

# Programme

Monday June 24		Tuesday June 25		Wednesday June 26		Thursday June 27		Friday June 28	
9h-9h30	Opening			9h-10h	<b>Ian Agol</b>			9h-10h	<b>Stefan Friedl</b>
9h30-10h30	<b>Alan Reid</b>	9h30-10h30	<b>Tao Li</b>	10h-10h30	Coffee break	9h30-10h30	<b>Daryl Cooper</b>	10h-10h30	Coffee break
10h30-11h	Coffee break	10h30-11h	Coffee break	10h30-11h30	<b>Jessica Purcell</b>	10h30-11h	Coffee break	10h30-11h30	<b>David Gabai</b>
11h-12h	<b>Juan Souto</b>	11h-12h	<b>Hyam Rubinstein</b>	11h30-11h45	Break	11h-12h	<b>Steven Kerckhoff</b>	11h30-11h45	Break
12h-12h15	Break	12h-12h15	Break	11h45-12h15	<b>Parallel sessions</b>	12h-12h15	Break	11h45-12h45	<b>Peter Shalen</b>
12h15-12h45	<b>Parallel sessions</b>	12h15-12h45	<b>Parallel sessions</b>	12h15-12h30	Break	12h15-12h45	<b>Parallel sessions</b>		
12h45-14h15	Lunch break	12h45-14h15	Lunch break	12h30-13h	<b>Parallel sessions</b>	12h45-14h15	Lunch break	12h45	Lunch
14h15-14h45	<b>Parallel sessions</b>	14h15-14h45	<b>Parallel sessions</b>	13h	Lunch	14h15-14h45	<b>Parallel sessions</b>		
14h45-15h	Break	14h45-15h	Break			14h45-15h	Break		
15h-16h	<b>Genevieve Walsh</b>	15h-16h	<b>Vincent Colin</b>			15h-16h	<b>François Guéritaud</b>		
16h-16h30	Coffee break	16h-16h30	Coffee break			16h-16h30	Coffee break		
16h30-17h30	<b>Richard Weidmann</b>	16h30-17h30	<b>Yi Ni</b>			16h30-17h30	<b>Danny Calegari</b>		
17h30-17h45	Break	17h30-17h45	Break			17h30-17h45	Break		
17h45-18h15	<b>Parallel sessions</b>	17h45-18h15	<b>Parallel sessions</b>			17h45-18h15	<b>Parallel sessions</b>		
				18h	Reception at the City Hall	19h30	Buffet at Upsidum		

# Practical information

## Conference site

Talks and coffee breaks will be held in the U4 building. Plenary talks take place in the Shannon Lecture Hall and session talks in the Shannon Lecture Hall, Room 211 and Room 212. For each talk, the room is indicated on the corresponding daily program (on the following pages).

## Meals

Lunch will be taken at the cafeteria-style restaurant Upsidum. On Thursday evening, there will be a buffet in the same restaurant.

