17:50****[Room 0.6]****Jueves 16****17:30-17:50****[Aula 0.6]****Osteguna 16****17:30-17:50****[Gela 0.6]**

*Holomorphic structures and the Chern correspondence for bundles with non-reductive structure group.*

**Diego Ruiz-Cases**

(ICMAT-UCM)

The aim of this talk is to report on some ongoing work to prove a Hitchin-Kobayashi correspondence for principal bundles  $E$  with non-reductive algebraic structure group. A first step (the Chern correspondence) is to identify holomorphic structures on  $E$  with unitary connections on a reduction of the structure group to a Levi subgroup plus a section of an associated bundle. This generalizes the known cases of extensions and filtrations of vector bundles.

Joint work with Oscar García-Prada.

**Friday 17****9:30-9:50****[Room 0.6]****Viernes 17****9:30-9:50****[Aula 0.6]****Ostirala 17****9:30-9:50****[Gela 0.6]**

*Line arrangements on smooth cubic surfaces*

**Juan Carlos Castro Rivera**

(Universidad de Zaragoza)

It is well known that any smooth cubic surface  $S$  contains exactly 27 lines  $L$  and that they can be built blowing-up 6 general points in  $\mathbb{P}^2$ , so  $S \setminus L$  is homeomorphic to the complement of a plane curve  $C$ . We study the relationship between the stratification of the moduli space of  $(S, L)$  using the number and position of Eckardt points by means of the fundamental group  $\pi_1(\mathbb{P}^2 \setminus C)$ .

Friday 17  
10:00-10:20  
[Room 0.6]

Viernes 17  
10:00-10:20  
[Aula 0.6]

Ostirala 17  
10:00-10:20  
[Gela 0.6]

*Stratification of the moduli space of plane branches with a single characteristic exponent*

**María de Leyva Elola-Olaso**

(Universitat Politècnica de Catalunya)

We study the moduli space of plane branches with a single characteristic exponent through a stratification using the semimodule of values of the Jacobian ideal of the branch. We provide an algorithmic procedure to describe the strata and their dimensions. This stratification refines a previously known one based on the Zariski invariant studied by Peraire in 1998.

Friday 17  
10:30-10:50  
[Room 0.6]

Viernes 17  
10:30-10:50  
[Aula 0.6]

Ostirala 17  
10:30-10:50  
[Gela 0.6]

*Stratification by the poles of the complex zeta function of  $\mu$ -constant plane branch deformations*

**Roger Gómez-López**

(Universitat Politècnica de Catalunya)

The complex zeta function is an analytic family of distributions which has a meromorphic extension to  $\mathbb{C}$ . Its poles are related with the roots of the Bernstein-Sato polynomial. We study the stratification by the poles of the complex zeta function of any  $\mu$ -constant deformation of a plane branch. The results we obtain also enable the explicit computation of stratifications without relying on Gröbner bases.

Joint work with Guillem Blanco.

**AL08****Numerical Algebraic Geometry**

Geometría Algebraica Numérica

Zenbakizko Geometria Aljebraikoa

**Organizers****Organizadores****Antolatzaileak****Margaret H. Regan**

(College of the Holy Cross)

**Alexandru Iosif**

(Universidad Rey Juan Carlos)

**Josué Tonelli-Cueto**

(Johns Hopkins University)

**Description****Descripción****Deskribapena**

*Numerical methods are among the fastest computational tools for solving problems in science. Algebraic geometry is no exception, and, as of today, the fastest methods for solving computational problems in this area are numerical. However, the need for reliable numerical methods and the current computational challenges demand the development of new analyses and numerical techniques that can fully exploit the structures we find in the problems from computational algebraic geometry. In this session, several of the latest advances in numerical algebraic geometry will be presented.*

Los métodos numéricos se encuentran entre las herramientas computacionales más rápidas para resolver problemas en ciencia. La geometría algebraica no es una excepción y, a día de hoy, los métodos más rápidos para resolver problemas computacionales en esta área son los numéricos. Sin embargo, la necesidad de métodos numéricos fiables y los retos computacionales actuales exigen el desarrollo de nuevos análisis y técnicas numéricas que puedan explotar plenamente las estructuras que encontramos en los problemas de geometría algebraica computacional. En esta sesión se presentarán varios de los últimos avances en geometría algebraica numérica.

Zenbakizko metodoak zientziako problemak ebazteko tresna konputazional azkarrenen artean daude. Geometria aljebraikoa ez da salbuespen bat, eta, gaur egun, eremu honetan problema konputazionalak ebazteko metodarik azkarrenak zenbakizkoak dira. Hala ere, zenbakizko metodo fidagarrien beharrak eta egungo erronka konputazionalak analisi eta zenbakizko teknika berriak garatzea eskatzen dute, geometria aljebraiko konputazionalaren problemaetan aurkitzen ditugun egiturak ustiatu ahal izateko. Saio honetan zenbakizko geometria aljebraikoan egindako azken aurrerapenetako batzuk aurkeztuko dira.

## MSC Codes

## Códigos MSC

## MSC Kodeak

65H14

(primary)

14Q65

(secondary)

## Slots

## Bloques

## Blokeak

1.B (Aula 0.5); 1.C (Aula 0.5)

## QR Code

## Código QR

## QR Kodea



## Session Schedule

## Horario de la Sesión

## Saioaren Ordutegia

M14 | 15:00-15:20 | 0.5

*SAGBI detection and SAGBI homotopy***Viktoriia Borovik** (Osnabrück University)

M14 | 15:30-15:50 | 0.5

*Singularities of spectrahedra***Khazhgali Kozhasov** (Université Côte d'Azur)

M14 | 16:00-16:20 | 0.5

*Generalized real monodromy***Margaret H Regan** (College of the Holy Cross)

M14 | 16:30-16:50 | 0.5

*Effective homology and numerical integration of periods***Eric Pichon-Pharabod** (MPI MiS Leipzig)



M14 | 17:30-17:50 | 0.5

*Mukai lifting of self-dual points in  $\mathbb{P}^6$*

**Leonie Kayser** (MPI MiS Leipzig)

M14 | 18:00-18:20 | 0.5

*Preconditioning via Geodesically Convex Optimization*

**M. Levent Doğan** (Ruhr Universität at Bochum)

M14 | 18:30-18:50 | 0.5

*Typical ranks of random order-three tensors*

**Sarah Eggleston** (Osnabrück University)

M14 | 19:00-19:20 | 0.5

*Decomposition loci of tensors*

**Pierpaola Santarsiero** (University of Bologna)

*Tuesday 14*  
*15:00-15:20*  
*[Room 0.5]*

**Martes 14**  
**15:00-15:20**  
**[Aula 0.5]**

**Asteartea 14**  
**15:00-15:20**  
**[Gela 0.5]**

*SAGBI detection and SAGBI homotopy*

**Viktoriia Borovik**

(Osnabrück University)

We introduce a SAGBI detection algorithm that, given a finite set of polynomials, finds all term orders for which they form a SAGBI basis. Using this tool, we implement a SAGBI homotopy feature in HomotopyContinuation.jl that provides a particular choice of a start system for homotopy continuation. For systems, where each equation is a linear combination of fixed polynomials, SAGBI homotopies significantly reduce the number of paths that need to be tracked, compared to polyhedral homotopies.

Joint work with E.Shehu and T.Duff, and ongoing joint work with B.Betti.

[arXiv:2404.16796](https://arxiv.org/abs/2404.16796)

*Tuesday 14*  
*15:30-15:50*  
*[Room 0.5]*

**Martes 14**  
**15:30-15:50**  
**[Aula 0.5]**

**Asteartea 14**  
**15:30-15:50**  
**[Gela 0.5]**

*Singularities of spectrahedra*

**Khazhgali Kozhasov**

(Université Côte d'Azur)

Spectrahedra are convex sets that are defined via linear matrix inequalities (LMIs) and can be thought of as nonlinear generalizations of polyhedra. Typically, the topological boundary of a spectrahedron is not smooth. In my talk I will discuss a classification of "combinatorial types" of spectrahedra defined by LMIs of size  $5 \times 5$ . Roughly speaking, a combinatorial type is the number of singular points on the boundary of the spectrahedron. The proof exploits tools of numerical algebraic geometry.

Joint work with Taylor Brysiewicz and Mario Kummer.

[arXiv:2011.13860](https://arxiv.org/abs/2011.13860)

*Tuesday 14*  
*16:00-16:20*  
*[Room 0.5]*

**Martes 14**  
**16:00-16:20**  
**[Aula 0.5]**

**Asteartea 14**  
**16:00-16:20**  
**[Gela 0.5]**

*Generalized real monodromy*

**Margaret H Regan**

(College of the Holy Cross)

The monodromy group is a geometric invariant that encodes the solution structure for a parameterized family of polynomial systems. An approach over the real numbers is the real monodromy structure, which contains tiered characteristics of the real solution set. This work generalizes the real monodromy structure to give information about partial permutations of real solutions induced by loops in an open subset of the parameter space. The talk will use motivating examples in optimization.

Joint work with Timothy Duff.

*Tuesday 14*  
*16:30-16:50*  
*[Room 0.5]*

**Martes 14**  
**16:30-16:50**  
**[Aula 0.5]**

**Asteartea 14**  
**16:30-16:50**  
**[Gela 0.5]**

*Effective homology and numerical integration of periods*

**Eric Pichon-Pharabod**

(MPI MiS Leipzig)

The period matrix of a smooth complex projective variety  $X$  encodes the isomorphism between its singular homology and its algebraic De Rham cohomology. Numerical approximations with sufficient precision of the entries of this matrix, called periods, allow to recover some algebraic invariants. We will present a method relying on the computation of an effective description of the homology for obtaining such numerical approximations of the periods of hypersurfaces and elliptic surfaces.

**Tuesday 14**  
**17:30-17:50**  
**[Room 0.5]**

**Martes 14**  
**17:30-17:50**  
**[Aula 0.5]**

**Asteartea 14**  
**17:30-17:50**  
**[Gela 0.5]**

*Mukai lifting of self-dual points in  $\mathbb{P}^6$*

**Leonie Kayser**

(MPI MiS Leipzig)

Motivated by Mukai's work on canonical curves, Petrakiev showed that a general self-dual set of 14 points in  $\mathbb{P}^6$ , invariant under the Gale transform, arises as the intersection of the Grassmannian  $\text{Gr}(2, 6)$  in  $\mathbb{P}^{14}$  with a linear space of dimension 6. In this paper we focus on the inverse problem of recovering such a linear space associated to a general self-dual set of points. We use numerical homotopy continuation to approach the problem and implement an algorithm in Julia to solve it.

Joint work with Barbara Betti.

[arXiv:2406.02734](https://arxiv.org/abs/2406.02734)

**Tuesday 14**  
**18:00-18:20**  
**[Room 0.5]**

**Martes 14**  
**18:00-18:20**  
**[Aula 0.5]**

**Asteartea 14**  
**18:00-18:20**  
**[Gela 0.5]**

*Preconditioning via Geodesically Convex Optimization*

**M. Levent Doğan**

(Ruhr Universität at Bochum)

The computational complexity of iterative methods in numerical algebra generally depends on the "condition number". Preconditioning is a common method, whose goal is to reduce the condition number. Surprisingly, it is not known whether common preconditioners actually reduce the condition number. We will show that the problem of minimizing the condition number can be cast as a geodesically convex optimization problem. This framework leads to fast methods to compute optimal preconditioners.

Joint work with Alperen Ali Ergür.

**Tuesday 14**  
**18:30-18:50**  
**[Room 0.5]**

**Martes 14**  
**18:30-18:50**  
**[Aula 0.5]**

**Asteartea 14**  
**18:30-18:50**  
**[Gela 0.5]**

***Typical ranks of random order-three tensors***

**Sarah Eggleston**

(Osnabrück University)

We study typical ranks of real  $m \times n \times \ell$  tensors. For  $(m-1)(n-1) < \ell < mn+1$  the typical ranks are contained in  $\{\ell, \ell+1\}$ , and  $\ell$  is always a typical rank; we provide a geometric proof. We express the probabilities of these ranks in terms of the probabilities of the numbers of intersection points of a random linear space with the Segre variety. For  $m=n=3$ , the typical ranks of real  $3 \times 3 \times 5$  tensors are 5 and 6; we link the rank probabilities to the probability of a random cubic surface having real lines.

Joint work with Paul Breiding and Andrea Rosana.

[arXiv:2407.08371](https://arxiv.org/abs/2407.08371)

**Tuesday 14**  
**19:00-19:20**  
**[Room 0.5]**

**Martes 14**  
**19:00-19:20**  
**[Aula 0.5]**

**Asteartea 14**  
**19:00-19:20**  
**[Gela 0.5]**

***Decomposition loci of tensors***

**Pierpaola Santarsiero**

(University of Bologna)

The decomposition locus of a tensor is the set of rank-one tensors appearing in a minimal tensor-rank decomposition of the tensor. In this talk, I will introduce this object, exploring its significance and trying to gain insights into the geometric and algebraic structures that govern tensor decompositions. I will highlight special examples of these loci, including the case of tangential tensors and pencil of tensors having maximal rank.

Joint work with Alessandra Bernardi and Alessandro Oneto.

[arXiv:2407.18138](https://arxiv.org/abs/2407.18138)

**AL09****Cryptography**  
Criptografía**Organizers****Organizadores****Antolatzaileak****David Balbás Gutiérrez**

(IMDEA Software Institute)

**Miguel Beltrá Vidal**

(Universidad de Alicante)

**Helena Martín Cruz**

(IMAC &amp; Universitat Jaume I)

**Guillermo Pascual Pérez**

(Inst. of Science and Technology Austria)

**Description****Descripción****Deskribapena**

*Cryptography is the science and practice of designing computation and communication systems in the presence of adversaries. This session includes presentations on multiple aspects of state-of-the-art cryptography. On the one hand, it will cover mathematical advances on techniques underlying the design and cryptanalysis of cryptographic primitives and protocols. These techniques often rely on results from number theory, coding theory, algebraic geometry, and combinatorics. On the other hand, it will address problems and solutions that arise when applying these mathematical results to the real world, including protocol design, computationally hard problems, and provable security.*

La criptografía es la ciencia que estudia la seguridad de la computación y de las comunicaciones en presencia de adversarios. Esta sesión incluye ponencias sobre múltiples aspectos de la criptografía actual. Por un lado, se tratarán avances matemáticos en técnicas que subyacen al diseño y criptoanálisis de primitivas y protocolos criptográficos. Estas técnicas frecuentemente se basan en resultados de teoría de números, teoría de códigos, geometría algebraica y combinatoria. Por otro lado, se plantearán problemas y soluciones que surgen al aplicar estos resultados matemáticos al mundo real, como el diseño de protocolos, los problemas computacionalmente difíciles, y la seguridad demostrable.

**MSC Codes****Códigos MSC****MSC Kodeak**

94-06

(primary)

94A15; 94A60; 94B05

(secondary)

## Slots

## Bloques

## Blokeak

1.A (Aula 0.6); 1.B (Aula 0.6); 1.C (Aula 0.6)

## QR Code

## Código QR

## QR Kodea



## Session Schedule

## Horario de la Sesión

## Saioaren Ordutegia

L13 | 17:30-17:50 | 0.6

*An alternative Commitment-based model for Authenticated Key Exchange protocols*

**Rodrigo Martín Sánchez-Ledesma** (Universidad Complutense de Madrid & Indra Sistemas de Comunicaciones Seguras)

L13 | 18:00-18:20 | 0.6

*Invertible Quadratic Non-Linear Functions over  $\mathbb{F}_p^n$  via multiple local maps*

**Ginevra Giordani** (Università degli Studi dell'Aquila)

L13 | 18:30-18:50 | 0.6

*Group Key Progression: Strong Security for Persistent Data*

**David Balbás** (IMDEA Software Institute, Universidad Politécnica de Madrid & NTT Social Informatics Laboratories)

L13 | 19:00-19:20 | 0.6

*Secret Sharing Schemes for Approximated Weighted Threshold Access Structures*

**Miquel Guiot** (Universitat Rovira i Virgili)

M14 | 15:00-15:20 | 0.6

*Lower bounds on the Communication Cost of Multicast Encryption and Group Messaging*

**Miguel Cueto Noval** (Institute of Science and Technology Austria)

M14 | 15:30-15:50 | 0.6

*Formal Modelling and Analysis for Cryptographic Protocols*

**Arturo Hernández Sánchez** (VRAIN, Universitat Politècnica de València)

M14 | 16:00-16:20 | 0.6

*Lattice problems and Security*

**Miguel Ángel González de la Torre** (Instituto de Tecnologías Físicas y de la Información-CSIC)

M14 | 16:30-16:50 | 0.6

*A Critical Look into Threshold Homomorphic Encryption for Private Average Aggregation*

**Miguel Morona-Mínguez** (Universidad de Vigo)

M14 | 17:30-17:50 | 0.6

*Advancing Symmetric Cryptography: Cryptanalysis of Symmetric Techniques for Advanced Protocols (STAP)*

**Iratí Manterola Ayala** (Simula UiB)

M14 | 18:00-18:20 | 0.6

*Advances in the Cryptanalysis of DME-minus signature scheme*

**Pilar Coscojuela** (Universidad Complutense de Madrid)

M14 | 18:30-18:50 | 0.6

*Security Analysis of a Code-based Cryptosystem Using Convolutional Codes*

**Miguel Beltrá Vidal** (University of Alicante)



**Monday 13****17:30-17:50****[Room 0.6]****Lunes 13****17:30-17:50****[Aula 0.6]****Astelehena 13****17:30-17:50****[Gela 0.6]*****An alternative Commitment-based model for Authenticated Key Exchange protocols*****Rodrigo Martín Sánchez-Ledesma**

(Universidad Complutense de Madrid &amp; Indra Sistemas de Comunicaciones Seguras)

In this talk we present an alternative Unauthenticated Model, intended to build a security framework to cover protocols whose specifics may not concur with those of already existing models for authenticated exchanges. This new model is constructed from the notion of commitment schemes, employing ephemeral information, therefore avoiding the exchange of long-term cryptographic material. From this model, we propose a number of key exchange protocols, formalizing their security under this model.

Joint work with David Domingo Martín and Iván Blanco Chacón.

**Monday 13****18:00-18:20****[Room 0.6]****Lunes 13****18:00-18:20****[Aula 0.6]****Astelehena 13****18:00-18:20****[Gela 0.6]*****Invertible Quadratic Non-Linear Functions over  $\mathbb{F}_p^n$  via multiple local maps*****Ginevra Giordani**

(Università degli Studi dell'Aquila)

The construction of invertible low-multiplicative non-linear layers over  $\mathbb{F}_p^n$  is crucial for the design of symmetric primitives targeting Multi Party Computation, Zero-Knowledge proofs and Fully Homomorphic Encryption. We generalize a construction recently studied by constructing a shift invariant lifting over finite fields via multiple local maps of degree  $\leq 2$ . We prove that if  $n \geq 3$ , then  $\mathcal{S}_{\mathbb{F}_0, \mathbb{F}_1}$  is never invertible unless it is a Type-II Feistel scheme.

Joint work with Lorenzo Grassi, Silvia Onofri and Marco Pedicini.

**Monday 13****18:30-18:50****[Room 0.6]****Lunes 13****18:30-18:50****[Aula 0.6]****Astelehena 13****18:30-18:50****[Gela 0.6]*****Group Key Progression: Strong Security for Persistent Data*****David Balbás**

(IMDEA Software Institute, Universidad Politécnica de Madrid & NTT Social Informatics Laboratories)

We study how to extend strong end-to-end security for data in transit to shared data at rest, such as for message backups and file sharing. We introduce Group Key Progression (GKP), a primitive which enables a (dynamic) group of users to agree on a persistent sequence of keys efficiently. Our construction Grappa satisfies post-compromise security and interval access control, a new notion that describes how group changes translate into access to keys in the sequence.

Joint work with Matilda Backendal and Miro Haller.

**Monday 13****19:00-19:20****[Room 0.6]****Lunes 13****19:00-19:20****[Aula 0.6]****Astelehena 13****19:00-19:20****[Gela 0.6]*****Secret Sharing Schemes for Approximated Weighted Threshold Access Structures*****Miquel Guíot**

(Universitat Rovira i Virgili)

In weighted threshold access structures, each party has a weight, and subsets are authorized if their combined weight reaches a threshold. For these access structures, existing secret sharing schemes result in large shares that scale linearly with the weights. To improve efficiency, the access structure can be approximated. This talk focuses on balancing efficiency and accuracy in such approximations by using techniques based on the Chow parameters

Joint work with Oriol Farràs.

**Tuesday 14**  
**15:00-15:20**  
**[Room 0.6]**

**Martes 14**  
**15:00-15:20**  
**[Aula 0.6]**

**Asteartea 14**  
**15:00-15:20**  
**[Gela 0.6]**

***Lower bounds on the Communication Cost of Multicast Encryption and Group Messaging***

**Miguel Cueto Noval**

(Institute of Science and Technology Austria)

We prove lower bounds on the communication cost of maintaining a shared key among a group of users and consider primitives like multicast encryption (ME) and continuous group-key agreement (CGKA). These are round-based primitives in which users can be added or removed from the group and its members in a given round agree on a key that should not be possible to derive by non-members. We prove our results in a combinatorial model that also implies lower bounds in a symbolic model for ME and CGKA.

Joint work with Michael Anastos, Benedikt Auerbach, Mirza Ahad Baig, Matthew Kwan, Guillermo Pascual-Perez and Krzysztof Pietrzak.

[eprint.iacr.org/2024/1097](https://eprint.iacr.org/2024/1097)

[eprint.iacr.org/2023/1123](https://eprint.iacr.org/2023/1123)

**Tuesday 14**  
**15:30-15:50**  
**[Room 0.6]**

**Martes 14**  
**15:30-15:50**  
**[Aula 0.6]**

**Asteartea 14**  
**15:30-15:50**  
**[Gela 0.6]**

***Formal Modelling and Analysis for Cryptographic Protocols***

**Arturo Hernández Sánchez**

(VRAIN, Universitat Politècnica de València)

Formal modeling uses computational logic to verify software systems. In the context of cryptographic protocols, it is used to determine whether an intruder can gain some knowledge from the exchange of information between participants by reasoning about the algebraic properties of their cryptographic primitives. In this talk, we will give an overview of how these models can be used to detect vulnerabilities in cryptographic protocols and how their analysis can be automated with Maude-NPA.

Joint work with Santiago Escobar.

**Tuesday 14****16:00-16:20****[Room 0.6]****Martes 14****16:00-16:20****[Aula 0.6]****Asteartea 14****16:00-16:20****[Gela 0.6]*****Lattice problems and Security*****Miguel Ángel González de la Torre**

(Instituto de Tecnologías Físicas y de la Información-CSIC)

Lattice-based cryptography is currently one of the most relevant fields of development in terms of public key cryptosystems. The security of these cryptosystems (like ML-KEM or Frodo-KEM) is based on the difficulty of solving hard lattice problems (LWE or SVP). The relationship between the parameters, the derived lattice problem and the security derived from these assumptions are the topics considered for this conference.

**Tuesday 14****16:30-16:50****[Room 0.6]****Martes 14****16:30-16:50****[Aula 0.6]****Asteartea 14****16:30-16:50****[Gela 0.6]*****A Critical Look into Threshold Homomorphic Encryption for Private Average Aggregation*****Miguel Morona-Mínguez**

(Universidad de Vigo)

Threshold Homomorphic Encryption is a good fit for private federated average aggregation, a key operation in Federated Learning. Despite its potential, recent studies show that threshold schemes in mainstream HE libraries can introduce security vulnerabilities if an adversary has access to a restricted decryption oracle. We survey the use of threshold RLWE-based HE for federated average aggregation and examine the performance impact of using smudging noise with large variance as countermeasure.

Tuesday 14

17:30-17:50

[Room 0.6]

Martes 14

17:30-17:50

[Aula 0.6]

Asteartea 14

17:30-17:50

[Gela 0.6]

*Advancing Symmetric Cryptography: Cryptanalysis of Symmetric Techniques for  
Advanced Protocols (STAP)*

**Iratí Manterola Ayala**

(Simula UiB)

We explore advancements in symmetric cryptography, focusing on Symmetric Techniques for Advanced Protocols (STAP). STAPs are ciphers designed for improving efficiency in cryptographic protocols such as ZK-proofs, FHE, and MPC. We evaluate the security of new STAPs against algebraic attacks, including a key recovery attack on the Rubato cipher family, and efficient Gröbner basis attacks for solving polynomial equations in primitives like Arion, Griffin, and Anemoi.

Tuesday 14

18:00-18:20

[Room 0.6]

Martes 14

18:00-18:20

[Aula 0.6]

Asteartea 14

18:00-18:20

[Gela 0.6]

*Advances in the Cryptanalysis of DME-minus signature scheme*

**Pilar Coscojuela**

(Universidad Complutense de Madrid)

Following the attack on the DME scheme by D. Smith-Tone et al., we are working to determine whether it can be adapted to DME-minus, a variant of the DME where only the even-indexed components of the public key are available. The resulting system of equations for recovering an equivalent last round is similar to that of DME but with half the number of equations. This talk will focus on studying the complexity of solving such a system.

Joint work with I. Luengo and M. Avendaño.

**Tuesday 14****18:30-18:50****[Room 0.6]****Martes 14****18:30-18:50****[Aula 0.6]****Asteartea 14****18:30-18:50****[Gela 0.6]*****Security Analysis of a Code-based Cryptosystem Using Convolutional Codes*****Miguel Beltrá Vidal**

(University of Alicante)

We study some security notions of a McEliece cryptosystem based on convolutional codes: Indistinguishability under Chosen-Plaintext Attacks (IND-CPA), Indistinguishability under Adaptive Chosen-Ciphertext Attacks (IND-CCA2), Non-Malleability under Adaptive Chosen-Ciphertext Attacks (NM-CCA2), and Indistinguishability of Keys under Chosen-Plaintext Attacks (IK-CPA). We show that they are not satisfied. Thus, the cryptosystem should not be used in practice unless proper conversions are applied.

Joint work with Paulo Almeida and Diego Napp.

**AL10****Coding Theory**

## Teoría de Códigos

**Organizers****Organizadores****Antolatzaileak****Iván Bailera Martín**

(Centro Univ. de la Defensa, Zaragoza)

**Helena Martín Cruz**

(IMAC &amp; Universitat Jaume I)

**Rodrigo San José Rubio**

(IMUVa, Universidad de Valladolid)

**Carlos Vela Cabello**

(Universität St. Gallen)

**Description****Descripción****Deskribapena**

*Information theory corresponds to a branch of mathematics and computer science that studies the transmission and processing of data. In this session, we will primarily focus on applications related to coding theory. These include computer science (code-based cryptography, data compression), electrical engineering (communication and coding theory), biology (DNA sequences), and physics (quantum computing and communication), among others. The session also includes applications from other areas to coding theory, such as lattice theory, finite geometries, algebraic geometry, commutative algebra, etc.*

La teoría de la información corresponde a una rama de las matemáticas y de la computación que estudia la transmisión y el procesamiento de datos. En esta sesión nos interesaremos principalmente en las aplicaciones relacionadas con la teoría de códigos. Estas incluyen a las ciencias de la computación (criptografía basada en códigos, compresión de datos), la ingeniería eléctrica (teoría de la comunicación y codificación), la biología (secuencias de ADN) y la física (computación y comunicación cuántica), entre otras. La sesión también contempla aplicaciones de otras áreas a teoría de códigos, como pueden ser la teoría de retículos, geometrías finitas, geometría algebraica, álgebra conmutativa, etc.

**MSC Codes****Códigos MSC****MSC Kodeak**

94-06

(primary)

94B05; 94B35; 81P70

(secondary)

## Slots

## Bloques

## Blokeak

2.A (Aula 0.7); 2.B (Aula 0.7); 2.C (Aula 0.7)

## QR Code

## Código QR

## QR Kodea



## Session Schedule

## Horario de la Sesión

## Saioaren Ordutegia

J16 | 11:00-11:20 | 0.7

*Computational Study of Binary Group Codes of Small Lengths*

**Beatriz García García** (Universidad de Oviedo)

J16 | 11:30-11:50 | 0.7

*Distributed matrix multiplication using multivariate polynomials*

**Adrián Fidalgo-Díaz** (University of Valladolid)

J16 | 12:00-12:20 | 0.7

*Computational Private Information Retrieval Protocol with Codes over Rings*

**Seyma Bodur** (Universidad de Valladolid)

J16 | 12:30-12:50 | 0.7

*Consistent flag codes*

**Miguel Ángel Navarro-Pérez** (University Carlos III of Madrid)

J16 | 16:30-16:50 | 0.7

*Using classical codes for quantum fault-tolerant computing*

**Rodrigo San-José** (Universidad de Valladolid)

J16 | 17:00-17:20 | 0.7

*On direct product group codes and associated quantum codes*

**Miguel Sales Cabrera** (Universitat d'Alacant)



J16 | 17:30-17:50 | 0.7

*Error-correcting codes on higher dimensional varieties*

**Daniel Camazón Portela** (University of Almería & Institute of Mathematics of the University of Valladolid)

V17 | 9:00-9:20 | 0.7

*On  $\mathbb{Z}_p^s$ -additive simplex codes*

**Sergi Sánchez Aragón** (Universitat Autònoma de Barcelona)

V17 | 9:30-9:50 | 0.7

*Geometry of Rank Metric Codes over Rings*

**Markel Epelde** (UPV/EHU)

V17 | 10:00-10:20 | 0.7

*Skew Recursive Linear Sequences and Skew Codes*

**Tamar Mesablishvili** (University of Granada)

**Thursday 16****11:00-11:20****[Room 0.7]****Jueves 16****11:00-11:20****[Aula 0.7]****Osteguna 16****11:00-11:20****[Gela 0.7]*****Computational Study of Binary Group Codes of Small Lengths*****Beatriz García García**

(Universidad de Oviedo)

Technological advances yield the need to develop quantum-resistant cryptosystems such as, for instance, the development of McEliece-type cryptosystems. In this direction, the study of group codes is interesting, being also the the construction of quantum codes another motivation for such a study. In this work, an exhaustive study of binary group codes with small lengths is carried out. It will allow to improve the knowledge of both algebraic and computational properties of the group code family.

Joint work with Consuelo Martínez López and Ignacio Fernández Rúa.

**Thursday 16****11:30-11:50****[Room 0.7]****Jueves 16****11:30-11:50****[Aula 0.7]****Osteguna 16****11:30-11:50****[Gela 0.7]*****Distributed matrix multiplication using multivariate polynomials*****Adrián Fidalgo-Díaz**

(University of Valladolid)

When running a distributed algorithm, the slowest of the worker nodes that perform the computation limits the speed of the execution. This justifies the need for designing distributed algorithms that do not require to gather the results from all the nodes, just the first of them that respond. Considering the slower nodes as erasures, this turns out to be a job for coding-theory. In this work, we tackle this problem using multivariate polynomials (in a Reed-Muller and hyperbolic codes fashion).

Joint work with Umberto Martínez-Peñas.

**Thursday 16****12:00-12:20****[Room 0.7]****Jueves 16****12:00-12:20****[Aula 0.7]****Osteguna 16****12:00-12:20****[Gela 0.7]*****Computational Private Information Retrieval Protocol with Codes over Rings*****Seyma Bodur**

(Universidad de Valladolid)

A Private Information Retrieval (PIR) protocol protects user's privacy. Computational privacy is one of the approaches that ensures security by preventing the database administrator from determining the file index with reasonable computational resources. We present a computational PIR scheme using codes over rings that utilize the coding theory perspective of Holzbaur, Hollanti, and Wachter-Zeh, and resists the attack presented by Bordage and Lavauzelle.

Joint work with Edgar Martínez-Moro and Diego Ruano.

**Thursday 16****12:30-12:50****[Room 0.7]****Jueves 16****12:30-12:50****[Aula 0.7]****Osteguna 16****12:30-12:50****[Gela 0.7]*****Consistent flag codes*****Miguel Ángel Navarro-Pérez**

(University Carlos III of Madrid)

A constant dimension code is a set of subspaces with the same dimension and a flag code is a set of flags (nested sequences of subspaces) with the same increasing sequence of dimensions.

Associated with any flag code, there is a family of constant dimension codes, the projected codes, whose parameters are related to the ones of the given flag code. In this talk, we introduce consistent flag codes, whose parameters are completely determined by the projected codes and study their properties.

Joint work with Clementa Alonso-González.

**Thursday 16****16:30-16:50****[Room 0.7]****Jueves 16****16:30-16:50****[Aula 0.7]****Osteguna 16****16:30-16:50****[Gela 0.7]*****Using classical codes for quantum fault-tolerant computing*****Rodrigo San-José**

(Universidad de Valladolid)

One of the main open problems for quantum fault-tolerant computing is the implementation of non-Clifford gates, particularly the T gate. Motivated by this, CSS-T were introduced as CSS codes which support a transversal T gate. In this talk, we show how to check if a CSS code is CSS-T using the Schur product, and we construct CSS-T codes from cyclic codes. We also study triorthogonal codes, which are a particular case of CSS-T codes that implements the T gate on the logical qubits.

Joint work with Eduardo Camps-Moreno, Hiram H. López, Gretchen L. Matthews, Diego Ruano and Ivan Soprunov.

[arXiv:2312.17518](https://arxiv.org/abs/2312.17518)**Thursday 16****17:00-17:20****[Room 0.7]****Jueves 16****17:00-17:20****[Aula 0.7]****Osteguna 16****17:00-17:20****[Gela 0.7]*****On direct product group codes and associated quantum codes*****Miguel Sales Cabrera**

(Universitat d'Alacant)

Group codes, which are linear codes viewed as left ideals in a group algebra, are studied when this algebra is semisimple. The talk focuses on group codes where the group is a direct product of cyclic and dihedral groups, showing that, in some cases, they achieve optimal distance for their dimension. Additionally, quantum CSS codes will be constructed from these classical codes, which are crucial for quantum computing.

Joint work with Xaro Soler-Escrivà and Víctor Sotomayor.

Thursday 16

17:30-17:50

[Room 0.7]

Jueves 16

17:30-17:50

[Aula 0.7]

Osteguna 16

17:30-17:50

[Gela 0.7]

*Error-correcting codes on higher dimensional varieties***Daniel Camazón Portela**

(University of Almería &amp; Institute of Mathematics of the University of Valladolid)

Tsfasman and Vlăduţ suggested the use of higher dimensional varieties to construct AG-codes, but the number of works in this sense does not equal that of curves or surfaces. Our aim is to go one step further the work of S. Hansen and study AG-codes on projective bundles over D-L surfaces. To obtain bounds on the parameters, we use intersection theory and the fact that, for some standard D-L surfaces, all their rational points are distributed on the irreducible components of a divisor  $D_i$ .

Joint work with Juan Antonio López Ramos.

Friday 17

9:00-9:20

[Room 0.7]

Viernes 17

9:00-9:20

[Aula 0.7]

Ostirala 17

9:00-9:20

[Gela 0.7]

*On  $\mathbb{Z}_{p^s}$ -additive simplex codes***Sergi Sánchez Aragón**

(Universitat Autònoma de Barcelona)

$\mathbb{Z}_{p^s}$ -additive codes are subgroups of  $\mathbb{Z}_{p^s}^n$  where  $p$  is prime and  $s \geq 1$ . We consider recursive constructions of  $\mathbb{Z}_{p^s}$ -additive simplex codes of type  $\alpha$  and  $\beta$ , which are a generalization over  $\mathbb{Z}_{p^s}$  of the already known  $\mathbb{Z}_{2^s}$ -additive simplex codes. In this work, we show the fundamental parameters of these codes, as well as their complete weight distributions for the Hamming and homogeneous weights.

joint work with Cristina Fernández-Córdoba and Mercè Villanueva.

Friday 17  
9:30-9:50  
[Room 0.7]

Viernes 17  
9:30-9:50  
[Aula 0.7]

Ostirala 17  
9:30-9:50  
[Gela 0.7]

*Geometry of Rank Metric Codes over Rings*

**Markel Epelde**  
(UPV/EHU)

In 1985, Gabidulin introduced the rank metric over finite fields. In 2022, Alfarano et al. studied the relations between this metric and the Hamming metrics. This metric has been generalized to rings in several papers, such as the Cardinal Rank. Based on support theory, in this talk we study the constructions of rank metrics over rings using ranked lattices, we classify those metrics and show some of their properties. Finally, we show their relations with the equivalent Hamming-like metrics.

Joint work with Alessandro Neri.

Friday 17  
10:00-10:20  
[Room 0.7]

Viernes 17  
10:00-10:20  
[Aula 0.7]

Ostirala 17  
10:00-10:20  
[Gela 0.7]

*Skew Recursive Linear Sequences and Skew Codes*

**Tamar Mesablishvili**  
(University of Granada)

We explore the relationship between the skew and classical recursive linear sequences, formulate the Massey agreement theorem for skew linear recursive sequences and derive a condition under which the cyclic and acyclic complexities is the same. We also introduce a family of MDS codes with respect to skew-linear complexity, and compare such codes with other families of skew codes we encounter in the literature.

Joint work with José Gómez-Torrecillas.

**AM01****Complex Analysis****Análisis Complejo****Organizers****Tanausú Aguilar Hernández**

(Universidad de Málaga)

**Organizadores****Alejandro Mas Mas**

(Universitat de València)

**Antolatzaileak****Description**

*The session is framed within the topic of complex analysis. During it, several current lines of research will be addressed, such as operator theory, complex dynamics, theory of weights, semigroup theory, etc...*

La sesión se enmarca dentro de la temática del análisis complejo. Durante la misma se abordarán diversas líneas de investigación actuales como la teoría de operadores, dinámica compleja, teoría de pesos, teoría de semigrupos, etc...

**Descripción****Deskribapena****MSC Codes****Códigos MSC****MSC Kodeak**

30-XX

(primary)

47-XX; 37Fxx; 30Hxx

(secondary)

**Slots****Bloques****Blokeak**

1.A (Aula 0.3); 1.B (Aula 0.3)

**QR Code****Código QR****QR Kodea**

## Session Schedule

## Horario de la Sesión

## Saioaren Ordutegia

L13 | 17:30-17:50 | 0.3

*Bergman projection induced by radial weight acting on growth spaces*

**Álvaro Miguel Moreno López** (Universidad de Málaga)

L13 | 18:00-18:20 | 0.3

*Cesàro-type operator induced by radial weight on Hilbert spaces*

**Elena de la Rosa Pérez** (Universidad de Málaga)

L13 | 18:30-18:50 | 0.3

*Cesàro-type operators associated with Borel measures on the unit disc*

**Noel Merchán** (Universidad de Málaga)

L13 | 19:00-19:20 | 0.3

*Hankel operators on Paley-Wiener spaces of convex domains*

**Konstantinos Bampouras** (Norwegian University of Science and Technology)

M14 | 15:00-15:20 | 0.3

*On the convolution of convex 2-gons*

**Adrián Llinares** (Universidad Autónoma de Madrid)

M14 | 15:30-15:50 | 0.3

*Counterexample of normability in Hardy and Bergman spaces with  $0 < p < 1$*

**Iván Jiménez Sánchez** (Universidad Autónoma de Madrid & I.C.A.I. Universidad Pontificia de Comillas)

M14 | 16:00-16:20 | 0.3

*Spectral picture of invertible weighted composition operators on  $\mathbb{D}$*

**J. Oliva-Maza** (Universidad de Zaragoza)

M14 | 16:30-16:50 | 0.3

*Iterates of finite Blaschke products*

**Odí Soler i Gibert** (Universitat Politècnica de Catalunya)



**Monday 13****17:30-17:50****[Room 0.3]****Lunes 13****17:30-17:50****[Aula 0.3]****Astelehena 13****17:30-17:50****[Gela 0.3]*****Bergman projection induced by radial weight acting on growth spaces*****Álvaro Miguel Moreno López**

(Universidad de Málaga)

Let  $\omega$  and  $\nu$  be radial weights on the unit disc of the complex plane. We describe the boundedness of the Bergman projection induced by  $\omega$  on the growth space of functions  $f$  for which the essential supremum of  $|f(z)|$  multiplied by the tail integral from  $|z|$  to 1 of  $\nu$  is finite assuming some doubling conditions. Moreover, we solve the analogous problem for the Bergman projection when mapping to a Bloch-type space and explore similar questions for radial weights that decrease exponentially.

Joint work with José Ángel Peláez and Jari Taskinen.

[arXiv:2406.18446](https://arxiv.org/abs/2406.18446)

**Monday 13****18:00-18:20****[Room 0.3]****Lunes 13****18:00-18:20****[Aula 0.3]****Astelehena 13****18:00-18:20****[Gela 0.3]*****Cesàro-type operator induced by radial weight on Hilbert spaces*****Elena de la Rosa Pérez**

(Universidad de Málaga)

We define a generalized Cesàro operator induced by radial weight, and we study its action on weighted Hardy spaces of analytic functions and on general weighted Bergman spaces.

Joint work with Alejandro Mas and Noel Merchán.

Monday 13

18:30-18:50

[Room 0.3]

Lunes 13

18:30-18:50

[Aula 0.3]

Astelehena 13

18:30-18:50

[Gela 0.3]

*Cesàro-type operators associated with Borel measures on the unit disc***Noel Merchán**

(Universidad de Málaga)

Given a complex Borel measure  $\mu$  on the unit disc  $D$ , we consider the Cesàro-type operator  $C_\mu$  defined on the space of all analytic functions in  $D$ . We study the action of the operators  $C_\mu$  on some Hilbert spaces of analytic functions in  $D$ , namely, the Hardy space  $H^2$  and the weighted Bergman spaces  $A_\alpha^2$  ( $\alpha > -1$ ).

Joint work with Petros Galanopoulos and Daniel Girela.

