



## GT05

### *Algebraic Topology*

### Topología Algebraica

#### Organizers

**Guille Carrión Santiago**

(Universidad de Málaga)

#### Organizadores

**Beatriz Molina Samper**

(Universidad de Valladolid)

#### Antolatzaileak

**Álvaro del Valle Vilchez**

(Universidad de Sevilla)

#### Description

*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*

#### Descripción

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.

#### Deskribapena

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

(primary)

57N65; 55PXX; 32S50

(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

*Generalizing the Euler characteristic on sheaves***Alejandro O. Majadas-Moure** (Universidad de Santiago de Compostela)

L13 | 18:00-18:20 | 0.20

*Discrete and Algebraic Morse Theories***David Mosquera Lois** (Universidade de Vigo)

L13 | 18:30-18:50 | 0.20

*Finite group actions in Maurer-Cartan spaces of L-infinity algebras***Rafael Gomes** (Universidad de Málaga)

L13 | 19:00-19:20 | 0.20

*Universal Ringed Spaces*

**Javier Sánchez González** (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 Orbeago 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  
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**Lunes 13**  
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[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**  
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**18:30-18:50**  
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**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)

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**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)

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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.

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**16:00-16:20**  
**[Room 0.20]**

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**16:00-16:20**  
**[Gela 0.20]**

*Homogeneous braids are visually prime*

**Miguel Orbeago 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)

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**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.

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17:30-17:50  
[Gela 0.20]

*When should you trust your drawings?*

**Ignacio Brea 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.

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*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*  
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**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.

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*Lie approach to the Toral Rank Conjecture.*

**Mario Fuentes Rumi**

(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.