## Reception

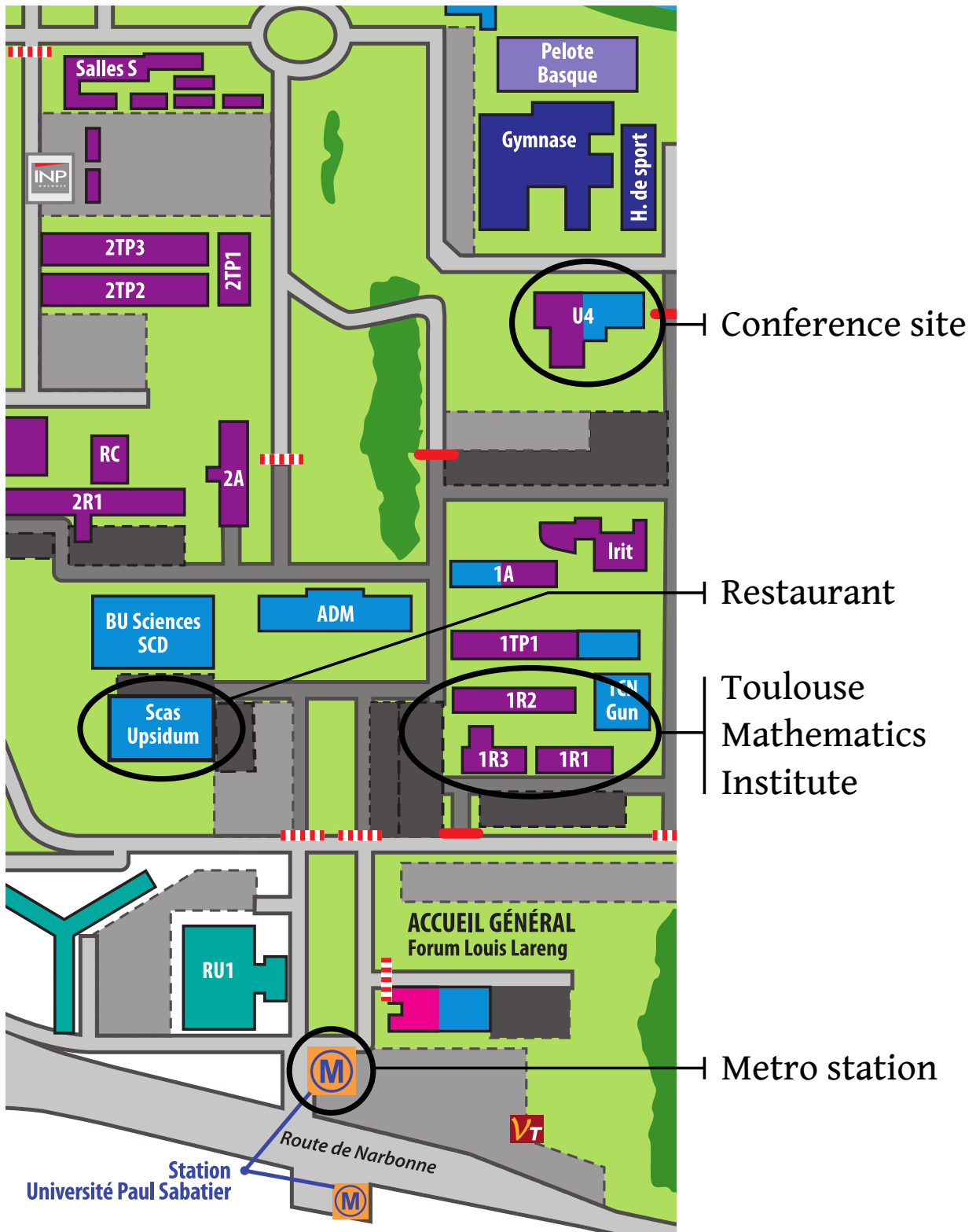
On Wednesday at 6pm, participants and families are invited to a reception at the City Hall (Hôtel de Ville), Salle des Illustres.

The City Hall (Hôtel de Ville) is located place du Capitole (metro station Capitole). There is a passageway in the middle of the building. The entrance is situated inside this passageway, Salle des Illustres is on the first floor (British numbering) and is well indicated.

## Wifi

To access the wifi network, connect to the network UPS. Then open any webpage on your usual browser. You should be redirected to a secured webpage where you can input the login and password that were provided with the conference package. Issues may arise between your browser and the certificate of the secured webpage (which you will have to solve by yourself).

# Partial map of the campus



## Monday June 24

9h-9h30, Shannon Hall  
**Opening**

9h30-10h30, Shannon Hall  
**Alan Reid**

10h30-11h  
Coffee break

11h-12h, Shannon Hall  
**Juan Souto**

12h15-12h45, Shannon Hall  
**Mark Baker**

12h15-12h45, Room 211  
**Inasa Nakamura**

12h15-12h45, Room 212  
**Thomas Fiedler**

12h45-14h15  
Lunch Break

14h15-14h45, Shannon Hall  
**Stefano Francaviglia**

14h15-14h45, Room 211  
**João Miguel Nogueira**

14h15-14h45, Room 212  
**Alexandre Paiva Barreto**

15h-16h, Shannon Hall  
**Genevieve Walsh**

16h-16h30  
Coffee break

16h30-17h30, Shannon Hall  
**Richard Weidmann**

17h45-18h15, Shannon Hall  
**Gregor Masbaum**

17h45-18h15, Room 211  
**Antonio Salgueiro**

# Abstracts

## Alan Reid

Monday, June 24, 9h30-10h30, Shannon Lecture Hall

### **The geometry of canonical curves**

Suppose that  $M$  is a 1-cusped hyperbolic 3-manifold. A component of the  $\mathrm{SL}(2, \mathbb{C})$  character variety containing the character of a faithful discrete representation is called a canonical component. Thurston proved that a canonical component is a curve (a canonical curve). This talk will discuss various questions about these canonical curves: for example, which curves arise as canonical curves, what are geometric and algebraic features of canonical curves and how do they relate to  $M$ . Finally we will discuss a possible connection to expander graphs.

---

## Juan Souto

Monday, June 24, 11h-12h, Shannon Lecture Hall

### **Virtual homomorphisms from mapping class groups to lattices in $SO(k, 1)$**

Let  $\Gamma$  be a finite index subgroup of the mapping class group of a surface of at least genus 3, and  $G$  a cocompact lattice in  $SO(k, 1)$ . We prove that every homomorphism  $\Gamma \rightarrow G$  virtually factors through a homomorphism to a surface group.