[doi:10.1016/j.jmaa.2023.127287](https://doi.org/10.1016/j.jmaa.2023.127287)

Monday 13

19:00-19:20

[Room 0.3]

Lunes 13

19:00-19:20

[Aula 0.3]

Astelehena 13

19:00-19:20

[Gela 0.3]

*Hankel operators on Paley-Wiener spaces of convex domains***Konstantinos Bampouras**

(Norwegian University of Science and Technology)

Z. Nehari (1957) proved that a Hankel operator defined on the Hardy space of the disc is bounded if and only if it attains a bounded symbol. R. Rochberg (1982) and V. Peller (2003) characterized their Schatten classes via Besov spaces. We study the analogues of these theorems in the case of Hankel operators on Paley-Wiener spaces of convex domains, giving partial positive and negative results.

Joint work with Karl-Mikael Perfekt.

[arXiv:2303.01208](https://arxiv.org/abs/2303.01208)

[arXiv:2409.04184](https://arxiv.org/abs/2409.04184)

Tuesday 14

15:00-15:20

[Room 0.3]

Martes 14

15:00-15:20

[Aula 0.3]

Asteartea 14

15:00-15:20

[Gela 0.3]

*On the convolution of convex 2-gons***Adrián Llinares**

(Universidad Autónoma de Madrid)

In 1973, Ruscheweyh and Sheil-Small showed that the convolution of two convex mappings (i.e., two holomorphic functions which conformally map the unit disk of the complex plane onto a convex domain) is also a convex mapping. However, no further properties of these convolutions are known in general. In this talk, we will talk about the asymptotic behaviour of the (arbitrary) convolution of convex 2-gons.

Joint work with M. Chuaqui, R. Hernández and A. Mas.

[arXiv:2311.12937](https://arxiv.org/abs/2311.12937)

Tuesday 14

15:30-15:50

[Room 0.3]

Martes 14

15:30-15:50

[Aula 0.3]

Asteartea 14

15:30-15:50

[Gela 0.3]

*Counterexample of normability in Hardy and Bergman spaces with  $0 < p < 1$* **Iván Jiménez Sánchez**

(Universidad Autónoma de Madrid &amp; I.C.A.I. Universidad Pontificia de Comillas)

It is known that Hardy spaces  $H^p$  and Bergman spaces  $A^p$  are not normable when  $0 < p < 1$ , though standard sources offer no proofs. In 1953, Livingston proved the non-normability of  $H^p$  for  $0 < p < 1$  using an indirect method. No proofs are known for Bergman spaces. In this talk, a direct proof is presented, showing that the usual norm expression is not valid for  $H^p$  when  $0 < p < 1$ , along with counterexamples for the triangle inequality in  $A^p$ .

Joint work with Dragan Vukotic.

[arXiv:2407.21212](https://arxiv.org/abs/2407.21212)

Tuesday 14

16:00-16:20

[Room 0.3]

Martes 14

16:00-16:20

[Aula 0.3]

Asteartea 14

16:00-16:20

[Gela 0.3]

*Spectral picture of invertible weighted composition operators on  $\mathbb{D}$* **J. Oliva-Maza**

(Universidad de Zaragoza)

Weighted composition operators play an important role in the study of Banach spaces of holomorphic functions on the unit disc. For a wide list of classical spaces the spectrum of invertible weighted composition operators is known in the case the composition automorphism is either elliptic or parabolic. In this talk, we present our recent work where we obtain the spectrum and the essential spectrum of for the remaining case, i.e., when the composition automorphism is hyperbolic.

Tuesday 14

16:30-16:50

[Room 0.3]

Martes 14

16:30-16:50

[Aula 0.3]

Asteartea 14

16:30-16:50

[Gela 0.3]

*Iterates of finite Blaschke products***Odi Soler i Gibert**

(Universitat Politècnica de Catalunya)

In this talk we will consider a finite Blaschke product  $f$  and the series of its iterates with coefficients  $\{a_n\}$  such that they tend to zero but are not absolutely summable. It is known that, for any  $w \in \mathbb{C}$ , there is at least one  $z$  in the unit circle where the series of iterates converges to  $w$ . We will see that the set of such points  $z$  has Hausdorff dimension 1. We will also mention an argument showing that this result is optimal in some sense.

Joint work with Spyridon Kakaroumpas.

[arXiv:2311.02717](https://arxiv.org/abs/2311.02717)

**AM02****Harmonic Analysis and Operator Theory**  
Análisis Armónico y Teoría de Operadores**Organizers****Organizadores****Antolatzaileak****Luciano Abadías Ullod**

(Universidad de Zaragoza)

**Marta De León Contreras**

(Universidad de La Laguna)

**Javier Gonzalez Doña**

(Universidad Carlos III de Madrid)

**Miguel Monsalve López**

(Universidad Complutense de Madrid)

**Description****Descripción****Deskribapena**

*The aim of this session is to bring together young researchers who develop their work in Mathematical Analysis, mainly Harmonic Analysis and Operator Theory. We want to place special emphasis on the relationship between the aforementioned areas and stimulate interaction and debate of problems from different points of view.*

*In particular, recent problems of Harmonic Analysis and Operator Theory will be shown, related to singular integrals, weighted inequalities, geometric measure theory, spectral properties, invariant subspaces, among others. In addition, the relationship of these topics with other areas, such as Complex Analysis and Partial Differential Equations, will be shown.*

El objetivo de esta sesión es reunir a jóvenes investigadores que desarrollan su trabajo en Análisis Matemático, siguiendo como líneas principales el Análisis Armónico y la Teoría de Operadores. Se quiere hacer especial hincapié en la relación entre las áreas mencionadas y estimular la interacción y el debate de los problemas desde diferentes puntos de vista.

En particular, se mostrarán problemas recientes del Análisis Armónico y Teoría de Operadores, relacionados con integrales singulares, desigualdades con peso, teoría de la medida geométrica, propiedades espectrales, subespacios invariantes, entre otros. Además se mostrará la relación de estos temas con otras áreas, como el Análisis Complejo y Ecuaciones en Derivadas Parciales.

| MSC Codes | Códigos MSC                                    | MSC Kodeak |
|-----------|--|------------|
|           | 43-XX; 47-XX<br>(primary)                      |            |
|           | 30-XX; 42-XX; 46-XX<br>(secondary)             |            |
| Slots     | Bloques  | Blokeak    |
|           | 1.A (Aula 0.7); 1.B (Aula 0.7); 1.C (Aula 0.7) |            |

| QR Code | Código QR  | QR Kodea |
|---------|--|----------|
|         |  |          |

| Session Schedule  | Horario de la Sesión | Saioaren Ordutegia |
|---|----------------------|--------------------|
| L13   17:30-17:50   0.7<br><i>A variant of the isoperimetric inequality</i><br><b>Andrea Olivo</b> (BCAM)   |                      |                    |
| L13   18:00-18:20   0.7<br><i>Random Carleson Measures in the Polydisc</i><br><b>Alberto Dayan</b> (Saarland University)  |                      |                    |
| L13   18:30-18:50   0.7<br><i>Boundedness of multilinear operators at the end-points with extrapolation techniques</i><br><b>Laura Sánchez-Pascuala Dones</b> (Universidad Complutense de Madrid) |                      |                    |
| L13   19:00-19:20   0.7<br><i>Pointwise localization and sharp weighted bounds for Rubio de Francia square functions</i><br><b>Mikel Flórez Amatriain</b> (BCAM)                                  |                      |                    |

M14 | 15:00-15:20 | 0.7

*Fine spectra of the Cesàro-Hardy operator on  $L^p[0, 1]$  and the Invariant Subspace Problem*

**Alejandro Mahillo Cazorla** (Universidad de Zaragoza)

M14 | 15:30-15:50 | 0.7

*Similarity to contraction semigroups on Hilbert spaces*

**Jesus Oliva-Maza** (Universidad de Zaragoza)

M14 | 16:00-16:20 | 0.7

*A counterexample for chain recurrence in Linear Dynamics*

**Antoni López-Martínez** (Universitat Politècnica de València)

M14 | 16:30-16:50 | 0.7

*Localization of non-trivial solutions for operator systems*

**Jorge Rodríguez López** (Universidade de Santiago de Compostela)

M14 | 17:30-17:50 | 0.7

*Volterra operator acting on Bergman spaces of Dirichlet series*

**Carlos Gómez Cabello** (Universidad de Sevilla)

M14 | 18:00-18:20 | 0.7

*An optimization problem and point-evaluation in Paley–Wiener spaces*

**Sarah May Instanes** (Norwegian University of Science and Technology)

M14 | 18:30-18:50 | 0.7

*Interpolation of weak Orlicz types and strong maximal in von Neumann algebras*

**Jorge Pérez García** (ICMAT)

M14 | 19:00-19:20 | 0.7

*Sparse domination of Bergman projectors and boundedness of integral operators on trees*

**Elena Rizzo** (Università di Milano Statale)

**Monday 13****17:30-17:50****[Room 0.7]****Lunes 13****17:30-17:50****[Aula 0.7]****Astelehena 13****17:30-17:50****[Gela 0.7]*****A variant of the isoperimetric inequality*****Andrea Olivo**

(BCAM)

It is well known that the celebrated Gagliardo estimate can be viewed as an extension of the classical isoperimetric inequality although the best constant was not obtained by Gagliardo. In this talk, we will explore some generalizations of this result involving weights, and we will discuss how it can be extended beyond smooth domains.

Ongoing joint work with Carlos Pérez and Ezequiel Rela.

**Monday 13****18:00-18:20****[Room 0.7]****Lunes 13****18:00-18:20****[Aula 0.7]****Astelehena 13****18:00-18:20****[Gela 0.7]*****Random Carleson Measures in the Polydisc*****Alberto Dayan**

(Saarland University)

The celebrated work of Carleson characterizes Carleson measures on the unit disc in terms of the so called one-box condition. In the polydisc, a geometric characterization of Carleson measures is much more elusive. In this talk, we will consider random atomic measures in the polydisc, and we will discuss their probability of being Carleson measures. We will discuss a well known re-formulation of the problem in terms of Gram matrices, and then use tools from the theory of random matrices.

Joint work with Nikolaos Chalmoukis and Giuseppe Lamberti.

[arXiv:2402.13645](https://arxiv.org/abs/2402.13645)



**Monday 13****18:30-18:50****[Room 0.7]****Lunes 13****18:30-18:50****[Aula 0.7]****Astelehena 13****18:30-18:50****[Gela 0.7]**

***Boundedness of multilinear operators at the end-points with extrapolation techniques***

**Laura Sánchez-Pascuala Dones**

(Universidad Complutense de Madrid)

Extrapolation techniques allow us to determine bounds for an operator in different spaces based on known bounds on other spaces. The aim of this talk is to use various multilinear extrapolation techniques that extend existing linear results. The techniques are based on the extrapolation theorems by Yano and Rubio de Francia, which use weights from the Muckenhoupt classes.

Joint work with M.J. Carro and T. Luque.

**Monday 13****19:00-19:20****[Room 0.7]****Lunes 13****19:00-19:20****[Aula 0.7]****Astelehena 13****19:00-19:20****[Gela 0.7]**

***Pointwise localization and sharp weighted bounds for Rubio de Francia square functions***

**Mikel Flórez Amatriain**

(BCAM)

The Rubio de Francia square function is the square function formed by frequency projections over a collection of disjoint intervals of the real line. In this talk, we will show a new pointwise sparse bound for the Rubio de Francia square functions. These sparse bounds lead to quantified weighted inequalities. In the first part of the talk, we will give the background of the problem. In the second part, we will explain the new results mentioned above.

Joint work with Francesco Di Plinio, Ioannis Parissis and Luz Roncal.

[arXiv:2308.01442](https://arxiv.org/abs/2308.01442)

Tuesday 14

15:00-15:20

[Room 0.7]

Martes 14

15:00-15:20

[Aula 0.7]

Asteartea 14

15:00-15:20

[Gela 0.7]

*Fine spectra of the Cesàro-Hardy operator on  $L^p[0, 1]$  and the Invariant Subspace Problem*

**Alejandro Mahillo Cazorla**

(Universidad de Zaragoza)

We study the boundedness and spectral properties of a generalized Cesàro-Hardy operator in  $L^p[0, 1]$ . Using semigroup theory, we express these operators and their duals via subordination with composition semigroups. Through functional calculus, we transfer the spectral properties of the semigroups' generators to the generalized Cesàro-Hardy operators. Additionally, we prove the universality of certain translations of the semigroup, providing new insights into the Invariant Subspace Problem.

Joint work with Luciano Abadías.

Tuesday 14

15:30-15:50

[Room 0.7]

Martes 14

15:30-15:50

[Aula 0.7]

Asteartea 14

15:30-15:50

[Gela 0.7]

*Similarity to contraction semigroups on Hilbert spaces*

**Jesus Oliva-Maza**

(Universidad de Zaragoza)

A semigroup of bounded operators  $(T(t))_{t \geq 0}$  on a Hilbert space  $H$  is said to be similar to a contraction semigroup if there exists an equivalent Hilbertian norm  $\|\cdot\|_e$  on  $H$  for which  $\|T(t)\|_e \leq 1$ ,  $t \geq 0$ . In this talk we present a new characterization of semigroups similar to contraction semigroups in terms of quasi-contraction semigroups. We also provide new counterexamples for this theory, namely a (quasi-)nilpotent semigroup which is not similar to a contraction one.

Joint work with Yuri Tomilov.

**Tuesday 14****16:00-16:20****[Room 0.7]****Martes 14****16:00-16:20****[Aula 0.7]****Asteartea 14****16:00-16:20****[Gela 0.7]*****A counterexample for chain recurrence in Linear Dynamics*****Antoni López-Martínez**

(Universitat Politècnica de València)

We exhibit the existence of continuous (and even invertible) linear operators acting on Banach (and even Hilbert) spaces whose restriction to their respective closed linear subspaces of chain recurrent vectors are not chain recurrent operators. This example completely solves in the negative a problem recently posed by N. C. Bernardes Jr. and A. Peris on chain recurrence in Linear Dynamics.

Joint work with Dimitris Papathanasiou.

[arXiv:2402.01377](https://arxiv.org/abs/2402.01377)

**Tuesday 14****16:30-16:50****[Room 0.7]****Martes 14****16:30-16:50****[Aula 0.7]****Asteartea 14****16:30-16:50****[Gela 0.7]*****Localization of non-trivial solutions for operator systems*****Jorge Rodríguez López**

(Universidade de Santiago de Compostela)

We deal with the existence and localization of solutions for operator systems by means of the fixed point index. We emphasize that our results are coexistence fixed point theorems for operator systems, that means that every component of the fixed points obtained is non-trivial. Finally, these coexistence fixed point theorems are applied to obtain results concerning the existence of positive solutions for systems of Hammerstein integral equations.

Tuesday 14

17:30-17:50

[Room 0.7]

Martes 14

17:30-17:50

[Aula 0.7]

Asteartea 14

17:30-17:50

[Gela 0.7]

*Volterra operator acting on Bergman spaces of Dirichlet series***Carlos Gómez Cabello**

(Universidad de Sevilla)

The Volterra operator  $T_g$ , although well understood in the unit disc setting, its study on Banach spaces of Dirichlet series is quite recent. In this talk, we focus on the boundedness of the operator  $T_g$  acting on some Bergman-type spaces of Dirichlet series: the  $\mathcal{A}_p^\mu$ -spaces. To do so, we shall introduce a new family of Bloch spaces of Dirichlet series, the Bloch  $\mu$ -spaces. Using these spaces we shall provide a sufficient and necessary condition for the operator  $T_g$  to act boundedly on the spaces  $\mathcal{A}_p^\mu$ .

Joint work with Professor Pascal Lefèvre and Professor Hervé Queffélec.

[arXiv:2402.12524](https://arxiv.org/abs/2402.12524)

Tuesday 14

18:00-18:20

[Room 0.7]

Martes 14

18:00-18:20

[Aula 0.7]

Asteartea 14

18:00-18:20

[Gela 0.7]

*An optimization problem and point-evaluation in Paley–Wiener spaces***Sarah May Instanes**

(Norwegian University of Science and Technology)

We study the constant  $\mathcal{C}_p$  defined as the smallest constant  $C$  such that  $|f(0)|^p \leq C\|f\|_p^p$  holds for every function  $f$  in the Paley–Wiener space  $PW^p$ . Brevig, Chirre, Ortega-Cerdà, and Seip have recently shown that  $\mathcal{C}_p < p/2$  for all  $p > 2$ . We improve this bound for  $2 < p \leq 5$  by solving an optimization problem.

[arXiv:2409.11963](https://arxiv.org/abs/2409.11963)

Tuesday 14

18:30-18:50

[Room 0.7]

Martes 14

18:30-18:50

[Aula 0.7]

Asteartea 14

18:30-18:50

[Gela 0.7]

*Interpolation of weak Orlicz types and strong maximal in von Neumann algebras***Jorge Pérez García**

(ICMAT)

The Marcinkiewicz interpolation theorem states that an operator of weak type  $(p_0, p_0)$  and  $(p_1, p_1)$  is of strong type  $(p, p)$  for all the  $p$ s in between  $p_0$  and  $p_1$ . It's non-commutative version is true, though the proof much more involved. In a joint work with Adrián González-Pérez and Javier Parcet, we adapt a recently published proof of this result in order to deal with operators of weak Orlicz type. We partially solve an open problem related to convergence of martingales in von Neumann algebras.

Joint work with Adrián González-Pérez and Javier Parcet.

[arXiv:2404.12061](https://arxiv.org/abs/2404.12061)

Tuesday 14

19:00-19:20

[Room 0.7]

Martes 14

19:00-19:20

[Aula 0.7]

Asteartea 14

19:00-19:20

[Gela 0.7]

*Sparse domination of Bergman projectors and boundedness of integral operators on trees***Elena Rizzo**

(Università di Milano Statale)

We consider harmonic Bergman spaces on radial trees and compute some onb and kernels. Assuming the tree to have bounded geometry we get sparse domination for the Bergman projector  $P$ , that implies boundedness results and provides weighted estimates for  $P$ . Allowing the tree to have unbounded geometry we deal with a nondoubling setting and prove a sparse domination-like result for  $P$ . Through a suitable dyadic system and a CZ decomposition, we get boundedness properties for integral operators

Joint work with J. Conde Alonso, F. De Mari, M. Monti and M. Vallarino.

**AM03****Operator Algebras and Applications**  
Álgebras de Operadores y Aplicaciones**Organizers****Jorge Pérez García**  
(CSIC)**Organizadores****Jesse Reimann**  
(TU Delft)**Antolatzaileak****Description**

*A transversal session covering some of the state-of-the-art topics related to operator algebras and their applications*

Esta es una sesión transversal que cubrirá varios temas de actualidad relacionados con las álgebras de operadores y sus aplicaciones

**Descripción****Deskribapena****MSC Codes****Códigos MSC****MSC Kodeak**46L05  
(primary)81R15; 47B49; 46L52  
(secondary)**Slots****Bloques****Blokeak**

2.A (Aula 0.12)

**QR Code****Código QR****QR Kodea****Session Schedule****Horario de la Sesión****Saioaren Ordutegia**

J16 | 11:00-11:20 | 0.12

*Modular theory in Algebraic Quantum Field Theory: Half-sided Modular Inclusions, Standard Pairs and beyond*

**Ian Koot** (Friedrich-Alexander-Universität Erlangen-Nürnberg)

J16 | 11:30-11:50 | 0.12

*Lie-Trotter formulae in Jordan-Banach algebras with applications to the study of spectral-valued multiplicative functionals*

**Gerardo Martín Escolano** (University of Granada & IMAG)

J16 | 12:00-12:20 | 0.12

*Non-commutative  $L^p$ -spaces: tracial and Haagerup constructions*

**Cristian Castillo Godoy** (Universidad de Alicante)

J16 | 12:30-12:50 | 0.12

*Schur multipliers, Fourier multipliers, and the transference method*

**Jesse Reimann** (TU Delft)

**Thursday 16**

11:00-11:20

[Room 0.12]

**Jueves 16**

11:00-11:20

[Aula 0.12]

**Osteguna 16**

11:00-11:20

[Gela 0.12]

***Modular theory in Algebraic Quantum Field Theory: Half-sided Modular Inclusions, Standard Pairs and beyond*****Ian Koot**

(Friedrich-Alexander-Universität Erlangen-Nürnberg)

In Algebraic Quantum Field Theory, the Tomita-Takesaki Modular Theory of the operator algebras making up the theory is related to thermal states. Although the modular theory is difficult to calculate for general theories, we discuss situations where geometric inclusions imply a simple modular theory. Specifically, we look at Half-Sided Modular Inclusions and a possible generalization.

Joint work with Gandalf Lechner.

**Thursday 16**

11:30-11:50

[Room 0.12]

**Jueves 16**

11:30-11:50

[Aula 0.12]

**Osteguna 16**

11:30-11:50

[Gela 0.12]

***Lie-Trotter formulae in Jordan-Banach algebras with applications to the study of spectral-valued multiplicative functionals*****Gerardo Martín Escolano**

(University of Granada &amp; IMAG)

We establish some Lie-Trotter formulae for unital complex Jordan-Banach algebras. These formulae are employed in the study of spectral-valued (non-necessarily linear) functionals. We prove that for any such a functional  $f$ , there exists a unique continuous (Jordan-)multiplicative linear functional  $\psi$  such that  $f(x) = \psi(x)$ , for every  $x$  in the principal component. If we additionally assume that  $A$  is a JB -algebra and  $f$  is continuous, then  $f$  is a linear multiplicative functional.

Joint work with A. M. Peralta and A. R. Villena.

[arXiv:2305.05530](https://arxiv.org/abs/2305.05530)



Thursday 16

12:00-12:20

[Room 0.12]

Jueves 16

12:00-12:20

[Aula 0.12]

Osteguna 16

12:00-12:20

[Gela 0.12]

*Non-commutative  $L^p$ -spaces: tracial and Haagerup constructions***Cristian Castillo Godoy**

(Universidad de Alicante)

If a von Neumann algebra  $\mathcal{M}$  is semifinite, then it admits a trace  $\tau$  that can be used to define the  $p$ -norm of certain operators. The  $L^p$ -space associated with  $\mathcal{M}$  and  $\tau$  is the completion of the space of such operators with this norm. In 1977, U. Haagerup gave a construction of  $L^p$ -spaces associated with an arbitrary von Neumann algebra. In this talk, we introduce both constructions of  $L^p$ -spaces of operators, along with their main properties and differences.

Thursday 16

12:30-12:50

[Room 0.12]

Jueves 16

12:30-12:50

[Aula 0.12]

Osteguna 16

12:30-12:50

[Gela 0.12]

*Schur multipliers, Fourier multipliers, and the transference method***Jesse Reimann**

(TU Delft)

Schur multipliers, which can be seen as a generalisation of componentwise matrix multiplication, have found applications in mathematical physics through noncommutative geometry; however, their boundedness is difficult to show directly. In this talk, I will introduce the so-called transference method, which allows us to study Schur multipliers through associated Fourier multipliers. If time permits, I will present some recent progress in the study of Schur multipliers.

Joint work with Martijn Caspers.

[arXiv:2405.00464](https://arxiv.org/abs/2405.00464)

**AM04*****Partial Differential Equations I:******Elliptic and Parabolic Equations***

Ecuaciones en Derivadas Parciales I:

Ecuaciones Elípticas y Parabólicas

Deribatu Partzialetako Ekuazioak I:

Ekuazio Eliptiko eta Parabolikoak

**Organizers****Organizadores****Antolatzaileak****Iñigo Urtiaga Erneta**

(Rutgers University)

**Clara Torres Latorre**

(Universitat de Barcelona)

**Salvador López Martínez**

(Universidad Autónoma de Madrid)

**Antonio J. Fernández Sánchez**

(Universidad Autónoma de Madrid)

**Description****Descripción****Deskribapena**

*Elliptic and parabolic partial differential equations are general models used to explain phenomena in fields as diverse as physics, biology, and economics. Today, these equations still pose significant mathematical challenges, including issues related to the regularity and stability of solutions, the occurrence of finite-time blow-up versus global existence, connections with other areas such as geometry and probability, and the existence of special solutions, among other topics. In our session, we aim to share the most notable recent advances in elliptic and parabolic equations made by young Spanish researchers or those based in Spain.*

Las Ecuaciones en Derivadas Parciales elípticas y parabólicas son modelos generales que sirven para explicar fenómenos provenientes de campos tan variados como la física, la biología o la economía. A día de hoy, estas ecuaciones presentan aún importantes retos matemáticos por resolver, relacionados con la regularidad y estabilidad de soluciones, la explosión en tiempo finito frente a la existencia global, la relación con otras áreas como la geometría y la probabilidad, o la existencia de soluciones especiales, entre otras cuestiones. En nuestra sesión pretendemos poner en común los avances recientes más destacados sobre ecuaciones elípticas y parabólicas llevados a cabo por la juventud investigadora española o radicada en España.

Deribatu Partzialetako Ekuazio eliptiko eta parabolikoak fisika, biologia edo ekonomia bezalako arlo ezberdinetako fenomenoak azaltzeko erabiltzen diren eredu matematiko orokorrak dira. Gaur egun, erronka matematiko esanguratsuak planteatzen dituzte ekuazio horiek horaindik, hala nola, hurrengo gaiekin lotutakoak: solu-

zioen erregularitasun eta egonkortasuna, leherketa denbora finituan soluzioen existentzia globala aurka, geometria eta probabilitatearekin harremana edo soluzio berezien existentzia, besteak beste. Gure sesioan, Espainako edo Espainian oinarritutako ikertzaile gazteek ekuazio eliptiko eta parabolikoei buruz lortutako azken aurrerapen nabarmenak partekatu nahi ditugu.

**MSC Codes****Códigos MSC****MSC Kodeak**

35J60; 35K55  
(primary)

**Slots****Bloques****Blokeak**

2.A (Aula 0.8); 2.B (Aula 0.8); 2.C (Aula 0.8)

**QR Code****Código QR****QR Kodea****Session Schedule****Horario de la Sesión****Saioaren Ordutegia**

J16 | 11:00-11:20 | 0.8

*Regularity of free interfaces in transmission problems arising from the jump of conductivity*

**María Soria-Carro** (Rutgers University)

J16 | 11:30-11:50 | 0.8

*Stable cones in the Alt-Phillips free boundary problem*

**Tomás Sanz-Perela** (Universitat de Barcelona)

J16 | 12:00-12:20 | 0.8

*Boundary regularity for nonlocal equations*

**Marvin Weidner** (Universitat de Barcelona)

J16 | 12:30-12:50 | 0.8

*Local behaviour of high energy Laplace eigenfunctions of polygonal domains*

**Alba Dolores García Ruiz** (ICMAT)

J16 | 16:30-16:50 | 0.8

*Uniqueness of positive solutions to the nonlocal heat equation associated to certain Lévy operators*

**Irene González** (Universidad Autónoma de Madrid)

J16 | 17:00-17:20 | 0.8

*A quasilinear Keller-Segel model with saturated discontinuous advection*

**Mikel Ispizua** (Euskal Herriko Unibertsitatea)

J16 | 17:30-17:50 | 0.8

*An overdetermined Neumann problem with a nonlinearity*

**Jing Wu** (Universidad Autónoma de Madrid)

J16 | 18:00-18:20 | 0.8

*Yau's conjecture for (non)local minimal surfaces*

**Enric Florit-Simon** (ETH Zürich)

V17 | 9:00-9:20 | 0.8

*Infinitely many positive solutions in a class of semilinear elliptic problems*

**Antonio J. Martínez Aparicio** (Universidad de Almería)

V17 | 9:30-9:50 | 0.8

*Symmetry breaking and rigidity results for semilinear elliptic equations*

**Camilla Chiara Polvara** (Università degli Studi di Milano)

V17 | 10:00-10:20 | 0.8

*Traveling waves for nonlinear Schrödinger equations*

**Laura Baldelli** (IMAG & Universidad de Granada)

V17 | 10:30-10:50 | 0.8

*Prescribing Gaussian and geodesic curvatures on surfaces with conical singularities and corners*

**Francisco J. Reyes-Sánchez** (Universidad de Granada)

Thursday 16

11:00-11:20

[Room 0.8]

Jueves 16

11:00-11:20

[Aula 0.8]

Osteguna 16

11:00-11:20

[Gela 0.8]

*Regularity of free interfaces in transmission problems arising from the jump of conductivity*

**María Soria-Carro**

(Rutgers University)

We introduce a parabolic free boundary problem motivated by the conductivity jump in composite materials undergoing a phase transition. Our goal is to establish the regularity of the free boundary at regular points following the classical strategy I. Flat implies  $C^{1,\alpha}$ .  $C^{1,\alpha}$  implies smooth. We discuss the main ideas and techniques to achieve these results in our parabolic context, largely inspired by the seminal works of Kinderlehrer-Nirenberg-Spruck 1978 Caffarelli 1989 and DeSilva 2011

Joint work with Dennis Kriventsov.

Thursday 16

11:30-11:50

[Room 0.8]

Jueves 16

11:30-11:50

[Aula 0.8]

Osteguna 16

11:30-11:50

[Gela 0.8]

*Stable cones in the Alt-Phillips free boundary problem*

**Tomás Sanz-Perela**

(Universitat de Barcelona)

In this talk I will describe a recent result, obtained in collaboration with Aram Karakhanyan, in which we obtain for the first time a stability condition for the Alt-Phillips free boundary problem. Then, I will discuss how do we use it to classify global stable axially-symmetric solutions in dimensions 3, 4, and 5.

Joint work with Aram Karakhanyan.

**Thursday 16**

12:00-12:20

[Room 0.8]

**Jueves 16**

12:00-12:20

[Aula 0.8]

**Osteguna 16**

12:00-12:20

[Gela 0.8]

***Boundary regularity for nonlocal equations*****Marvin Weidner**

(Universitat de Barcelona)

Local and nonlocal problems are significantly different regarding the boundary behavior of their solutions. For instance,  $s$ -harmonic functions (fractional Laplacian nonlocal equations' solutions) are, in general, not better than  $C^s$  up to the boundary. In recent years, the huge interest in the boundary behavior of nonlocal equations' solutions has led to understanding the case of the fractional Laplacian. However, several questions remained open for more general nonlocal operators.

Joint work with Xavier Ros-Oton and Minhyun Kim.

**Thursday 16**

12:30-12:50

[Room 0.8]

**Jueves 16**

12:30-12:50

[Aula 0.8]

**Osteguna 16**

12:30-12:50

[Gela 0.8]

***Local behaviour of high energy Laplace eigenfunctions of polygonal domains*****Alba Dolores García Ruiz**

(ICMAT)

We consider the Laplace eigenvalue problem with boundary conditions. A blowup argument shows that the local behavior of a rescaled high energy eigenfunction is described by a solution to the Helmholtz equation. This is independent of the domain. A central question in spectral geometry is how the corresponding classical system (i.e. the dynamical billiard) affects this connection between eigenfunctions and monochromatic waves. We study this in the case of all polygons with integrable dynamics.

**Thursday 16****16:30-16:50****[Room 0.8]****Jueves 16****16:30-16:50****[Aula 0.8]****Osteguna 16****16:30-16:50****[Gela 0.8]**

***Uniqueness of positive solutions to the nonlocal heat equation associated to certain Lévy operators***

**Irene González**

(Universidad Autónoma de Madrid)

We establish a representation formula for nonnegative classical solutions of a nonlocal heat equation where the diffusion operator is given by a positive symmetric Lévy kernel comparable to radial functions with mixed polynomial growths. To this aim we prove existence of initial trace, uniqueness and existence for nonnegative solutions.

**Thursday 16****17:00-17:20****[Room 0.8]****Jueves 16****17:00-17:20****[Aula 0.8]****Osteguna 16****17:00-17:20****[Gela 0.8]**

***A quasilinear Keller-Segel model with saturated discontinuous advection***

**Mikel Ispizua**

(Euskal Herriko Unibertsitatea)

The Keller-Segel model is used to explain the formation and propagation of bacterial colonies, it describes how cell density moves towards a nutrient  $N$  and a chemical molecule  $S$  (chemoattractant) which is generated by the cells themselves. In this talk I will present some results for the singular limit of a chemotaxis model recently introduced in arXiv:2009.11048.

Joint work with Maria Gualdani and Nicola Zamponi.

**Thursday 16****17:30-17:50****[Room 0.8]****Jueves 16****17:30-17:50****[Aula 0.8]****Osteguna 16****17:30-17:50****[Gela 0.8]*****An overdetermined Neumann problem with a nonlinearity*****Jing Wu**

(Universidad Autónoma de Madrid)

In this talk, we present the existence of a family of nontrivial compact subdomains in the manifold such that the overdetermined nonlinear problem with zero Neumann and constant Dirichlet boundary values admits sign-changing solutions. The proof uses a local bifurcation argument. This is a joint work with Ignace Aristide Minlend.

**Thursday 16****18:00-18:20****[Room 0.8]****Jueves 16****18:00-18:20****[Aula 0.8]****Osteguna 16****18:00-18:20****[Gela 0.8]*****Yau's conjecture for (non)local minimal surfaces*****Enric Florit-Simon**

(ETH Zürich)

In this talk we will explain a recent result on the existence of infinitely many nonlocal minimal surfaces, obtained as min-max critical points of a canonical definition of non-local perimeter, on any closed Riemannian manifold. We will moreover describe further directions regarding the convergence of nonlocal minimal surfaces to classical minimal surfaces, as well as a Weyl-type Law for these objects, (continues in Comments)

Joint work with Michele Caselli and Joaquim Serra.



Friday 17  
9:00-9:20  
[Room 0.8]

Viernes 17  
9:00-9:20  
[Aula 0.8]

Ostirala 17  
9:00-9:20  
[Gela 0.8]

*Infinitely many positive solutions in a class of semilinear elliptic problems*

**Antonio J. Martínez Aparicio**

(Universidad de Almería)

In this work, we study the behavior of the set of solutions of the semilinear elliptic problem

$$\begin{cases} -\Delta u = \lambda f(u) & \text{in } \Omega, \\ u = 0 & \text{on } \partial\Omega, \end{cases}$$

where  $\Omega$  is a bounded open subset of  $\mathbb{R}^N$  and  $f$  is a nonnegative continuous real function with multiple positive zeros.

Friday 17  
9:30-9:50  
[Room 0.8]

Viernes 17  
9:30-9:50  
[Aula 0.8]

Ostirala 17  
9:30-9:50  
[Gela 0.8]

*Symmetry breaking and rigidity results for semilinear elliptic equations*

**Camilla Chiara Polvara**

(Università degli Studi di Milano)

We consider semilinear elliptic equations in spherical sectors with mixed boundary type conditions and in unbounded cones with Neumann boundary conditions. The aim of the talk is to show that a radial symmetry result of Gidas-Ni-Nirenberg type for positive solutions does not hold in general when the cone is nonconvex, while a rigidity result holds in some class of non convex cones.

Joint work with G. Ciraolo and F. Pacella.

Friday 17  
10:00-10:20  
[Room 0.8]

Viernes 17  
10:00-10:20  
[Aula 0.8]

Ostirala 17  
10:00-10:20  
[Gela 0.8]

*Traveling waves for nonlinear Schrödinger equations*

**Laura Baldelli**

(IMAG & Universidad de Granada)

Motivated by the fact that in the last years, much progress has been made to give rigorous proofs of the so-called Jones-Puterman-Roberts program, the purpose of the present talk is to analyse existence of finite energy traveling waves moving with subsonic speed for a class of nonlinear Schrödinger equations, including the Gross-Pitaevskii one, in the spirit of Berestycki-Lions, and provide a direct and simpler variational approach based on a new Sobolev-type inequality involving the momentum.

Joint work with Bartosz Bieganski and Jarosław Mederski.

[arXiv:2406.03910](https://arxiv.org/abs/2406.03910)

Friday 17  
10:30-10:50  
[Room 0.8]

Viernes 17  
10:30-10:50  
[Aula 0.8]

Ostirala 17  
10:30-10:50  
[Gela 0.8]

*Prescribing Gaussian and geodesic curvatures on surfaces with conical singularities and corners*

**Francisco J. Reyes-Sánchez**

(Universidad de Granada)

In this talk, we will explore the construction of conformal metrics on compact Riemannian surfaces with boundary, featuring conical singularities and corners, with prescribed Gaussian and geodesic curvatures. We will establish conditions for the existence of such metrics by studying a nonlinear elliptic PDE, taking into account the coexistence of both types of singularities.

Joint work with L. Battaglia.

**AM05*****Partial Differential Equations II:  
Dispersive Equations and Spectral Theory*****Ecuaciones en Derivadas Parciales II:  
Ecuaciones Dispersivas y Teoría Espectral****Organizers****Organizadores****Antolatzaileak****Lucrezia Cossetti**

(UPV/EHU)

**Fabio Pizzichillo**

(Universidad Politecnica de Madrid)

**Biagio Cassano**

(Università degli Studi della Campania)

**Description****Descripción****Deskribapena**

*The session "Partial Differential Equations II: Dispersive Equations and Spectral Theory" is distinguished by its interdisciplinary nature. It has long been recognized that there is significant overlap and interesting interplay between Dispersive Equations and Spectral Theory. Nevertheless, most events on these topics tend to focus on one area at the expense of the other. In contrast, this session brings together young scientists from both fields with the goal of fostering new connections, inspiring collaborations, and drawing mutual inspiration.*

La sesión "Ecuaciones en Derivadas Parciales II: Ecuaciones Dispersivas y Teoría Espectral" se distingue por su carácter interdisciplinario. Se ha reconocido desde hace tiempo que existe una gran superposición y una interacción interesante entre las Ecuaciones Dispersivas y la Teoría Espectral. Sin embargo, la mayoría de los eventos sobre estos temas tienden a centrarse en un área en detrimento de la otra. En cambio, esta sesión reúne a jóvenes científicos de ambos campos con el objetivo de fomentar nuevas conexiones, inspirar colaboraciones y extraer inspiración mutua.

**MSC Codes****Códigos MSC****MSC Kodeak**

35P05

(primary)

35Q40; 81Q10; 47N20; 47A10

(secondary)

## Slots

## Bloques

## Blokeak

1.A (Aula 0.15); 1.B (Aula 0.15); 1.C (Aula 0.15)

## QR Code

## Código QR

## QR Kodea



## Session Schedule

## Horario de la Sesión

## Saioaren Ordutegia

L13 | 17:30-17:50 | 0.15

*Spectral properties of the magnetic Laplacian in the context of surface superconductivity*

**Germán Miranda** (Lund University)

L13 | 18:00-18:20 | 0.15

*A 3D Schrödinger operator under magnetic steps with applications in superconductivity*

**Emanuela Laura Giacomelli** (LMU)

L13 | 18:30-18:50 | 0.15

*Pointwise Convergence of the Klein-Gordon Flow*

**Pablo Merino San José** (BCAM & UPV/EHU)

L13 | 19:00-19:20 | 0.15

*Energy decay for strongly damped wave equations*

**Borbala Gerhat** (Institute of Science and Technology Austria)

M14 | 15:00-15:20 | 0.15

*Spectral gap of generalized MIT bag models*

**Joaquim Duran Lamiel** (Centre de Recerca Matemàtica & Universitat Politècnica de Catalunya)

M14 | 15:30-15:50 | 0.15

*Stability of thermodynamic equilibria for the Hartree-Fock equation with exchange term*

**Elena Danesi** (Politecnico di Torino)

M14 | 16:00-16:20 | 0.15

*Weighted Poincarè inequality and Hardy improvements related to some degenerate elliptic differential operators*

**Lorenzo D'Arca** (Università degli Studi di Roma "La Sapienza")

M14 | 16:30-16:50 | 0.15

*Intertwining Operators beyond the Stark Effect*

**Ying Wang** (BCAM)

M14 | 17:30-17:50 | 0.15

*On Neuman-Poincaré operators and self-adjoint transmission problems*

**Badreddine Benhellal** (Carl von Ossietzky Universität Oldenburg)

M14 | 18:00-18:20 | 0.15

*High-energy eigenfunctions of the Laplacian with a point-perturbation*

**Santiago Verdasco-Ramos** (Universidad Politécnica de Madrid)

M14 | 18:30-18:50 | 0.15

*On the Bäcklund transformation and the stability of the line soliton of the KP-II equation on  $\mathbb{R}^2$*

**Lorenzo Pompili** (Universität Bonn)

M14 | 19:00-19:20 | 0.15

*Uniform counterexample to the convergence problem for periodic dispersive equations with a polynomial symbol*

**Daniel Eceizabarrena** (BCAM)

**Monday 13****17:30-17:50****[Room 0.15]****Lunes 13****17:30-17:50****[Aula 0.15]****Astelehena 13****17:30-17:50****[Gela 0.15]**

*Spectral properties of the magnetic Laplacian in the context of surface  
superconductivity*

**Germán Miranda**

(Lund University)

When a superconducting sample is submitted to an applied magnetic field the behaviour around the third critical field reduces to the study of the Neumann self-adjoint realization of the magnetic Laplacian. In this talk, we will discuss how the geometry of the sample or the applied magnetic field affect the distribution of surface superconductivity. In particular, we will focus on the case of a cylindrical sample which is connected with the magnetic Laplacian on the disc.

**Monday 13****18:00-18:20****[Room 0.15]****Lunes 13****18:00-18:20****[Aula 0.15]****Astelehena 13****18:00-18:20****[Gela 0.15]**

*A 3D Schrödinger operator under magnetic steps with applications in  
superconductivity*

**Emanuela Laura Giacomelli**

(LMU)

This talk presents a semiclassical problem in a bounded three-dimensional domain, involving the magnetic Neumann Laplacian with a piecewise-constant field. We establish localization of the semiclassical ground state near magnetic discontinuities by introducing an effective Schrödinger operator on the half-space. We expect our result to provide insights into identifying the magnetic field strength at which a superconductor transitions to the normal state, marking superconductivity's breakdown.

Monday 13  
18:30-18:50  
[Room 0.15]

Lunes 13  
18:30-18:50  
[Aula 0.15]

Astelehena 13  
18:30-18:50  
[Gela 0.15]

*Pointwise Convergence of the Klein-Gordon Flow*

**Pablo Merino San José**

(BCAM & UPV/EHU)

I will present a nonlinear pointwise convergence theory for the case of the 3d cubic Klein-Gordon equation. Namely, we address the following question, considering the initial datum in  $H^s(\mathbb{T}^3) \times H^{s-1}(\mathbb{T}^3)$ : which is the minimal regularity  $s$  such that the solution of the aforementioned equation converges, as time goes to 0 and almost everywhere in space, to the initial datum? Using deterministic and probabilistic frameworks, we provide two different answers.

