



## 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
L16   11:00-11:20   0.1 <i>Narrow graphs and virtual fiber subgroups</i> <b>Pénélope Azuelos</b> (University of Bristol)		
L16   11:30-11:50   0.1 <i>Twisted right-angled Artin groups</i> <b>Islam Foniqi</b> (University of East Anglia)		
L16   12:00-12:20   0.1 <i>Folding quasiconvex semigroups of automatic groups</i> <b>Lucía Asencio Martín</b> (Newcastle University)		
L16   12:30-12:50   0.1 <i>Fixed points of automorphisms and <math>L^2</math>-homology</i> <b>Ismael Morales</b> (University of Oxford)		

L16 | 16:30-16:50 | 0.1

*Ribbon property conjecture for Artin groups*

**José Gálvez Mateos** (Universidad de Sevilla & UPV/EHU)

L16 | 17:00-17:20 | 0.1

*Universal localizations, Atiyah conjectures and graphs of groups.*

**Pablo Sánchez Peralta** (Universidad Autónoma de Madrid)

L16 | 17:30-17:50 | 0.1

*An Introduction to the Compressed Word Problem for Groups*

**Paloma López Larios** (Universidad Complutense de Madrid)

L16 | 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)

L17 | 9:00-9:20 | 0.1

*Around subgroups of Artin groups*

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

L17 | 9:30-9:50 | 0.1

*Torsion subgroups of small cancellation groups*

**Karol Duda** (UPV/EHU)

L17 | 10:00-10:20 | 0.1

*McCullough-Miller space for RAAGs*

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

L17 | 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  $C(6)$ ,  $C(4)\text{-}T(4)$  or  $C(3)\text{-}T(6)$  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)

McCullough and Miller constructed a contractible simplicial complex on which  $\text{PAut}(F_n)$ , the pure automorphisms of  $F_n$ , acts. This complex has been used to compute the cohomology ring of the groups  $\text{PAut}(F_n)$  and certain cohomological properties. We will generalize the construction of the McCullough-Miller complex for pure automorphism groups of RAAGs. Once the generalization is done, we will use it to generalize some results from  $F_n$  to RAAGs, such as cd or cohomology ring.

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.