---

## Mark Baker

Monday, June 24, 12h15-12h45, Shannon Lecture Hall

### **Conservative subgroup separability for surfaces with boundary**

If  $F$  is a compact surface with boundary, then a finitely generated subgroup without peripheral elements of  $G = \pi_1(F)$  can be separated from finitely

many other elements of  $G$  by a finite index subgroup of  $G$  corresponding to a finite cover  $F$  with the same number of boundary components as  $F$ .

## **Inasa Nakamura**

Monday, June 24, 12h15-12h45, Room 211

### **On surface links whose link groups are abelian**

It is known that the link group of a classical link  $L$  is abelian if and only if  $L$  is an unknot or a Hopf link, and the link type is determined from the linking number. In this talk, we show that the analog of this fact does not hold for surface links. We study surface links whose link groups are free abelian, and we construct various examples of such surface links with the same link group but with various double linking numbers and triple linking numbers. Here the double and triple linking numbers are link-homotopy invariants of surface links, defined as natural generalizations of the classical linking numbers. This is joint work with Tetsuya Ito (RIMS, Kyoto University).

## **Thomas Fiedler**

Monday, June 24, 12h15-12h45, Room 212

### **Quantum one-cocycles for knots**

We give a method to construct non symmetric solutions of a global tetrahedron equation from solutions of the Yang-Baxter equation. The solution in the HOMFLYPT case gives rise to the first combinatorial quantum 1-cocycle which represents a non trivial cohomology class in the topological moduli space of long knots. We conjecture that the difference of its values on the rotation around the long axis and on Hatcher's loop is related to the simplicial volume of the knot complement in the 3-sphere and we prove this for the figure eight knot. Our 1-cocycle applied to 2-string links can very easily distinguish mutants which can not be distinguished neither by the HOMFLYPT nor by the 2-variable Kauffman invariant nor by Kuperberg's  $g_2$ -invariant in their corresponding skein modules.

## Stefano Francaviglia

Monday, June 24, 14h15-14h45, Shannon Lecture Hall

### **Branched projective structures with (quasi)-Fuchsian holonomy**

We will discuss the following result. If  $S$  is a closed compact surface of genus  $g \geq 2$ , and  $R$  is a quasi-Fuchsian representation of the fundamental group of  $S$  into  $PSL(2, \mathbb{C})$ , then the deformation space of branched projective structures on  $S$  with given total branching order  $k$  and holonomy  $R$  is connected, as soon as  $k > 0$ . Equivalently, two branched projective structures with the same quasi-Fuchsian holonomy and the same number of branch points are related by a movement of branch points. This is joint work with G. Calsamiglia and B. Deroin.

## João Miguel Nogueira

Monday, June 24, 14h15-14h45, Room 211

### **Tunnel number degeneration under the connected sum of prime knots**

We study 2-string free tangle decompositions of knots with tunnel number two. As an application, we construct infinitely many counter-examples to a conjecture in the literature stating that the tunnel number of the connected sum of prime knots doesn't degenerate by more than one:  $t(K_1 \# K_2) > t(K_1) + t(K_2) - 2$ , for  $K_1$  and  $K_2$  prime knots.

## Alexandre Paiva Barreto

Monday, June 24, 14h15-14h45, Room 212

### **Generalizations of the Omori-Yau Maximum Principle**

Due to the large number of applications it has in geometry and analysis, the Omori-Yau Maximum Principle became a fundamental tool for Geometric Analysis. Along the years, many generalizations of this principle have been proposed. In this talk we prove that the classical generalization of the Omori-Yau maximum principle that was given by Pigola-Rigoli-Setti are logically equivalent to the assumption that the manifold carries a  $C^2$  proper function whose gradient and Hessian (Laplacian) are bounded. In particular, this

result extends the scope of the original Omori-Yau principle, formulated in terms of lower bounds for curvature.

---

## Genevieve Walsh

Monday, June 24, 15h-16h, Shannon Lecture Hall

### **Coxeter groups, hyperbolic polytopes, and acute triangulations**

Let  $C(L)$  be the right-angled Coxeter group defined by an abstract triangulation  $L$  of the two-sphere. We show that  $C(L)$  can be realized as a hyperbolic right-angled reflection group if and only if  $L$  can be realized as an acute geodesic triangulation. We prove a more general result for the case when the angles are not necessarily all right. A corollary is that an abstract triangulation of  $S^2$  can be realized as an acute geodesic triangulation exactly when it contains no separating 3- or 4-cycles. This is joint work with Sang-hyun Kim.