Joint work with Renato Lucà.

[arXiv:2402.10105](https://arxiv.org/abs/2402.10105)

Monday 13  
19:00-19:20  
[Room 0.15]

Lunes 13  
19:00-19:20  
[Aula 0.15]

Astelehena 13  
19:00-19:20  
[Gela 0.15]

*Energy decay for strongly damped wave equations*

**Borbala Gerhat**

(Institute of Science and Technology Austria)

For wave equations with damping unbounded at infinity, essential spectrum may cover the whole negative semi-axis. One can thus not expect the semigroup norm to decay exponentially in time and a more delicate analysis needs to be done. We derive bounds for the resolvent norm along the imaginary axis and thereby obtain the corresponding polynomial decay rates of the semigroup. This generalises a result by R. Ikehata and H. Takeda obtained by a different approach based on PDE analysis methods.

Joint work with A. Arnal, J. Royer and P. Siegl.

**Tuesday 14**  
**15:00-15:20**  
**[Room 0.15]**

**Martes 14**  
**15:00-15:20**  
**[Aula 0.15]**

**Asteartea 14**  
**15:00-15:20**  
**[Gela 0.15]**

***Spectral gap of generalized MIT bag models***

**Joaquim Duran Lamiel**

(Centre de Recerca Matemàtica & Universitat Politècnica de Catalunya)

We study spectral properties of generalized MIT bag models. These are Dirac operators  $H_\tau$  ( $\tau \in \mathbb{R}$ ) acting on domains of  $\mathbb{R}^3$  with confining boundary conditions. Their lowest positive eigenvalue is of special interest, and it is conjectured to be minimal for a ball among all domains with fixed volume. Studying the resolvent convergence of  $H_\tau$  in the limits  $\tau \rightarrow \pm\infty$ , some spectral properties of the limiting operators  $H_{\pm\infty}$  are inherited throughout the parameterization.

Joint work with A. Mas.

**Tuesday 14**  
**15:30-15:50**  
**[Room 0.15]**

**Martes 14**  
**15:30-15:50**  
**[Aula 0.15]**

**Asteartea 14**  
**15:30-15:50**  
**[Gela 0.15]**

***Stability of thermodynamic equilibria for the Hartree-Fock equation with exchange term***

**Elena Danesi**

(Politecnico di Torino)

The Hartree-Fock equation admits homogeneous states that model infinitely many particles at equilibrium. The aim of this talk is to present a result on their asymptotic stability in large dimensions. This has been obtained for the equivalent formulation of the equation in the framework of random fields and it includes the exchange term for the first time in the study of these stationary solutions.

Joint work with C. Collot, A.S. de Suzzoni, and C. Maléze.



**Tuesday 14****16:00-16:20****[Room 0.15]****Martes 14****16:00-16:20****[Aula 0.15]****Asteartea 14****16:00-16:20****[Gela 0.15]**

***Weighted Poincaré inequality and Hardy improvements related to some degenerate elliptic differential operators***

**Lorenzo D'Arca**

(Università degli Studi di Roma "La Sapienza")

We analyze two fundamental inequalities, Hardy's and Poincaré inequalities. Our approach avoids symmetric rearrangement arguments, simplifying their analysis in Euclidean and non-Euclidean contexts. We characterize the sharp constant and maximizing functions for weighted Poincaré inequalities. These results are used to derive  $L^p$  generalizations of the Brezis-Vázquez improvement of Hardy's inequality.

**Tuesday 14****16:30-16:50****[Room 0.15]****Martes 14****16:30-16:50****[Aula 0.15]****Asteartea 14****16:30-16:50****[Gela 0.15]**

***Intertwining Operators beyond the Stark Effect***

**Ying Wang**

(BCAM)

In this talk, we study the Schrödinger operators in scaling-critical electromagnetic field. First, we use eigenfunction expansions and Hankel transforms to construct two intertwining operators  $W$ . And then, we prove that they are bounded on  $L^p(\mathbb{R}^d)$  for certain values of  $p$ . As applications, we show the dispersive estimates, uniform resolvent estimates and Bochner-Riesz means, etc.

Joint work with Luca Fanelli, Xiaoyan Su, Junyong Zhang and Jiqiang Zheng.

**Tuesday 14**  
**17:30-17:50**  
**[Room 0.15]**

**Martes 14**  
**17:30-17:50**  
**[Aula 0.15]**

**Asteartea 14**  
**17:30-17:50**  
**[Gela 0.15]**

***On Neuman-Poincaré operators and self-adjoint transmission problems***

**Badreddine Benhellal**

(Carl von Ossietzky Universität Oldenburg)

We study the self-adjointness in the  $L^2$  setting of operators of the form  $-\operatorname{div} \cdot h \nabla$ , where  $h$  is piecewise constant with a jump across a Lipschitz hypersurface  $\Sigma$ , without assumptions on the sign of  $h$ . Sufficient conditions for self-adjointness of the operator with  $H^s$ -Sobolev regularity are provided, based on the jump value and geometric properties of  $\Sigma$ . A key step is the connection to the Fredholm properties of the Neumann-Poincaré operator on  $\Sigma$ .

Joint work with K. Pankrashkin.

**Tuesday 14**  
**18:00-18:20**  
**[Room 0.15]**

**Martes 14**  
**18:00-18:20**  
**[Aula 0.15]**

**Asteartea 14**  
**18:00-18:20**  
**[Gela 0.15]**

***High-energy eigenfunctions of the Laplacian with a point-perturbation***

**Santiago Verdasco-Ramos**

(Universidad Politécnica de Madrid)

High-energy eigenfunctions of the Laplacian on a closed Riemannian manifolds exhibit behaviors related with the geodesic flow on the manifold. Invariant subsets in phase space appear in the limit, and in some cases, even closed geodesics. We will talk about how many of these subsets are lost after a point-perturbation on the Laplacian is made, in addition to the spectral properties of this new operator.

**Tuesday 14**  
**18:30-18:50**  
**[Room 0.15]**

**Martes 14**  
**18:30-18:50**  
**[Aula 0.15]**

**Asteartea 14**  
**18:30-18:50**  
**[Gela 0.15]**

*On the Bäcklund transformation and the stability of the line soliton of the KP-II equation on  $\mathbb{R}^2$*

**Lorenzo Pompili**  
(Universität Bonn)

Is it possible to decompose a nonlinear wave into its various components (solitons, radiation)? Integrable PDEs possess such a structure: they admit soliton addition maps that allow to superpose a soliton on another solution of the same PDE. We study the soliton addition map of the KP-II equation on  $\mathbb{R}^2$  and recover codimension-1 stability of the line soliton in  $L^2$  in a weighted space. We discuss the meaning of the codimension-1 condition and the multisoliton case.

**Tuesday 14**  
**19:00-19:20**  
**[Room 0.15]**

**Martes 14**  
**19:00-19:20**  
**[Aula 0.15]**

**Asteartea 14**  
**19:00-19:20**  
**[Gela 0.15]**

*Uniform counterexample to the convergence problem for periodic dispersive equations with a polynomial symbol*

**Daniel Eceizabarrena**  
(BCAM)

For the free Schrödinger equation, what is the minimum Sobolev regularity for the data such that the solution converges to the data a.e.? We know since 2019 that the right exponent in  $\mathbb{R}^n$  is  $n/(2(n+1))$ . We do not know if changing the dispersion relation alters the result. I will show a periodic counterexample that proves that the exponent  $n/(2(n+1))$  is necessary for the periodic equation with a power of the Laplacian  $\Delta^k$ ,  $k \in \mathbb{N}$ , independently of  $k$ .

**AM06**  
*Partial Differential Equations III:*  
*Mathematical Analysis and Applications*  
Ecuaciones en Derivadas Parciales III:  
Análisis Matemático y Aplicaciones

**Organizers**

**Organizadores**

**Antolatzaileak**

**María Soria-Carro**  
(Rutgers University)

**Claudia García**  
(Universidad de Granada)

**Gissell Estrada-Rodriguez**  
(Universitat Politècnica de Catalunya)

**Marta de León-Contreras**  
(Universidad de La Laguna)

**Description**

**Descripción**

**Deskribapena**

*This session is dedicated to young researchers working in the field of Analysis, Partial Differential Equations, and their applications. The aim is to give visibility to junior analysts, especially women, and foster new connections that promote future collaborations. We want to highlight the innovative work of these researchers and create a space where they can share their advancements, exchange ideas, and establish mutual support networks.*

Esta sesión está dedicada a jóvenes investigadores que trabajan en el campo de Análisis, Ecuaciones en Derivadas Parciales y sus aplicaciones. El objetivo es dar visibilidad a les analistas junior, especialmente mujeres, y fomentar nuevas conexiones que impulsen colaboraciones futuras. Queremos destacar su trabajo innovador y crear un espacio donde puedan compartir sus avances, intercambiar ideas y establecer redes de apoyo mutuo.

**MSC Codes**

**Códigos MSC**

**MSC Kodeak**

35-02  
(primary)  
  
42-02; 76-02; 92-02  
(secondary)

**Slots**

**Bloques**

**Blokeak**

1.A (Aula 0.13); 1.B (Aula 0.13); 1.C (Aula 0.13)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

L13 | 17:30-17:50 | 0.13

*Boundary regularity for harmonic functions: from classical results to  $C^1$  domains***Clara Torres-Latorre** (ICMAT)

L13 | 18:00-18:20 | 0.13

*Prescribed local extrema of Laplace eigenfunctions of polygonal domains***Alba D. García Ruiz** (ICMAT)

L13 | 18:30-18:50 | 0.13

*On curved nonlinear waveguides***Laura Baldelli** (IMAG & Universidad de Granada)

L13 | 19:00-19:20 | 0.13

*Nonlinear systems of ODEs coupled to linear non-local boundary conditions***Lucía López Somoza** (Universidade de Santiago de Compostela)

M14 | 15:00-15:20 | 0.13

*Heat-flow methods in harmonic analysis***Jennifer Duncan** (Universidad Autónoma de Madrid)

M14 | 15:30-15:50 | 0.13

*Zero-dispersion limit for the Benjamin-Ono Equation***Louise Gassot** (CNRS / Université de Rennes)

M14 | 16:00-16:20 | 0.13

*Spectral stability via the method of multipliers.***Lucrezia Cossetti** (UPV/EHU & Ikerbasque)

M14 | 16:30-16:50 | 0.13

*Semilinear overdetermined free boundary problems*

**Pablo Hidalgo-Palencia** (ICMAT)

M14 | 17:30-17:50 | 0.13

*Existence of steady states in a Transport-Coagulation equation*

**Carmela Moschella** (University of Vienna)

M14 | 18:00-18:20 | 0.13

*Mean-field limit of particle systems over hypergraphs*

**Nastassia Pouradier Duteil** (Inria Paris)

M14 | 18:30-18:50 | 0.13

*Global existence vs. finite-time blow-up for the two-phase gravity Stokes system*

**Elena Salguero** (MPI MiS Leipzig)

M14 | 19:00-19:20 | 0.13

*A constructive proof of existence of traveling waves*

**Martina Magliocca** (Universidad de Sevilla)

Monday 13  
17:30-17:50  
[Room 0.13]

Lunes 13  
17:30-17:50  
[Aula 0.13]

Astelehena 13  
17:30-17:50  
[Gela 0.13]

*Boundary regularity for harmonic functions: from classical results to  $C^1$  domains*

**Clara Torres-Latorre**  
(ICMAT)

The boundary regularity of harmonic functions is well established for domains with smooth or  $C^{k,\alpha}$  boundaries. Conversely, the minimal requirements for continuous solutions to the Dirichlet problem are also well understood. In this talk, I will explore the nuanced regularity issues that arise in the intermediate case where the domain has  $C^1$  boundaries.

Monday 13  
18:00-18:20  
[Room 0.13]

Lunes 13  
18:00-18:20  
[Aula 0.13]

Astelehena 13  
18:00-18:20  
[Gela 0.13]

*Prescribed local extrema of Laplace eigenfunctions of polygonal domains*

**Alba D. Garcia Ruiz**  
(ICMAT)

In this talk we will consider a polygonal domain drawn on a certain family of tilings of the plane and the Dirichlet or Neumann boundary problem associated to it for the Laplace operator. We will show that for any open set  $O$  and for any natural number  $N$ , one can find a big enough eigenvalue and an associated eigenfunction of the polygon that has at least  $N$  non-degenerate local extrema in the open set  $O$ .

Joint work with Alberto Enciso and Daniel Peralta.

Monday 13  
18:30-18:50  
[Room 0.13]

Lunes 13  
18:30-18:50  
[Aula 0.13]

Astelehena 13  
18:30-18:50  
[Gela 0.13]

*On curved nonlinear waveguides*

**Laura Baldelli**

(IMAG & Universidad de Granada)

Since there has been an increasing interest in the  $p$ -Laplacian operator, we will review recent developments concerning quantum waveguides modelled by the Dirichlet Laplacian in unbounded tubes of uniform cross-section in Euclidean spaces. Precisely, for bent and asymptotic straight tubes discrete eigenvalues appear below the essential spectrum, meaning that the particle in the waveguide gets trapped. While, twisted tubes give a Hardy-type inequality, preventing the particle from being trapped.

Joint work with David Krejcirik.

[arXiv:2312.10357](https://arxiv.org/abs/2312.10357)

Monday 13  
19:00-19:20  
[Room 0.13]

Lunes 13  
19:00-19:20  
[Aula 0.13]

Astelehena 13  
19:00-19:20  
[Gela 0.13]

*Nonlinear systems of ODEs coupled to linear non-local boundary conditions*

**Lucía López Somoza**

(Universidade de Santiago de Compostela)

We show how to obtain an explicit expression for the Green's function of a certain type of systems of differential equations subject to non-local linear boundary conditions. The novelty of our work is that the unknown functions do not appear separated neither in the equations nor in the boundary conditions in the system. We will show how the previous decomposition allows to improve some results for existence of solutions of nonlinear systems with linear non-local boundary conditions.

Joint work with Alberto Cabada and Mouhcine Yousfi.



**Tuesday 14**  
**15:00-15:20**  
**[Room 0.13]**

**Martes 14**  
**15:00-15:20**  
**[Aula 0.13]**

**Asteartea 14**  
**15:00-15:20**  
**[Gela 0.13]**

*Heat-flow methods in harmonic analysis*

**Jennifer Duncan**

(Universidad Autónoma de Madrid)

Heat-flow monotonicity, otherwise known as semigroup interpolation, is a classical analytic tool that falls under the broader category of ‘proof-by-deformation’, and has found a broad range of applications in geometry and analysis. In this talk, I will discuss applications of heat-flow methods to certain problems in harmonic analysis, with a particular focus on Brascamp-Lieb inequalities, a class of highly invariant multilinear inequalities that encompasses a number of classical examples.

[arXiv:2101.07672](https://arxiv.org/abs/2101.07672)

**Tuesday 14**  
**15:30-15:50**  
**[Room 0.13]**

**Martes 14**  
**15:30-15:50**  
**[Aula 0.13]**

**Asteartea 14**  
**15:30-15:50**  
**[Gela 0.13]**

*Zero-dispersion limit for the Benjamin-Ono Equation*

**Louise Gassot**

(CNRS / Université de Rennes)

We focus on the Benjamin-Ono equation on the line with a small dispersion parameter. The goal of this talk is to precisely describe the solution at all times when the dispersion parameter is small enough. This solution may exhibit locally rapid oscillations, which are a manifestation of a dispersive shock. The description involves the multivalued solution of the underlying inviscid Burgers equation, obtained by using the method of characteristics.

Joint work with Elliot Blackstone, Patrick Gérard and Peter D. Miller.

**Tuesday 14**  
**16:00-16:20**  
**[Room 0.13]**

**Martes 14**  
**16:00-16:20**  
**[Aula 0.13]**

**Asteartea 14**  
**16:00-16:20**  
**[Gela 0.13]**

*Spectral stability via the method of multipliers.*

**Lucrezia Cossetti**

(UPV/EHU & Ikerbasque)

Originally arisen in a purely PDEs setting, in the last decades the method of multipliers has been recognized as a useful tool for proving absence of point spectrum for self-adjoint and non self-adjoint operators.

In this seminar we will see the developments of the method reviewing some recent results concerning self-adjoint and non self-adjoint Schrödinger operators in different settings and relativistic Pauli, Dirac and biharmonic operators.

Joint work with L. Fanelli and D. Krejcirik.

**Tuesday 14**  
**16:30-16:50**  
**[Room 0.13]**

**Martes 14**  
**16:30-16:50**  
**[Aula 0.13]**

**Asteartea 14**  
**16:30-16:50**  
**[Gela 0.13]**

*Semilinear overdetermined free boundary problems*

**Pablo Hidalgo-Palencia**

(ICMAT)

In general, it is not possible to obtain solutions to PDE with more boundary conditions than needed (overdetermined problems). Indeed, Serrin ('71) showed that, at least for an easy Poisson equation, the only domains that admit solutions with constant Dirichlet and Neumann boundary conditions are balls. In this talk, we will show how to extend a well-known scheme (by Alt and Caffarelli) to obtain regular solutions to overdetermined PDE with general semilinear right hand sides.

Joint work with Alberto Enciso and Xavier Ros-Oton.

**Tuesday 14**  
**17:30-17:50**  
**[Room 0.13]**

**Martes 14**  
**17:30-17:50**  
**[Aula 0.13]**

**Asteartea 14**  
**17:30-17:50**  
**[Gela 0.13]**

*Existence of steady states in a Transport-Coagulation equation*

**Carmela Moschella**

(University of Vienna)

This talk is motivated by a biological phenomena known as autophagy, where cells recycle damaged cellular components, resulting in the spontaneous formation of aggregates. The model we consider involves an evolution equation for the distribution of aggregates of various sizes, denoted as  $f(x, t)$ , where  $x$  is the aggregate's size. This leads to a transport-coagulation equation in which we seek to examine necessary and sufficient conditions for the existence of non-trivial steady states.

**Tuesday 14**  
**18:00-18:20**  
**[Room 0.13]**

**Martes 14**  
**18:00-18:20**  
**[Aula 0.13]**

**Asteartea 14**  
**18:00-18:20**  
**[Gela 0.13]**

*Mean-field limit of particle systems over hypergraphs*

**Nastassia Pouradier Duteil**

(Inria Paris)

We present a generalization of non-exchangeable particle systems with higher-order interactions. In such models, individuals interact by groups so that a full group jointly generates a non-linear force on any individual. This interaction is modeled by an underlying hypergraph. We show that the mean-field limit is determined by a Vlasov-type equation, where the hypergraph limit is given by an unbounded-rank hypergraphon, and the mean-field force admits infinitely-many orders of interactions.

Joint work with Nathalie Ayi and David Poyato.

[arXiv:2406.04691](https://arxiv.org/abs/2406.04691)

**Tuesday 14**  
**18:30-18:50**  
**[Room 0.13]**

**Martes 14**  
**18:30-18:50**  
**[Aula 0.13]**

**Asteartea 14**  
**18:30-18:50**  
**[Gela 0.13]**

*Global existence vs. finite-time blow-up for the two-phase gravity Stokes system*

**Elena Salguero**

(MPI MiS Leipzig)

We study the dynamics of two different fluids evolving in a 2D domain, governed by the Stokes-transport system, with particular emphasis on the evolution of the free interface between them. Using a contour dynamics approach, we analyze the global-in-time behavior of the nonlinear equation describing the free boundary. We find that this equation exhibits a subtle nonlinear structure that ensures global well-posedness, whereas simplified models show finite-time blow-up.

This work is in collaboration with F. Gancedo and R. Granero-Belinchón.

[arXiv:2402.15593](https://arxiv.org/abs/2402.15593)

**Tuesday 14**  
**19:00-19:20**  
**[Room 0.13]**

**Martes 14**  
**19:00-19:20**  
**[Aula 0.13]**

**Asteartea 14**  
**19:00-19:20**  
**[Gela 0.13]**

*A constructive proof of existence of traveling waves*

**Martina Magliocca**

(Universidad de Sevilla)

In this talk, we will give constructive proof of the existence of traveling wave solutions to a particular cell motility model. The model equations include a convection diffusion equation for the polarity marker concentration and the incompressible Darcy's equation.

Joint work with Thomas Alazard and Nicolas Meunier.

**AM07*****Partial Differential Equations IV:******Fluid Dynamics and Related Areas*****Ecuaciones en Derivadas Parciales IV:****Dinámica de Fluidos y Áreas Relacionadas****Organizers****Organizadores****Antolatzaileak****Antonio Hidalgo Torné**

(MPI MiS Leipzig)

**Luis Martínez Zorua**

(University of Basel)

**Francisco Mengual Bretón**

(MPI MiS Leipzig)

**Elena Salguero Quirós**

(MPI MiS Leipzig)

**Description****Descripción****Deskribapena**

*Fluid dynamics is an essential discipline in mathematics with significant applications in the natural sciences. In this session, young researchers will present their latest results in the theoretical study of partial differential equation models arising from fluid dynamics and related areas.*

*Theoretical issues such as the existence and uniqueness of solutions, stability, formation of singularities, bifurcations, and asymptotic behavior in various fluid models and related problems will be explored. The session will address some of the most recent challenges in the analysis of PDEs in fluid dynamics and will promote collaboration and the exchange of ideas among young mathematicians.*

La dinámica de fluidos es una disciplina esencial en matemáticas con aplicaciones significativas en las ciencias naturales. En esta sesión, jóvenes investigadores presentarán sus últimos resultados en el estudio teórico de modelos de ecuaciones en derivadas parciales que surgen de la dinámica de fluidos y áreas relacionadas.

Se explorarán cuestiones teóricas como la existencia y unicidad de soluciones, estabilidad, formación de singularidades, bifurcaciones y comportamiento asintótico en varios modelos de fluidos y problemas relacionados. La sesión abordará algunos de los desafíos más recientes en el análisis de EDPs en dinámica de fluidos y promoverá la colaboración y el intercambio de ideas entre jóvenes matemáticos.

| MSC Codes | Códigos MSC                        | MSC Kodeak |
|-----------|------------------------------------|------------|
|           | 76-XX<br>(primary)                 |            |
|           | 35-XX; 70-XX; 37-XX<br>(secondary) |            |

| Slots | Bloques   | Blokeak |
|-------|---|---------|
|       | 1.A (Aula 0.12); 1.B (Aula 0.12); 1.C (Aula 0.12) |         |

| QR Code | Código QR  | QR Kodea |
|---------|--|----------|
|         |  |          |

| Session Schedule   | Horario de la Sesión | Saioaren Ordutegia |
|--|----------------------|--------------------|
| L13   17:30-17:50   0.12<br><i>Smooth self-similar singularity formation in fluids</i><br><b>Gonzalo Cao-Labora</b> (NYU Courant)                              |                      |                    |
| L13   18:00-18:20   0.12<br><i>On Gavrilov-Mikado flows</i><br><b>Francisco Javier Torres de Lizaur</b> (Universidad de Sevilla)                               |                      |                    |
| L13   18:30-18:50   0.12<br><i>On the dynamics of magma</i><br><b>Rafael Granero-Belinchón</b> (Universidad de Cantabria)                                      |                      |                    |
| L13   19:00-19:20   0.12<br><i>Global existence for certain IV evolution equations arising in Physics</i><br><b>Martina Magliocca</b> (Universidad de Sevilla) |                      |                    |

M14 | 15:00-15:20 | 0.12

*Mixing and ideal dynamo with randomized ABC flows*

**Víctor Navarro-Fernández** (Imperial College London)

M14 | 15:30-15:50 | 0.12

*Traveling waves near shear flows for 2D Euler*

**Daniel Lear** (Universidad de Cantabria)

M14 | 16:00-16:20 | 0.12

*Unstable vortices and nonuniqueness for 2D Euler and SQG*

**Marcos Solera Diana** (Universitat de València)

M14 | 16:30-16:50 | 0.12

*Pre-Lie and Novikov algebras for (stochastic) (partial) differential equations*

**Pablo Linares Ballesteros** (Universidad Autónoma de Madrid)

M14 | 17:30-17:50 | 0.12

*Monitoring fluid migration from Lipschitz resistivities*

**María Ángeles García Ferrero** (ICMAT)

M14 | 18:00-18:20 | 0.12

*Regularity of isometric embeddings*

**Ángel D. Martínez** (CUNEF Universidad)

M14 | 18:30-18:50 | 0.12

*Smooth nonradial stationary Euler flows on the plane with compact support*

**Antonio J. Fernández** (Universidad Autónoma de Madrid)

M14 | 19:00-19:20 | 0.12

*Global existence and asymptotic behavior for diffusive Hamilton-Jacobi equations with Neumann boundary conditions*

**Joaquín Domínguez de Tena** (ICMAT)

**Monday 13**  
**17:30-17:50**  
**[Room 0.12]**

**Lunes 13**  
**17:30-17:50**  
**[Aula 0.12]**

**Astelehena 13**  
**17:30-17:50**  
**[Gela 0.12]**

*Smooth self-similar singularity formation in fluids*

**Gonzalo Cao-Labora**

(NYU Courant)

We will talk about smooth singularity formation for the compressible Euler equations, with applications to compressible Navier-Stokes and to the supercritical defocusing NLS equation. This is based on a discrete countable family of smooth self-similar profiles that blow-up in finite time, which are unstable but stable in some finite codimension space. We will explain how to obtain those profiles and the tools to show their stability properties.

Joint work with Tristan Buckmaster, Javier Gómez-Serrano, Jia Shi, and Gigliola Staffilani.

[arXiv:2208.09445](https://arxiv.org/abs/2208.09445)

[arXiv:2310.05325](https://arxiv.org/abs/2310.05325)

[arXiv:2410.04532](https://arxiv.org/abs/2410.04532)

**Monday 13**  
**18:00-18:20**  
**[Room 0.12]**

**Lunes 13**  
**18:00-18:20**  
**[Aula 0.12]**

**Astelehena 13**  
**18:00-18:20**  
**[Gela 0.12]**

*On Gavrilov-Mikado flows*

**Francisco Javier Torres de Lizaur**

(Universidad de Sevilla)

Gavrilov-Mikado flows are a special class of divergence-free fields on the 3-torus that give rise to quasiperiodic solutions to the 3D Euler equations. We will review their construction and present some applications as well as open problems.



Monday 13  
18:30-18:50  
[Room 0.12]

Lunes 13  
18:30-18:50  
[Aula 0.12]

Astelehena 13  
18:30-18:50  
[Gela 0.12]

*On the dynamics of magma*  
**Rafael Granero-Belinchón**  
(Universidad de Cantabria)

In this talk we will review some recent results on the transport of deep mantle material. Such situation can be described as a buoyancy driven, cylindrical free interface between two immiscible, Stokes fluids with high viscosity contrast. In particular, we will derive a new asymptotic model for this situation and describe some of the properties of the solutions.

Monday 13  
19:00-19:20  
[Room 0.12]

Lunes 13  
19:00-19:20  
[Aula 0.12]

Astelehena 13  
19:00-19:20  
[Gela 0.12]

*Global existence for certain IV evolution equations arising in Physics*  
**Martina Magliocca**  
(Universidad de Sevilla)

We will focus on global existence and regularity results with Wiener data for certain fourth order problems. We will mainly discuss the cases of a porous-medium type equation (modeling the evolution of a thin-film liquid height spreading on a solid surface), and the one of an equation involving the hessian of the solution (modeling epitaxial growth).

Joint work with Rafael Granero-Belinchón.

**Tuesday 14**  
**15:00-15:20**  
**[Room 0.12]**

**Martes 14**  
**15:00-15:20**  
**[Aula 0.12]**

**Asteartea 14**  
**15:00-15:20**  
**[Gela 0.12]**

***Mixing and ideal dynamo with randomized ABC flows***

**Víctor Navarro-Fernández**

(Imperial College London)

In this work we consider the Lagrangian properties of a random version of the ABC flows in a three-dimensional periodic box. We prove that the flow map possesses a positive top Lyapunov exponent, and its associated Markov chains are geometrically ergodic. For a passive scalar, it follows that such a velocity is a space-time smooth exponentially mixing field, uniformly in the diffusivity coefficient. For a passive vector, it provides an example of a universal ideal kinematic dynamo.

Joint work with M. Coti Zelati.

[arXiv:2407.18028](#)

**Tuesday 14**  
**15:30-15:50**  
**[Room 0.12]**

**Martes 14**  
**15:30-15:50**  
**[Aula 0.12]**

**Asteartea 14**  
**15:30-15:50**  
**[Gela 0.12]**

***Traveling waves near shear flows for 2D Euler***

**Daniel Lear**

(Universidad de Cantabria)

In this talk we will consider the existence of traveling waves arbitrarily close to shear flows for the incompressible 2D Euler equations. In particular we will present some results concerning the existence of such solutions near Couete, Taylor-Couete and Poiseuille flows. In the first part of the talk we will introduce the problem and review some well-known results on this subject. In the second, we will outline some of the ideas underlying the construction of our traveling waves.

**Tuesday 14**  
**16:00-16:20**  
**[Room 0.12]**

**Martes 14**  
**16:00-16:20**  
**[Aula 0.12]**

**Asteartea 14**  
**16:00-16:20**  
**[Gela 0.12]**

***Unstable vortices and nonuniqueness for 2D Euler and SQG***

**Marcos Solera Diana**

(Universitat de València)

We present an alternative proof of Vishik's nonuniqueness theorem for the forced 2D Euler equation in the vorticity class  $L^1 \cap L^p$ , where  $2 < p < \infty$ . Our main contribution is the construction of a smooth, compactly supported unstable vortex. Notably, we extend this approach to the Surface Quasi-Geostrophic (SQG) equation, addressing new challenges that arise at each step and require refined techniques.

Joint work with Á. Castro, D. Faraco, and F. Mengual.

[arXiv:2404.15995](https://arxiv.org/abs/2404.15995)

**Tuesday 14**  
**16:30-16:50**  
**[Room 0.12]**

**Martes 14**  
**16:30-16:50**  
**[Aula 0.12]**

**Asteartea 14**  
**16:30-16:50**  
**[Gela 0.12]**

***Pre-Lie and Novikov algebras for (stochastic) (partial) differential equations***

**Pablo Linares Ballesteros**

(Universidad Autónoma de Madrid)

Since the works of Cayley, combinatorial structures based on trees have been applied in the description of solutions to differential equations: first for their numerical approximations (Butcher, Hairer, Wanner, etc), later in the theories of rough paths (Gubinelli) and regularity structures (Hairer). A different bookkeeping based on multi-indices was introduced in works of Otto and collaborators. We will compare these two approaches and describe their algebraic structures and applications.

Joint work with Y. Bruned, F. Otro and M. Tempelmayr.

[arXiv:2307.06769](https://arxiv.org/abs/2307.06769)

[arXiv:2307.03036](https://arxiv.org/abs/2307.03036)

**Tuesday 14**  
**17:30-17:50**  
**[Room 0.12]**

**Martes 14**  
**17:30-17:50**  
**[Aula 0.12]**

**Asteartea 14**  
**17:30-17:50**  
**[Gela 0.12]**

***Monitoring fluid migration from Lipschitz resistivities***

**María Ángeles García Ferrero**  
(ICMAT)

Electrical resistivity tomography is a geophysical technique for determining the resistivity of the interior of a structure from electrical measurements on its surface, which can be used to track the movement of fluids in the subsurface during gas drilling.

Greatly studied by mathematicians, reconstruction solutions were provided for  $C^2$  resistivities in the 80's. In this talk, we will address the reconstruction in the case that the resistivities are only Lipschitz continuous.

Joint work with Pedro Caro and Keith M. Rogers.

**Tuesday 14**  
**18:00-18:20**  
**[Room 0.12]**

**Martes 14**  
**18:00-18:20**  
**[Aula 0.12]**

**Asteartea 14**  
**18:00-18:20**  
**[Gela 0.12]**

***Regularity of isometric embeddings***

**Ángel D. Martínez**  
(CUNEF Universidad)

A celebrated result of Nash provides the existence of isometric embeddings with  $C^1$  regularity in codimension two (Kuiper provided a variant to reach codimension one). Another celebrated result of Nash constructs smooth embeddings in high codimension. The precise relation of regularity and codimension is an intriguing open question. In this talk we will discuss a result that for codimension  $n(n+1)/2$  claims  $C^{1,1}$  regularity of (local) isometric embeddings (improving Kallen's 1978 codimension).

[arXiv:2409.00440](https://arxiv.org/abs/2409.00440)

**Tuesday 14**  
**18:30-18:50**  
**[Room 0.12]**

**Martes 14**  
**18:30-18:50**  
**[Aula 0.12]**

**Asteartea 14**  
**18:30-18:50**  
**[Gela 0.12]**

***Smooth nonradial stationary Euler flows on the plane with compact support***

**Antonio J. Fernández**

(Universidad Autónoma de Madrid)

In this talk we will show how to construct nonradial classical solutions to the 2d incompressible Euler equations. More precisely, for any positive integer  $k$ , we will see how to construct compactly supported stationary Euler flows of class  $C^k(\mathbb{R}^2)$  which are not locally radial.

Joint work with Alberto Enciso and David Ruiz.

**Tuesday 14**  
**19:00-19:20**  
**[Room 0.12]**

**Martes 14**  
**19:00-19:20**  
**[Aula 0.12]**

**Asteartea 14**  
**19:00-19:20**  
**[Gela 0.12]**

***Global existence and asymptotic behavior for diffusive Hamilton-Jacobi equations with Neumann boundary conditions***

**Joaquín Domínguez de Tena**

(ICMAT)

We will present recent results on the diffusive Hamilton-Jacobi equation  $u_t - \Delta u = |\nabla u|^p$ , an important model in stochastic control. This equation has been extensively studied in the whole space or bounded domains with Dirichlet conditions, where gradient blow-up can occur in finite time. However, it has been less studied with Neumann conditions. We focus on the global existence and asymptotic behaviour for the Neumann problem with Lipschitz data, improving some previous results.

Joint work with Philippe Souplet.

arXiv:2409.07338

**AM08****Quantum Information and Computation**  
Información y Computación Cuántica**Organizers****Angela Capel Cuevas**

(University of Cambridge)

**Organizadores****Angelo Lucia**

(Politecnico di Milano)

**Antolatzaileak****Antonio Pérez Hernández**

(Universidad Nacional de Educación a Distancia)

**Description**

*Quantum mechanics has been a catalyst for new advances in many areas of mathematics, from the theory of Hilbert spaces and operators to category theory. At the dawn of quantum technologies, understanding quantum phenomena and their potential applications in faster computing or more secure information transmission, is highly relevant.*

*Quantum information has emerged at the interplay of math, physics and computer science for classifying simple and complex states and algorithms. Here, we will discuss recent progress in quantum information and computation, with a focus on the necessary mathematical tools to derive relevant applications such as efficient learning algorithms to extract information about the behavior of quantum systems.*

**Descripción**

La mecánica cuántica ha sido catalizador de nuevos avances en muchas áreas de las matemáticas, desde la teoría de los espacios de Hilbert hasta la teoría de categorías. En los albores de las tecnologías cuánticas, la comprensión de los fenómenos cuánticos y sus posibles aplicaciones en una computación más rápida o una transmisión de información más segura es de gran relevancia.

La información cuántica ha surgido en la interacción de las matemáticas, la física y la informática para clasificar estados y algoritmos simples y complejos. Analizaremos los avances recientes, centrándonos en las herramientas necesarias en aplicaciones relevantes como algoritmos de aprendizaje eficientes para estudiar comportamiento de los sistemas cuánticos.

**Deskribapena**

| MSC Codes | Códigos MSC                               | MSC Kodeak |
|-----------|---|------------|
|           | 81Qxx<br>(primary)                        |            |
|           | 81P68; 81P73; 68Q12; 81S22<br>(secondary) |            |
| Slots     | Bloques                                   | Blokeak    |
|           | 2.B (Aula 0.12); 2.C (Aula 0.12)          |            |

| QR Code | Código QR  | QR Kodea |
|---------|--|----------|
|         |  |          |

| Session Schedule  | Horario de la Sesión | Saioaren Ordutegia |
|---|----------------------|--------------------|
| J16   16:30-16:50   0.12<br><i>Hamiltonian simulation through the Magnus expansion: is it universal?</i><br><b>Emilio Onorati</b> (Technical University of Munich)  |                      |                    |
| J16   17:00-17:20   0.12<br><i>A cb-Bohnenblust-Hille inequality with constant one and its applications in Learning Theory</i><br><b>Francisco Escudero Gutiérrez</b> (QuSoft & Centrum Wiskunde & Informatica Amsterdam) |                      |                    |
| J16   17:30-17:50   0.12<br><i>Local minima and barren plateaus in energy landscapes of spin glass Ising models</i><br><b>Pablo Páez Velasco</b> (Universidad Complutense de Madrid)                                      |                      |                    |

J16 | 18:00-18:20 | 0.12

*Learning finitely correlated states: stability of the spectral reconstruction*

**Marco Fanizza** (University of Copenhagen)

V17 | 9:00-9:20 | 0.12

*Quantum Fisher Information and its dynamical nature*

**Matteo Scandi** (Instituto de Física Teórica)

V17 | 9:30-9:50 | 0.12

*Undecidability of the spectral gap in symmetric Hamiltonians*

**Laura Castilla Castellano** (Universidad Complutense de Madrid)

V17 | 10:00-10:20 | 0.12

*Beyond the Contraction Coefficient: Understanding the Average Contraction of Quantum Channels*

**Rubén Ibarrondo** (UPV/EHU)

V17 | 10:30-10:50 | 0.12

*A generic quantum Wielandt's inequality in matrix algebra and Lie algebra*

**Yifan Jia** (University of Copenhagen)



**Thursday 16****16:30-16:50****[Room 0.12]****Jueves 16****16:30-16:50****[Aula 0.12]****Osteguna 16****16:30-16:50****[Gela 0.12]*****Hamiltonian simulation through the Magnus expansion: is it universal?*****Emilio Onorati**

(Technical University of Munich)

Hamiltonian simulation is considered a powerful instrument in quantum science as well as a precious tool for philosophical inquiry of reality: given a set of Hamiltonians, can we use them to reproduce properties of other systems that we cannot directly access? We will explore the possibility of simulating other quantum systems when we can manipulate only Hamiltonians that vary over time under physically-motivated constraints. The answer will be determined by the corresponding Magnus expansion.

**Thursday 16****17:00-17:20****[Room 0.12]****Jueves 16****17:00-17:20****[Aula 0.12]****Osteguna 16****17:00-17:20****[Gela 0.12]*****A cb-Bohnenblust-Hille inequality with constant one and its applications in Learning Theory*****Francisco Escudero Gutiérrez**

(QuSoft &amp; Centrum Wiskunde &amp; Informatica Amsterdam)

We show that Bohnenblust-Hille inequality for  $m$ -homogeneous polynomials holds with constant one when the operator norm is replaced by the completely bounded norm. Moreover, we show that it finds some interesting consequences in quantum learning theory. Next, we broaden our investigation of the Bohnenblust-Hille inequality to other contexts, and we extend recent results by Volberg and Zhang, demonstrating its applicability within a framework we have termed 'Learning Low-Degree Quantum Objects'.

**Thursday 16****17:30-17:50****[Room 0.12]****Jueves 16****17:30-17:50****[Aula 0.12]****Osteguna 16****17:30-17:50****[Gela 0.12]*****Local minima and barren plateaus in energy landscapes of spin glass Ising models*****Pablo Páez Velasco**

(Universidad Complutense de Madrid)

One of the main obstacles in VQAs is the presence of barren plateaus (BP) and local minima in their energy landscape. We will study the problem of minimising the energy of a family of classical Ising models and prove that the problem is hard to solve. We compare this fact to some previous results obtained for the convergence of Langevin dynamics algorithms. From this, we conclude that our family of Ising models do not have local minima, so they must exhibit BP in their energy landscapes.

**Thursday 16****18:00-18:20****[Room 0.12]****Jueves 16****18:00-18:20****[Aula 0.12]****Osteguna 16****18:00-18:20****[Gela 0.12]*****Learning finitely correlated states: stability of the spectral reconstruction*****Marco Fanizza**

(University of Copenhagen)

Matrix product operators efficiently describe states on a 1D lattice. We consider the task of learning a realization from copies of an unknown state, measuring the error of the reconstructed operators in trace norm. We bound the error as a function of  $t$  and other relevant parameters, proving that the sample and computational complexity of the task are polynomial. We give refined bounds for states generated by quantum memories, and we extend the bounds to the non-translation invariant case.

Friday 17  
9:00-9:20  
[Room 0.12]

Viernes 17  
9:00-9:20  
[Aula 0.12]

Ostirala 17  
9:00-9:20  
[Gela 0.12]

*Quantum Fisher Information and its dynamical nature*

**Matteo Scandi**

(Instituto de Física Teórica)

Quantum Fisher Information is customarily used in metrology, where it is interpreted as a distinguishability measure between quantum states. In this talk we change the perspective, focussing on an aspect that was partly overlooked in the literature: its connection to quantum dynamics. Indeed, we prove that natural properties of evolutions can be formulated rather simply in terms of quantum Fisher information, showcasing its inherently dynamical nature.

Friday 17  
9:30-9:50  
[Room 0.12]

Viernes 17  
9:30-9:50  
[Aula 0.12]

Ostirala 17  
9:30-9:50  
[Gela 0.12]

*Undecidability of the spectral gap in symmetric Hamiltonians*

**Laura Castilla Castellano**

(Universidad Complutense de Madrid)

The problem of determining the existence of a spectral gap has previously been shown to be undecidable in systems of one or more dimensions. However, since symmetric behaviours can be found in most physical systems, we study if the problem is still undecidable even for 2-dimensional systems whose Hamiltonian presents rotational symmetry. Our result shows that even with this symmetry, the problem remains undecidable.

Friday 17  
10:00-10:20  
[Room 0.12]

Viernes 17  
10:00-10:20  
[Aula 0.12]

Ostirala 17  
10:00-10:20  
[Gela 0.12]

*Beyond the Contraction Coefficient: Understanding the Average Contraction of Quantum Channels*  
**Rubén Ibarrondo**  
(UPV/EHU)

The contraction coefficient quantifies the noise introduced by a quantum channel. However, it is often overly optimistic and may not represent the behavior encountered in practical tasks. In this talk, we introduce the moments of contraction obtained from the distribution of the ratio between output and input state distinguishability, including the average contraction. We find a notable gap between the contraction coefficient and the average contraction for a set of product and LDP channels.

Friday 17  
10:30-10:50  
[Room 0.12]

Viernes 17  
10:30-10:50  
[Aula 0.12]

Ostirala 17  
10:30-10:50  
[Gela 0.12]

*A generic quantum Wielandt's inequality in matrix algebra and Lie algebra*  
**Yifan Jia**  
(University of Copenhagen)

Quantum Wielandt's inequality provides an optimal upper bound on the minimal length  $k$  such that  $k$ -length products of elements in a generating set span the  $n$ -by- $n$  matrix algebra. These bounds yield nice results for the primitivity index of quantum channels and injectivity index of PEPS. We show that  $k$  generically scales as  $\Theta(\log n)$  and discuss a recent proof that  $k$  is  $O(n^2)$  in general. We extend this to Lie algebras and explore its application to unitary generation in quantum computation.

**CD01****Complex Data Analysis**  
Análisis de Datos Complejos**Organizers****Organizadores****Antolatzaileak****Belén Pulido Bravo**

(IBiDat - Universidad Carlos III de Madrid)

**Jose Ameijeiras Alonso**

(CITMAga, Univ. Santiago de Compostela)

**Diego Bolón Rodríguez**

(Université Libre de Bruxelles)

**Description****Descripción****Deskribapena**

*This session aims to explore various advanced statistical techniques for dealing with the complexity of contemporary data, as well as some of their applications. In particular, three different areas of study will be considered: functional data analysis, where the data can be considered as a function that depends on some continuous variable, non-parametric statistics, where no assumptions are made about the underlying distribution of the data, and survival analysis, where some data cannot be directly observed due to the presence of censoring.*

Esta sesión pretende explorar diversas técnicas estadísticas avanzadas para abordar la complejidad de los datos contemporáneos, así como algunas de sus aplicaciones. En particular, se considerarán tres áreas de estudio diferentes: el análisis de datos funcional, donde los datos pueden considerarse como una función que depende de alguna variable continua, la estadística no paramétrica, donde no se hacen suposiciones sobre la distribución subyacente de los datos, y el análisis de supervivencia, donde algunos datos no pueden ser observados directamente por la presencia de censura.

**MSC Codes****Códigos MSC****MSC Kodeak**

62-XX

(primary)

62R10; 62G05; 62N02

(secondary)

**Slots****Bloques****Blokeak**

1.B (Aula 0.16); 1.C (Aula 0.16); 2.A (Aula 0.16)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

M14 | 15:00-15:20 | 0.16

*Improved Seasonal Adjustment for Long Time Series***Cheyenne Amoroso** (CITIC - Universidade da Coruña)

M14 | 15:30-15:50 | 0.16

*An independent component approach for scalar-on-function linear regression.***Helena Ortiz Alcalá** (University of Granada)

M14 | 16:00-16:20 | 0.16

*New versions of the epigraph and hypograph indices based on areas between curves***Belén Pulido Bravo** (IBiDat - Universidad Carlos III de Madrid)

M14 | 17:30-17:50 | 0.16

*Cure models in cardio-oncology: dealing with functional and image covariates***Beatriz Piñeiro-Lamas** (Universidade da Coruña)

M14 | 18:00-18:20 | 0.16

*Regularization techniques for Cox regression in high-dimensional survival analysis***Pilar González-Barquero** (Universidad Carlos III de Madrid)

M14 | 18:30-18:50 | 0.16

*Random slope mixed models for Small Area Estimation of complex data***Naomi Diz-Rosales** (CITIC - Universidade da Coruña)

M14 | 19:00-19:20 | 0.16

*ROC curves with time-dependent variables***Arís Fanjul Hevia** (Universidad de Oviedo)

J16 | 11:00-11:20 | 0.16

*Bootstrap prediction intervals for quantile autoregression*

**Silvia Novo** (Universidad Carlos III de Madrid)

J16 | 11:30-11:50 | 0.16

*Different applications and extensions of the distance covariance*

**Laura Freijeiro González** (Universidad de Oviedo)

J16 | 12:00-12:20 | 0.16

*Quick quantile segmentation*

**Luis Alberto Rodríguez Ramírez** (Georg August-Universität Göttingen)

J16 | 12:30-12:50 | 0.16

*High density region estimation on manifolds*

**Diego Bolón** (Université Libre de Bruxelles)

**Tuesday 14**  
**15:00-15:20**  
**[Room 0.16]**

**Martes 14**  
**15:00-15:20**  
**[Aula 0.16]**

**Asteartea 14**  
**15:00-15:20**  
**[Gela 0.16]**

***Improved Seasonal Adjustment for Long Time Series***

**Cheyenne Amoroso**

(CITIC - Universidade da Coruña)

A common task in economics is seasonal adjusting time series, often using Tramo-Seats methodology. However, long time series complicate identifying a single model, especially with structural changes in the data. New methodologies are proposed for cases with two identified ARIMA models and a transition period, modeled as a weighted average of the two events through a time-dependent weighting function. These approaches are evaluated through simulations to assess improvements and robustness.

Joint work with Carolina García-Martos, Germán Aneiros-Pérez, José Antonio Vilar, Manuel Oviedo de la Fuente and Mario Francisco Fernandez.

**Tuesday 14**  
**15:30-15:50**  
**[Room 0.16]**

**Martes 14**  
**15:30-15:50**  
**[Aula 0.16]**

**Asteartea 14**  
**15:30-15:50**  
**[Gela 0.16]**

***An independent component approach for scalar-on-function linear regression.***

**Helena Ortiz Alcalá**

(University of Granada)

The estimation of scalar-on-function linear regression model presents challenges due to the infinite dimension of functional data. In this context, we propose a new estimation method based on Independent Component Analysis, which is obtained by maximising kurtosis rather than variability or covariance with the response, classical solutions found in the literature. The performance and advantages of this new approach in comparison with other methods will be tested through a simulation study.

Joint work with Marc Vidal, Christian Acal and Ana M. Aguilera.



**Tuesday 14**  
**16:00-16:20**  
**[Room 0.16]**

**Martes 14**  
**16:00-16:20**  
**[Aula 0.16]**

**Asteartea 14**  
**16:00-16:20**  
**[Gela 0.16]**

***New versions of the epigraph and hypograph indices based on areas between curves***

**Belén Pulido Bravo**

(IBiDat - Universidad Carlos III de Madrid)

Ordering functions is a well-known problem in FDA. The statistical depth provides a criterion to order curves from center to outwards, while the epigraph and hypograph indices give an ordination from top to bottom or vice versa. This work proposes new definitions of these indices based on areas between curves, enhancing their ability to isolate outliers. These indices can be considered in several data analysis problems, demonstrating good performance on both synthetic and real datasets.

Joint work with Rosa E. Lillo and Alba M. Franco-Pereira.

**Tuesday 14**  
**17:30-17:50**  
**[Room 0.16]**

**Martes 14**  
**17:30-17:50**  
**[Aula 0.16]**

**Asteartea 14**  
**17:30-17:50**  
**[Gela 0.16]**

***Cure models in cardio-oncology: dealing with functional and image covariates***

**Beatriz Piñeiro-Lamas**

(Universidade da Coruña)

In medical practice, mixture cure models can be used to estimate the probability of experiencing a side effect and the distribution of the time until its appearance. Single-index mixture cure models, which avoid the curse of dimensionality in vector covariates, are extended to functional and image covariates, commonly used in medicine. The effect of Tissue Doppler Imaging in breast cancer patients receiving cardiotoxic therapies is analyzed.

Joint work with Ana López-Cheda and Ricardo Cao.

**Tuesday 14**  
**18:00-18:20**  
**[Room 0.16]**

**Martes 14**  
**18:00-18:20**  
**[Aula 0.16]**

**Asteartea 14**  
**18:00-18:20**  
**[Gela 0.16]**

*Regularization techniques for Cox regression in high-dimensional survival analysis*

**Pilar González-Barquero**

(Universidad Carlos III de Madrid)

Variable selection methods are crucial in high-dimensional settings, as the presence of numerous covariates complicates decision-making processes. In this context, Cox regression models are unfeasible since they present an infinite number of possible solutions for the regression coefficients. This study focuses on the proposal and evaluation of weight calculation methods for adaptive Lasso and their comparison with other regularization techniques for Cox regression in high-dimensional scenarios.

Joint work with Rosa E. Lillo and Álvaro Méndez-Civieta.

[arXiv:2406.19213](https://arxiv.org/abs/2406.19213)

**Tuesday 14**  
**18:30-18:50**  
**[Room 0.16]**

**Martes 14**  
**18:30-18:50**  
**[Aula 0.16]**

**Asteartea 14**  
**18:30-18:50**  
**[Gela 0.16]**

*Random slope mixed models for Small Area Estimation of complex data*

**Naomi Diz-Rosales**

(CITIC - Universidade da Coruña)

The increasing complexity of data in societal challenges, whether economic or health, highlights the need for flexible modelling tools. This study presents an innovative approach using random slope mixed models for small area estimation. We compute maximum likelihood estimates and random effects predictors, and evaluate the effectiveness of the methodology through simulation studies, demonstrating its relevance in addressing various social challenges.

Joint work with María José Lombardía and Domingo Morales.

[arXiv:2404.18493](https://arxiv.org/abs/2404.18493)

**Tuesday 14**  
**19:00-19:20**  
**[Room 0.16]**

**Martes 14**  
**19:00-19:20**  
**[Aula 0.16]**

**Asteartea 14**  
**19:00-19:20**  
**[Gela 0.16]**

***ROC curves with time-dependent variables***

**Arís Fanjul Hevia**

(Universidad de Oviedo)

The Receiver Operating Characteristic (ROC) curve is a statistical tool that combines the concepts of sensitivity and specificity to evaluate a diagnostic marker's discriminatory capability. This work aims to explore existing alternatives in the literature for incorporating time-dependent variables into ROC curve analysis, particularly when comparing different diagnostic markers.

Joint work with Wenceslao González Manteiga and Juan Carlos Pardo Fernández.

**Thursday 16**  
**11:00-11:20**  
**[Room 0.16]**

**Jueves 16**  
**11:00-11:20**  
**[Aula 0.16]**

**Osteguna 16**  
**11:00-11:20**  
**[Gela 0.16]**

***Bootstrap prediction intervals for quantile autoregression***

**Silvia Novo**

(Universidad Carlos III de Madrid)

New methods are proposed to compute prediction intervals in quantile autoregression models, both under homoscedasticity and in general quantile autoregression models. The proposed methods are based on quantile estimation, bootstrap multipliers to mimic the variability in coefficient estimation, and bootstrap replicates of future values. The consistency of the proposed methods is proven. Simulations and a real data analysis are provided to evaluate their finite-sample performance.

Joint work with César Sánchez-Sellero.

**Thursday 16****11:30-11:50****[Room 0.16]****Jueves 16****11:30-11:50****[Aula 0.16]****Osteguna 16****11:30-11:50****[Gela 0.16]*****Different applications and extensions of the distance covariance*****Laura Freijeiro González**

(Universidad de Oviedo)

In recent years, different extensions of the well-known distance covariance coefficient of Székely et al. (2007) have been proposed. These are devoted to quantifying distinct types of dependence, providing a deeper understanding of the underlying structure of the data. Additionally, these can be employed to characterize not only dependence but other structures as well. A brief review of these methodologies will be provided, jointly with some practical applications and extensions.

Joint work with Wenceslao González Manteiga and Manuel Febrero Bande.

**Thursday 16****12:00-12:20****[Room 0.16]****Jueves 16****12:00-12:20****[Aula 0.16]****Osteguna 16****12:00-12:20****[Gela 0.16]*****Quick quantile segmentation*****Luis Alberto Rodríguez Ramírez**

(Georg August-Universität Göttingen)

Change point estimation is formulated as finding the maximum of a gain function that improves data segmentation. Searching through all candidates requires  $O(n)$  evaluations, which can be computationally expensive. We propose optimistic search methods with  $O(\log n)$  evaluations, exploiting the gain function's structure. This talk presents asymptotic consistency results for robust gain functions using empirical process theory. Further, efficiency bounds for optimistic search methods are also given.

Joint work with Housen Li and Axel Munk.

**Thursday 16****12:30-12:50****[Room 0.16]****Jueves 16****12:30-12:50****[Aula 0.16]****Osteguna 16****12:30-12:50****[Gela 0.16]*****High density region estimation on manifolds*****Diego Bolón**

(Université Libre de Bruxelles)

Highest density regions (HDRs) are the sets where the density function of the data exceeds a given (and usually high) threshold. We introduce a new HDR estimator for manifold data that combines an underlying density estimator with some prior geometric information. The consistency of the new estimator is proven, and its consistency rate is derived. Finally, the performance in practice of the new HDR estimator is illustrated with a real data example.

Joint work with Rosa M. Crujeiras and Alberto Rodriguez-Casal.

[arXiv:2407.07559](https://arxiv.org/abs/2407.07559)

CD02

Topological Data Analysis: Theory and Applications  
Análisis Topológico de Datos: Teoría y Aplicaciones

| Organizers                                    | Organizadores                                    | Antolatzaileak |
|---|--|----------------|
| <b>Manuel M Cuerno</b><br>(CUNEF Universidad) | <b>Inés García-Redondo</b><br>(Imperial College) |                |

| Description | Descripción | Deskribapena |
|-------------|-------------|--------------|
|-------------|-------------|--------------|

*Topological Data Analysis (TDA) leverages algebraic topology to address high-dimensional, complex data problems, where data present non-linear interactions that are hard to capture using traditional statistical and data analytic techniques. Since its introduction in the early 2000s, TDA has been instrumental in advancing both theoretical and applied research. In this special session, we invite you to embark on a journey through both sides of TDA: the rich mathematical framework that underpins TDA, which has led to robust methodologies for analyzing complex data sets, and the successful application of this theory to cutting-edge, real-world problems across diverse scientific domains.*

El Análisis de Datos Topológico (TDA, por sus siglas en inglés) utiliza la topología algebraica para abordar problemas de datos complejos y de alta dimensión, los cuales presentan interacciones no lineales difíciles de capturar con técnicas estadísticas y analíticas tradicionales. Desde su introducción a principios de los 2000, el TDA ha sido fundamental para avanzar en investigación teórica y aplicada. En esta sesión especial, invitamos a un recorrido por ambas facetas del TDA: el rico marco matemático que lo sustenta, el cual ha dado lugar a metodologías robustas para analizar problemas de datos complejos, y la exitosa aplicación de esta teoría a problemas de vanguardia en el mundo real en diversos dominios científicos.

| MSC Codes | Códigos MSC          | MSC Kodeak |
|-----------|----------------------|------------|
|           | 55N31<br>(primary)   |            |
|           | 62R40<br>(secondary) |            |

| Slots | Bloques   | Blokeak |
|-------|---|---------|
|       | 2.A (Aula 0.13); 2.B (Aula 0.13); 2.C (Aula 0.13) |         |

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

J16 | 11:00-11:20 | 0.13

*On the Limitations of Fractal Dimension as a Measure of Generalization***Inés García-Redondo** (Imperial College)

J16 | 11:30-11:50 | 0.13

*Simplicial-based neural networks***Eduardo Paluzo Hidalgo** (Universidad de Loyola)

J16 | 12:00-12:20 | 0.13

*Topological evolution of the layers of a neural network during training***Jon Ander Alonso** (Universidad de La Rioja)

J16 | 12:30-12:50 | 0.13

*Shedding light on black-box models through topological data analysis***Clara Isabel López González** (Universidad Complutense de Madrid)

J16 | 16:30-16:50 | 0.13

*The Mayer-Vietoris spectral sequence for Alpha Complexes***Álvaro Torras** (CRESS UMR 1153 Inserm)

J16 | 17:00-17:20 | 0.13

*Reach of Embeddings of Metric Spaces inside the Persistence Diagram Space***Javier Casado** (Universidad Autónoma de Madrid)

J16 | 17:30-17:50 | 0.13

*The Depth Poset: A Channel Between Topology and Dynamics***Manuel Soriano-Trigueros** (Institute of Science and Technology Austria)

J16 | 18:00-18:20 | 0.13

*New Betti numbers for finite simplicial complexes*

**Pablo Hernández** (Universidad de Salamanca)

V17 | 9:30-9:50 | 0.13

*Topology and data reduction*

**Javier Perera Lago** (Universidad de Sevilla)

V17 | 10:00-10:20 | 0.13

*Topology across scales on multiplexed data*

**María Torras Pérez** (University of Oxford)

V17 | 10:30-10:50 | 0.13

*The Extended Pareto Grid in Multiparameter Persistent Homology*

**Eloy Mosig** (Università di Pisa)



**Thursday 16**

11:00-11:20

[Room 0.13]

**Jueves 16**

11:00-11:20

[Aula 0.13]

**Osteguna 16**

11:00-11:20

[Gela 0.13]

***On the Limitations of Fractal Dimension as a Measure of Generalization*****Inés García-Redondo**

(Imperial College)

Bounding and predicting the generalization gap of neural networks remains a central open problem in machine learning. Neural network optimization trajectories have been proposed to possess fractal structure, leading to bounds based on notions of fractal dimension on these trajectories. In this talk, I will present an extended statistical evaluation of these topological generalization measures, as well as two counterexamples where the predicted theory fails.

Joint work with Charlie Tan, Qiquan Wang, Michael Bronstein and Anthea Monod.

[arXiv:2406.02234](https://arxiv.org/abs/2406.02234)**Thursday 16**

11:30-11:50

[Room 0.13]

**Jueves 16**

11:30-11:50

[Aula 0.13]

**Osteguna 16**

11:30-11:50

[Gela 0.13]

***Simplicial-based neural networks*****Eduardo Paluzo Hidalgo**

(Universidad de Loyola)

This talk explores the use of simplicial complexes and maps in designing neural networks, introducing a novel simplicial layer and advancements in training algorithms for these topologically inspired structures. These methods enhance network robustness and universal approximation capabilities. Theoretical insights and practical implementations will be presented, showing how this approach integrates with classical neural networks and its potential impact on machine learning.

[arXiv:2403.15083](https://arxiv.org/abs/2403.15083)

**Thursday 16****12:00-12:20****[Room 0.13]****Jueves 16****12:00-12:20****[Aula 0.13]****Osteguna 16****12:00-12:20****[Gela 0.13]*****Topological evolution of the layers of a neural network during training*****Jon Ander Alonso**

(Universidad de La Rioja)

TDA is increasingly used in DL model analysis, offering insights into issues like generalization and explainability. We conducted an experimental study of the topological evolution of a small neural network during training. At each epoch, we applied persistent homology to the activations of layers as they processed training and test samples. Our findings indicate relationships between the learning curve and topological statistics, as well as variations in topological complexity across layers.

Joint work with Eduardo Sáenz de Cabezón.

**Thursday 16****12:30-12:50****[Room 0.13]****Jueves 16****12:30-12:50****[Aula 0.13]****Osteguna 16****12:30-12:50****[Gela 0.13]*****Shedding light on black-box models through topological data analysis*****Clara Isabel López González**

(Universidad Complutense de Madrid)

Convolutional neural networks excel in many computer vision tasks, but their black-box nature limits decision transparency. To address this, we introduce Latent Landscapes, a TDA-based tool for studying the topology of latent representations. It offers a global view of encoded information, its variety, and evolution, and compares these insights with existing explanatory methods.

**Thursday 16****16:30-16:50****[Room 0.13]****Jueves 16****16:30-16:50****[Aula 0.13]****Osteguna 16****16:30-16:50****[Gela 0.13]*****The Mayer-Vietoris spectral sequence for Alpha Complexes*****Álvaro Torras**

(CRESS UMR 1153 Inserm)

The alpha filtration is used to compute persistent homology (PH) from point samples, but interpreting PH in complex or periodic datasets is challenging. I present the Mayer-Vietoris spectral sequence (MVSS) for distributed computation of alpha filtration PH, along with conditions for simplicial collapses and experiments using the PermaViss++ package.

Joint work with F. Jensen.

**Thursday 16****17:00-17:20****[Room 0.13]****Jueves 16****17:00-17:20****[Aula 0.13]****Osteguna 16****17:00-17:20****[Gela 0.13]*****Reach of Embeddings of Metric Spaces inside the Persistence Diagram Space*****Javier Casado**

(Universidad Autónoma de Madrid)

We recall the reach of a subset of a metric space, defined as the supremum of radii for which the metric projection onto the subset is unique. The reach is 0 if no neighborhood of the subset admits a unique projection. Bubenik and Wagner present an isometric embedding of any bounded separable metric space into the space of persistence diagrams. The main result shows that if every point in  $X$  is an accumulation point, the reach of  $X$  in the persistence diagram space is 0.

Joint work with Manuel Cuerno and Jaime Santos-Rodríguez.

[arXiv:2307.01051](https://arxiv.org/abs/2307.01051)

**Thursday 16****17:30-17:50****[Room 0.13]****Jueves 16****17:30-17:50****[Aula 0.13]****Osteguna 16****17:30-17:50****[Gela 0.13]*****The Depth Poset: A Channel Between Topology and Dynamics*****Manuel Soriano-Trigueros**

(Institute of Science and Technology Austria)

The depth poset is defined over persistence pairs of a filtered complex, with its minimal elements being shallow pairs, recently defined by U. Bauer and F. Roll. When viewed as a Morse function, shallow pairs act as vectors of the combinatorial gradient, offering insights into the topological simplification of the complex. This talk will explore the structure of the poset and its connection to classical concepts in persistence and discrete Morse theory.

Joint work with Herbert Edelsbrunner, Marian Mrozek, and Michał Lipiński.

[arXiv:2311.14364](https://arxiv.org/abs/2311.14364)

**Thursday 16****18:00-18:20****[Room 0.13]****Jueves 16****18:00-18:20****[Aula 0.13]****Osteguna 16****18:00-18:20****[Gela 0.13]*****New Betti numbers for finite simplicial complexes*****Pablo Hernández**

(Universidad de Salamanca)

Simplicial homology's homotopy invariance limits Betti numbers in capturing properties of simplicial complexes. In this talk, I will introduce new invariants for finite simplicial complexes that extend traditional Betti numbers, revealing dimensions and higher-order adjacencies of simplices around holes. I'll also discuss how persistence enhances the interpretation of these invariants and explore their applications in topological data analysis.

**Friday 17**  
**9:30-9:50**  
**[Room 0.13]**

**Viernes 17**  
**9:30-9:50**  
**[Aula 0.13]**

**Ostirala 17**  
**9:30-9:50**  
**[Gela 0.13]**

***Topology and data reduction***

**Javier Perera Lago**

(Universidad de Sevilla)

Training machine learning models requires large datasets and can be computationally expensive. Data reduction is a family of preprocessing techniques that reduces the size or complexity of the data, speeding up the training process. In this talk, we present data reduction methods based on topological concepts and demonstrate that preserving the dataset's topological properties leads to models with strong performance.

**Friday 17**  
**10:00-10:20**  
**[Room 0.13]**

**Viernes 17**  
**10:00-10:20**  
**[Aula 0.13]**

**Ostirala 17**  
**10:00-10:20**  
**[Gela 0.13]**

***Topology across scales on multiplexed data***

**María Torras Pérez**

(University of Oxford)

Advancements in multiplex imaging have enabled the simultaneous visualisation of multiple cell types in a single tissue sample. In this talk, we present a data analysis pipeline based on persistence homology (PH) and its application to multiplexed lupus murine spleen data. We propose a visualisation of PH cycles which is simple and computationally inexpensive and can help interpretability. We investigate various PH vectorisations and propose additional weightings of persistence images.

Joint work with Heather Harrington, Ulrike Tillmann, Iris Yoon, and Helen Byrne.

**Friday 17**  
**10:30-10:50**  
**[Room 0.13]**

**Viernes 17**  
**10:30-10:50**  
**[Aula 0.13]**

**Ostirala 17**  
**10:30-10:50**  
**[Gela 0.13]**

***The Extended Pareto Grid in Multiparameter Persistent Homology***

**Eloy Mosig**

(Università di Pisa)

Recent research has developed strategies for computing and approximating the matching distance in multiparameter persistent homology. This talk will focus on the extended Pareto grid, a geometric construction at the intersection of Morse theory and optimization. Associated with smooth functions from a Riem. manifold to the Eucl. plane, the Pareto grid helps track homological features of the manifold's filtration, offering new methods for computing matching distance in the multiparameter regime.

Joint work with P. Frosini, N. Quercioli and F. Tombari.

[arXiv:2312.04201](https://arxiv.org/abs/2312.04201)

CD03

Fairness and Interpretability in Machine Learning  
Equidad e Interpretabilidad en Aprendizaje Automático

Organizers

Organizadores

Antolatzaileak

**Pablo Morala Miguélez**  
(Universidad Carlos III de Madrid)

**Paula Gordaliza Pastor**  
(Universidad Pública de Navarra)

Description

Descripción

Deskribapena

*The adoption of machine learning and artificial intelligence techniques across various fields requires careful oversight to ensure their use is fair, non-discriminatory, and understandable to those affected. Two key areas have emerged to address these concerns: fairness and interpretability. Fairness focuses on detecting and preventing biases, especially those impacting vulnerable groups, both in data and models. Interpretability, on the other hand, aims to make model decisions understandable, allowing the assignment of importance to original variables and thus facilitating fairness analysis.*

La adopción de técnicas de machine learning e inteligencia artificial en diversos campos requiere un control cuidadoso para asegurar un uso justo, no discriminatorio y comprensible para las personas afectadas. Así, han surgido dos áreas clave para abordar estas preocupaciones: el fairness y la interpretabilidad. El fairness se enfoca en detectar y prevenir sesgos, especialmente contra colectivos vulnerables, tanto en los datos como en los modelos. La interpretabilidad, por su parte, busca hacer entendibles las decisiones de los modelos, permitiendo asignar importancia a las variables originales y facilitando así el análisis de fairness.

MSC Codes

Códigos MSC

MSC Kodeak

62-XX  
(primary)

Slots

Bloques

Blokeak

2.B (Aula 0.16); 2.C (Aula 0.16)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

J16 | 16:30-16:50 | 0.16

*Functional relevance based on the Shapley value***Cristian Pachón García** (Universitat Politècnica de Catalunya)

J16 | 17:00-17:20 | 0.16

*Fourier Analysis in CNN***Isabel María Moreno Cuadrado** (University Complutense)

J16 | 17:30-17:50 | 0.16

*Sensitivity Analysis of NSUM Estimators in the context of Social-Networks***Sergio Díaz-Aranda** (IMDEA Networks)

J16 | 18:00-18:20 | 0.16

*Feature interactions in XAI: a comparison study of SHAP extensions and NN2Poly***Pablo Morala** (IBiDat - Universidad Carlos III de Madrid)

V17 | 9:30-9:50 | 0.16

*Fair Partial Least Squares***Adrián Pérez-Suay** (Universitat de València)

V17 | 10:00-10:20 | 0.16

*Integrating bias mitigation techniques for fair and accurate machine learning with multiple sensitive variables***Sandra Benítez-Peña** (Universidad Carlos III de Madrid)

V17 | 10:30-10:50 | 0.16

*Estimating Average Treatment Effects through Generalized Trimming: Applications to Decision Auditing***Hristo Inouzhe** (Universidad Autónoma de Madrid)



**Thursday 16****16:30-16:50****[Room 0.16]****Jueves 16****16:30-16:50****[Aula 0.16]****Osteguna 16****16:30-16:50****[Gela 0.16]*****Functional relevance based on the Shapley value*****Cristian Pachón García**

(Universitat Politècnica de Catalunya)

Consider a scalar-on-function regression problem, where the goal is to predict a scalar response from a functional predictor. Several predictive models have been proposed in the Functional Data Analysis literature, but many of them are difficult to interpret since it is hard to identify the relevance of the functional predictors. In this work, we extend relevance measures based on the Shapley value from multivariate to functional predictors by adapting concepts from the continuous games theory.

Joint work with Pedro Delicado.

**Thursday 16****17:00-17:20****[Room 0.16]****Jueves 16****17:00-17:20****[Aula 0.16]****Osteguna 16****17:00-17:20****[Gela 0.16]*****Fourier Analysis in CNN*****Isabel María Moreno Cuadrado**

(University Complutense)

In an era where explainability in Deep Learning (DL) is crucial, this talk demonstrates how mathematics supports advances in DL, particularly in Convolutional Neural Networks (CNN). The presentation is divided into two parts: a mathematical exploration of Fourier analysis and its application to image filtering, followed by a computational analysis using the Fast Fourier Transform (FFT) to optimize CNN training. This approach aims to improve efficiency, aligning with the goals of "Green AI".

**Thursday 16****17:30-17:50****[Room 0.16]****Jueves 16****17:30-17:50****[Aula 0.16]****Osteguna 16****17:30-17:50****[Gela 0.16]*****Sensitivity Analysis of NSUM Estimators in the context of Social-Networks*****Sergio Díaz-Aranda**

(IMDEA Networks)

The Network Scale-up Methods (NSUM) estimate hidden populations through indirect surveys using participants' aggregated data about acquaintances. This study compares nine NSUM through simulations, examining factors like network structure, subpopulation distribution, sample size, and biases. Findings show that some lesser-used estimators excel in specific cases of network configuration and biases, while the most common estimator is less sensitive to subpopulation configuration and recall error.

Joint work with Jose Aguilar, Juan Marcos Ramírez, David Rabanedo, Antonio Fernández Anta, and Rosa E. Lillo.

[doi:10.1080/00031305.2024.2421361](https://doi.org/10.1080/00031305.2024.2421361)

**Thursday 16****18:00-18:20****[Room 0.16]****Jueves 16****18:00-18:20****[Aula 0.16]****Osteguna 16****18:00-18:20****[Gela 0.16]*****Feature interactions in XAI: a comparison study of SHAP extensions and NN2Poly*****Pablo Morala**

(IBiDat - Universidad Carlos III de Madrid)

Explaining feature importance in model predictions is key in Explainable AI (XAI). However, most methods focus on single variables, overlooking interactions common in real-world problems. This work compares extensions of SHAP values, a popular interpretability method, to account for interactions, alongside NN2Poly, a neural network specific interpretability method. Simulations under various settings compare local and global explanations and propose metrics for computing importance order.

Joint work with J. Alexandra Cifuentes, Rosa E. Lillo, and Iñaki Úcar.

**Friday 17**  
**9:30-9:50**  
**[Room 0.16]**

**Viernes 17**  
**9:30-9:50**  
**[Aula 0.16]**

**Ostirala 17**  
**9:30-9:50**  
**[Gela 0.16]**

***Fair Partial Least Squares***  
**Adrián Pérez-Suay**  
(Universitat de València)

We address fair representation learning using fair Partial Least Squares (PLS) components, a technique commonly used in statistics for efficient data dimensionality reduction tailored for prediction. We introduce a novel method that integrates fairness constraints into the construction of PLS components, applicable in both linear and nonlinear cases using kernel embeddings. Our algorithm's effectiveness is demonstrated across various datasets.

Joint work with Elena M. De Diego, Paula Gordaliza and Jean-Michel Loubes.

**Friday 17**  
**10:00-10:20**  
**[Room 0.16]**

**Viernes 17**  
**10:00-10:20**  
**[Aula 0.16]**

**Ostirala 17**  
**10:00-10:20**  
**[Gela 0.16]**

***Integrating bias mitigation techniques for fair and accurate machine learning with multiple sensitive variables***  
**Sandra Benítez-Peña**  
(Universidad Carlos III de Madrid)

As machine learning's role in decision-making grows, concerns about fairness and bias have risen. Various fairness techniques address discrimination based on sensitive variables like race or gender, but little research combines these methods or considers multiple sensitive attributes simultaneously. This project explores the impact of combining fairness algorithms to enhance equity, offering insights for real-world applications like hiring and credit approval.

Joint work with Rosa Lillo, Arturo Pérez and Fabio Scielzo.

Friday 17  
10:30-10:50  
[Room 0.16]

Viernes 17  
10:30-10:50  
[Aula 0.16]

Ostirala 17  
10:30-10:50  
[Gela 0.16]

*Estimating Average Treatment Effects through Generalized Trimming: Applications to Decision Auditing*

**Hristo Inouzhe**

(Universidad Autónoma de Madrid)

Causal inference estimates the impact of a treatment on an outcome under strong assumptions. A key measure, the Average Treatment Effect, reflects the difference in outcome likelihood between the same population when fully treated or untreated. This applies to auditing decisions involving sensitive attributes that shouldn't influence outcomes. We introduce a generalized trimming method using Maximum Mean Discrepancies, offering a flexible alternative to existing causal inference techniques.

Joint work with Eustasio del Barrio, Paula Gordaliza and Jean Michel Loubes.

CD04

Mathematical Optimization

Optimización Matemática

Organizers

Organizadores

Antolatzaileak

Alberto Torrejón Valenzuela

Paula Terán Viadero

(Universidad de Sevilla)

(Universidad Complutense de Madrid)

Concepción Domínguez Sánchez

(Universidad de Murcia)

Description

Descripción

Deskribapena

*The phrase "you can always be better" has a limit: finding the global optimum. One cannot be "more optimal" than optimal. Mathematical optimization aims to achieve this in various decision-making areas. It improves decision-making by providing optimal solutions to complex problems, maximizing resources, and minimizing costs for greater efficiency. Optimization algorithms tackle difficult problems by efficiently exploring large solution spaces using techniques like dimensionality reduction or problem decomposition. When exact optimal solutions are unfeasible, heuristics provide good approximations. This session will present papers on optimization techniques, showcasing researchers' progress and contributions.*

La frase "siempre se puede ser mejor" tiene un claro límite dibujado en su horizonte, encontrar el óptimo global. No se puede ser mejor que el óptimo. La optimización matemática busca este objetivo en diversos ámbitos de toma de decisiones, mejorando la eficiencia y ahorrando recursos al proporcionar soluciones óptimas a problemas complejos. Los algoritmos de optimización exploran eficientemente grandes espacios de soluciones, utilizando técnicas como la reducción de dimensionalidad o descomposición del problema. Cuando las instancias son demasiado grandes para soluciones exactas, se emplean heurísticas para aproximaciones. En esta sesión, se presentarán trabajos sobre técnicas de optimización y sus avances.

MSC Codes

Códigos MSC

MSC Kodeak

90Bxx

(primary)

Slots

Bloques

Blokeak

1.C (Aula 0.17); 2.A (Aula 0.17)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

M14 | 17:30-17:50 | 0.17

*Optimisation approaches for solving the two-dimensional cutting stock problem with variable-sized stock***Paula Terán Viadero** (Complutense University of Madrid)

M14 | 18:00-18:20 | 0.17

*Exact methods for solving the premarshalling problem with limited crane time assumption***Consuelo Parreño-Torres** (Department of Statistics and Operations Research, University of Valencia, Spain)

M14 | 18:30-18:50 | 0.17

*Advances in ordered optimization methods***Alberto Torrejón** (Universidad de Sevilla)

J16 | 11:00-11:20 | 0.17

*Tightening branch-and-bound schemes with conic constraints***Brais González Rodríguez** (Universidad de Vigo)

J16 | 11:30-11:50 | 0.17

*A New Linkage in Hierarchical Clustering***Lorena Nácher** (Universidad Miguel Hernández de Elche)

J16 | 12:00-12:20 | 0.17

*Forward-backward algorithms devised by graphs*

**César López-Pastor** (Universidad de Alicante)

J16 | 12:30-12:50 | 0.17

*Weakly stable solutions for the Capacitated Facility Location problem with Customer Preferences*

**Concepción Domínguez** (Universidad de Murcia)

**Tuesday 14**  
**17:30-17:50**  
**[Room 0.17]**

**Martes 14**  
**17:30-17:50**  
**[Aula 0.17]**

**Asteartea 14**  
**17:30-17:50**  
**[Gela 0.17]**

***Optimisation approaches for solving the two-dimensional cutting stock problem with variable-sized stock***

**Paula Terán Viadero**

(Complutense University of Madrid)

The two-dimensional cutting stock problem (2D-CSP) involves cutting large rectangular pieces into smaller ones, minimizing waste. Complexity increases when the stock dimensions are not known in advance. We present and compare exact algorithms and meta-heuristics for solving 2D-CSP with variable sized stock (2D-VSCSP), highlighting trade-offs between accuracy and computational cost, and suggesting strategies to choose the best approach based on industry-specific needs.

Joint work with Antonio Alonso Ayuso and F. Javier Martín Campo.

**Tuesday 14**  
**18:00-18:20**  
**[Room 0.17]**

**Martes 14**  
**18:00-18:20**  
**[Aula 0.17]**

**Asteartea 14**  
**18:00-18:20**  
**[Gela 0.17]**

***Exact methods for solving the premarshalling problem with limited crane time assumption***

**Consuelo Parreño-Torres**

(Department of Statistics and Operations Research, University of Valencia, Spain)

The premarshalling problem involves reorganizing a container yard during low workload periods to prepare for efficient ship loading and unloading. Traditionally, unlimited crane time is assumed to retrieve all containers in order. This work considers limited crane time, aiming to maximize accessible containers. A novel lower bound on crane time is proposed, along with heuristic algorithms within a branching framework. Computational experiments show that this approach outperforms existing methods.

Joint work with Juan Romero del Hombrebueno Martínez.



**Tuesday 14**  
**18:30-18:50**  
**[Room 0.17]**

**Martes 14**  
**18:30-18:50**  
**[Aula 0.17]**

**Asteartea 14**  
**18:30-18:50**  
**[Gela 0.17]**

***Advances in ordered optimization methods***

**Alberto Torrejón**

(Universidad de Sevilla)

Ordered optimization generalizes many known problems using the lambda vector, which multiplies ordered costs in the objective function. This talk covers recent advances in applying this method to discrete facility location problems. With an appropriate lambda vector, various models like median, center, centdian, and even obnoxious location or fairness problems can be addressed. The presentation includes mathematical formalization, applications, and computational results to support the findings.

Joint work with Ivana Ljubic, Miguel A. Pozo, and Justo Puerto.

**Thursday 16**  
**11:00-11:20**  
**[Room 0.17]**

**Jueves 16**  
**11:00-11:20**  
**[Aula 0.17]**

**Osteguna 16**  
**11:00-11:20**  
**[Gela 0.17]**

***Tightening branch-and-bound schemes with conic constraints***

**Brais González Rodríguez**

(Universidad de Vigo)

This talk explores the use of conic constraints to tighten the relaxations of spatial branch-and-bound algorithms for solving nonconvex polynomial optimization problems. We integrate linear SDP-cuts, SOCP, and SDP constraints into an RLT-based algorithm and present a computational study. The results show that these new relaxations outperform standard RLT in about 50% of cases. Additionally, we discuss the use of machine learning to select the best constraints for a given instance.

Joint work with Raúl Alvite Pazó, Samuel Alvite Pazó, Bissan Ghaddar, and Julio González Díaz.

**Thursday 16****11:30-11:50****[Room 0.17]****Jueves 16****11:30-11:50****[Aula 0.17]****Osteguna 16****11:30-11:50****[Gela 0.17]*****A New Linkage in Hierarchical Clustering*****Lorena Nácher**

(Universidad Miguel Hernández de Elche)

This work introduces a new linkage for hierarchical clustering, aimed at improving how distances are represented in dendrograms. The objective is to align the dendrogram distances with the original data distances. To achieve this, an optimization model is formulated to adjust the linkage, maximizing similarity between original and represented distances, with a focus on solving large problems efficiently. This new linkage also has potential applications in minimum spanning trees.

Joint work with Mercedes Landete, Marina Leal and Hande Yaman.

**Thursday 16****12:00-12:20****[Room 0.17]****Jueves 16****12:00-12:20****[Aula 0.17]****Osteguna 16****12:00-12:20****[Gela 0.17]*****Forward-backward algorithms devised by graphs*****César López-Pastor**

(Universidad de Alicante)

This work introduces a methodology for developing forward-backward methods to minimize the sum of convex functions, extending recent techniques to smooth functions evaluated via gradients rather than proximal mappings. The algorithms are guided by three graphs that dictate variable interactions and iteration computation, ensuring minimal lifting and frugality. Each proximal mapping and gradient is evaluated only once per iteration. The framework recovers known methods and generates new ones.

Joint work with Francisco J. Aragón-Artacho and Rubén Campoy.

*Thursday 16**12:30-12:50**[Room 0.17]**Jueves 16**12:30-12:50**[Aula 0.17]**Osteguna 16**12:30-12:50**[Gela 0.17]*

*Weakly stable solutions for the Capacitated Facility Location problem with Customer Preferences*

**Concepción Domínguez**

(Universidad de Murcia)

The Capacitated Facility Location problem with Customer Preferences (CFLCP) seeks to open facilities and assign customers while minimizing total location and allocation costs. Facilities have limited capacity, and customers rank preferences. To avoid unfair allocations and envious customers preferring full facilities, three stability-based criteria are proposed. Two new formulations generate weakly stable allocations, with computational results showing model efficiency and stable solutions.

**CD05****Operations Research in Data Science and Applications****Investigación Operativa en Ciencia de Datos y Aplicaciones****Organizers****Organizadores****Antolatzaileak****Vanesa Guerrero Lozano**

(Universidad Carlos III de Madrid)

**Daniel García de Vicuña Bilbao**

(Universidad Pública de Navarra)

**Imanol Gago Carro**

(BCAM)

**Cristina Molero del Río**

(LIX École Polytechnique)

**Description****Descripción****Deskribapena**

*Analyzing complex data and making decisions based on them makes it necessary to develop new methodologies and computational tools that adapt to this revolution. In this sense, Operations Research, together with Statistics and other disciplines related to Data Science, plays a key role in providing explainability to data-driven decision making, as well as in providing in a way that is transparent, efficient and easy to adapt to new situations. In this section, several works related to these topics will be presented, and young researchers will have the opportunity to share and disseminate the latest contributions in this area.*

La necesidad de analizar cada vez datos más complejos y de tomar decisiones en base a ellos hace que surja la necesidad de desarrollar nuevas metodologías y herramientas computacionales que se adapten a esta revolución. En este sentido la Investigación Operativa, junto con la Estadística y otras disciplinas ligadas a la Ciencia de Datos, juega un papel fundamental a la hora de dotar de explicabilidad a los procesos de toma de decisiones, así como a dar soluciones de una manera transparente a la vez que eficiente y fácil de adaptar a nuevas situaciones. En esta sesión, se presentarán trabajos relacionados con esta temática donde los y las ponentes tendrán la oportunidad de compartir y dar difusión a sus últimas contribuciones en el área.

**MSC Codes****Códigos MSC****MSC Kodeak**

90Bxx

(primary)

**Slots****Bloques****Blokeak**

1.B (Aula 0.18); 1.C (Aula 0.18); 2.B (Aula 0.18)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

M14 | 15:30-15:50 | 0.18

*Learning firmly nonexpansive operators***Jonathan Chirinos Rodriguez** (INP-ENSEEIH)

M14 | 16:00-16:20 | 0.18

*Robust Life-Time Estimation for Highly Reliable Products***María Jaenada** (Universidad Complutense de Madrid)

M14 | 16:30-16:50 | 0.18

*Imperfect maintenance and dependence analysis in a bivariate Wiener degradation model***Lucía Bautista Bárcena** (Universidad de Extremadura)

M14 | 17:30-17:50 | 0.18

*Shape-constrained regression models to assist global optimization algorithms***Vanesa Guerrero** (Universidad Carlos III de Madrid)

M14 | 18:00-18:20 | 0.18

*Implementing Predictive Models for Resource Optimization in Critical Care***Daniel Garcia-Vicuña** (Universidad Pública de Navarra)

M14 | 18:30-18:50 | 0.18

*Optimal median based ensemble models in regression problems***Thomas Ashley** (Universidad Loyola)

M14 | 19:00-19:20 | 0.18

*Optimal Participation of Energy Communities in Electricity Markets under Uncertainty. A Multi-Stage Stochastic Programming Approach.***Albert Solà Vilalta** (Universitat Politècnica de Catalunya)

J16 | 16:30-16:50 | 0.18

*An incentive model for frontier projection in the context of Data Envelopment Analysis*

**Víctor J. España** (Universidad Miguel Hernández de Elche)

J16 | 17:00-17:20 | 0.18

*A Hierarchical Compromise Model and Matheuristic Algorithm for Stochastic Location-Allocation in Healthcare*

**Imanol Gago-Carro** (BCAM)

J16 | 17:30-17:50 | 0.18

*Operations research in firefighting: two real-life applications*

**Marta Rodríguez Barreiro** (Universidade da Coruña & CITMAga)

J16 | 18:00-18:20 | 0.18

*On the construction of optimal risk scores for continuous predictors*

**Cristina Molero-Río** (Universidad Carlos III de Madrid)

**Tuesday 14**  
**15:30-15:50**  
**[Room 0.18]**

**Martes 14**  
**15:30-15:50**  
**[Aula 0.18]**

**Asteartea 14**  
**15:30-15:50**  
**[Gela 0.18]**

*Learning firmly nonexpansive operators*

**Jonathan Chirinos Rodriguez**

(INP-ENSEEIH)

We propose a data-driven approach for constructing firmly nonexpansive (FNE) operators. We demonstrate its applicability in Plug-and-Play methods and we provide sound mathematical background to the problem of learning FNE operators via expected and empirical risk minimization. Further, we derive a solution strategy that ensures FNE and piecewise affine operators within the convex envelope of the training set. We finally show its applicability in image denoising problems.

Joint work with Kristian Bredies and Emanuele Naldi.

[arXiv:2407.14156](#)

[arXiv:2011.02281](#)

[arXiv:2012.13247](#)

**Tuesday 14**  
**16:00-16:20**  
**[Room 0.18]**

**Martes 14**  
**16:00-16:20**  
**[Aula 0.18]**

**Asteartea 14**  
**16:00-16:20**  
**[Gela 0.18]**

*Robust Life-Time Estimation for Highly Reliable Products*

**María Jaenada**

(Universidad Complutense de Madrid)

Handling censored data is key in reliability. Interval-censoring occurs when failure times are known to fall within a specific interval rather than being observed exactly. Many modern devices are extremely reliable, requiring extended testing under normal conditions. Accelerated life tests speed up failure by increasing stress factors. Classical likelihood-based methods can be affected by data contamination, so robust estimators using distance measures are developed for reliable inference.

Joint work with N. Balakrishnan and L. Pardo.

**Tuesday 14**  
**16:30-16:50**  
**[Room 0.18]**

**Martes 14**  
**16:30-16:50**  
**[Aula 0.18]**

**Asteartea 14**  
**16:30-16:50**  
**[Gela 0.18]**

***Imperfect maintenance and dependence analysis in a bivariate Wiener degradation model***

**Lucía Bautista Bárcena**  
(Universidad de Extremadura)

Some degrading systems have two parts or components whose overall degradation is described by a bivariate process. The correlation is analysed in a bivariate degradation model subject to imperfect maintenance. The underlying degradation is modelled as a Wiener process and the effects of maintenance are assumed to be imperfect, described by an Arithmetic Reduction of Degradation model. This reduces the degradation of the system by an amount proportional to the state just before maintenance.

Joint work with Inma T. Castro, Christophe Bérenguer, Olivier Gaudoin and Laurent Doyen.

**Tuesday 14**  
**17:30-17:50**  
**[Room 0.18]**

**Martes 14**  
**17:30-17:50**  
**[Aula 0.18]**

**Asteartea 14**  
**17:30-17:50**  
**[Gela 0.18]**

***Shape-constrained regression models to assist global optimization algorithms***

**Vanesa Guerrero**  
(Universidad Carlos III de Madrid)

This work merges statistical modeling and mathematical optimization to create surrogate optimization models using shape-constrained generalized additive models. A novel framework enables the use of shape-constrained smooth functions in non-parametric regression, aiming to approximate complex functions in mixed-integer nonlinear programming. The shape-constrained models exploit separability, making these problems more tractable.

Joint work with Manuel Navarro-García, María Durbán, Claudia D'Ambrosio and Renan Spencer Trindade.



**Tuesday 14**  
**18:00-18:20**  
**[Room 0.18]**

**Martes 14**  
**18:00-18:20**  
**[Aula 0.18]**

**Asteartea 14**  
**18:00-18:20**  
**[Gela 0.18]**

***Implementing Predictive Models for Resource Optimization in Critical Care***

**Daniel Garcia-Vicuña**

(Universidad Pública de Navarra)

The shortage of ICU beds highlights the challenges hospitals face with limited resources. Increasing demand forces prioritization, leading to delayed surgeries or early discharges, creating logistical issues. This study develops methodologies based on real data to predict ICU length of stay and improve resource planning. Through simulations, we aim to optimize hospital management, enhancing resource utilization and improving patient outcomes

Joint work with Ana María Anaya-Arenas, Janosch Ortmann, Angel Ruiz and Fermín Mal-lor.

**Tuesday 14**  
**18:30-18:50**  
**[Room 0.18]**

**Martes 14**  
**18:30-18:50**  
**[Aula 0.18]**

**Asteartea 14**  
**18:30-18:50**  
**[Gela 0.18]**

***Optimal median based ensemble models in regression problems***

**Thomas Ashley**

(Universidad Loyola)

In this work, we consider a novel ensemble learning framework inspired by modern portfolio optimization in order to address regression problems. Four distinct KKT reformulations of the ensemble framework are considered, taking into account different combinations in the restriction set and the inclusion of a diversification term in the objective function. Additionally, multiple metaheuristics are implemented and the results from all methods are compared against benchmark ensemble methods from the literature.

Joint work with Antonio Manuel Durán Rosal, Natividad González Blanco, Javier Pérez-Rodríguez and Francisco Fernández-Navarro.

**Tuesday 14**  
**19:00-19:20**  
**[Room 0.18]**

**Martes 14**  
**19:00-19:20**  
**[Aula 0.18]**

**Asteartea 14**  
**19:00-19:20**  
**[Gela 0.18]**

***Optimal Participation of Energy Communities in Electricity Markets under Uncertainty. A Multi-Stage Stochastic Programming Approach.***

**Albert Solà Vilalta**

(Universitat Politècnica de Catalunya)

We propose a multi-stage stochastic programming model for the optimal participation of energy communities in electricity markets. The multi-stage aspect captures the different times at which variable renewable generation and electricity prices are observed. This results in large-scale optimization problem instances containing large scenario trees with 34 stages, to which scenario reduction techniques are applied. Case studies with real data are discussed to analyse proposed regulatory frameworks in Europe. The added value of considering stochasticity is also analysed.

Joint work with Marlyn D. Cuadrado, F.-Javier Heredia Cervera, and Ignasi Mañé Bosch.

**Thursday 16**  
**16:30-16:50**  
**[Room 0.18]**

**Jueves 16**  
**16:30-16:50**  
**[Aula 0.18]**

**Osteguna 16**  
**16:30-16:50**  
**[Gela 0.18]**

***An incentive model for frontier projection in the context of Data Envelopment Analysis***

**Víctor J. España**

(Universidad Miguel Hernández de Elche)

In today's competitive environment, organizations are leveraging incentive models to enhance performance. This talk introduces an incentive model based on Data Envelopment Analysis (DEA), rewarding DMUs that achieve or move toward technical efficiency. Grounded in game theory and Nash equilibrium, the model balances incentives with investment costs. Applicable across sectors, it promotes continuous improvement and efficient resource utilization.

Joint work with Juan Carlos Gonçalves, and Juan Aparicio.

**Thursday 16****17:00-17:20****[Room 0.18]****Jueves 16****17:00-17:20****[Aula 0.18]****Osteguna 16****17:00-17:20****[Gela 0.18]**

***A Hierarchical Compromise Model and Matheuristic Algorithm for Stochastic  
Location-Allocation in Healthcare***

**Imanol Gago-Carro**

(BCAM)

Health emergencies require swift and accurate decisions that save people's lives. This study focuses on the ambulance location-allocation problem in the Basque Country, whose fleet comprises ALS and BLS vehicles. We propose a two-stage stochastic MILP model that maximizes the expected coverage and optimizes three secondary objectives within a hierarchical decision framework. Due to the model's computational challenge, we introduce a mathheuristic algorithm based on primal decomposition.

Joint work with María Merino, and Unai Aldasoro.

**Thursday 16****17:30-17:50****[Room 0.18]****Jueves 16****17:30-17:50****[Aula 0.18]****Osteguna 16****17:30-17:50****[Gela 0.18]**

***Operations research in firefighting: two real-life applications***

**Marta Rodríguez Barreiro**

(Universidade da Coruña &amp; CITMAga)

Two optimization models are presented to assist in the optimal planning of firefighting helicopters. The first model attempts to solve the optimal planning problem of helicopters working on extinguishing a wildfire. The second problem deals with the assignment of aircraft to wildfires, taking into account the risk of new wildfires starting. Both models are complex, so the optimization problems require the design of metaheuristic algorithms that address good solutions in a reasonable time.

Joint work with María José Ginzo Villamayor, Fernando Pérez Porras, María Luisa Carpenente Rodríguez, Silvia María Lorenzo Freire.

**Thursday 16****18:00-18:20****[Room 0.18]****Jueves 16****18:00-18:20****[Aula 0.18]****Osteguna 16****18:00-18:20****[Gela 0.18]***On the construction of optimal risk scores for continuous predictors***Cristina Molero-Río**

(Universidad Carlos III de Madrid)

We propose a novel Mixed-Integer Non-Linear Optimization formulation to construct a risk score. A trade-off between prediction accuracy and sparsity is sought. Previous approaches are typically designed to handle binary datasets, where numerical predictor variables are discretized in a preprocessing step by using arbitrary thresholds, such as quantiles. In contrast, we allow the model to decide for each continuous predictor variable the particular threshold that is critical for prediction.

Joint work with Claudia D'Ambrosio.

**CD06****Operations Research Models****Modelos de Investigación Operativa****Organizers****Organizadores****Antolatzaileak****Paula Segura Martínez**

(Universidad de Valencia)

**Laura Davila Pena**

(University of Kent)

**Francisco Temprano García**

(Universidad de Sevilla)

**Description****Descripción****Deskribapena**

*Operations research is a mathematical discipline in which advanced analytical techniques are developed and used to solve problems and facilitate decision making. Areas such as logistics, resource planning or supply chain management, among others, where it is common to seek the maximum of a profit or the minimum of a risk, can be treated from the perspective of operations research. The development of efficient mathematical models that explain and describe the needs of these systems is essential to find the best solution to a problem from a set of possible options, taking into account the constraints and objectives in question. In this session, young researchers will present their most recent advances in this field.*

La investigación operativa (IO) es una disciplina matemática en la que se desarrollan y utilizan técnicas analíticas avanzadas para resolver problemas y facilitar la toma de decisiones. Áreas como logística, planificación de recursos o gestión de cadenas de suministro, donde es común buscar el máximo de una ganancia o el mínimo de un riesgo, pueden ser tratadas desde la perspectiva de la IO. El desarrollo de modelos matemáticos eficientes que expliquen y describan las necesidades de estos sistemas resulta imprescindible para encontrar la mejor solución a un problema a partir de un conjunto de opciones posibles, teniendo en cuenta las restricciones y los objetivos en cuestión. En esta sesión, se presentarán avances recientes en este área.

**MSC Codes****Códigos MSC****MSC Kodeak**

90Cxx

(primary)

## Slots

## Bloques

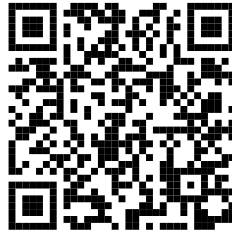
## Blokeak

1.A (Aula 0.17); 1.B (Aula 0.17); 2.C (Aula 0.17)

## QR Code

## Código QR

## QR Kodea



## Session Schedule

## Horario de la Sesión

## Saioaren Ordutegia

L13 | 17:30-17:50 | 0.17

*An Integrated Network Design Model for a Transportation Problem*

**Natividad González-Blanco** (Universidad Loyola & Universidad de Sevilla)

L13 | 18:00-18:20 | 0.17

*Integrated Schedule Planning for Regional Airlines Using Column Generation*

**Alberto Santini** (Universitat Pompeu Fabra)

L13 | 18:30-18:50 | 0.17

*A time space network model for a truck and drones delivery system*

**Carlos Valverde** (University of Seville)

L13 | 19:00-19:20 | 0.17

*Solving the Chinese postman problem with load-dependent costs*

**Paula Segura Martínez** (Universidad de Valencia)

M14 | 15:00-15:20 | 0.17

*A MILP for the Robotic Disassembly Sequence Planning Problem*

**Miguel Reula** (Universitat de Valencia)

M14 | 15:30-15:50 | 0.17

*Mathematical Optimization for Computing the Growth of Chemical Systems*

**Gabriel González Domínguez** (Universidad de Granada)

M14 | 16:00-16:20 | 0.17

*The Fesenthal Power Index for simple games with a priori unions*

**Alicia Mascareñas Pazos** (Universidade de A Coruña)

M14 | 16:30-16:50 | 0.17

*A novel view of exponential sets of constraints*

**Francisco Temprano García** (Universidad de Sevilla)

**Monday 13**  
**17:30-17:50**  
**[Room 0.17]**

**Lunes 13**  
**17:30-17:50**  
**[Aula 0.17]**

**Astelehena 13**  
**17:30-17:50**  
**[Gela 0.17]**

***An Integrated Network Design Model for a Transportation Problem***

**Natividad González-Blanco**

(Universidad Loyola & Universidad de Sevilla)

Awareness of traffic congestion and environmental issues has promoted public transit worldwide. When a new rapid transit line is built, the slow mode—usually buses covering existing demand—must be canceled or modified, leading to suboptimal solutions. Therefore, we consider an integrated model to design rapid and slow networks simultaneously, aiming to maximize the demand captured by both modes. We present a mathematical formulation solved using an improved Benders decomposition.

Joint work with Antonio J. Lozano, Vladimir Marianov and Juan A. Mesa.

**Monday 13**  
**18:00-18:20**  
**[Room 0.17]**

**Lunes 13**  
**18:00-18:20**  
**[Aula 0.17]**

**Astelehena 13**  
**18:00-18:20**  
**[Gela 0.17]**

***Integrated Schedule Planning for Regional Airlines Using Column Generation***

**Alberto Santini**

(Universitat Pompeu Fabra)

We simultaneously optimise medium-term airline schedule planning decisions (frequency planning, timetable design, fleet assignment, and limited route selection) for regional feeder airlines. We exploit a tight exponential-size formulation to obtain gaps under 0.2% within minutes.

Joint work with Vikrant Vaze.



**Monday 13**  
**18:30-18:50**  
**[Room 0.17]**

**Lunes 13**  
**18:30-18:50**  
**[Aula 0.17]**

**Astelehena 13**  
**18:30-18:50**  
**[Gela 0.17]**

***A time space network model for a truck and drones delivery system***

**Carlos Valverde**

(University of Seville)

We present a multiperiod mixed-integer quadratic programming formulation for a delivery problem involving a mothership and drones. The mothership can only stop at designated parking locations, separate from customer sites. During these stops, drones deliver packages at varying speeds. The formulation integrates mothership routing, drone scheduling, and battery charging cycles. A matheuristic algorithm is developed and validated through a case study in Rome with up to 200 customers, supported by extensive computational results on a large testbed.

Joint work with Lavinia Amorosi, Paolo Dell’Olmo and Justo Puerto.

**Monday 13**  
**19:00-19:20**  
**[Room 0.17]**

**Lunes 13**  
**19:00-19:20**  
**[Aula 0.17]**

**Astelehena 13**  
**19:00-19:20**  
**[Gela 0.17]**

***Solving the Chinese postman problem with load-dependent costs***

**Paula Segura Martínez**

(Universidad de Valencia)

In this talk, we summarize two mathematical programming formulations proposed in the literature for the Chinese Postman Problem with load-dependent costs, reviewing the strengths and drawbacks of each of them, and present a new mixed-integer linear programming formulation for the problem, proposing some families of valid inequalities to reinforce this formulation. The computational results obtained with a new branch-and-cut algorithm are compared with those already existing in the literature.

Joint work with Isaac Plana and José María Sanchis.

**Tuesday 14**  
**15:00-15:20**  
**[Room 0.17]**

**Martes 14**  
**15:00-15:20**  
**[Aula 0.17]**

**Asteartea 14**  
**15:00-15:20**  
**[Gela 0.17]**

***A MILP for the Robotic Disassembly Sequence Planning Problem***

**Miguel Reula**

(Universitat de Valencia)

Maximizing the benefits of remanufacturing requires efficient reuse of components from end-of-life (EoL) products. This work presents a MILP model to design the robotic disassembly process for EoL products, optimizing economic performance and environmental compliance. The model is able to identify the optimal disassembly level, disassembly sequence, and component recovery options. Two case studies on gear pumps validate the model, offering insights into recovery strategies.

Joint work with Consuelo Parreño-Torres and F. Javier Ramírez.

**Tuesday 14**  
**15:30-15:50**  
**[Room 0.17]**

**Martes 14**  
**15:30-15:50**  
**[Aula 0.17]**

**Asteartea 14**  
**15:30-15:50**  
**[Gela 0.17]**

***Mathematical Optimization for Computing the Growth of Chemical Systems***

**Gabriel González Domínguez**

(Universidad de Granada)

This work presents a novel optimization framework for computing the growth factor of autocatalytic subnetworks in chemical reaction networks (CRNs). By formalizing CRNs with stoichiometric matrices and developing mixed-integer programming models, we capture the structure of autocatalytic subnetworks. This approach offers insights into the role of autocatalysis in complex systems, advancing our understanding of the chemical foundations of life and related applications.

Joint work with Víctor Blanco and Praful Gagrani.

**Tuesday 14**  
**16:00-16:20**  
**[Room 0.17]**

**Martes 14**  
**16:00-16:20**  
**[Aula 0.17]**

**Asteartea 14**  
**16:00-16:20**  
**[Gela 0.17]**

*The Fesenthal Power Index for simple games with a priori unions*

**Alicia Mascareñas Pazos**

(Universidade de A Coruña)

In game theory, simple games are often used to model collective decision-making. Power indices measure a player's ability to influence the final result, i.e., to form part of a winning coalition. Fesenthal introduced a new index based on the formation of winning coalitions of least size. We generalize the definition of the Fesenthal index taking into account certain affinities that might exist between players, and obtain an axiomatic characterization for this new power index.

Joint work with S. Lorenzo-Freire and J.M. Alonso-Meijide.

**Tuesday 14**  
**16:30-16:50**  
**[Room 0.17]**

**Martes 14**  
**16:30-16:50**  
**[Aula 0.17]**

**Asteartea 14**  
**16:30-16:50**  
**[Gela 0.17]**

*A novel view of exponential sets of constraints*

**Francisco Temprano García**

(Universidad de Sevilla)

In this talk, we present interesting properties and structures that can be exploited in our advantages when analyzing an optimization combinatorial problem. Specifically, we refer to families of constraints or valid inequalities whose sizes are exponential. Exponential number of constraints and variables normally provides a better description of the problem polytope. That is why it is worth studying this kind of models to try to give a detailed description of its convex hull.

Joint work with Ivana Ljubic, Alfredo Marín, and Justo Puerto.

**GT01*****Differential Geometry and Submanifold Theory***  
Geometría Diferencial y Teoría de Subvariedades**Organizers****Organizadores****Antolatzaileak****Andrea Del Prete**

(Università Degli studi di Pavia)

**Lilia Mehidi**

(Instituto de Matemáticas de Granada)

**José Santiago Villanueva**

(Universidad de Jaén)

**Description****Descripción****Deskribapena**

*This is a session specialized in differential geometry and submanifold theory. The main idea is to address topics of this nature from different points of view. Within this scope, there will be talks covering perspectives from algebraic approaches, through common issues in Riemannian and semi-Riemannian geometry, to a somewhat more analytical focus.*

*It is hoped that this will serve as a meeting and discussion point among colleagues in the same field, but who may have different approaches to similar situations.*

Esta es una sesión especializada en geometría diferencial y teoría de subvariedades. La idea principal es tratar temas de esta índole desde diferentes puntos de vista. Dentro de este ámbito, se darán charlas que abarquen desde una perspectiva más algebraica, pasando por cuestiones habituales de geometría riemanniana y semi-riemanniana, hasta un enfoque algo más analítico.

Se espera que esto sirva como punto de encuentro y de discusión entre compañeros de la misma área, pero que pueden tener un enfoque distinto de situaciones similares.

**MSC Codes****Códigos MSC****MSC Kodeak**

53-XX

(primary)

**Slots****Bloques****Blokeak**

1.B (Aula 0.19); 1.C (Aula 0.19); 2.A (Aula 0.19)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

M14 | 15:30-15:50 | 0.19

*Cohomogeneity one actions in products***Tomás Otero Casal** (Universität Münster)

M14 | 16:00-16:20 | 0.19

*Completeness of Unchanged Direction Trajectories in Galilean Spacetimes***Jose Torrente Teruel** (Universidad de Córdoba)

M14 | 16:30-16:50 | 0.19

*What do large finite group actions tell us about the structure of a manifold?***Jordi Daura Serrano** (Universitat de Barcelona)

M14 | 17:30-17:50 | 0.19

*Minimal complex Lagrangian in the bi-complex hyperbolic space***Nicholas Rungi** (Grenoble University)

M14 | 18:00-18:20 | 0.19

*Rigidity of Einstein manifolds with positive Yamabe invariant***Letizia Branca** (Milano University)

M14 | 18:30-18:50 | 0.19

*Some canonical metrics via Aubin's local deformations***Davide Dameno** (Milano University)

J16 | 11:00-11:20 | 0.19

*Codimension two spacelike submanifolds in Lorentzian manifolds and conformal structures.***Rodrigo Morón** (University of León)

J16 | 11:30-11:50 | 0.19

*Towards a 'complete description' of compact Brinkmann manifolds*

**Lilia Mehidi** (IMAG)

J16 | 12:00-12:20 | 0.19

*Foliated geometric structures, symmetric spaces and completeness*

**Malek Hanounah** (Greifswald University)

**Tuesday 14**  
**15:30-15:50**  
**[Room 0.19]**

**Martes 14**  
**15:30-15:50**  
**[Aula 0.19]**

**Asteartea 14**  
**15:30-15:50**  
**[Gela 0.19]**

***Cohomogeneity one actions in products***

**Tomás Otero Casal**

(Universität Münster)

The classification of cohomogeneity one actions on Euclidean and hyperbolic spaces follows from classical work of Segre, Levi-Civita and Cartan. However, obtaining similar results for manifolds has proven to be a difficult problem. In this talk, we study cohomogeneity one actions on products of Riemannian manifolds. We are able to classify homogeneous codimension one foliations on simply connected symmetric spaces.

Joint work with Hiroshi Tamaru.

**Tuesday 14**  
**16:00-16:20**  
**[Room 0.19]**

**Martes 14**  
**16:00-16:20**  
**[Aula 0.19]**

**Asteartea 14**  
**16:00-16:20**  
**[Gela 0.19]**

***Completeness of Unchanged Direction Trajectories in Galilean Spacetimes***

**Jose Torrente Teruel**

(Universidad de Córdoba)

The notion of Unchanged Direction (UD) motion in non-relativistic Galilean spacetimes is introduced, providing a mathematical framework for the notion "proper acceleration does not change its direction". The initial value problem for prescribed acceleration is analyzed and UD trajectories are shown to be the projection of integral curves in some fibre bundle. Under physical hypotheses, we prove a completeness result of inextensible UD motions, meaning that UD observers live forever.

Joint work with Rafael M. Rubio and Daniel de la Fuente.

**Tuesday 14**  
**16:30-16:50**  
**[Room 0.19]**

**Martes 14**  
**16:30-16:50**  
**[Aula 0.19]**

**Asteartea 14**  
**16:30-16:50**  
**[Gela 0.19]**

***What do large finite group actions tell us about the structure of a manifold?***

**Jordi Daura Serrano**  
(Universitat de Barcelona)

The theory of finite transformation groups studies topologic and geometric properties of manifolds by means of finite group actions. In this talk we will explain a how we can use finite group actions to study rigidity questions on aspherical manifolds. We will introduce a new invariant, called the discrete degree of symmetry of a manifold, and we will show how this invariant can be helpful for the study of nilmanifolds and manifolds admitting a non-zero degree map to them.

[arXiv:2407.13602](https://arxiv.org/abs/2407.13602)

**Tuesday 14**  
**17:30-17:50**  
**[Room 0.19]**

**Martes 14**  
**17:30-17:50**  
**[Aula 0.19]**

**Asteartea 14**  
**17:30-17:50**  
**[Gela 0.19]**

***Minimal complex Lagrangian in the bi-complex hyperbolic space***

**Nicholas Rungi**  
(Grenoble University)

Given a closed oriented surface  $S$  of genus  $g > 1$ , we introduce a class of smooth immersions which are equivariant with respect to a surface group representation into  $SL_3(\mathbb{C})$ . These immersions simultaneously generalize hyperbolic affine spheres which are equivariant with respect to the real split form  $SL_3(\mathbb{R})$  and minimal Lagrangians in complex hyperbolic space which are equivariant with respect to the real Hermitian form  $SU(2, 1)$ . Such immersions permit finding a parameterization of an open subset in  $SL_3(\mathbb{C})$ .



**Tuesday 14**  
**18:00-18:20**  
**[Room 0.19]**

**Martes 14**  
**18:00-18:20**  
**[Aula 0.19]**

**Asteartea 14**  
**18:00-18:20**  
**[Gela 0.19]**

***Rigidity of Einstein manifolds with positive Yamabe invariant***

**Letizia Branca**

(Milano University)

In this talk I will present some optimal pinching results on closed Einstein manifolds with positive Yamabe invariant in any dimension, extending the optimal bound for the scalar curvature due to Gursky and LeBrun in dimension four. I will also present an improvement the known bounds of the Yamabe invariant via the  $L^{n/2}$ -norm of the Weyl tensor for low-dimensional Einstein manifolds. Finally, we discuss some advances on an algebraic inequality involving the Weyl tensor for dimensions 5 and 6.

Giovanni Catino, Davide Dameno and Paolo Mastrolia.

**Tuesday 14**  
**18:30-18:50**  
**[Room 0.19]**

**Martes 14**  
**18:30-18:50**  
**[Aula 0.19]**

**Asteartea 14**  
**18:30-18:50**  
**[Gela 0.19]**

***Some canonical metrics via Aubin's local deformations***

**Davide Dameno**

(Milano University)

In this talk, we will present some recent results concerning the existence of some canonical Riemannian metrics on closed manifolds: in particular, applying a local deformation method due to Aubin, we show that there exist infinitely many metrics with nowhere vanishing Bach tensor on a closed Riemannian four-manifold. We also show the lack of topological obstructions for the existence of "weak half harmonic Weyl" metrics and discuss some advances concerning the Bach tensor

Giovanni Catino and Paolo Mastrolia.

**Thursday 16****11:00-11:20****[Room 0.19]****Jueves 16****11:00-11:20****[Aula 0.19]****Osteguna 16****11:00-11:20****[Gela 0.19]**

*Codimension two spacelike submanifolds in Lorentzian manifolds and conformal structures.*

**Rodrigo Morón**

(University of León)

Starting from a Riemannian conformal structure on a manifold  $M$ , a method is introduced to construct a family of Lorentzian manifolds. This construction involves choosing a metric from the conformal class and a smooth 1-parameter family of self-adjoint tensor fields. Each metric in the conformal class corresponds to the induced metric on  $M$ , viewed as a codimension two spacelike submanifold. A lightlike normal vector provides a Möbius structure on the Riemannian conformal structure and viceversa.

**Thursday 16****11:30-11:50****[Room 0.19]****Jueves 16****11:30-11:50****[Aula 0.19]****Osteguna 16****11:30-11:50****[Gela 0.19]**

*Towards a 'complete description' of compact Brinkmann manifolds*

**Lilia Mehidi**

(IMAG)

Transversally Riemannian 1-dimensional foliations generalize those defined by an isometric flow of a Riemannian metric. A natural question is whether such a foliation arises from an isometric flow on  $M$ . Carrière showed the answer can be negative. In positive cases, the flow is called equicontinuous. In the context of Brinkmann manifolds (admitting a parallel lightlike vector field  $V$ ), we investigate if there exists a Riemannian metric on  $M$  for which the flow of  $V$  is isometric in the compact case.

Joint work with A. Zeghib.

**Thursday 16****12:00-12:20****[Room 0.19]****Jueves 16****12:00-12:20****[Aula 0.19]****Osteguna 16****12:00-12:20****[Gela 0.19]*****Foliated geometric structures, symmetric spaces and completeness*****Malek Hanounah**

(Greifswald University)

In the first part, we will explore the notion of tangential  $(G, X)$ -foliations, a natural generalization of  $(G, X)$ -structures. A general question in this context is how the topology of the manifold  $M$  affects the geometry of the leaves. We begin with a structure arising in a class of Lorentzian manifolds called pp-wave spacetimes. We show the completeness of the leaves under the assumption that  $M$  is compact and discuss pseudo-Riemannian variants that naturally arise.

Joint work with Lilia Mehidi.

**GT02*****Differential Geometry, Mathematical Physics and Control Theory*****Geometría Diferencial, Física Matemática y Teoría de Control****Organizers****Organizadores****Antolatzaileak****Miguel Ángel Berbel López**

(Universidad Pontificia de Comillas)

**Asier López Gordón**(Institute of Mathematics of the Polish  
Academy of Sciences)**Silvia Souto Pérez**

(Universidade de Santiago de Compostela)

**Description****Descripción****Deskribapena**

*The goal of this session is to highlight various topics of current research in differential geometry and its applications to physics, dynamical systems, and control theory. It has a remarkable interdisciplinary character, aiming to encourage collaboration among geometers, applied mathematicians, physicists, and engineers. The proposal has the support of the Geometry, Dynamics, and Field Theory Network, which will cover the travel and accommodation expenses for several speakers.*

Esta sesión temática tiene por objetivo dar a conocer diversos temas de investigación actual en geometría diferencial y sus aplicaciones a la física, los sistemas dinámicos y la teoría de control. Tiene un carácter fuertemente interdisciplinar, pretendiendo fomentar la colaboración entre geómetras, matemáticos aplicados, físicos e ingenieros. La propuesta cuenta con el respaldo de la Red Temática de Geometría, Dinámica y Teoría de Campos, la cual financiaría el alojamiento y los viajes de varios ponentes.

**MSC Codes****Códigos MSC****MSC Kodeak**

53Z05

(primary)

37J39; 37J60; 53D20; 53Z30; 70H06; 70H40; 70Q05; 81T20

(secondary)

**Slots****Bloques****Blokeak**

2.A (Aula 0.19S); 2.B (Aula 0.19S); 2.C (Aula 0.19S)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

J16 | 11:00-11:20 | 0.19S

*An invitation to the world of higher geometry***Arnau Mas** (ICMAT)

J16 | 11:30-11:50 | 0.19S

*Generalized Hamilton spaces: new developments and applications***Lucía Santamaría-Sanz** (Universidad de Burgos)

J16 | 12:00-12:20 | 0.19S

*Symmetry reduction for contact Lagrangian systems***Silvia Souto Pérez** (Universidade de Santiago de Compostela)

J16 | 12:30-12:50 | 0.19S

*Comments on the contact Marsden-Weinstein reduction***Bartosz M. Zawora** (University of Warsaw)

J16 | 16:30-16:50 | 0.19S

*Nonholonomic mechanics and virtual constraints on Riemannian homogeneous spaces***Efstathios Stratoglou** (American College of Thessaloniki)

J16 | 17:00-17:20 | 0.19S

*Global Stability***Jordi Gaset** (CUNEF Universidad)

J16 | 17:30-17:50 | 0.19S

*Contact Lie systems on three-dimensional Riemannian and Lorentzian spaces of constant curvature***Oscar Carballal** (Universidad Complutense de Madrid)

J16 | 18:00-18:20 | 0.19S

*k*-contact geometry and its application

**Tomasz Sobczak** (University of Warsaw)

V17 | 9:30-9:50 | 0.19S

*AdS Space: Hyperbolic Geometry and Diffusion*

**Valle Varo** (Universidad de Deusto)

V17 | 10:00-10:20 | 0.19S

*A graded aproach to brackets in classical field theory*

**Rubén Izquierdo-López** (UNIR-ICMAT)

V17 | 10:30-10:50 | 0.19S

*Hamilton-Jacobi theory for non-conservative field theories in the *k*-contact framework*

**Julia Lange** (University of Warsaw)

**Thursday 16**

11:00-11:20

[Room 0.19S]

**Jueves 16**

11:00-11:20

[Aula 0.19S]

**Osteguna 16**

11:00-11:20

[Gela 0.19S]

*An invitation to the world of higher geometry***Arnau Mas**

(ICMAT)

Many of the objects of interest that appear in field theories are of infinite dimension, namely spaces of fields, spaces of solutions, moduli spaces, etc. Nevertheless, the standard machinery of differential geometry is ill equipped to deal with objects of this kind. I will attempt to make the case in this talk that ideas of category theory can be used to construct a context that generalises finite dimensional differential geometry while accommodating infinite dimensional objects.

**Thursday 16**

11:30-11:50

[Room 0.19S]

**Jueves 16**

11:30-11:50

[Aula 0.19S]

**Osteguna 16**

11:30-11:50

[Gela 0.19S]

*Generalized Hamilton spaces: new developments and applications***Lucía Santamaría-Sanz**

(Universidad de Burgos)

We make new developments in generic cotangent bundle geometries depending on all phase-space variables. We focus on the generalized Hamilton spaces, discussing how the main ingredients of this geometrical framework can be derived from a given metric. We study the spacetime and momentum isometries of the metric, and also discuss the possible applications of cotangent bundle geometries in quantum gravity, such as the construction of deformed relativistic kinematics and non-commutative spacetimes.

Joint work with Javier Relancio.

arXiv:2407.18819

Thursday 16  
12:00-12:20  
[Room 0.19S]

Jueves 16  
12:00-12:20  
[Aula 0.19S]

Osteguna 16  
12:00-12:20  
[Gela 0.19S]

*Symmetry reduction for contact Lagrangian systems*

**Silvia Souto Pérez**

(Universidade de Santiago de Compostela)

In this talk, we investigate the reduction process of a contact Lagrangian system whose Lagrangian is invariant under a group of symmetries. We will show that the resulting reduced differential equations, the so-called Lagrange-Poincaré-Herglotz equations, can be derived in a relatively straightforward fashion from the Herglotz equations, by choosing a suitable adapted frame, or equivalently by employing well-chosen quasi-velocities.

Joint work with A. Anahory Simoes, L. Colombo, M. de León and M. Salgado.

[arXiv:2308.00990](https://arxiv.org/abs/2308.00990)

Thursday 16  
12:30-12:50  
[Room 0.19S]

Jueves 16  
12:30-12:50  
[Aula 0.19S]

Osteguna 16  
12:30-12:50  
[Gela 0.19S]

*Comments on the contact Marsden-Weinstein reduction*

**Bartosz M. Zawora**

(University of Warsaw)

The first generalization of the Marsden-Weinstein reduction theorem to contact manifolds was proven by C. Albert in 1989. However, this result applies only to coorientable contact manifolds and depends on the choice of the contact form. I will review various approaches to the contact reduction theorem and focus on the technical condition introduced by C. Willett, demonstrating its necessity. I will then present a new version of the theorem, applying when Willett's condition fails.

Joint work with J. de Lucas, X. Rivas, S. Vilariño.



**Thursday 16****16:30-16:50****[Room 0.19S]****Jueves 16****16:30-16:50****[Aula 0.19S]****Osteguna 16****16:30-16:50****[Gela 0.19S]**

***Nonholonomic mechanics and virtual constraints on Riemannian homogeneous spaces***

**Efstathios Stratoglou**

(American College of Thessaloniki)

In this talk, we describe nonholonomic systems on Riemannian homogeneous spaces and introduce the notion of virtual nonholonomic constraint (VC) which is a controlled invariant distribution associated with an affine connection control system. Moreover, we show the existence and uniqueness of a control law preserving the VC and also give the closed-loop dynamics obtained using the unique control law in terms of an affine connection. Examples inspired by robotics will be presented.

Joint work with Alexandre Anahory Simoes, Anthony Bloch, and Leonardo J. Colombo.

**Thursday 16****17:00-17:20****[Room 0.19S]****Jueves 16****17:00-17:20****[Aula 0.19S]****Osteguna 16****17:00-17:20****[Gela 0.19S]**

***Global Stability***

**Jordi Gaset**

(CUNEF Universidad)

Global stability studies the asymptotic behaviour of all solutions, not only those around a critical point. This concept arises from theoretical physics as it is challenging to quantize systems that are not globally stable.

In this talk, we will see that global stability is a geometric property of the system. We will review methods to prove global stability and present new extensions. We will see how these concepts are related to integrable systems and explain the relevant challenges ahead.

**Thursday 16****17:30-17:50****[Room 0.19S]****Jueves 16****17:30-17:50****[Aula 0.19S]****Osteguna 16****17:30-17:50****[Gela 0.19S]**

***Contact Lie systems on three-dimensional Riemannian and Lorentzian spaces of constant curvature***

**Oscar Carballal**

(Universidad Complutense de Madrid)

In this talk we will show how four-dimensional Lie-Hamilton systems based the Lie algebra  $\mathfrak{sp}(4, \mathbb{R})$  can be reduced to contact Lie systems on the three-dimensional sphere. These systems also arise as particular case of a novel construction of contact Lie systems on the so-called three-dimensional Cayley-Klein spaces. Finally, under some topological assumptions, we will prove that some of these systems produce well-known two-dimensional Lie-Hamilton systems through a curvature-dependent reduction.

Joint work with R. Campoamor-Stursberg and F. J. Herranz.

[arXiv:2406.17479](https://arxiv.org/abs/2406.17479)

**Thursday 16****18:00-18:20****[Room 0.19S]****Jueves 16****18:00-18:20****[Aula 0.19S]****Osteguna 16****18:00-18:20****[Gela 0.19S]**

***k-contact geometry and its application***

**Tomasz Sobczak**

(University of Warsaw)

This talk aims to introduce  $k$ -contact geometry, a generalization of contact geometry that has appeared when studying field theories and dissipative systems. I will present this extension and highlight its properties, such as conditions on  $k$ -contact distributions, which improve the analysis of differential equations. These results will be mainly applied to Lie systems, a class of ODEs whose general solutions can be expressed in terms of a family of particular solutions and a set of constants.

Joint work with J. de Lucas and X. Rivas.

[arXiv:2409.11001](https://arxiv.org/abs/2409.11001)

Friday 17  
9:30-9:50  
[Room 0.19S]

Viernes 17  
9:30-9:50  
[Aula 0.19S]

Ostirala 17  
9:30-9:50  
[Gela 0.19S]

*AdS Space: Hyperbolic Geometry and Diffusion*

**Valle Varo**

(Universidad de Deusto)

In this talk, we will explore Anti-de Sitter (AdS) manifolds by examining key models, such as the Poincaré one that provides a unique simply connected and geodesically complete Lorentzian manifold of constant curvature  $-1$ , up to isometries. We will focus on the  $(2+1)$ -dimensional case, where, through the  $\mathrm{PSL}(2, \mathbb{R})$  model, the AdS-3 space may be endowed with a Lie group structure. This will allow us to analyze diffusion processes and define a Fokker-Planck equation in a geometric manner.

Friday 17  
10:00-10:20  
[Room 0.19S]

Viernes 17  
10:00-10:20  
[Aula 0.19S]

Ostirala 17  
10:00-10:20  
[Gela 0.19S]

*A graded approach to brackets in classical field theory*

**Rubén Izquierdo-López**

(UNIR-ICMAT)

In this talk I will present some recent work where we generalized the notion of Poisson and Dirac structures to classical field theory, obtaining objects of graded nature. We will focus on explaining some results obtained in this recent work, specially those relating the obtained graded Poisson algebra and the graded Poisson tensor.

Joint work with Manuel de León.

arXiv:2410.06034

**Friday 17****10:30-10:50****[Room 0.19S]****Viernes 17****10:30-10:50****[Aula 0.19S]****Ostirala 17****10:30-10:50****[Gela 0.19S]**

***Hamilton-Jacobi theory for non-conservative field theories in the  $k$ -contact framework***

**Julia Lange**

(University of Warsaw)

The Hamilton-De Donder-Weyl (HDW) equations generalize Hamilton's equations to field theory, with HDW equations expressed geometrically via  $k$ -vector fields. This talk inspects the dynamics of classical field theories described via  $k$ -contact structures. A generalisation of the evolutionary contact vector field to the  $k$ -contact realm is provided and its HDW equations are defined and analysed. In particular, a Hamilton-Jacobi theory for non-conservative Hamiltonian field theories is developed.

**GT03****Geometric Structures in Manifolds****Estructuras Geométricas en Variedades Diferenciables****Organizers****Organizadores****Antolatzaileak****Guillermo Sánchez Arellano**

(Universidad Complutense de Madrid)

**Pablo Nicolás Martínez**

(Centre de Recerca Matemàtica)

**Benedetta Facciotti**

(Universitat Politècnica de Catalunya)

**Robert Cardona Aguilar**

(Universitat de Barcelona)

**Description****Descripción****Deskribapena**

*The main object of study of differential topology are differentiable manifolds. Their behavior is in many instances too flexible, so they are commonly endowed with a geometric structure which simplifies and enriches their study. Such structures can be of various types: Riemannian metrics, symplectic forms, contact distributions, complex structures, spin structures, foliations... All of them behave differently, but one can commonly observe relations between techniques from different areas.*

*Here we provide a link between geometers from different fields mainly focused on symplectic and contact geometry, as well as in their applications to different areas such as topology and dynamical systems.*

El comportamiento de las variedades diferenciables puede resultar demasiado flexible en algunas ocasiones, por lo que se les suele agregar algún tipo de estructura geométrica que enriquezca y simplifique su estudio. Algunos ejemplos son: métricas riemannianas, formas simplécticas, distribuciones de contacto, estructuras complejas, estructuras de spin o foliaciones. Aunque cada una presenta diferentes comportamientos, en ocasiones pueden encontrarse relaciones entre las técnicas empleadas en cada área.

Con esta sesión tratamos de poner en contacto a geómetras de diferentes áreas, enfocándonos especialmente en las geometrías simpléctica y de contacto y en sus aplicaciones a la topología y a los sistemas dinámicos

**MSC Codes****Códigos MSC****MSC Kodeak**

57R17

(primary)

57R15; 37J39

(secondary)

## Slots

## Bloques

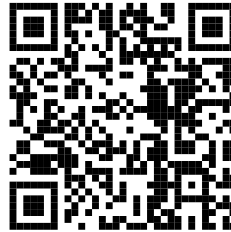
## Blokeak

1.A (Aula 0.19S); 1.B (Aula 0.19S); 1.C (Aula 0.19S)

## QR Code

## Código QR

## QR Kodea



## Session Schedule

## Horario de la Sesión

## Saioaren Ordutegia

L13 | 17:30-17:50 | 0.19S

*Hodge structures on configuration spaces of orbits*

**Alejandro Calleja** (UCM-ICMAT)

L13 | 18:00-18:20 | 0.19S

*Complex and symplectic geometry in dimension 8*

**Luis Pizarro Golvano** (Universidad de Zaragoza)

L13 | 18:30-18:50 | 0.19S

*The cosymplectic Chern–Hamilton conjecture*

**Søren István Adorján Dyhr** (Universitat Politècnica de Catalunya & Centre de Recerca Matemàtica)

L13 | 19:00-19:20 | 0.19S

*On integrable contact systems and bi-Hamiltonian structures*

**Asier López-Gordón** (Institute of Mathematics of the Polish Academy of Sciences)

M14 | 15:00-15:20 | 0.19S

*Prelegendrian submanifolds in elliptic distribution*

**Wei Zhou** (UCM-ICMAT)

M14 | 15:30-15:50 | 0.19S

*Geometric formalism of Poisson–Poincaré reduction*

**Miguel A. Berbel** (Universidad Pontificia Comillas)

M14 | 16:00-16:20 | 0.19S

*Symplectic invariant connections*

**José Luis Carmona Jiménez** (IMAR)

M14 | 16:30-16:50 | 0.19S

*A Gentle Introduction to Generalized Riemannian Geometry*

**Jaime Pedregal Pastor** (Utrecht University)

M14 | 17:30-17:50 | 0.19S

*Floer Theory for the 3-Body Problem*

**Jagna Wiśniewska** (Universitat Politècnica de Catalunya)

M14 | 18:00-18:20 | 0.19S

*Morse Theory Applied to Topological Quantum Field Theories*

**Enrique Aycart Maldonado** (Complutense University of Madrid)

M14 | 18:30-18:50 | 0.19S

*A sketch of the Atiyah-Singer index theorem and its extensions*

**Josep Fontana McNally** (Universitat Politècnica de Catalunya)

**Monday 13**  
**17:30-17:50**  
**[Room 0.19S]**

**Lunes 13**  
**17:30-17:50**  
**[Aula 0.19S]**

**Astelehena 13**  
**17:30-17:50**  
**[Gela 0.19S]**

*Hodge structures on configuration spaces of orbits*

**Alejandro Calleja**  
(UCM-ICMAT)

Given an algebraic variety  $X$  with an action of an algebraic group  $G$ , we define the  $n$ -th configuration space of orbits as the set of  $n$ -tuples of points of  $X$  such that the orbits through  $G$  of these points are pairwise disjoint. In this talk we introduce these spaces and their applications to Knot Theory. We will also show how we can study the Hodge structure of these spaces by relating it to the one of  $X$ .

[arXiv:2403.07765](https://arxiv.org/abs/2403.07765)

**Monday 13**  
**18:00-18:20**  
**[Room 0.19S]**

**Lunes 13**  
**18:00-18:20**  
**[Aula 0.19S]**

**Astelehena 13**  
**18:00-18:20**  
**[Gela 0.19S]**

*Complex and symplectic geometry in dimension 8*

**Luis Pizarro Golvano**  
(Universidad de Zaragoza)

The objective of this talk is to ask some questions about complex non-Kähler geometry and symplectic geometry by working with some examples of homogeneous spaces that are built from a nilpotent Lie group. This type of homogeneous spaces are known as nilmanifolds and they are the key in order to build examples and counter examples in problems of geometric structures in manifolds. In addition, nilmanifolds allow you to study geometry using linear algebra and Lie Groups theory.



**Monday 13**  
**18:30-18:50**  
**[Room 0.19S]**

**Lunes 13**  
**18:30-18:50**  
**[Aula 0.19S]**

**Astelehena 13**  
**18:30-18:50**  
**[Gela 0.19S]**

***The cosymplectic Chern–Hamilton conjecture***

**Søren István Adorján Dyhr**

(Universitat Politècnica de Catalunya & Centre de Recerca Matemàtica)

We study a functional on compatible metrics on compact, 3-dimensional, cosymplectic manifolds. It generalizes the functional studied by Chern and Hamilton in 1984 for contact manifolds.

We classify which manifolds admit critical metrics by computing local forms and making explicit constructions: they are either co-Kähler or mapping tori of the 2-torus by maps conjugate to hyperbolic toral automorphisms. In the first case, the Reeb vector field is Killing, in the second it is Anosov.

Joint work with Ángel González-Prieto, Eva Miranda, and Daniel Peralta-Salas.

**Monday 13**  
**19:00-19:20**  
**[Room 0.19S]**

**Lunes 13**  
**19:00-19:20**  
**[Aula 0.19S]**

**Astelehena 13**  
**19:00-19:20**  
**[Gela 0.19S]**

***On integrable contact systems and bi-Hamiltonian structures***

**Asier López-Gordón**

(Institute of Mathematics of the Polish Academy of Sciences)

We have recently proven a Liouville–Arnol’d theorem for contact Hamiltonian systems. In this setting, one has a  $(2n+1)$ -dimensional contact manifold with  $n+1$  functions in involution w.r.t. the Jacobi bracket, and the invariant submanifolds are  $n$ -codimensional and coisotropic. In a work in progress, we utilize Jacobi–Nijenhuis structures and extend the theory of bi-Hamiltonian systems to obtain those functions in involution in a contact manifold.

Joint work with Leonardo Colombo, Manuel de León, María Emma Eyrea Irazú, and Manuel Lainz.

[arXiv:2302.12061](https://arxiv.org/abs/2302.12061)

**Tuesday 14**  
**15:00-15:20**  
**[Room 0.19S]**

**Martes 14**  
**15:00-15:20**  
**[Aula 0.19S]**

**Asteartea 14**  
**15:00-15:20**  
**[Gela 0.19S]**

***Prelegendrian submanifolds in elliptic distribution***

**Wei Zhou**  
(UCM-ICMAT)

The maximally non-involutive  $(4, 6)$ -distribution has two classes: elliptic and hyperbolic. The latter was shown to exhibit an h-principle by Javier Martínez and Álvaro del Pino. For the elliptic case, there is a natural association with a contact 7-manifold, an  $S^1$ -fibration. In this talk, we introduce the counterpart to Legendrian submanifolds in elliptic distributions and discuss the potential existence of non-isotopic PreLegendrian submanifolds in  $\mathbb{R}^6$ .

Joint work with Álvaro del Pino.

**Tuesday 14**  
**15:30-15:50**  
**[Room 0.19S]**

**Martes 14**  
**15:30-15:50**  
**[Aula 0.19S]**

**Asteartea 14**  
**15:30-15:50**  
**[Gela 0.19S]**

***Geometric formalism of Poisson-Poincaré reduction***

**Miguel A. Berbel**  
(Universidad Pontificia Comillas)

This talk presents the covariant bracket formulation of first-order Hamiltonian field theories, introducing specific polysymplectic and multisymplectic structures on the configuration bundle. When the physical system has a symmetry, a  $G$ -principal connection can be used to reduce these geometric structures and simplify its description. We focus on the Poisson-Poincaré reduction and related canonical structures that may play a crucial role in this reduction process.

**Tuesday 14**  
**16:00-16:20**  
**[Room 0.19S]**

**Martes 14**  
**16:00-16:20**  
**[Aula 0.19S]**

**Asteartea 14**  
**16:00-16:20**  
**[Gela 0.19S]**

***Symplectic invariant connections***  
**José Luis Carmona Jiménez**  
(IMAR)

Homogeneous spaces are differentiable manifolds with a transitive action of a Lie group. The Ambrose-Singer Theorem characterizes Riemannian homogeneous spaces through an invariant tensor that satisfies covariant equations and is central to the Tricerri-Vanhecke program, which focuses on Riemannian homogeneous manifolds. However, it is limited to metric cases.

We present a generalization of the Ambrose-Singer Theorem for non-metric instances and apply this to symplectic homogeneous manifolds.

Joint work with Marco Castrillón López.

[arXiv:2001.06254](https://arxiv.org/abs/2001.06254)

**Tuesday 14**  
**16:30-16:50**  
**[Room 0.19S]**

**Martes 14**  
**16:30-16:50**  
**[Aula 0.19S]**

**Asteartea 14**  
**16:30-16:50**  
**[Gela 0.19S]**

***A Gentle Introduction to Generalized Riemannian Geometry***  
**Jaime Pedregal Pastor**  
(Utrecht University)

Generalized geometry has proven to be a powerful unifying framework for different geometries such as complex, symplectic, Poisson and the like. The theory of generalized metrics has led to further links to other geometries, e.g. bihermitian geometry, which are also of interest in supersymmetric sigma models in string theory. In this talk we will give a gentle introduction to generalized geometry, focusing in particular on the Riemannian aspect of the theory.

*Tuesday 14*  
*17:30-17:50*  
*[Room 0.19S]*

**Martes 14**  
**17:30-17:50**  
**[Aula 0.19S]**

**Asteartea 14**  
**17:30-17:50**  
**[Gela 0.19S]**

*Floer Theory for the 3-Body Problem*

**Jagna Wiśniewska**

(Universitat Politècnica de Catalunya)

In my talk I will explain how to use tools from symplectic geometry and Hamiltonian dynamics to tackle the following problem: Can we send a rocket between any two points in the gravitational field of the Moon and the Earth, using the engines only at the beginning and at the end of the journey?

*Tuesday 14*  
*18:00-18:20*  
*[Room 0.19S]*

**Martes 14**  
**18:00-18:20**  
**[Aula 0.19S]**

**Asteartea 14**  
**18:00-18:20**  
**[Gela 0.19S]**

*Morse Theory Applied to Topological Quantum Field Theories*

**Enrique Aycart Maldonado**

(Complutense University of Madrid)

Topological Quantum Field Theories (TQFTs) are powerful algebro-geometric tools that provide us with a new way of computing topological and algebraic invariants of closed manifolds. In particular, cobordism categories play a fundamental role in the formulation of TQFTs, providing a geometric framework that connects category theory, topology and theoretical physics. We will focus on the application of Morse theory to the study of the two-dimensional case and the associated bicategory of bordisms.

**Tuesday 14****18:30-18:50****[Room 0.19S]****Martes 14****18:30-18:50****[Aula 0.19S]****Asteartea 14****18:30-18:50****[Gela 0.19S]*****A sketch of the Atiyah-Singer index theorem and its extensions*****Josep Fontana McNally**

(Universitat Politècnica de Catalunya)

The Atiyah-Singer index theorem brings together ideas from analysis, geometry, and topology, and generalizes many important results such as the Gauss-Bonnet and Riemann-Roch theorems. In this talk, we present the key objects in the statement, sketch one of the different proofs that have been given, and describe an extension to manifolds with boundary. We discuss how this last extension is the starting point of  $b$ -geometry, a framework to work with singular differential forms.

**GT04****Geometric Analysis****Análisis Geométrico****Organizers****Organizadores****Antolatzaileak****Alberto Cerezo Cid**

(Univ. de Sevilla y Univ. de Granada)

**Alba García Ruiz**

(ICMAT)

**Diego Alfonso Marín Muñoz**

(Universidad de Granada)

**Description****Descripción****Deskribapena**

*In this session, we will cover several topics related to geometric analysis, such as fluid dynamics, minimal surfaces, spectral analysis or problems related to the physical theory of General Relativity (models, solutions to the Einstein equation, etc).*

*The aim of this session is to allow PhD students in geometric analysis to present their research and to establish a meeting point among them.*

En esta sesión trataremos diversos temas relacionados con el análisis geométrico, que cubrirán áreas como teoría de fluidos, superficies mínimas, análisis espectral o problemas relacionados con la teoría de la relatividad general (modelos de la teoría, soluciones de la ecuación de Einstein, etc).

Esta sesión tiene como objetivo permitir a los y las doctorandos en análisis geométrico dar a conocer los resultados obtenidos durante su tesis así como establecer un punto de encuentro entre ellos.

**MSC Codes****Códigos MSC****MSC Kodeak**

53C21

(primary)

58J05

(secondary)

**Slots****Bloques****Blokeak**

1.A (Aula 0.19); 2.C (Aula 0.19)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

- L13 | 17:30-17:50 | 0.19

*The Vlasov equation in de Sitter spacetime*

**Mónica Tapia del Moral** (University of Cambridge)
- L13 | 18:00-18:20 | 0.19

*Schur theorem in Finsler geometry*

**Fidel F. Villaseñor** (Universidad de Granada)
- L13 | 18:30-18:50 | 0.19

*The Mittag-Leffler theorem for proper minimal surfaces and directed meromorphic curves*

**Tjaša Vrhovnik** (Universidad de Granada)
- L13 | 19:00-19:20 | 0.19

*Bryant surfaces*

**Jorge Hidalgo Calderón** (Universidad de Granada)
- V17 | 9:00-9:20 | 0.19

*The geometry of fluid flows in the low regularity regime*

**Javier Peñafiel Tomás** (Instituto de Ciencias Matemáticas)
- V17 | 9:30-9:50 | 0.19

*Beyond Dvoretzky's Theorem*

**Victoria Pelayo** (Universidad Autónoma de Madrid)
- V17 | 10:00-10:20 | 0.19

*Mean exit time function comparison criteria in Riemannian manifolds*

**Erik Sarrión Pedralva** (Universidad Rey Juan Carlos)

V17 | 10:30-10:50 | 0.19

*High-energy study of point potentials on the 2-sphere*

**Santiago Verdasco Ramos** (Universidad Politécnica de Madrid)



Monday 13  
17:30-17:50  
[Room 0.19]

Lunes 13  
17:30-17:50  
[Aula 0.19]

Astelehena 13  
17:30-17:50  
[Gela 0.19]

*The Vlasov equation in de Sitter spacetime*

**Mónica Tapia del Moral**

(University of Cambridge)

A simple way of modelling matter in a spacetime is by a nonnegative function defined on the (co)tangent bundle of the spacetime manifold that has to be constant along the particle trajectories, i.e. geodesics. This condition translates into the function having to satisfy the so-called Vlasov equation, widely studied in Mathematics and Physics. In this talk, we briefly recall the geometry underlying the Vlasov equation and discuss some of its features when studied in a particular spacetime model.

Monday 13  
18:00-18:20  
[Room 0.19]

Lunes 13  
18:00-18:20  
[Aula 0.19]

Astelehena 13  
18:00-18:20  
[Gela 0.19]

*Schur theorem in Finsler geometry*

**Fidel F. Villaseñor**

(Universidad de Granada)

In Finsler geometry, a key challenge is extending the Schur theorem from Riemannian geometry or finding counterexamples. While the flag curvature version extends easily to Finsler geometry, the Ricci curvature version has few known results, often relying on specific Finsler classes of metrics. This talk presents a new approach that extends the Ricci-Schur theorem to "weakly Landsberg" Finsler metrics, which includes all Riemannian ones. The proof uses Noether's theorem, inspired by physics.

[arXiv:2304.08933](https://arxiv.org/abs/2304.08933)

**Monday 13****18:30-18:50****[Room 0.19]****Lunes 13****18:30-18:50****[Aula 0.19]****Astelehena 13****18:30-18:50****[Gela 0.19]**

*The Mittag-Leffler theorem for proper minimal surfaces and directed meromorphic curves*

**Tjaša Vrhovnik**

(Universidad de Granada)

This talk studies meromorphic  $A$ -immersions from an open Riemann surface  $M$  into  $\mathbb{C}^n$  (with  $n \geq 3$ ) and relates it to the Mittag-Leffler theorem (1884), that addresses meromorphic functions in  $\mathbb{C}$ . In 2022, A. Alarcón and F. J. López proved an analogue for complete minimal surfaces in  $\mathbb{R}^n$ . In this talk we introduce a generalization of their result, showing a Mittag-Leffler-type theorem for proper directed immersions into  $\mathbb{C}^n$  and some applications to the theory of minimal surfaces.

Joint work with Antonio Alarcón.

**Monday 13****19:00-19:20****[Room 0.19]****Lunes 13****19:00-19:20****[Aula 0.19]****Astelehena 13****19:00-19:20****[Gela 0.19]*****Bryant surfaces*****Jorge Hidalgo Calderón**

(Universidad de Granada)

Constant mean curvature one surfaces in hyperbolic space are also known as Bryant surfaces, as he introduced in 1987 a holomorphic representation of these. This fact motivated its study from a complex analytic viewpoint, and, in 2015, A. Alarcón and F. Forstnerič posed the following problem:  $\zeta$  is every open Riemann surface conformally equivalent to a properly immersed Bryant surface? In this talk, I will discuss recent progress in answering this question.

Friday 17  
9:00-9:20  
[Room 0.19]

Viernes 17  
9:00-9:20  
[Aula 0.19]

Ostirala 17  
9:00-9:20  
[Gela 0.19]

*The geometry of fluid flows in the low regularity regime*

**Javier Peñafiel Tomás**

(Instituto de Ciencias Matemáticas)

In this talk we will discuss new ideas on convex integration methods for the 3d Euler equations, and present some applications of a strongly geometric nature.

Joint work with Alberto Enciso, and Daniel Peralta-Salas.

Friday 17  
9:30-9:50  
[Room 0.19]

Viernes 17  
9:30-9:50  
[Aula 0.19]

Ostirala 17  
9:30-9:50  
[Gela 0.19]

*Beyond Dvoretzky's Theorem*

**Victoria Pelayo**

(Universidad Autónoma de Madrid)

Dvoretzky's theorem essentially states that in normed spaces of high dimension, there exist subspaces that are nearly Euclidean. A geometric interpretation of this fact is that every high-dimensional symmetric convex body has a section of dimension of order  $\log(n)$  that is almost a Euclidean ball. This can be understood in terms of a radial function defined on the Euclidean sphere. Our goal will be to explain this interpretation and generalize it to other spaces, like complex projective space.

Friday 17  
10:00-10:20  
[Room 0.19]

Viernes 17  
10:00-10:20  
[Aula 0.19]

Ostirala 17  
10:00-10:20  
[Gela 0.19]

*Mean exit time function comparison criteria in Riemannian manifolds*

**Erik Sarrión Pedralva**

(Universidad Rey Juan Carlos)

We will show some explicit upper and lower bounds for the Poisson hierarchy, the averaged moment spectra, and the torsional rigidity of a geodesic ball in a Riemannian manifold which satisfies some conditions for the mean curvatures of its geodesic spheres. As a consequence, we will see a first Dirichlet eigenvalue comparison theorem and show that equality between the first eigenvalues characterizes the moment spectrum and vice-versa.

Joint work with Vicente Palmer.

[arXiv:2110.03330](https://arxiv.org/abs/2110.03330)

Friday 17  
10:30-10:50  
[Room 0.19]

Viernes 17  
10:30-10:50  
[Aula 0.19]

Ostirala 17  
10:30-10:50  
[Gela 0.19]

*High-energy study of point potentials on the 2-sphere*

**Santiago Verdasco Ramos**

(Universidad Politécnica de Madrid)

Physicists expect that classical behaviours should appear in the high-energy regime of quantum systems. In this talk, we will delve into this problem and show how a point perturbation of a quantum system could interfere with this principle.

**GT05****Algebraic Topology**  
Topología Algebraica**Organizers****Organizadores****Antolatzaileak****Guille Carrión Santiago**

(Universidad de Málaga)

**Beatriz Molina Samper**

(Universidad de Valladolid)

**Álvaro del Valle Vilchez**

(Universidad de Sevilla)

**Description****Descripción****Deskribapena**

*Algebraic topology is the branch of mathematics that aims to classify topological spaces using algebraic tools. Its powerful development during the twentieth century is largely due to the discovery of algebraic invariants such as homology and homotopy groups. The scientific progress of algebraic topology can be noticed in the big developments happening in different subareas, such as low-dimensional topology and homotopy theory. Its connections with other areas of mathematics, such as group theory and algebraic geometry, are also noteworthy.*

*In this context, we suggest a session with 9 speakers, divided into 3 time and thematic blocks:*

- *Topology of manifolds*
- *Homotopy theory*
- *Topological study of singularities*

La topología algebraica persigue clasificar espacios topológicos utilizando herramientas algebraicas. Su gran desarrollo a lo largo del siglo XX ha recaído en el descubrimiento de invariantes algebraicos como los grupos de homología y de homotopía.

El avance científico de la topología algebraica se refleja en el gran desarrollo que acontece en distintas subáreas, como la topología de bajas dimensiones y la teoría de homotopía. Destacan también sus conexiones con otras áreas de las matemáticas, como la teoría de grupos y la geometría algebraica.

En este contexto se plantea una sesión de 9 ponentes, dividida en 3 bloques horarios y temáticos:

- Topología de variedades
- Teoría de homotopía
- Estudio topológico de singularidades

| MSC Codes | Códigos MSC                        | MSC Kodeak |
|-----------|------------------------------------|------------|
|           | 55-XX<br>(primary)                 |            |
|           | 57N65; 55PXX; 32S50<br>(secondary) |            |

| Slots | Bloques   | Blokeak |
|-------|---|---------|
|       | 1.A (Aula 0.20); 1.B (Aula 0.20); 1.C (Aula 0.20) |         |

| QR Code | Código QR  | QR Kodea |
|---------|--|----------|
|         |  |          |

| Session Schedule   | Horario de la Sesión | Saioaren Ordutegia |
|--|----------------------|--------------------|
| L13   17:30-17:50   0.20<br><i>Generalizing the Euler characteristic on sheaves</i><br><b>Alejandro O. Majadas-Moure</b> (Universidad de Santiago de Compostela) |                      |                    |
| L13   18:00-18:20   0.20<br><i>Discrete and Algebraic Morse Theories</i><br><b>David Mosquera Lois</b> (Universidade de Vigo)                                    |                      |                    |
| L13   18:30-18:50   0.20<br><i>Finite group actions in Maurer-Cartan spaces of L-infinity algebras</i><br><b>Rafael Gomes</b> (Universidad de Málaga)            |                      |                    |
| L13   19:00-19:20   0.20<br><i>Universal Ringed Spaces</i><br><b>Javier Sánchez González</b> (Universidad de Castilla la Mancha)                                 |                      |                    |

M14 | 15:00-15:20 | 0.20

*Cohomology and Carlson's depth conjecture*

**Oihana Garaialde Ocaña** (UPV/EHU)

M14 | 15:30-15:50 | 0.20

*Higher limits over posets and the sharpness conjecture for fusion systems*

**Marco Praderio Bova** (TU Dresden)

M14 | 16:00-16:20 | 0.20

*Homogeneous braids are visually prime*

**Miguel Orbegoza Rodríguez** (ETH Zurich)

M14 | 16:30-16:50 | 0.20

*Classifying topological quantum field theories: from Frobenius algebras to the Cobordism Hypothesis*

**Santiago Pareja Pérez** (Unizar & UCM)

M14 | 17:30-17:50 | 0.20

*When should you trust your drawings?*

**Ignacio Breva Ribes** (Universitat de València)

M14 | 18:00-18:20 | 0.20

*Topological description and fine normal forms of a vector field with Hopf-zero singularity*

**María Martín Vega** (Universidad de Valladolid)

M14 | 18:30-18:50 | 0.20

*Computing the effective homology of a group extension*

**J. A. Delgado** (Universidad de La Rioja)

M14 | 19:00-19:20 | 0.20

*Lie approach to the Toral Rank Conjecture.*

**Mario Fuentes Rumí** (Université Toulouse III - Paul Sabatier)

**Monday 13**  
**17:30-17:50**  
**[Room 0.20]**

**Lunes 13**  
**17:30-17:50**  
**[Aula 0.20]**

**Astelehena 13**  
**17:30-17:50**  
**[Gela 0.20]**

***Generalizing the Euler characteristic on sheaves***

**Alejandro O. Majadas-Moure**

(Universidad de Santiago de Compostela)

The Euler characteristic is an invariant very important inside mathematics. This is such that it has been extended to other contexts rather than topological spaces. One of these contexts are the sheaves, where it is yet known a relationship between the E.C. of a sheaf and the integral with respect to the E. C. of an associated constructible map. In this work, we present the notion of Lefschetz number of a sheaf and establish a relationship between this and the combinatorial Lefschetz number.

Joint work with David Mosquera-Lois.

[arXiv:2312.02909](https://arxiv.org/abs/2312.02909)

**Monday 13**  
**18:00-18:20**  
**[Room 0.20]**

**Lunes 13**  
**18:00-18:20**  
**[Aula 0.20]**

**Astelehena 13**  
**18:00-18:20**  
**[Gela 0.20]**

***Discrete and Algebraic Morse Theories***

**David Mosquera Lois**

(Universidade de Vigo)

We will discuss the underlying motivations behind the different approaches to discrete Morse theories and their relationship with their algebraic counterparts. Finally, we will present a way to unify these theories within the contexts of chain complexes (algebraic theory), CW-complexes, and partially ordered sets (discrete theories).



**Monday 13**  
**18:30-18:50**  
**[Room 0.20]**

**Lunes 13**  
**18:30-18:50**  
**[Aula 0.20]**

**Astelehena 13**  
**18:30-18:50**  
**[Gela 0.20]**

***Finite group actions in Maurer-Cartan spaces of L-infinity algebras***

**Rafael Gomes**

(Universidad de Málaga)

We will define L-infinity algebras, the respective Maurer-Cartan (MC) simplicial sets and how to extend this theory to the G-equivariant context. In particular, we will explain a result by Moreno-Fernández y Wierstra that says that for a finite group G, the inclusion of the fixed points into the homotopy fixed points of the MC-space of an L-infinity algebra (with a finite group action) is an homotopy equivalence. We will share some ideas on how to extend this work to curved L-infinity algebras.

Joint work with José Manuel Fernández-Moreno and Félix Wierstra.

[arXiv:2203.03200](https://arxiv.org/abs/2203.03200)

**Monday 13**  
**19:00-19:20**  
**[Room 0.20]**

**Lunes 13**  
**19:00-19:20**  
**[Aula 0.20]**

**Astelehena 13**  
**19:00-19:20**  
**[Gela 0.20]**

***Universal Ringed Spaces***

**Javier Sánchez González**

(Universidad de Castilla la Mancha)

In this talk I will introduce analogues for affine spaces, projective spaces and Grassmannians in the category of ringed spaces, rather than locally ringed spaces. These incarnations arise from representing natural presheaves on the category of ringed spaces and their underlying topological spaces turn out to be finite—i.e. posets—. Finally, I will conclude with some remarks on the comparison between ringed and locally ringed spaces.

Joint work with Fernando Sancho de Salas.

[arXiv:2101.02126](https://arxiv.org/abs/2101.02126)  
[arXiv:1602.02393](https://arxiv.org/abs/1602.02393)

**Tuesday 14**  
**15:00-15:20**  
**[Room 0.20]**

**Martes 14**  
**15:00-15:20**  
**[Aula 0.20]**

**Asteartea 14**  
**15:00-15:20**  
**[Gela 0.20]**

*Cohomology and Carlson's depth conjecture*  
**Oihana Garaialde Ocaña**  
(UPV/EHU)

For a prime number  $p$ , the mod- $p$  cohomology ring of a finite group is a graded-commutative ring and its computation can be intrinsically hard. Instead, it is desirable, and sometimes satisfactory, to describe certain ring invariants in terms of group theoretic properties. In this talk we will introduce some of such concepts such as the Krull dimension and the depth. Additionally, we present some conjectures and partial results on this topic.

Joint work with Jon González Sánchez and Lander Guerrero Sánchez.

[arXiv:math/0206127](https://arxiv.org/abs/math/0206127)

**Tuesday 14**  
**15:30-15:50**  
**[Room 0.20]**

**Martes 14**  
**15:30-15:50**  
**[Aula 0.20]**

**Asteartea 14**  
**15:30-15:50**  
**[Gela 0.20]**

*Higher limits over posets and the sharpness conjecture for fusion systems*  
**Marco Praderio Bova**  
(TU Dresden)

In 2014 Diaz and Park conjectured that the higher limits of the contravariant part of any Mackey functor over a fusion system vanish. Such conjecture (known as sharpness for fusion systems) has seen a lot of recent activity. During this talk we will briefly recall the definitions of fusion systems and Mackey functor, precisely state the conjecture and view how it can be reduced to the study of higher limits over certain poset categories.

Joint work with Guille Carrión Santiago.

**Tuesday 14**  
**16:00-16:20**  
**[Room 0.20]**

**Martes 14**  
**16:00-16:20**  
**[Aula 0.20]**

**Asteartea 14**  
**16:00-16:20**  
**[Gela 0.20]**

*Homogeneous braids are visually prime*

**Miguel Orbegozo Rodríguez**

(ETH Zurich)

Knots and links are most commonly presented via diagrams. However, it is not always easy to read properties of the knots from their diagrams. In particular, we can ask, if a knot is decomposed as a connected sum, is this visible in a given diagram of it? The answer is yes, if the diagram arises as a closure of a homogeneous braid, which partially resolves a conjecture made by Cromwell in 1991. The proof relies on a criterion for primeness of fibered knots.

Joint work with Peter Feller and Lukas Lewark.

[arXiv:2408.15730](https://arxiv.org/abs/2408.15730)

**Tuesday 14**  
**16:30-16:50**  
**[Room 0.20]**

**Martes 14**  
**16:30-16:50**  
**[Aula 0.20]**

**Asteartea 14**  
**16:30-16:50**  
**[Gela 0.20]**

*Classifying topological quantum field theories: from Frobenius algebras to the*

*Cobordism Hypothesis*

**Santiago Pareja Pérez**

(Unizar & UCM)

A famous “folklore theorem” states that oriented 2D TQFTs are the same as commutative Frobenius algebras. Trying to generalize this classification to higher dimension has led to the development of new tools and language — in particular, the effort to prove the Baez–Dolan Cobordism Hypothesis has blossomed into a deeper understanding of the structure of manifolds, expressed in the language of n-categories. We will give a quick overview on these topics and highlight some interesting consequences.

**Tuesday 14**  
**17:30-17:50**  
**[Room 0.20]**

**Martes 14**  
**17:30-17:50**  
**[Aula 0.20]**

**Asteartea 14**  
**17:30-17:50**  
**[Gela 0.20]**

*When should you trust your drawings?*

**Ignacio Breva Ribes**

(Universitat de València)

In order to represent a complex object, many times we resort to just drawing their real part hoping that it is faithful enough. Mond studied this problem for the image of stabilizations of complex map-germs. In this talk we generalize some of Mond's results by giving a necessary condition so that a real representative of a complex stabilization preserves all the homology groups of the complex image. This is joint work with Roberto Giménez Conejero.

Joint work with Roberto Giménez Conejero.

**Tuesday 14**  
**18:00-18:20**  
**[Room 0.20]**

**Martes 14**  
**18:00-18:20**  
**[Aula 0.20]**

**Asteartea 14**  
**18:00-18:20**  
**[Gela 0.20]**

*Topological description and fine normal forms of a vector field with Hopf-zero singularity*

**María Martín Vega**

(Universidad de Valladolid)

In this talk, we will give the topological description of the asymptotics of the solution curves of vector fields with a Hopf-zero singularity. We will highlight the possible forms of the locus of local cycles, up to homeomorphism. With this purpose, we use normal form theory, introducing new normal forms when the singularity is non-isolated.

Joint work with Nuria Corral and Fernando Sanz Sánchez.

*Tuesday 14*  
*18:30-18:50*  
*[Room 0.20]*

**Martes 14**  
**18:30-18:50**  
**[Aula 0.20]**

**Asteartea 14**  
**18:30-18:50**  
**[Gela 0.20]**

*Computing the effective homology of a group extension*

**J. A. Delgado**

(Universidad de La Rioja)

Given a group extension  $G \rightarrow H \rightarrow K$ , can we compute the group homology of  $H$  knowing it for  $G$  and  $K$ ? In this talk, we present a solution to this problem in the framework of Effective Homology, whose aim is to compute the homology of complicated spaces by means of reductions, a special kind of chain equivalence, and perturbations. The presented results are not only theoretic but also constructive, so they lead to algorithms that have been implemented in the algebraic topology computer system Kenzo.

Joint work with Ana Romero, Julio Rubio and Francis Sergeraert.

*Tuesday 14*  
*19:00-19:20*  
*[Room 0.20]*

**Martes 14**  
**19:00-19:20**  
**[Aula 0.20]**

**Asteartea 14**  
**19:00-19:20**  
**[Gela 0.20]**

*Lie approach to the Toral Rank Conjecture.*

**Mario Fuentes Rumí**

(Université Toulouse III - Paul Sabatier)

The Toral Rank Conjecture (TRC) was formulated by Halperin in 1985 and states the following: If a torus acts almost freely on a "nice" space, then the dimension of the cohomology of the space is greater than or equal to that of the torus.

This seems very interesting, but I am running out of room to explain more, so come to my talk if you want to know more.

**GT06*****Categorical and Homotopical Methods*****Métodos Categóricos y Homotópicos****Organizers****Organizadores****Antolatzaileak****Víctor Carmona Sánchez**

(MPI MiS Leipzig)

**Alba Sendón Blanco**

(Vrije Universiteit Amsterdam)

**Manuel Soriano Trigueros**

(Inst. of Science and Technology Austria)

**Description****Descripción****Deskribapena**

*Homotopy theory is the study of mathematical contexts where there exists a notion of morphisms and deformations between them. Throughout last decades, categorical and homotopical methods have stopped being a subfield of Topology to become an independent discipline.*

*Nowadays, these techniques are applied in several problems within algebraic geometry (motivic homotopy theory), computation theory (homotopy type theory), functional analysis or mathematical physics (quantum field theory).*

*The objective of this session is to gather mathematicians that, even coming from different areas, have in common the use of these methods.*

La teoría de homotopía es el estudio de contextos matemáticos en donde hay una noción de morfismos y de deformaciones entre los mismos. Durante las últimas décadas, los métodos categóricos y homotópicos han dejado de ser un subcampo de la Topología para convertirse en una disciplina independiente.

En la actualidad, estas técnicas se aplican en numerosos problemas de geometría algebraica (teoría de homotopía motivica), teoría de la computación (teoría homotópica de tipos), análisis funcional o física matemática (teoría cuántica de campos).

El objetivo de esta sesión es reunir a matemáticos y matemáticas que, aún proveniente de distintas áreas, tienen en común el uso de estos métodos.

**MSC Codes****Códigos MSC****MSC Kodeak**

18-XX

(primary)

55PXX; 46MXX; 16D90

(secondary)

## Slots

## Bloques

## Blokeak

2.A (Aula 0.20); 2.B (Aula 0.20); 2.C (Aula 0.20)

## QR Code

## Código QR

## QR Kodea



## Session Schedule

## Horario de la Sesión

## Saioaren Ordutegia

J16 | 11:00-11:20 | 0.20

*Stable homotopy type of classifying spaces*

**Antonio Ceres Sánchez** (Universidad de Málaga)

J16 | 11:30-11:50 | 0.20

*Abstract representation theory via stable homotopy theory*

**Álvaro Sánchez** (Universidad de Murcia & Charles University of Prague)

J16 | 12:00-12:20 | 0.20

*Introduction to global algebraic K-theory*

**Gabriel Martínez de Cestafe Pumares** (Universitat Autònoma de Barcelona)

J16 | 12:30-12:50 | 0.20

*(Co)homology for data bases*

**Isaac Carcacia Campos** (Universidade de Santiago de Compostela)

J16 | 16:30-16:50 | 0.20

*Real Models of Configuration Categories*

**João Candeias** (Universitat de Barcelona)

J16 | 17:00-17:20 | 0.20

*The motivation behind higher sketches*

**David Martínez-Carpena** (Universitat de Barcelona)

J16 | 17:30-17:50 | 0.20

*Hopf braces and Hopf bracoids*

**Brais Ramos Pérez** (Universidade de Santiago de Compostela)

V17 | 10:00-10:20 | 0.20

*Homotopical operadic calculus in positive characteristic*

**Víctor Roca i Lucio** (Université Paris Cité)

V17 | 10:30-10:50 | 0.20

*bbA<sub>∞</sub>-algebras*

**Anna Sopena-Gilboy** (Universitat de Barcelona)



**Thursday 16**

11:00-11:20

[Room 0.20]

**Jueves 16**

11:00-11:20

[Aula 0.20]

**Osteguna 16**

11:00-11:20

[Gela 0.20]

***Stable homotopy type of classifying spaces*****Antonio Ceres Sánchez**

(Universidad de Málaga)

Martino and Priddy proved various results relating  $p$ -local properties of certain groups with the homotopy type of their classifying spaces (after  $p$ -completion). In particular, in this talk we shall see how to classify the stable homotopy type of classifying spaces of compact Lie groups. The ideas and techniques used by the authors will be explained as well as possible generalizations of their result.

Joint work with Antonio Viruel.

**Thursday 16**

11:30-11:50

[Room 0.20]

**Jueves 16**

11:30-11:50

[Aula 0.20]

**Osteguna 16**

11:30-11:50

[Gela 0.20]

***Abstract representation theory via stable homotopy theory*****Álvaro Sánchez**

(Universidad de Murcia &amp; Charles University of Prague)

Certain tilting results for quivers which are independent of the ground field often have a rather deep explanation; namely, they arise as formal consequences of stability, and so hold for representations over any stable homotopy theory (e.g. arbitrary rings, schemes, dg algebras, or ring spectra). I will present here a systematic study of representations of quivers over arbitrary stable infinity categories, including vast generalisations of such results.

Joint work with Jan Stovicek.

**Thursday 16****12:00-12:20****[Room 0.20]****Jueves 16****12:00-12:20****[Aula 0.20]****Osteguna 16****12:00-12:20****[Gela 0.20]*****Introduction to global algebraic K-theory*****Gabriel Martínez de Cestafe Pumares**

(Universitat Autònoma de Barcelona)

Global algebraic K-theory is a refinement of algebraic K-theory due to Stefan Schwede, where the adjective "global" refers to actions of all finite groups. His construction turns a certain kind of categorical input data into a symmetric ring spectrum. One can then look at the equivariant homotopy groups of this spectrum to recover precise information about the input data. I will explain these ideas in the talk, taking as example the global algebraic K-theory of a commutative ring.

[arXiv:1912.08872](https://arxiv.org/abs/1912.08872)**Thursday 16****12:30-12:50****[Room 0.20]****Jueves 16****12:30-12:50****[Aula 0.20]****Osteguna 16****12:30-12:50****[Gela 0.20]*****(Co)homology for data bases*****Isaac Carcacia Campos**

(Universidade de Santiago de Compostela)

The application of category theory to the study of computation has recently been a very interesting field. In this talk we will use David Spivak's ideas about databases, i.e. a functor from a small category to the category of sets. This work can be enriched when we use the free vector spaces associated to a database. In that case we can apply some (co)homological notions in order to study algebraic obstructions to the solution of some problems.

Joint work with David Mosquera Lois and Enrique Macías Virgós.

**Thursday 16****16:30-16:50****[Room 0.20]****Jueves 16****16:30-16:50****[Aula 0.20]****Osteguna 16****16:30-16:50****[Gela 0.20]*****Real Models of Configuration Categories*****João Candeias**

(Universitat de Barcelona)

We start this presentation by introducing configuration spaces and categories, as well as their Fulton-MacPherson compactifications. We go over the proof of the homotopy equivalence between the category of configurations of a manifold and its Fulton-MacPherson compactification. We review the recent results of Idrissi, providing a real model for the configuration spaces of compact, simply-connected manifolds. We then generalize these results to closed simply-connected parallelizable manifolds.

Joint work with Pedro Boavida.

**Thursday 16****17:00-17:20****[Room 0.20]****Jueves 16****17:00-17:20****[Aula 0.20]****Osteguna 16****17:00-17:20****[Gela 0.20]*****The motivation behind higher sketches*****David Martínez-Carpena**

(Universitat de Barcelona)

Sketches can be considered as one of the many formalizations of the concept of theory, by describing certain logical operations through limits and colimits. In this talk, we explore a homotopy-coherent generalization of sketches in the setting of  $\infty$ -categories. We show that numerous  $\infty$ -categories can be constructed as  $\infty$ -categories of models of limit sketches, including complete Segal spaces,  $\infty$ -operads,  $E_\infty$ -algebras, spectra, and infinite loop spaces.

Joint work with Carles Casacuberta and Javier J. Gutiérrez.

**Thursday 16****17:30-17:50****[Room 0.20]****Jueves 16****17:30-17:50****[Aula 0.20]****Osteguna 16****17:30-17:50****[Gela 0.20]*****Hopf braces and Hopf bracoids*****Brais Ramos Pérez**

(Universidade de Santiago de Compostela)

In this talk we will introduce the notion of Hopf bracoid as the quantum version of skew bracoids in a braided monoidal framework. Taking into account that Hopf braces are examples of Hopf bracoids, many properties that Hopf braces satisfy will be extended for Hopf bracoids. Moreover, it is well known that there exists a categorical equivalence between Hopf braces and invertible 1-cocycles. So, we will also prove that certain subcategories of Hopf bracoids and 1-cocycles are isomorphic.

Joint work with José Manuel Fernández Vilaboa and Ramón González Rodríguez.

[arXiv:2401.02925](https://arxiv.org/abs/2401.02925)**Friday 17****10:00-10:20****[Room 0.20]****Viernes 17****10:00-10:20****[Aula 0.20]****Ostirala 17****10:00-10:20****[Gela 0.20]*****Homotopical operadic calculus in positive characteristic*****Víctor Roca i Lucio**

(Université Paris Cité)

Algebraic operads provide a powerful tool to understand the homotopy theory of the types of (co)algebras they encode. So far, the principal results and methods that this theory provides were only available in characteristic zero. The main reason is that operads carry an action of all the symmetric groups, whose representation theory is involved in positive characteristic. The goal of this talk will be to explain how one can extend these results and methods over a positive characteristic field.

Joint work with Brice Le Grignou.

[arXiv:2310.13095](https://arxiv.org/abs/2310.13095)

Friday 17  
10:30-10:50  
[Room 0.20]

Viernes 17  
10:30-10:50  
[Aula 0.20]

Ostirala 17  
10:30-10:50  
[Gela 0.20]

*bbA<sub>∞</sub>-algebras*

**Anna Sopena-Gilboy**

(Universitat de Barcelona)

In complex manifolds, the algebra of differential forms is equipped with a bigrading, with the differential decomposing as  $d = \partial + \bar{\partial}$ . This structure defines weak equivalences related to  $\partial$  and  $\bar{\partial}$ , sensitive to the complex structure, leading to a stronger notion of formality. This talk introduces tools to understand this homotopical framework, specifically  $bbA_\infty$ -algebras, which act as an analog of  $A_\infty$ -algebras in the bidifferential context.

Joint work with Joana Cirici and Jonas Stelzig.

**MA01*****Numerical Methods for Applied Mathematics.*****Métodos Numéricos para Matemáticas Aplicadas****Organizers****Organizadores****Antolatzaileak****Alejandro Bandera Moreno****Pablo Manuel Berná Larrosa**

(Universidad Loyola Andalucía)

(CUNEF)

**Celia Caballero Cárdenas**

(Universidad de Málaga)

**Description****Descripción****Deskribapena**

*Numerical methods play a crucial role in solving mathematical problems that cannot be tackled analytically. These methods involve approximating solutions using computational techniques. Over the years, advancements in technology have significantly enhanced our ability to handle complex problems numerically. This fact allows us to study more realistic situations.*

*Numerical methods can be applied in a broad variety of fields, like economy, engineering, industry, physical and natural science. Furthermore, they can be applied to different mathematical objects, like differential equations and neural networks, among others.*

Los métodos numéricos desempeñan un papel crucial en la resolución de problemas matemáticos que no pueden abordarse analíticamente. Estos métodos implican aproximar soluciones mediante técnicas computacionales. A lo largo de los años, los avances tecnológicos han mejorado significativamente nuestra capacidad para manejar problemas complejos de manera numérica. Este hecho nos permite estudiar situaciones más realistas.

Los métodos numéricos se aplican en una amplia variedad de campos, como la economía, la ingeniería, la industria, las ciencias físicas y naturales. Además, se pueden aplicar a diferentes objetos matemáticos, como ecuaciones diferenciales y redes neuronales, entre otros.

| MSC Codes | Códigos MSC                        | MSC Kodeak |
|-----------|------------------------------------|------------|
|           | 65-XX<br>(primary)                 |            |
|           | 65Mxx; 65Zxx; 68T07<br>(secondary) |            |

| Slots | Bloques   | Blokeak |
|-------|---|---------|
|       | 1.A (Aula 0.8); 1.B (Aula 0.8); 2.C (Aula 0.15) |         |

| QR Code | Código QR  | QR Kodea |
|---------|--|----------|
|         |  |          |

| Session Schedule   | Horario de la Sesión | Saioaren Ordutegia |
|--|----------------------|--------------------|
| L13   17:30-17:50   0.8<br><i>Data-Driven Reduced-Order Modeling for Multiscale Dynamical Systems Using POD-based techniques</i><br><b>Alejandro Bandera Moreno</b> (Universidad Loyola Andalucía) |                      |                    |
| L13   18:30-18:50   0.8<br><i>On the stiff stochastic models</i><br><b>Ignacio Roldán Bocanegra</b> (Universidad de Sevilla)   |                      |                    |
| M14   15:00-15:20   0.8<br><i>Universality for non-linear convex variational problems</i><br><b>Pablo M. Berná</b> (CUNEF Universidad)   |                      |                    |
| M14   15:30-15:50   0.8<br><i>A mathematical approach to the Grover-Rudolph quantum algorithm</i><br><b>Daniela Falcó-Pomares</b> (Grupo de investigación BISITE)                                  |                      |                    |

M14 | 16:00-16:20 | 0.8

*Stochastic quadrature rules for solving PDEs using Neural Networks*

**Jamie M. Taylor** (CUNEF Universidad)

V17 | 9:00-9:20 | 0.8

*Well-balanced semi-implicit schemes for shallow water models*

**Celia Caballero Cárdenas** (Universidad de Málaga)

V17 | 9:30-9:50 | 0.8

*Evaluation of augmented Riemann solvers applied to the shallow water equations using intrusive POD-based reduced-order models*

**Pablo Solán-Fustero** (University of Zaragoza)

V17 | 10:00-10:20 | 0.8

*POD-based reduced order models for parameter-dependent hyperbolic PDEs: dealing with nonlinearities and well-balancedness*

**Irene Gómez Bueno** (Universidad de Málaga)

V17 | 10:30-10:50 | 0.8

*Avoiding order reduction in evolutionary PDEs with rational and exponential methods.*

**Carlos Arranz Simón** (Universidad de Valladolid)



**Monday 13****17:30-17:50****[Room 0.8]****Lunes 13****17:30-17:50****[Aula 0.8]****Astelehena 13****17:30-17:50****[Gela 0.8]**

***Data-Driven Reduced-Order Modeling for Multiscale Dynamical Systems Using  
POD-based techniques***

**Alejandro Bandera Moreno**

(Universidad Loyola Andalucía)

We present a novel ROM technique based on the POD for dynamical systems with multiple timescales. Our method retains the original model's structure, often lost in traditional POD, while significantly reducing the number of equations and computational time. Using a data-driven analysis, it automatically identifies the optimal structure for the reduced system. Numerical tests on three neural network models with multiple timescales validate the technique's effectiveness.

Joint work with Soledad Fernández García, Macarena Gómez Mármol and Alexandre Vidal.

[doi:10.1016/j.cnsns.2024.107844](https://doi.org/10.1016/j.cnsns.2024.107844)

**Monday 13****18:30-18:50****[Room 0.8]****Lunes 13****18:30-18:50****[Aula 0.8]****Astelehena 13****18:30-18:50****[Gela 0.8]**

***On the stiff stochastic models***

**Ignacio Roldán Bocanegra**

(Universidad de Sevilla)

This work introduces a new second-order stochastic scheme based on the TR-BDF2 method, applied to the numerical analysis of stochastic differential equations. While numerical resolution in deterministic contexts is well-established, stochastic terms capture the inherent randomness in natural processes. We analyze the stability and accuracy of the proposed scheme in stiff stochastic scenarios, validating the theoretical results with numerical tests.

**Tuesday 14****15:00-15:20****[Room 0.8]****Martes 14****15:00-15:20****[Aula 0.8]****Asteartea 14****15:00-15:20****[Gela 0.8]*****Universality for non-linear convex variational problems*****Pablo M. Berná**

(CUNEF Universidad)

In this talk we will introduce a mathematical framework designed to tackle non-linear convex variational problems in reflexive Banach spaces. The approach employs a versatile technique that can handle a broad range of variational problems, including standard ones.

Joint work with Antonio Falcó.

**Tuesday 14****15:30-15:50****[Room 0.8]****Martes 14****15:30-15:50****[Aula 0.8]****Asteartea 14****15:30-15:50****[Gela 0.8]*****A mathematical approach to the Grover-Rudolph quantum algorithm*****Daniela Falcó-Pomares**

(Grupo de investigación BISITE)

This talk explores the mathematical approach around the Grover-Rudolph algorithm, which provides an efficient method to create quantum states representing probability distributions. Grounded in quantum probability theory and operator algebras, it offers a formal basis for understanding quantum algorithm implementations. It bridges theoretical cryptography with practical quantum computing, exploring quantum algorithm advancements.

Joint work with Antonio Falcó and Hermann Mathies.

**Tuesday 14****16:00-16:20****[Room 0.8]****Martes 14****16:00-16:20****[Aula 0.8]****Asteartea 14****16:00-16:20****[Gela 0.8]*****Stochastic quadrature rules for solving PDEs using Neural Networks*****Jamie M. Taylor**

(CUNEF Universidad)

When solving PDEs using Neural Networks, most errors and computational costs arise from the numerical integration of the loss. In this talk, we demonstrate how using fixed integration rules in the Deep Ritz Method lead to disastrous overfitting, whilst biased stochastic integration rules lead to erroneous results. We propose the use of high-order, unbiased, stochastic rules, which provide significant gains in convergence for low-dimensional problems compared to existing techniques.

Joint work with David Pardo.

**Friday 17****9:00-9:20****[Room 0.8]****Viernes 17****9:00-9:20****[Aula 0.8]****Ostirala 17****9:00-9:20****[Gela 0.8]*****Well-balanced semi-implicit schemes for shallow water models*****Celia Caballero Cárdenas**

(Universidad de Málaga)

This work focuses on the design of well balanced semi-implicit schemes for one dimensional shallow water models, such as the two-layer one or shallow water with moments. In order to do so, splitting and relaxation techniques are employed. The proposed methods outperform standard explicit schemes in the low Froude regime, where celerity is larger than fluid velocity, avoiding the need for many iterations on large time intervals.

Joint work with M.J. Castro, C. Chalons, T. Morales de Luna, and M.L. Muñoz-Ruiz.

Friday 17  
9:30-9:50  
[Room 0.8]

Viernes 17  
9:30-9:50  
[Aula 0.8]

Ostirala 17  
9:30-9:50  
[Gela 0.8]

*Evaluation of augmented Riemann solvers applied to the shallow water equations using intrusive POD-based reduced-order models*

**Pablo Solán-Fustero**

(University of Zaragoza)

The numerical resolution of the shallow water equations by means of augmented Roe-based Finite Volume methods involves high computational costs. Intrusive reduced-order models (ROMs) are presented as alternative to speed up computational calculations without compromising the accuracy of the solutions. In this contribution, we study whether the inclusion of numerical corrections in the ROM strategy is necessary to obtain proper solutions or not.

Joint work with José Luis Gracia, Adrián Navas-Montilla, and Pilar García-Navarro.

Friday 17  
10:00-10:20  
[Room 0.8]

Viernes 17  
10:00-10:20  
[Aula 0.8]

Ostirala 17  
10:00-10:20  
[Gela 0.8]

*POD-based reduced order models for parameter-dependent hyperbolic PDEs: dealing with nonlinearities and well-balancedness*

**Irene Gómez Bueno**

(Universidad de Málaga)

This work studies 1D hyperbolic systems of balance laws. These systems have stationary solutions which are important to be preserved. We explore reduced-order models (ROMs) using Proper Orthogonal Decomposition (POD) to reduce computational costs. Our results show that ROMs based on well-balanced full-order models (FOMs) preserve balance. Furthermore, we extend the analysis to parameter-dependent systems to provide accurate approximations for different values of the parameter.

Joint work with Enrique D. Fernandez-Nieto, and Samuele Rubino.

Friday 17  
10:30-10:50  
[Room 0.8]

Viernes 17  
10:30-10:50  
[Aula 0.8]

Ostirala 17  
10:30-10:50  
[Gela 0.8]

*Avoiding order reduction in evolutionary PDEs with rational and exponential methods.*

**Carlos Arranz Simón**  
(Universidad de Valladolid)

It is well known that a Runge-Kutta method of order  $p$  applied to time integrate a initial boundary value problem (IBVP) suffers from the so called order reduction. It occurs that the method exhibits a lower order of convergence which is related to the stage order of the method, rather than to  $p$  itself. New numerical schemes, based on rational and exponential methods, are introduced to avoid order reduction for typical evolutionary PDEs, such as diffusion-reaction equations or advection equation.

From joint works with César Palencia, Begoña Cano and Alexander Ostermann.

[arXiv:2405.04195](https://arxiv.org/abs/2405.04195)

**MA02****Mathematics Applied to Medicine****Matemática Aplicada a la Medicina****Organizers****Organizadores****Antolatzaileak****Ana Niño-López**

(Biomed. R&amp;I Inst. of Cádiz (INiBICA))

**Juan Jiménez-Sánchez**

(Politecnico di Torino)

**Description****Descripción****Deskribapena**

*The use of mathematical tools to study biological problems, especially in medicine, is becoming increasingly common. In this session, which focuses on mathematical oncology, strategies will be presented to address both clinical questions and fundamental problems related to tumor development and other diseases. New techniques for predicting treatment responses will be shown, as well as the analysis of clinical data using topological tools and mechanistic, descriptive, and predictive mathematical models based on differential equations. The aim is to highlight the work of the speakers in applied mathematics and to foster the creation of connections with other attending researchers, enriching current and future work in this field.*

El uso de herramientas matemáticas para estudiar problemas biológicos, especialmente en medicina, es cada vez más habitual. En esta sesión, centrada en la oncología matemática, se presentará la resolución tanto de problemas relacionados con el desarrollo tumoral y otras enfermedades. Se mostrarán nuevas técnicas de predicción de respuesta a tratamientos, análisis de datos clínicos mediante herramientas topológicas, y modelos matemáticos mecanicistas y predictivos basados en ecuaciones diferenciales. El objetivo es destacar el trabajo de los ponentes en matemáticas aplicadas y fomentar la creación de vínculos con otros investigadores, enriqueciendo el trabajo presente y futuro en este campo.

**MSC Codes****Códigos MSC****MSC Kodeak**

92-XX

(primary)

92B05; 92-08; 92-10

(secondary)

**Slots****Bloques****Blokeak**

1.B (Aula 0.20S); 1.C (Aula 0.20S)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

- M14 | 15:30-15:50 | 0.20S

*UMAP Dimensionality Reduction as a Bone Marrow Analysis Technique*

**Ana Niño-López** (Universidad de Cádiz)
- M14 | 16:30-16:50 | 0.20S

*Mathematical Model of CAR-T Cell Therapy for a B-cell Lymphoma Lymph Node*

**Soukaina Sabir** (MOLAB, Universidad de Castilla-La Mancha)
- M14 | 17:30-17:50 | 0.20S

*Proliferation-Immuno-Evasion Trade-Off: A Continuous Model for Tumor-Immune Dynamics and Therapeutic Strategies*

**Giulia Chiari** (BCAM)
- M14 | 18:00-18:20 | 0.20S

*Modelling brain tumour growth including phenotypic heterogeneity: A non-local reaction-diffusion framework*

**Francesca Ballatore** (Politecnico di Torino)
- M14 | 19:00-19:20 | 0.20S

*Mathematical Modeling of Fibrous Dysplasia: Bone Cell Dynamics*

**Mariia Soloviova** (MOLAB, Universidad de Castilla-La Mancha)

**Tuesday 14**  
**15:30-15:50**  
**[Room 0.20S]**

**Martes 14**  
**15:30-15:50**  
**[Aula 0.20S]**

**Asteartea 14**  
**15:30-15:50**  
**[Gela 0.20S]**

***UMAP Dimensionality Reduction as a Bone Marrow Analysis Technique***

**Ana Niño-López**

(Universidad de Cádiz)

Pediatric Acute Lymphoblastic Leukemia treatment fails in 15-20% of cases. This study focuses on improving relapse risk detection using bone marrow flow cytometry data. By applying machine learning techniques, we aim to develop algorithms to identify patterns that differentiate between patients who relapse and those who do not, from a mathematical perspective. This approach enhances diagnosis, monitoring, and treatment decisions, offering a more precise method for assessing patient outcomes.

Joint work with Álvaro Martínez-Rubio, Salvador Chulián, Rocío Picón-González, and María Rosa.

**Tuesday 14**  
**16:30-16:50**  
**[Room 0.20S]**

**Martes 14**  
**16:30-16:50**  
**[Aula 0.20S]**

**Asteartea 14**  
**16:30-16:50**  
**[Gela 0.20S]**

***Mathematical Model of CAR-T Cell Therapy for a B-cell Lymphoma Lymph Node***

**Soukaina Sabir**

(MOLAB, Universidad de Castilla-La Mancha)

CAR-T cell therapies have demonstrated efficacy in treating B-cell leukemia but face limitations in B-cell lymphomas due to solid tumors within lymph nodes, impeding therapeutic access. This study presents a mathematical model investigating CAR-T cell interactions with diffuse large B-cell lymphoma in lymph nodes, identifying potential causes of treatment failure, exploring tumor-induced immunosuppression, and highlighting the role of product characteristics in enhancing therapeutic outcomes.

Sergio Serrano, Roberto Barrio, Victor M. Perez-Garcia.

[arXiv:2409.01164](https://arxiv.org/abs/2409.01164)



**Tuesday 14****17:30-17:50****[Room 0.20S]****Martes 14****17:30-17:50****[Aula 0.20S]****Asteartea 14****17:30-17:50****[Gela 0.20S]**

***Proliferation-Immuno-Evasion Trade-Off: A Continuous Model for Tumor-Immune Dynamics and Therapeutic Strategies***

**Giulia Chiari**

(BCAM)

We propose a continuous PDE model to study the interaction between tumor mass and T cells. Immune cells are attracted to tumor cells, seeking to eliminate them. Highly proliferative cancer cells are more visible and easier to target, while low proliferative cells may achieve immuno-invisibility and resistance. This model investigates how this trade-off influences T cell infiltration, providing insights into various tumor-immune dynamics and informing therapeutic strategies.

Joint work with J.A. Carrillo, and M. E. Delitala.

**Tuesday 14****18:00-18:20****[Room 0.20S]****Martes 14****18:00-18:20****[Aula 0.20S]****Asteartea 14****18:00-18:20****[Gela 0.20S]**

***Modelling brain tumour growth including phenotypic heterogeneity: A non-local reaction-diffusion framework***

**Francesca Ballatore**

(Politecnico di Torino)

In this work, we introduce a reaction-diffusion model with non-local terms to capture tumour growth dynamics, incorporating phenotypic heterogeneity. The model includes oxygen dynamics and spatial anisotropy through diffusion tensors. Numerical simulations reveal complex travelling-wave solutions with distinct phenotypic dominance. Additionally, 3D simulations explore tumour evolution in brain geometry reconstructed from patient-specific MRI and DTI data.

Joint work with Chiara Giverso, and Tommaso Lorenzi.

**Tuesday 14**  
**19:00-19:20**  
**[Room 0.20S]**

**Martes 14**  
**19:00-19:20**  
**[Aula 0.20S]**

**Asteartea 14**  
**19:00-19:20**  
**[Gela 0.20S]**

***Mathematical Modeling of Fibrous Dysplasia: Bone Cell Dynamics***

**Mariia Soloviova**

(MOLAB, Universidad de Castilla-La Mancha)

Fibrous dysplasia (FD) is a rare genetic disorder of the skeleton, characterized by the replacement of normal bone with fibrous tissue. In this study, we introduce a simplified mathematical model that captures the remodeling dynamics of bone affected by FD. Our model tracks the time-dependent interactions between different populations of bone cells. The model highlights the critical role of the parameter controlling the flow of osteoprogenitor cells derived from mutant skeletal stem cells.

Joint work with Magdalena Caballero, Luis Fernandez de Castro, Juan Belmonte-Beitia, Víctor M. Pérez-García, and Juan C. Beltrán-Vargas.

[doi:10.1007/s11538-024-01336-7](https://doi.org/10.1007/s11538-024-01336-7)

**MA03*****Nonlinear Dynamics and Applications*****Dinámica No Lineal y Aplicaciones****Organizers****Organizadores****Antolatzaileak****Juan Garcia Fuentes**

(Universidad de Sevilla)

**Eduardo Muñoz Hernandez**

(Universidad Complutense de Madrid)

**Ainoa Murillo López**

(Universitat de Barcelona)

**Description****Descripción****Deskribapena**

*One of the branches of mathematics grounded in the modeling natural processes is dynamical systems, through the study of differential equations. Furthermore, to more realistically characterize certain evolutions of the phenomena we aim to model, it is logical to lean towards models that describe a nonlinear dynamic.*

*The following session consists of researchers who aim to work with nonlinear models, which can be applied to study natural processes such as the movement of celestial bodies, the spread of pandemics or the evolution of species populations.*

Una de las ramas de las matemáticas que se basa en la modelización de los procesos naturales es la de los sistemas dinámicos, mediante el estudio de las ecuaciones diferenciales. Además, para caracterizar de forma más realista ciertas evoluciones de dichos fenómenos es lógico inclinarse por modelos que describan una dinámica no lineal.

La siguiente sesión está formada por investigadores que trabajan con modelos no lineales que pueden aplicarse al estudio de procesos naturales como el movimiento de los cuerpos celestes, la propagación de pandemias o la evolución de las poblaciones de especies.

**MSC Codes****Códigos MSC****MSC Kodeak**

37J46

(primary)

37N05; 37D05; 37J20

(secondary)

**Slots****Bloques****Blokeak**

2.A (Aula 0.20S); 2.B (Aula 0.20S)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

J16 | 11:00-11:20 | 0.20S

*Mean Motion Resonance in Saturn's Moons***Óscar Rodríguez** (Universitat Politècnica de Catalunya)

J16 | 11:30-11:50 | 0.20S

*Bifurcation and resonance analysis in a Celestial Mechanics model***Begoña Nicolás** (Universidade de Santiago de Compostela)

J16 | 12:00-12:20 | 0.20S

*Billiards with Keplerian potential: refractive and reflective case***Irene De Blasi** (University of Turin)

J16 | 12:30-12:50 | 0.20S

*Invariant tori in Hamiltonian systems***Álvaro Fernández-Mora** (Universitat de Barcelona)

J16 | 16:30-16:50 | 0.20S

*Unfolding dynamics from a coupling of two FitzHugh-Nagumo systems***Diego Noriega Rodríguez** (Universidad de Oviedo)

J16 | 17:00-17:20 | 0.20S

*An overview of connecting trajectories in the Earth-Moon Spatial Restricted Three-Body Problem***Miquel Barcelona** (Universitat Autònoma de Barcelona)

J16 | 17:30-17:50 | 0.20S

*Advances in the study of the Hide-Skeldon-Acheson system***Érika Diz Pita** (Universidade de Santiago de Compostela)

J16 | 18:00-18:20 | 0.20S

*Periodic solutions to superlinear indefinite planar systems: A topological degree approach*

**Juan Carlos Sampedro Pascual** (Universidad Politécnica de Madrid)

**Thursday 16****11:00-11:20****[Room 0.20S]****Jueves 16****11:00-11:20****[Aula 0.20S]****Osteguna 16****11:00-11:20****[Gela 0.20S]*****Mean Motion Resonance in Saturn's Moons*****Óscar Rodríguez**

(Universitat Politècnica de Catalunya)

The interaction between Hyperion and Titan illustrates a 3:4 mean motion resonance. Titan, Saturn's largest moon, exerts significant gravitational influence, while Hyperion is smaller and orbits farther out. This system is well-suited for modeling via the Restricted Three-Body Problem (RTBP). We will discuss how to integrate JPL data into our model to compute periodic and quasi-periodic orbits, using Poincaré sections to analyze invariant tori and their stability.

**Thursday 16****11:30-11:50****[Room 0.20S]****Jueves 16****11:30-11:50****[Aula 0.20S]****Osteguna 16****11:30-11:50****[Gela 0.20S]*****Bifurcation and resonance analysis in a Celestial Mechanics model*****Begoña Nicolás**

(Universidade de Santiago de Compostela)

In this work we analyse a Hamiltonian system of two and a half degrees of freedom corresponding to a Restricted Three-Body Problem (RTBP) under a time-periodic perturbation that depends on two parameters. Hence, the dynamical equivalents of the Lagrangian points in this model go through different bifurcations and resonances as the parameters vary. Their analysis will help us to understand the conditions needed for the presence of stability regions in the vicinity of the triangular points.

Joint work with Joan Gimeno, Àngel Jorba and Marc Jorba-Cuscó.

**Thursday 16****12:00-12:20****[Room 0.20S]****Jueves 16****12:00-12:20****[Aula 0.20S]****Osteguna 16****12:00-12:20****[Gela 0.20S]*****Billiards with Keplerian potential: refractive and reflective case*****Irene De Blasi**

(University of Turin)

A new type of billiard system, of interest for Celestial Mechanics, is taken into consideration: here, a closed refraction interface separates two regions in which different potentials (harmonic and Keplerian) act. This model, which can be studied both in two and three dimensions, presents strong analogies with the more studied Kepler billiard, where a Keplerian inner potential is associated with a reflecting wall.

Joint work with Vivina Barutello, and Susanna Terracini.

[arXiv:2105.02108](#)[arXiv:2108.11159](#)[arXiv:2212.01150](#)[arXiv:2312.01312](#)**Thursday 16****12:30-12:50****[Room 0.20S]****Jueves 16****12:30-12:50****[Aula 0.20S]****Osteguna 16****12:30-12:50****[Gela 0.20S]*****Invariant tori in Hamiltonian systems*****Álvaro Fernández-Mora**

(Universitat de Barcelona)

We are concerned with the existence and computation of invariant tori in Hamiltonian systems. In particular, under the parameterization method, we focus on KAM schemes for invariant tori and their invariant manifolds. Such schemes can be both used for numerical implementations and to obtain the necessary theorems for existence. We will cover both aspects in this synergy between computation and rigor.

Joint work with Alex Haro, Rafael de la LLave, and Josep-María Mondelo.

[arXiv:2212.00412](#)

**Thursday 16****16:30-16:50****[Room 0.20S]****Jueves 16****16:30-16:50****[Aula 0.20S]****Osteguna 16****16:30-16:50****[Gela 0.20S]*****Unfolding dynamics from a coupling of two FitzHugh-Nagumo systems*****Diego Noriega Rodríguez**

(Universidad de Oviedo)

The FitzHugh-Nagumo oscillator is a well-known 2-dimensional system displaying a Hopf bifurcation. We explore the dynamics unfolded from the linear coupling of two identical FitzHugh-Nagumo systems on both of its variables; among others, we expect to observe a Hopf-Hopf bifurcation on the global system. We will look for non-resonance and find all possible cases in the system, paying special attention to one of them whose phase portrait theoretically contains 3-toroidal repelling orbits.

Joint work with Fátima Drubi Vega, and Santiago Ibáñez Mesa.

**Thursday 16****17:00-17:20****[Room 0.20S]****Jueves 16****17:00-17:20****[Aula 0.20S]****Osteguna 16****17:00-17:20****[Gela 0.20S]*****An overview of connecting trajectories in the Earth-Moon Spatial Restricted******Three-Body Problem*****Miquel Barcelona**

(Universitat Autònoma de Barcelona)

Heteroclinic and homoclinic connections in the spatial circular restricted three-body problem play a key role in astrodynamics by providing zero-propellant transfers. This work presents results on the numerical computation of these connections between the libration points  $L_1$  and  $L_2$  in the Earth-Moon system, including their geometrical structure and potential applications in mission design.

Joint work with Alex Haro and Josep-Maria Mondelo.

[arXiv:2301.08526](https://arxiv.org/abs/2301.08526)



**Thursday 16****17:30-17:50****[Room 0.20S]****Jueves 16****17:30-17:50****[Aula 0.20S]****Osteguna 16****17:30-17:50****[Gela 0.20S]*****Advances in the study of the Hide-Skeldon-Acheson system*****Érika Diz Pita**

(Universidade de Santiago de Compostela)

This presentation focuses on the Hide, Skeldon and Acheson dynamical system, which models a self-excited dynamo. We provide by first time its invariant algebraic surfaces, first integrals and Darboux invariants. To show the importance and usefulness of these results, we will illustrate how they allow us to study the global dynamics with some examples, one with a first integral and another with a Darboux invariant.

Joint work with Jaume Libra, M. Victoria Otero-Espinar and Claudia Valls.

**Thursday 16****18:00-18:20****[Room 0.20S]****Jueves 16****18:00-18:20****[Aula 0.20S]****Osteguna 16****18:00-18:20****[Gela 0.20S]*****Periodic solutions to superlinear indefinite planar systems: A topological degree approach*****Juan Carlos Sampredo Pascual**

(Universidad Politécnica de Madrid)

In this talk, we deal with a general type of superlinear indefinite planar differential systems. Based on the coincidence degree theory, we prove the existence of positive T-periodic solutions. Our results generalise and unify previous contributions about Butler's problem on positive periodic solutions for second-order differential equations (involving linear or  $\phi$ -Laplacian-type differential operators).

Joint work with Guglielmo Feltrin and Fabio Lanolin.

[doi:10.1016/j.jde.2023.03.042](https://doi.org/10.1016/j.jde.2023.03.042)

**MA04*****Dynamical Systems: Theory and Applications*****Sistemas Dinámicos: Teoría y Aplicaciones****Organizers****Organizadores****Antolatzaileak****Érika Diz Pita**

(Universidad de Santiago de Compostela)

**Lucía Pérez Pérez**

(Universidad de Oviedo)

**Salvador Borrós Cullell**

(Universitat Autònoma de Barcelona)

**Sebastián Buedo Fernández**

(Universidad De Santiago de Compostela)

**Description****Descripción****Deskribapena**

*This session will focus on the study of different aspects of dynamical systems, both in their discrete and continuous aspects, and from both a theoretical and applied point of view.*

*The topics covered will include global stability, attractors, chaos, bifurcations, classification problems and modeling of natural phenomena.*

*The session will provide a broad meeting environment for researchers in this area of mathematics, together with the related parallel session MA03 Nonlinear Dynamics and Applications.*

Esta sesión tratará sobre el estudio de diferentes aspectos de los sistemas dinámicos, tanto en su vertiente discreta como continua, y tanto desde un punto de vista teórico como aplicado.

Entre las temáticas que se tratarán se incluyen cuestiones sobre estabilidad global, atractores, caos, bifurcaciones, problemas de clasificación y modelización de fenómenos naturales.

La sesión proporcionará un entorno amplio de encuentro a investigadores/as de esta área de las matemáticas, junto con la sesión paralela afín MA03 Dinámica no lineal y aplicaciones.

**MSC Codes****Códigos MSC****MSC Kodeak**

37-XX

(primary)

**Slots****Bloques****Blokeak**

1.A (Aula 0.27); 1.B (Aula 0.27); 1.C (Aula 0.27)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

L13 | 17:30-17:50 | 0.27

*A handy Jacobian criterion for uniqueness of solution to systems of equations***Daniel Cao Labora** (Universidade de Santiago de Compostela)

L13 | 18:00-18:20 | 0.27

*Dynamics around a normally elliptic invariant curve in a 3D volume-preserving map***Ainoa Murillo López** (Universitat de Barcelona)

L13 | 18:30-18:50 | 0.27

*Study of maximal attractors of parabolic problems***Juan García Fuentes** (Universidad de Sevilla)

L13 | 19:00-19:20 | 0.27

*Unfolding of a unipotent fixed point***Paula Álvarez** (Universidad de Oviedo)

M14 | 15:30-15:50 | 0.27

*Nonautonomous saddle-node bifurcations in  $d$ -concave in measure equations with applications***Jesús Dueñas** (Universidad de Valladolid)

M14 | 16:00-16:20 | 0.27

*Conley-Zehnder index for the search of periodic solutions in planar Hamiltonian systems***Eduardo Muñoz Hernández** (Universidad Complutense de Madrid)

M14 | 16:30-16:50 | 0.27

*A taste of transcendental dynamics: boundaries of Fatou components***Anna Jové** (Universitat de Barcelona)

M14 | 17:30-17:50 | 0.27

*Dynamics of the Takagi function*

**Jesús Llorente** (Universidad Politécnica de Madrid)

M14 | 18:00-18:20 | 0.27

*Mean-Field Models of Neural Populations: The Role of Synaptic Dynamics*

**Ana Mayora-Cebollero** (Universidad de Zaragoza)

M14 | 18:30-18:50 | 0.27

*Looking into the asymptotic behaviour of non-smooth maps arising in populations models subject to combinations of constant catch and threshold harvesting strategies*

**Cristina Lois-Prados** (Universidade de Santiago de Compostela)

M14 | 19:00-19:20 | 0.27

*Chaoticity Analysis with Deep Learning: Theoretical and Real Data*

**Carmen Mayora-Cebollero** (Universidad de Zaragoza)

**Monday 13****17:30-17:50****[Room 0.27]****Lunes 13****17:30-17:50****[Aula 0.27]****Astelehena 13****17:30-17:50****[Gela 0.27]*****A handy Jacobian criterion for uniqueness of solution to systems of equations*****Daniel Cao Labora**

(Universidade de Santiago de Compostela)

We know that a real function defined on  $[a, b]$  such that  $f(a)f(b) < 0$  and whose derivative never vanishes has exactly one zero in  $[a, b]$ . Nevertheless, it is less known that similar results hold for higher dimensions. In this talk we will expose a new result in this direction, based on a combination of the Poincaré-Miranda theorem and a mix of some old and new arguments for the injectivity issue. Finally, we will apply the criterion to an example and we will discuss some applications.

Joint work with Sebastián Buedo Fernández.

**Monday 13****18:00-18:20****[Room 0.27]****Lunes 13****18:00-18:20****[Aula 0.27]****Astelehena 13****18:00-18:20****[Gela 0.27]*****Dynamics around a normally elliptic invariant curve in a 3D volume-preserving map*****Ainoa Murillo López**

(Universitat de Barcelona)

We investigate the dynamics near a normally elliptic invariant curve in a 3D volume-preserving map, reducing the map to a resonant Birkhoff normal form around the curve. This depends on the set of resonances between the tangent and normal frequencies to the curve. Single-resonances may destroy the curve, eventually leading to a chain of stability bubbles. When the elliptic curve persists, the normal dynamics become reducible, allowing the classification of 3D resonant structures around it.

Joint work with Arturo Vieiro.

Monday 13  
18:30-18:50  
[Room 0.27]

Lunes 13  
18:30-18:50  
[Aula 0.27]

Astelehena 13  
18:30-18:50  
[Gela 0.27]

*Study of maximal attractors of parabolic problems*

**Juan García Fuentes**

(Universidad de Sevilla)

Dissipative semigroups produce structures that are invariants and attracts every trajectory of the phase space, well known as global attractors, that are bounded. We are going to introduce the concept of an attractor that it is unbounded, the maximal attractor, and study their existence and properties, such as characterize it. Finally, we apply our result to a parabolic semilinear PDE, where the nonlinearity can be unbounded, as long as it grows linearly with a controlled growth constant.

Joint work with Matheus Bortolan, Juliana Fernandes and Piotr Kalita.

Monday 13  
19:00-19:20  
[Room 0.27]

Lunes 13  
19:00-19:20  
[Aula 0.27]

Astelehena 13  
19:00-19:20  
[Gela 0.27]

*Unfolding of a unipotent fixed point*

**Paula Álvarez**

(Universidad de Oviedo)

In this talk, we explore a two-parameter family of 3D diffeomorphisms related to a generic unfolding of a unipotent fixed point. We begin presenting a parameter subset with an interesting dynamical behaviour consisting of two saddle-focus fixed points with different unstable indices. After that, we examine the distances between the one-dimensional manifolds and explain how these dynamics may give rise to Tatjer's homoclinic tangencies.

**Tuesday 14**  
**15:30-15:50**  
**[Room 0.27]**

**Martes 14**  
**15:30-15:50**  
**[Aula 0.27]**

**Asteartea 14**  
**15:30-15:50**  
**[Gela 0.27]**

***Nonautonomous saddle-node bifurcations in  $d$ -concave in measure equations with applications***

**Jesús Dueñas**

(Universidad de Valladolid)

Nonautonomous saddle-node bifurcations have often been studied under the condition of concavity of the flow; in previous works, we explored them under  $d$ -concavity properties. This talk weakens that condition, identifying such bifurcations in equations with  $d$ -concavity properties in measure. The new framework allows equation coefficients to vary within large chaotic sets, in some way approaching a stochastic formulation. Applications in circuit theory and critical transitions are also presented.

Joint work with Carmen Núñez and Rafael Obaya.

[arXiv:2407.15515](https://arxiv.org/abs/2407.15515)

**Tuesday 14**  
**16:00-16:20**  
**[Room 0.27]**

**Martes 14**  
**16:00-16:20**  
**[Aula 0.27]**

**Asteartea 14**  
**16:00-16:20**  
**[Gela 0.27]**

***Conley-Zehnder index for the search of periodic solutions in planar Hamiltonian systems***

**Eduardo Muñoz Hernández**

(Universidad Complutense de Madrid)

In this talk, we will start characterizing the Conley-Zehnder index in terms of the winding number of a linear planar periodic Hamiltonian system. This will allow us to apply the Poincaré-Birkhoff theorem in order to prove existence and multiplicity of periodic solutions in general nonlinear and nonautonomous Hamiltonian systems. Finally, some applications will be provided.

Joint work with Alberto Boscaggin.

[arXiv:2203.02998](https://arxiv.org/abs/2203.02998)

**Tuesday 14**  
**16:30-16:50**  
**[Room 0.27]**

**Martes 14**  
**16:30-16:50**  
**[Aula 0.27]**

**Asteartea 14**  
**16:30-16:50**  
**[Gela 0.27]**

*A taste of transcendental dynamics: boundaries of Fatou components*

**Anna Jové**

(Universitat de Barcelona)

This talk is meant to be a friendly introduction to complex dynamics, starting from the iteration of  $z^2$ , and providing the definition of the basic concepts in the field: the Fatou set (stability) and the Julia set (chaos). The goal is to describe the dynamics on the boundaries of Fatou components (connected components of the Fatou set), from a measure-theoretical, symbolic and qualitative point of view, in the case when the iterated function is a transcendental entire function.

Joint work with Núria Fagella.

**Tuesday 14**  
**17:30-17:50**  
**[Room 0.27]**

**Martes 14**  
**17:30-17:50**  
**[Aula 0.27]**

**Asteartea 14**  
**17:30-17:50**  
**[Gela 0.27]**

*Dynamics of the Takagi function*

**Jesús Llorente**

(Universidad Politécnica de Madrid)

The Takagi function is a classical example of a continuous nowhere differentiable function. It is defined as

$$T(x) = \sum_{n=0}^{\infty} \frac{\phi(2^n x)}{2^n}, \quad x \in [0, 1]$$

where  $\phi(x)$  denotes the distance from the point  $x$  to the nearest integer. In this talk, we will study the discrete dynamical system generated by the Takagi function, namely

$$x_{n+1} = T(x_n), \quad x_0 \in [0, 1].$$

Joint work with Zoltán Buczolich.



**Tuesday 14**  
**18:00-18:20**  
**[Room 0.27]**

**Martes 14**  
**18:00-18:20**  
**[Aula 0.27]**

**Asteartea 14**  
**18:00-18:20**  
**[Gela 0.27]**

***Mean-Field Models of Neural Populations: The Role of Synaptic Dynamics***

**Ana Mayora-Cebollero**

(Universidad de Zaragoza)

The study of neural populations is of increasing interest. In the literature, there are two mean-field models representing the dynamics of heterogeneous all-to-all networks of QIF neurons with and without synaptic dynamics. In this presentation, we study the different dynamical changes observed when a parameter (linking both models and related with the synapsis) is varied, and we analyze the bifurcations underlying these changes.

Joint work with R. Barrio, J.A. Jover-Galtier, C. Mayora-Cebollero, S. Serrano and L. Pérez.

[doi:10.1103/PhysRevE.109.014301](https://doi.org/10.1103/PhysRevE.109.014301)

**Tuesday 14**  
**18:30-18:50**  
**[Room 0.27]**

**Martes 14**  
**18:30-18:50**  
**[Aula 0.27]**

**Asteartea 14**  
**18:30-18:50**  
**[Gela 0.27]**

***Looking into the asymptotic behaviour of non-smooth maps arising in populations models subject to combinations of constant catch and threshold harvesting strategies***

**Cristina Lois-Prados**

(Universidade de Santiago de Compostela)

In the studies developed with E. Liz and F. M. Hilker, we considered discrete 1D population models subject to control rules that combine constant quota and threshold harvesting. These combination lead in a natural way to piecewise-smooth maps whose dynamics are challenging because multiple non-smooth bifurcations may appear. The main aim of this talk is to show how we have procced to determine the asymptotic dynamics of the models by studying the “geometry” of the associated non-smooth maps.

Joint work with E. Liz and F. M. Hilker.

**Tuesday 14****19:00-19:20****[Room 0.27]****Martes 14****19:00-19:20****[Aula 0.27]****Asteartea 14****19:00-19:20****[Gela 0.27]*****Chaoticity Analysis with Deep Learning: Theoretical and Real Data*****Carmen Mayora-Cebollero**

(Universidad de Zaragoza)

The chaoticity analysis of a dynamical system is usually performed with classical techniques as Lyapunov Exponents. Recently, Deep Learning (DL) has also been used to obtain such analysis. However, when working with real data, classical and DL techniques have drawbacks. In this presentation, we show how DL can be used to obtain the chaoticity analysis of theoretical data (3D analysis of Lorenz system), and we propose a DL chaoticity algorithm for the analysis of real data (frog heart dynamics).

Joint work with R. Barrio, F.H. Fenton, Á. Lozano, A. Mayora-Cebollero, A. Miguel, A. Ortega, S. Serrano and R. Vígara.

[doi:10.1063/5.0143876](https://doi.org/10.1063/5.0143876)

**MA05*****Partial Differential Equations V:  
Fluid Dynamics and Control Theory*****Ecuaciones en Derivadas Parciales V:  
Dinámica de Fluidos y Teoría de Control****Organizers****Organizadores****Antolatzaileak****Jon Asier Bárcena Petisco**

(UPV/EHU)

**Arnab Roy**

(BCAM)

**Irene Marín Gayte**

(Universidad Loyola)

**Description****Descripción****Deskribapena**

*The purpose of this parallel session is to examine recent trends in the mathematical analysis and control of fluid dynamics. Developing efficient control systems and comprehending the complex behavior of fluids are essential for process optimization and problem-solving in real-world scenarios. A wide range of subjects will be covered at the parallel session, such as novel control strategies, modeling of complex fluid flows, numerical approaches to fluid dynamics problems, and theoretical advances in PDE analysis.*

El objetivo de esta sesión paralela es examinar las tendencias recientes en el análisis matemático y el control de la dinámica de fluidos. El desarrollo de sistemas de control eficaces y la comprensión del complejo comportamiento de los fluidos son esenciales para la optimización de procesos y la resolución de problemas en escenarios del mundo real. En la sesión paralela se tratará una amplia gama de temas, como estrategias de control novedosas, modelización de flujos de fluidos complejos, enfoques numéricos de los problemas de dinámica de fluidos y avances teóricos en el análisis de EDP.

**MSC Codes****Códigos MSC****MSC Kodeak**

35Q35; 93C15; 93C20

(primary)

**Slots****Bloques****Blokeak**

2.A (Aula 0.27); 2.B (Aula 0.27); 2.C (Aula 0.27)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

J16 | 11:00-11:20 | 0.27

*The effect of a large cloud of rigid particles on the motion of an incompressible fluid***Arnab Roy** (BCAM)

J16 | 11:30-11:50 | 0.27

*Dirichlet boundary control problem for lake eutrophication***Éloïse Comte** (French National Research Institute for Agriculture, Food and Environment)

J16 | 12:00-12:20 | 0.27

*Existence of undercompressive travelling waves of a non-local generalised Korteweg-de Vries-Burgers equation***Xuban Diez Izagirre** (UPV/EHU)

J16 | 12:30-12:50 | 0.27

*Modeling the Aortic Valve: A Fluid-Structure Interaction Approach Using Navier-Stokes Equations***Irene Marín-Gayte** (Universidad Loyola Andalucía)

J16 | 16:30-16:50 | 0.27

*A priori estimates for the 2D one-phase Muskat problem with contact points***Edoardo Bocchi** (Politecnico di Milano)

J16 | 17:00-17:20 | 0.27

*Time-periodic solutions for fluids and elastic structures***Claudiu Mindrila** (BCAM)

J16 | 17:30-17:50 | 0.27

*Polymeric fluid-structure interaction*

**Romeo Mensah** (TU Clausthal)

V17 | 9:00-9:20 | 0.27

*Finite-difference least square method for solving Hamilton-Jacobi equations using neural networks*

**Carlos Esteve Yagüe** (Universidad de Alicante)

V17 | 9:30-9:50 | 0.27

*Remarks on matching measures with ML architectures*

**Domènec Ruiz-Balet** (Imperial College London)

V17 | 10:00-10:20 | 0.27

*Kinetic modeling of social crowds with infectious disease contagion*

**Damián A. Knopoff** (Universidad de Deusto)

**Thursday 16****11:00-11:20****[Room 0.27]****Jueves 16****11:00-11:20****[Aula 0.27]****Osteguna 16****11:00-11:20****[Gela 0.27]***The effect of a large cloud of rigid particles on the motion of an incompressible fluid***Arnab Roy**

(BCAM)

In this talk, we examine multiple bodies moving within a fluid and explore the collective impact of their motion on the fluid dynamics as the bodies simultaneously decrease in size.

**Thursday 16****11:30-11:50****[Room 0.27]****Jueves 16****11:30-11:50****[Aula 0.27]****Osteguna 16****11:30-11:50****[Gela 0.27]***Dirichlet boundary control problem for lake eutrophication***Éloïse Comte**

(French National Research Institute for Agriculture, Food and Environment)

We propose an optimal control problem for the lake eutrophication modeling the dynamics of phosphorus stock and cyanobacteria concentration with coupled non-linear PDE. Our control is only defined on the lake shore leading to a Dirichlet boundary control problem which is generally treated by using a lifting of the control from the boundary into the whole domain. We discuss the originality of the model, detail the shifting of the control and prove the existence of a global solution.

Joint work with Catherine Choquet.

**Thursday 16****12:00-12:20****[Room 0.27]****Jueves 16****12:00-12:20****[Aula 0.27]****Osteguna 16****12:00-12:20****[Gela 0.27]**

***Existence of undercompressive travelling waves of a non-local generalised  
Korteweg-de Vries-Burgers equation***

**Xuban Diez Izagirre**

(UPV/EHU)

Hyperbolic conservation laws are ill-posed in general and a common way to derive uniqueness of weak solutions are the so called regularisations. In this talk we study a non-local diffusive and dispersive regularisations of a hyperbolic conservation law given by a fractional derivative. We will analyse the travelling wave solutions in relation with shock formation and show the existence of undercompressive waves that in the limit of vanishing diffusion and dispersion lead to non-classical shocks.

Joint work with F. Achleitner and C. M. Cuesta.

**Thursday 16****12:30-12:50****[Room 0.27]****Jueves 16****12:30-12:50****[Aula 0.27]****Osteguna 16****12:30-12:50****[Gela 0.27]**

***Modeling the Aortic Valve: A Fluid-Structure Interaction Approach Using  
Navier-Stokes Equations***

**Irene Marín-Gayte**

(Universidad Loyola Andalucía)

In this talk, we will present a mathematical model based on the Navier-Stokes equations applied to simulating blood flow through the aortic valve. We will focus on the fluid-structure interaction (FSI) between the blood and valve leaflets, essential for capturing valve dynamics. Numerical simulations will demonstrate the model's real-world application, providing insights into mechanisms contributing to aortic valve calcification.

Joint work with Inmaculada Gayte Delgado.

**Thursday 16****16:30-16:50****[Room 0.27]****Jueves 16****16:30-16:50****[Aula 0.27]****Osteguna 16****16:30-16:50****[Gela 0.27]**

*A priori estimates for the 2D one-phase Muskat problem with contact points*

**Edoardo Bocchi**

(Politecnico di Milano)

We address the dynamics of a viscous and incompressible free surface fluid in a Hele-Shaw cell or, equivalently, in a 2D bounded region of a porous medium with vertical lateral walls. In order to close a scheme of a priori estimates, following the approach of Guo and Tice for the Stokes problem, we bootstrap from energy-dissipation control of the time derivatives to higher spatial regularity via elliptic estimates. Despite the presence of corners, we avoid weights and restrictions on the angles.

Joint work with Ángel Castro and Francisco Gancedo.

**Thursday 16****17:00-17:20****[Room 0.27]****Jueves 16****17:00-17:20****[Aula 0.27]****Osteguna 16****17:00-17:20****[Gela 0.27]**

*Time-periodic solutions for fluids and elastic structures*

**Claudiu Mindrila**

(BCAM)

We present some existence results for time-periodic weak solutions of systems modelling the interaction of viscous incompressible fluids with elastic structures.



**Thursday 16****17:30-17:50****[Room 0.27]****Jueves 16****17:30-17:50****[Aula 0.27]****Osteguna 16****17:30-17:50****[Gela 0.27]*****Polymeric fluid-structure interaction*****Romeo Mensah**

(TU Clausthal)

We analyse the finitely extensible nonlinear elastic (FENE) dumbbell model of Warner-type for an incompressible polymer fluid (described by the Navier-Stokes-Fokker-Planck equations) interacting with a flexible elastic shell. The latter occupies the flexible boundary of the polymer fluid domain and is modeled by a beam equation coupled through kinematic boundary conditions and the balance of forces. We give a description of the model and discuss the construction of solutions.

**Friday 17****9:00-9:20****[Room 0.27]****Viernes 17****9:00-9:20****[Aula 0.27]****Ostirala 17****9:00-9:20****[Gela 0.27]*****Finite-difference least square method for solving Hamilton-Jacobi equations using neural networks*****Carlos Esteve Yagüe**

(Universidad de Alicante)

I consider the numerical approximation of Hamilton-Jacobi equations by means of a neural network. I will discuss the choice of the loss functional, which should satisfy that any critical point approximates the viscosity solution. I will consider functionals involving a numerical Hamiltonian of Lax-Friedrichs type. Using the numerical diffusion built in the numerical Hamiltonian, we can prove that any critical point solves the associated finite-difference problem and approximates the solution.

Joint work with Richard Tsai and Alex Massucco.

[arXiv:2406.10758](https://arxiv.org/abs/2406.10758)

Friday 17  
9:30-9:50  
[Room 0.27]

Viernes 17  
9:30-9:50  
[Aula 0.27]

Ostirala 17  
9:30-9:50  
[Gela 0.27]

*Rermarks on matching measures with ML architectures*

**Domènec Ruiz-Balet**

(Imperial College London)

In this talk we will speak about matching measures with deep learning architectures a problem that can be casted as a type of control problem for linear and nonlinear continuity equations.

Friday 17  
10:00-10:20  
[Room 0.27]

Viernes 17  
10:00-10:20  
[Aula 0.27]

Ostirala 17  
10:00-10:20  
[Gela 0.27]

*Kinetic modeling of social crowds with infectious disease contagion*

**Damián A. Knopoff**

(Universidad de Deusto)

In this presentation, I will introduce a kinetic model that couples social behavior in crowds with contagion dynamics. The approach is based on the kinetic theory of active particles where the activity represents the psychological state of pedestrians and the state related to a disease (e.g., infected). The activity evolves as the crowd moves and leaves from a closed room. Some case studies are proposed to show the role of activity and how awareness and stress influence the movement and shaping.

Joint work with Juan P. Agnelli, Claudio Armas, Bruno Buffa and Germán Torres.

**OT01****Computational Geometry and Graph Theory****Geometría Computacional y Teoría de Grafos****Organizers****Organizadores****Antolatzaileak****Alberto Espuny Díaz**

(Universität Heidelberg)

**Irene Gil Fernández**

(University of Warwick)

**Irene Parada**

(Universitat Politècnica de Catalunya)

**Description****Descripción****Deskribapena**

*This session will serve to present some of the recent developments in the areas of graph theory and of computational and discrete geometry. These two areas of discrete mathematics are particularly relevant, both historically and in the present. Some of the topics that will be discussed revolve around extremal graph theory, random graphs, geometric graphs, and point proximity structures, such as Voronoi diagrams.*

En esta sesión se presentarán recientes avances en las áreas de teoría de grafos y de geometría discreta y computacional. Estos dos ámbitos de la matemática discreta tienen una particular relevancia y presencia nacional tanto históricamente como en la actualidad. Algunos de los temas que se tratarán incluyen teoría de grafos extremales y aleatorios, grafos geométricos y estructuras de proximidad de puntos, como los diagramas de Voronoi.

**MSC Codes****Códigos MSC****MSC Kodeak**

05Cxx; 52Cxx

(primary)

**Slots****Bloques****Blokeak**

1.A (Aula 1.12); 1.B (Aula 1.12)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

L13 | 17:30-17:50 | 1.12

*The temporal stochastic block model***Sofiya Burova** (Universitat Politècnica de Catalunya & Universitat Pompeu Fabra)

L13 | 18:00-18:20 | 1.12

*Enumeration of unlabelled chordal graphs with bounded tree-width***Jordi Castellví Foguet** (Centre de Recerca Matemàtica)

L13 | 18:30-18:50 | 1.12

*Colour-bias perfect matchings in hypergraphs***Camila Zárate Guerén** (University of Birmingham)

L13 | 19:00-19:20 | 1.12

*Rainbow graph decompositions***Tássio Naia** (Centre de Recerca Matemàtica)

M14 | 15:00-15:20 | 1.12

*Saturated drawings of  $k$ -planar drawings***Fabian Klute** (Universitat Politècnica de Catalunya)

M14 | 15:30-15:50 | 1.12

*Sibson's formula for higher order Voronoi diagrams***Andrea de las Heras Parrilla** (Universitat Politècnica de Catalunya)

M14 | 16:00-16:20 | 1.12

*On the unbounded faces of order- $k$  color VD's***Nicolau Oliver Burwitz** (Università della Svizzera Italiana)

M14 | 16:30-16:50 | 1.12

*Shortest path problems in weighted regions*

**Guillermo Esteban** (Universidad de Alcalá)

**Monday 13**  
**17:30-17:50**  
**[Room 1.12]**

**Lunes 13**  
**17:30-17:50**  
**[Aula 1.12]**

**Astelehena 13**  
**17:30-17:50**  
**[Gela 1.12]**

***The temporal stochastic block model***

**Sofiya Burova**

(Universitat Politècnica de Catalunya & Universitat Pompeu Fabra)

Temporal graphs model time-dependent propagation processes. We study the temporal Stochastic Block Model. Each edge has a unique, randomly chosen timestamp, and connectivity depends on sequences of edges with increasing timestamps. Our goal is to understand the asymptotic behavior of the temporal diameter in the subcritical regime, where the average connections per node are  $c \log n$ , with  $c < 1$ . We analyze longest increasing paths and the size of reachable vertex sets.

Joint work with Guillem Perarnau and Gabor Lugosi.

**Monday 13**  
**18:00-18:20**  
**[Room 1.12]**

**Lunes 13**  
**18:00-18:20**  
**[Aula 1.12]**

**Astelehena 13**  
**18:00-18:20**  
**[Gela 1.12]**

***Enumeration of unlabelled chordal graphs with bounded tree-width***

**Jordi Castellví Foguet**

(Centre de Recerca Matemàtica)

We count unlabelled chordal graphs with tree-width at most  $t$ , which are the graphs that can be obtained from an initial vertex by iteratively adding a new vertex connected to all vertices of an existing clique of size at most  $t$ . In order to do so, we extend Pólya theory and the method of cycle pointing to take into account cycles of cliques.

Joint work with Clément Requilé.

Monday 13  
18:30-18:50  
[Room 1.12]

Lunes 13  
18:30-18:50  
[Aula 1.12]

Astelehena 13  
18:30-18:50  
[Gela 1.12]

*Colour-bias perfect matchings in hypergraphs*

**Camila Zárate Guerén**

(University of Birmingham)

Given a  $k$ -graph  $H$  of size  $n$  with an  $r$ -edge-colouring, we look for a minimum  $l$ -degree condition that guarantees the existence of a colour-bias perfect matching in  $H$ , this is, one that has more than  $n/rk$  edges in one colour. For each  $1 \leq l \leq k$  and  $r \geq 2$ , we determined the minimum  $l$ -degree threshold that forces a perfect matching of significant colour-bias in an  $r$ -coloured  $k$ -graph.

The presented result is joint work with J. Balogh and A. Treglown, and with H. Hàn, R. Lang, J. P. Marciano, M. Pavez-Signé, N. Sanhueza-Matamala and A. Treglown.

[arXiv:2401.17073](#)

[arXiv:2408.11016](#)

Monday 13  
19:00-19:20  
[Room 1.12]

Lunes 13  
19:00-19:20  
[Aula 1.12]

Astelehena 13  
19:00-19:20  
[Gela 1.12]

*Rainbow graph decompositions*

**Tássio Naia**

(Centre de Recerca Matemàtica)

A subgraph  $H$  of an edge-coloured graph  $G$  is rainbow if no two edges of  $H$  have the same colour. In this talk we will present a few advances towards decomposing edge-coloured random graphs into small collections of rainbow subgraphs, in a variety of scenarios.

This is joint work with Antônio Kaique, Guilherme Mota, and Walner Mendonça, and with Lyuben Lichev, Jaehoon Kim and Marc Noy.

**Tuesday 14**  
**15:00-15:20**  
**[Room 1.12]**

**Martes 14**  
**15:00-15:20**  
**[Aula 1.12]**

**Asteartea 14**  
**15:00-15:20**  
**[Gela 1.12]**

***Saturated drawings of  $k$ -planar drawings***

**Fabian Klute**

(Universitat Politècnica de Catalunya)

Given a class  $C$  of drawings of (multi-)graphs in the plane, we say that a particular drawing in  $C$  is saturated when the addition of any edge to it results in a drawing not included in  $C$ . In this talk I will focus on  $k$ -planar drawings, in which each edge is crossed at most  $k$  times. In my talk I will introduce a generic framework to determine tight bounds on the minimum number of edges among all  $n$ -vertex saturated  $k$ -planar drawings in many natural classes of graph drawings.

Joint work with Steven Chaplick, Irene Parada, Jonathan Rollin, and Torsten Ueckerdt.

[arXiv:2012.08631](https://arxiv.org/abs/2012.08631)

**Tuesday 14**  
**15:30-15:50**  
**[Room 1.12]**

**Martes 14**  
**15:30-15:50**  
**[Aula 1.12]**

**Asteartea 14**  
**15:30-15:50**  
**[Gela 1.12]**

***Sibson's formula for higher order Voronoi diagrams***

**Andrea de las Heras Parrilla**

(Universitat Politècnica de Catalunya)

Let  $S$  be a point set in general position in  $\mathbb{R}^d$ . The order- $k$  Voronoi diagram of  $S$ ,  $V_k(S)$ , is a subdivision of  $\mathbb{R}^d$  into cells whose points have the same  $k$  nearest points of  $S$ . Sibson's formula expresses a point  $Q$  of  $S$  as a convex combination of other points of  $S$  using ratios of volumes of the intersection of cells of  $V_2(S)$  and the cell of  $Q$  in  $V_1(S)$ . We generalize this result to express  $Q$  as a convex combination of other points of  $S$  using ratios of volumes from Voronoi diagrams of any given order.

Collaborators: Mercè Claverol, Clemens Huemer y Dolores Lara.

[arXiv:2404.17422](https://arxiv.org/abs/2404.17422)



**Tuesday 14**  
**16:00-16:20**  
**[Room 1.12]**

**Martes 14**  
**16:00-16:20**  
**[Aula 1.12]**

**Asteartea 14**  
**16:00-16:20**  
**[Gela 1.12]**

*On the unbounded faces of order- $k$  color VD's*

**Nicolau Oliver Burwitz**

(Università della Svizzera Italiana)

In abstract Voronoi diagrams of order  $\leq k$ , the number of unbounded faces ranges from  $k(k+1)$  to  $k(2n-k-1)$ . This result is shown via a permutation framework that maps unbounded faces to permutations of sites and unbounded edges to switches between adjacent elements in these permutations. This combinatorial approach has further applications in Computational Geometry. Our ongoing work extends the framework by exploring colorings of permutation elements, with the goal of deriving tight inequalities.

Joint work with Evanthia Papadopoulou and Sang Won Bae.

**Tuesday 14**  
**16:30-16:50**  
**[Room 1.12]**

**Martes 14**  
**16:30-16:50**  
**[Aula 1.12]**

**Asteartea 14**  
**16:30-16:50**  
**[Gela 1.12]**

*Shortest path problems in weighted regions*

**Guillermo Esteban**

(Universidad de Alcalá)

Shortest path problems are fundamental problems in computational geometry. In a general version of the problem the space is subdivided into regions. Each of the regions has a (non-negative) weight associated to it, representing the cost per unit distance of traveling in that region. This variant cannot be solved exactly within the Algebraic Computation Model over the Rational Numbers. In this talk, I will explore some of the most common techniques used to approximate a solution to this problem.

**OT02****Combinatorial Algebra and Geometry****Álgebra y Geometría Combinatoria****Organizers****Organizadores****Antolatzaileak****Mario González-Sánchez**

(Universidad de Valladolid)

**Luis José Santana Sánchez**

(Univ. Valladolid / Univ. La Laguna)

**Javier Sendra-Arranz**

(Tübingen Univ. / CUNEF Univ.)

**Raquel Tapia-Ramos**

(Universidad de Cádiz)

**Description****Descripción****Deskribapena**

*Combinatorial algebraic geometry and commutative algebra are two interconnected and active areas of research that use combinatorial tools to approach theoretical, applied, and computational problems in algebra and geometry. These synergies between algebra, geometry, and combinatorics have been useful for developments in these fields, leading to significant advances in toric geometry, enumerative geometry, invariant theory, semigroup algebras, free resolutions, and more. In this session, some recent advancements in combinatorial algebra and geometry will be presented.*

La geometría algebraica combinatoria y el álgebra conmutativa son dos áreas de investigación interconectadas y activas que utilizan herramientas combinatorias para abordar problemas teóricos, aplicados y computacionales en álgebra y geometría. Estas sinergias entre álgebra, geometría y combinatoria han sido vitales para desarrollar estos campos, dando lugar a avances significativos en geometría tórica, geometría enumerativa, teoría de invariantes, álgebras de semigrupos, resoluciones libres, y más. En esta sesión, se presentarán algunos avances recientes en álgebra y geometría combinatoria.

**MSC Codes****Códigos MSC****MSC Kodeak**

05E40

(primary)

05E14; 14N10; 20M14

(secondary)

**Slots****Bloques****Blokeak**

1.C (Aula 1.12); 2.A (Aula 1.12); 2.B (Aula 1.12)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

M14 | 17:30-17:50 | 1.12

*Multigraded regularity for solving 0-dimensional projections***Carles Checa** (University of Copenhagen)

M14 | 18:00-18:20 | 1.12

*Minimal and cellular free resolutions from involutive bases***Rodrigo Iglesias** (Universidad de La Rioja)

M14 | 18:30-18:50 | 1.12

*Some results on bounded negativity conjecture***Elvira Pérez-Callejo** (Universitat Jaume I)

M14 | 19:00-19:20 | 1.12

*General  $2^{\times n}$  tensors are not identifiable for  $n \neq 3$* **Pablo Mazón** (Università di Trento)

J16 | 11:00-11:20 | 1.12

*Standard monomials in characteristic two***Laura Casabella** (MPI MiS Leipzig)

J16 | 11:30-11:50 | 1.12

*Prime ideals of Moh and the characteristic of the field***Laura González** (Universitat Politècnica de Catalunya)

J16 | 12:00-12:20 | 1.12

*Studying invariants of C-semigroups***Raquel Tapia-Ramos** (Universidad de Cádiz)

J16 | 12:30-12:50 | 1.12

*Edge-bicolored graphs and critical points of polynomials*

**Chiara Meroni** (ETH Institute for Theoretical Studies)

J16 | 16:30-16:50 | 1.12

*KP Solitons: Tropical Curves meet Grassmannians*

**Claudia Fevola** (Inria Saclay)

J16 | 17:00-17:20 | 1.12

*A combinatorial approach to the Tjurina algebra of a complete intersection monomial curve*

**Patricio Almirón** (Universidad de Granada)

J16 | 17:30-17:50 | 1.12

*On the finite generation of the effective cone and the Cox ring of a rational surface*

**Carlos Jesús Moreno-Ávila** (Universidad de Extremadura)

J16 | 18:00-18:20 | 1.12

*On the Hilbert scheme of points on a singular curve*

**Ángel David Ríos Ortiz** (Université Paris Saclay)

**Tuesday 14**  
**17:30-17:50**  
**[Room 1.12]**

**Martes 14**  
**17:30-17:50**  
**[Aula 1.12]**

**Asteartea 14**  
**17:30-17:50**  
**[Gela 1.12]**

***Multigraded regularity for solving 0-dimensional projections***

**Carles Checa**

(University of Copenhagen)

Systems with multihomogeneous structure can be described using multigraded invariants. We consider multihomogeneous polynomial systems such that the projection to one group of variables is 0-dimensional. In our work, we show that one can rely on the partial regularity region we introduced in a previous article and construct multiplication matrices whose eigenvalues correspond to evaluating the points 0-dimensional projection in linear forms.

Joint work with Matías R. Bender, Laurent Busé and Elias Tsigaridas.

**Tuesday 14**  
**18:00-18:20**  
**[Room 1.12]**

**Martes 14**  
**18:00-18:20**  
**[Aula 1.12]**

**Asteartea 14**  
**18:00-18:20**  
**[Gela 1.12]**

***Minimal and cellular free resolutions from involutive bases***

**Rodrigo Iglesias**

(Universidad de La Rioja)

Involutive bases are a special kind of Gröbner bases with additional combinatorial properties. These bases induce free resolutions with nice combinatorial properties. Although these free resolutions are generally far from the minimal, we study the different classes of monomial ideals that lead to minimal resolutions and also to cellular resolutions. We give cellular structures for these cellular resolutions as well as a constructive algorithm that reduces them to the minimal one.

Joint work with Eduardo Sáenz De Cabezón.

[arXiv:2401.13788](https://arxiv.org/abs/2401.13788)

**Tuesday 14**  
**18:30-18:50**  
**[Room 1.12]**

**Martes 14**  
**18:30-18:50**  
**[Aula 1.12]**

**Asteartea 14**  
**18:30-18:50**  
**[Gela 1.12]**

*Some results on bounded negativity conjecture*

**Elvira Pérez-Callejo**

(Universitat Jaume I)

The bounded negativity conjecture is an old conjecture that states that there is a lower bound for the self-intersection of reduced and irreducible curves on a smooth complex projective surface that depends only on the surface. In this talk, we present two approaches to this problem by giving bounds that are either linear or quadratic with respect to its intersection with some nef divisor.

Joint work with Carlos Galindo and Francisco Monserrat.

**Tuesday 14**  
**19:00-19:20**  
**[Room 1.12]**

**Martes 14**  
**19:00-19:20**  
**[Aula 1.12]**

**Asteartea 14**  
**19:00-19:20**  
**[Gela 1.12]**

*General  $2^{\times n}$  tensors are not identifiable for  $n \neq 3$*

**Pablo Mazón**

(Università di Trento)

A tensor is identifiable if it admits a unique decomposition as a sum of rank-one tensors. An interesting family consists of  $2 \times \dots \times 2$  ( $n$  times) tensors since they appear frequently in Bayesian networks, tensor network states, latent-class models, and binary games with multiple players. In this talk, we show that, for every  $n \neq 3$ , a general tensor in  $\mathbb{C}^2 \otimes \dots \otimes \mathbb{C}^2 = (\mathbb{C}^2)^{\otimes n}$  is not identifiable.

Joint work with Elisa Postinghel.

**Thursday 16**

11:00-11:20

[Room 1.12]

**Jueves 16**

11:00-11:20

[Aula 1.12]

**Osteguna 16**

11:00-11:20

[Gela 1.12]

***Standard monomials in characteristic two*****Laura Casabella**

(MPI MiS Leipzig)

Over a field of characteristic zero, De Concini, Eisenbud and Procesi developed a theory of standard monomials, which are a basis for determinantal ideals and provide a tool to study many of their properties, exploiting tableaux combinatorics. In this talk, we present our contribution to a new standard monomial theory in characteristics  $p$  modulo a Frobenius power, examining the case  $p = 2$ . A main feature of this investigation is given by analogs of semistandard Young tableaux in this new context.

Joint work with Teresa Vu.

[arXiv:2311.05530](#)

**Thursday 16**

11:30-11:50

[Room 1.12]

**Jueves 16**

11:30-11:50

[Aula 1.12]

**Osteguna 16**

11:30-11:50

[Gela 1.12]

***Prime ideals of Moh and the characteristic of the field*****Laura González**

(Universitat Politècnica de Catalunya)

In this talk, we will see that the minimal number of generators of the prime ideals of Moh, defined in the power series ring in three variables over a field, may change when the characteristic of the field changes. This contradicts a statement of Sally and leaves as an open problem to find families of prime ideals in  $K[[x, y, z]]$  with an unbounded minimal number of generators, when  $K$  has characteristic other than zero.

Joint work with Francesc Planas-Vilanova.

[arXiv:2407.21692](#)

**Thursday 16****12:00-12:20****[Room 1.12]****Jueves 16****12:00-12:20****[Aula 1.12]****Osteguna 16****12:00-12:20****[Gela 1.12]*****Studying invariants of  $\mathcal{C}$ -semigroups*****Raquel Tapia-Ramos**

(Universidad de Cádiz)

Let  $\mathcal{C}$  be an integer cone. We say that an affine semigroup  $S \subseteq \mathcal{C}$  is a  $\mathcal{C}$ -semigroup if the complement of  $S$  in  $\mathcal{C}$  is finite. We present a study of  $\mathcal{C}$ -semigroups, exploring their properties. Additionally, we develop algorithms for counting  $\mathcal{C}$ -semigroups with fixed invariants, such as genus and Frobenius elements.

Joint work with José Carlos Rosales and Alberto Vigneron-Tenorio.

[arXiv:2409.06376](https://arxiv.org/abs/2409.06376)

**Thursday 16****12:30-12:50****[Room 1.12]****Jueves 16****12:30-12:50****[Aula 1.12]****Osteguna 16****12:30-12:50****[Gela 1.12]*****Edge-bicolored graphs and critical points of polynomials*****Chiara Meroni**

(ETH Institute for Theoretical Studies)

We show that a class of bivariate integrals can be seen as generating functions of labeled edge-bicolored graphs. Based on this, we prove an effective algorithm to compute the number of such graphs, and an asymptotic formula for the number of regular edge-bicolored graphs with arbitrary weights assigned to different vertex structures. The phase transitions for the asymptotic formulas correspond to critical points of a specific polynomial. We will discuss examples, computation, and conjectures.

Joint work with Michael Borinsky and Maximilian Wiesmann.



**Thursday 16****16:30-16:50****[Room 1.12]****Jueves 16****16:30-16:50****[Aula 1.12]****Osteguna 16****16:30-16:50****[Gela 1.12]*****KP Solitons: Tropical Curves meet Grassmannians*****Claudia Fevola**

(Inria Saclay)

The KP equation, a partial differential equation describing nonlinear wave motion, has solutions linked to algebraic curves. Solitons, a special class of solutions, arise from rational nodal curves. Kodama and Williams explored real regular solitons and their connection to totally positive Grassmannians. Building on Abenda and Grinevich's work, I discuss the relationship between real regular solitons, dual graphs of singular curves, Le-graphs, and cells in the totally positive Grassmannian.

Joint work with Simonetta Abenda, Trk zlm elik, and Yelena Mandelshtam.

**Thursday 16****17:00-17:20****[Room 1.12]****Jueves 16****17:00-17:20****[Aula 1.12]****Osteguna 16****17:00-17:20****[Gela 1.12]*****A combinatorial approach to the Tjurina algebra of a complete intersection monomial curve*****Patricio Almirn**

(Universidad de Granada)

Complete intersection monomial curves (CIMC) illustrate the interplay between curve singularities and the combinatorics of semigroup values from intersection multiplicities with the curve.

This talk will show how a characterization given by Delorme in 1976 helps study the miniversal deformation of CIMCs and provides a decomposition result for its basis.

We will also explore the connection with the moduli space of curves.

Joint work with J.J. Moyano Fernndez.

[arXiv:2310.20394](https://arxiv.org/abs/2310.20394)

**Thursday 16****17:30-17:50****[Room 1.12]****Jueves 16****17:30-17:50****[Aula 1.12]****Osteguna 16****17:30-17:50****[Gela 1.12]**

*On the finite generation of the efective cone and the Cox ring of a rational surface*

**Carlos Jesús Moreno-Ávila**

(Universidad de Extremadura)

Let  $X$  be a rational surface obtained from a Hirzebruch surface by a sequence of blowups centered at closed points. We see conditions which imply, on the one hand, that the efective cone of  $X$  is polyhedral and minimally generated and, on the other hand, the finite generation of the Cox ring of  $X$ . Moreover, we provide a set of generators of the nef cone of  $X$  in these cases.

Joint work with C. Galindo and F. Monserrat.

Partially supported by grant PID2022-138906NB-C22 funded by MICIU/AEI/ 10.13039/501100011033 and by ERDF/EU, as well as by Universitat Jaume I, Grants UJI-B2021-02 and GACUJIMB-2023-03.

**Thursday 16****18:00-18:20****[Room 1.12]****Jueves 16****18:00-18:20****[Aula 1.12]****Osteguna 16****18:00-18:20****[Gela 1.12]**

*On the Hilbert scheme of points on a singular curve*

**Ángel David Ríos Ortiz**

(Université Paris Saclay)

The Hilbert scheme of points on a variety parametrizes how points behave when they collide. In the case of smooth curves their structure is well understood, whereas for singular curves the general expectation is that is impossible to know. I will report on a work with Javier Sendra Arranz about a class of singular curves for which we describe the irreducible components and their behavior when we increase the number of points and a particularly nice combinatorial description emerging from them.

Joint work with Javier Sendra Arranz.

**OT03*****Mathematics in the Classroom: from Research to Practice*****Matemáticas en el Aula: de la Investigación a la Práctica****Organizers****Organizadores****Antolatzaileak****Andrea de la Fuente Silva**

(Universidad Autónoma de Madrid)

**Pablo Giadas**

(Universidad de Oviedo)

**Juan Miguel Ribera Puchades**

(Universitat de les Illes Balears)

**Description****Descripción****Deskribapena**

*The session will bridge research in mathematics education with its teaching and learning processes. It will address questions such as: Why is mathematics education necessary? What is it for? and How can research be applied in the mathematical field? Contexts where innovative practices foster a deeper understanding of mathematics will be presented, promoting critical thinking, problem-solving, the use of playful resources, and creativity. Through practical examples and case studies, attendees will learn how to implement research in mathematics education in specific educational contexts.*

La sesión conectará las investigaciones en didáctica de la matemática con sus procesos de enseñanza-aprendizaje. Se abordarán preguntas como: ¿por qué es necesaria la educación matemática?, ¿para qué sirve? y ¿cómo aplicar la investigación en el ámbito matemático? Se presentarán contextos donde prácticas innovadoras fomentan una comprensión más profunda de las matemáticas, promoviendo el pensamiento crítico, la resolución de problemas, el uso de recursos lúdicos y la creatividad. A través de ejemplos prácticos y estudios de caso, los asistentes aprenderán a implementar la investigación en didáctica en contextos educativos específicos.

**MSC Codes****Códigos MSC****MSC Kodeak**

97-02

(primary)

97-02; 97D40; 97D50; 97U10

(secondary)

**Slots****Bloques****Blokeak**

1.B (Aula 1.4); 1.C (Aula 1.4)

QR Code

Código QR

QR Kodea



Session Schedule

Horario de la Sesión

Saioaren Ordutegia

M14 | 15:30-15:50 | 1.4

*Assisting Students in Mastering Linear Equation-Solving Skills***María Sanz Ruiz** (Universidad de Cantabria)

M14 | 16:00-16:20 | 1.4

*Enhancing Mathematical Visualization Through 3D Printing***Lucía Rotger García** (Universitat de les Illes Balears)

M14 | 16:30-16:50 | 1.4

*On the modality of study of the real numbers in the Degree of Mathematics***José Ginés Espín Buendía** (Universidad de Murcia)

M14 | 17:30-17:50 | 1.4

*A first approach to the development of a pre-university teaching proposal on the notion of limits***Mónica Arnal Palacián** (IUMA - Universidad de Zaragoza)

M14 | 18:00-18:20 | 1.4

*From the quadrivium to STEAM education: the figure of the mathematics teacher.***Jon Anasagasti Aguirre** (UPV/EHU)

M14 | 18:30-18:50 | 1.4

*Qualitative analysis of a mathematics education classroom experience with a digital tool***Carlos Carbonell Urtubia** (Universidad de La Rioja)

M14 | 19:00-19:20 | 1.4

*Fostering Creativity and Proof Skills in Gifted Mathematicians through RSME Olympiad Challenges*

**Juan Miguel Ribera Puchades** (Universitat de les Illes Balears)

**Tuesday 14****15:30-15:50****[Room 1.4]****Martes 14****15:30-15:50****[Aula 1.4]****Asteartea 14****15:30-15:50****[Gela 1.4]*****Assisting Students in Mastering Linear Equation-Solving Skills*****María Sanz Ruiz**

(Universidad de Cantabria)

Mathematical learning involves revisiting known concepts to gain deeper insights and apply them in new contexts. Solving linear equations, a skill acquired in Secondary Education, remains challenging for some students in higher levels. To enhance these skills, we propose using STACK, a customizable tool providing adaptive formative assessment. Our study with 196 students analyzes how they interact with the assessment and overcome difficulties, offering insights into their cognitive processes.

Joint work with José Manuel Diego-Mantecón, and Zaira Ortiz-Laso.

**Tuesday 14****16:00-16:20****[Room 1.4]****Martes 14****16:00-16:20****[Aula 1.4]****Asteartea 14****16:00-16:20****[Gela 1.4]*****Enhancing Mathematical Visualization Through 3D Printing*****Lucía Rotger García**

(Universitat de les Illes Balears)

3D printing as an educational tool transforms math teaching in higher education by helping students visualize abstract concepts. This project enhances visualization skills through designing, modelling, and printing 3D objects with tools like Tinkercad. These models serve as manipulatives for problem-solving. Applied in math courses, the approach improves spatial reasoning, creativity, and technical skills, while increasing student motivation.

**Tuesday 14**  
**16:30-16:50**  
**[Room 1.4]**

**Martes 14**  
**16:30-16:50**  
**[Aula 1.4]**

**Asteartea 14**  
**16:30-16:50**  
**[Gela 1.4]**

*On the modality of study of the real numbers in the Degree of Mathematics*

**José Ginés Espín Buendía**

(Universidad de Murcia)

Standard mathematics textbooks often present real numbers through artificial methods like axioms or Dedekind cuts. A theorem links real numbers to decimal expansions, raising the question of whether they could be introduced as decimals. This work investigates why real numbers are taught this way and explores alternative approaches that avoid these constructions. The aim is to enhance training in mathematics degrees, fostering deeper understanding and reflective learning among students.

Joint work with Josep Gascón and Pedro Nicolás.

**Tuesday 14**  
**17:30-17:50**  
**[Room 1.4]**

**Martes 14**  
**17:30-17:50**  
**[Aula 1.4]**

**Asteartea 14**  
**17:30-17:50**  
**[Gela 1.4]**

*A first approach to the development of a pre-university teaching proposal on the notion of limits*

**Mónica Arnal Palacián**

(IUMA - Universidad de Zaragoza)

The mathematical and phenomenological differences between types of limits, as defined by Freudenthal, should guide their teaching. This forum discusses creating a didactic proposal that incorporates both elementary and advanced thinking with various representation formats. Analysis of Spanish textbooks and student feedback reveals a preference for verbal representations, enriching the proposal and avoiding rigid distinctions.

Joint work with Javier Claros-Mellado, and María Teresa Sánchez-Compañá.

**Tuesday 14****18:00-18:20****[Room 1.4]****Martes 14****18:00-18:20****[Aula 1.4]****Asteartea 14****18:00-18:20****[Gela 1.4]**

*From the quadrivium to STEAM education: the figure of the mathematics teacher.*

**Jon Anasagasti Aguirre**

(UPV/EHU)

The transmission of mathematical knowledge has recently transformed, with methodologies like STEM/STEAM education emerging. Curricular frameworks emphasize 'Mathematical competence and competence in science, technology, and engineering' as key. A study of 185 teachers in the Basque Autonomous Community shows that engineering studies are most represented (31.89%), raising questions about their influence on teaching.

Joint work with Ainhoa Berciano and Ane Izagirre.

**Tuesday 14****18:30-18:50****[Room 1.4]****Martes 14****18:30-18:50****[Aula 1.4]****Asteartea 14****18:30-18:50****[Gela 1.4]**

*Qualitative analysis of a mathematics education classroom experience with a digital tool*

**Carlos Carbonell Urtubia**

(Universidad de La Rioja)

This work presents an innovative classroom problem-solving and problem-creation experience designed for secondary school students that makes use of three-dimensional modeling software, along with a subsequent case study.



Tuesday 14  
19:00-19:20  
[Room 1.4]

Martes 14  
19:00-19:20  
[Aula 1.4]

Asteartea 14  
19:00-19:20  
[Gela 1.4]

*Fostering Creativity and Proof Skills in Gifted Mathematicians through RSME  
Olympiad Challenges*  
**Juan Miguel Ribera Puchades**  
(Universitat de les Illes Balears)

This study examines how talented students in RSME olympiads, through problems involving mathematical proofs, develop advanced skills and creativity. Analyzing their responses reveals how these challenges enhance problem-solving abilities and deductive proof skills.

[mtrj.commonscs.cuny.edu/wp-content/blogs.dir/  
34462/files/2024/06/07.-Ribera\\_Puchades.pdf](https://mtrj.commonscs.cuny.edu/wp-content/blogs.dir/34462/files/2024/06/07.-Ribera_Puchades.pdf)