---

## Richard Weidmann

Monday, June 24, 16h30-17h30, Shannon Lecture Hall

### **Nielsen equivalence in a class of random groups**

We consider groups given by presentations of type

$$\langle a_1, \dots, a_n, b_1, \dots, b_n \mid a_i = w_i(b_1, \dots, b_n), b_i = u_i(a_1, \dots, a_n) \text{ for } 1 \leq i \leq n \rangle.$$

We show that for most of these groups the generating tuples  $(a_1, \dots, a_n)$  and  $(b_1, \dots, b_n)$  do not become Nielsen equivalent after  $n - 1$  stabilisations, i.e. the  $(2n - 1)$ -tuples  $(a_1, \dots, a_n, 1, \dots, 1)$  and  $(b_1, \dots, b_n, 1, \dots, 1)$  are not Nielsen equivalent. (this is joint work with Ilya Kapovitch).

---



## **Gregor Masbaum**

Monday, June 24, 17h45-18h15, Shannon Lecture Hall

### **TQFT and modular representations of mapping class groups**

Together with P. Gilmer, we have used Integral TQFT to construct modular representations in finite characteristic of mapping class groups of surfaces. In this talk, I plan to discuss joint work with Reid in which we use these representations to answer a question of Hamenstaedt about finite quotients of the mapping class group. I will also present Verlinde-like dimension formulas for the irreducible factors of these representations in the case of equal characteristic.

## **Antonio Salgueiro**

Monday, June 24, 17h45-18h15, Room 211

### **On the degree of a cyclic covering of a link**

We prove that if  $L$  is a link in  $S^3$  which is not the unknot, then all its strongly cyclic branched coverings are distinct.

## Tuesday June 25

9h30-10h30, Shannon Hall  
**Tao Li**

10h30-11h  
Coffee break

11h-12h, Shannon Hall  
**Hyam Rubinstein**

12h15-12h45, Shannon Hall  
**Bruno Martelli**

12h15-12h45, Room 211  
**Dmitry Bolotov**

12h15-12h45, Room 212  
**Fathi Ben Aribi**

12h45-14h15  
Lunch Break

14h15-14h45, Shannon Hall  
**Stephan Tillmann**

14h15-14h45, Room 211  
**Makoto Osawa**

14h15-14h45, Room 212  
**Peter Feller**

15h-16h, Shannon Hall  
**Vincent Colin**

16h-16h30  
Coffee break

16h30-17h30, Shannon Hall  
**Yi Ni**

17h45-18h15, Shannon Hall  
**Sylvain Maillot**

17h45-18h15, Room 211  
**Alexander Zupan**

17h45-18h15, Room 212  
**Adam Levine**

# Abstracts

## Tao Li

Tuesday, June 25, 9h30-10h30, Shannon Lecture Hall

### **Rank and genus of 3-manifolds**

We construct a closed orientable hyperbolic 3-manifold with rank of its fundamental group smaller than its Heegaard genus. Moreover, we show that the discrepancy between rank and Heegaard genus can be arbitrarily large for hyperbolic 3-manifolds.

---

## Hyam Rubinstein

Tuesday, June 25, 11h-12h, Shannon Lecture Hall

### **Efficient triangulations and the index of a cusped hyperbolic 3-manifold**

This is joint work with Stavros Garoufalidis, Craig Hodgson and Henry Segerman. The 3D index of an ideal triangulation  $T$  of an oriented cusped 3-manifold  $M$  (a collection of  $q$ -series with integer coefficients, introduced by Dimofte-Gaiotto-Gukov, coming from string theory) is shown to be a topological invariant of oriented cusped hyperbolic 3-manifolds. To achieve this, we show that (a)  $T$  admits an index structure if and only if  $T$  is 1-efficient and (b) if  $M$  is hyperbolic, it has a canonical set of 1-efficient ideal triangulations related by 2-3 and 0-2 moves which preserve the 3D index. The results will be illustrated by several examples.

---

## Bruno Martelli

Tuesday, June 25, 12h15-12h45, Shannon Lecture Hall

### **From cubulations to cusped hyperbolic 4-manifolds**

We expose a simple algorithm which transforms any four-dimensional cubulation into a cusped hyperbolic finite-volume 4-manifold tessellated by regular

ideal 24-cells. The algorithm allows to construct easily plenty of cusped hyperbolic finite-volume 4-manifolds, including the first examples of hyperbolic 4-manifolds having only one cusp.

This is joint work with Kolpakov.

## **Dmitry Bolotov**

Tuesday, June 25, 12h15-12h45, Room 211

### **Foliations of nonnegative curvature on 3-Manifolds**

We will describe the topology of nonnegative curvature foliation. Then we will give the classification of closed 3-Manifolds admitting nonnegative curvature foliations and flat foliations.

## **Fathi Ben Aribi**

Tuesday, June 25, 12h15-12h45, Room 212

### **The $L^2$ -Alexander invariant detects the unknot**

The  $L^2$ -Alexander invariant is a knot invariant introduced by Li and Zhang in 2006. It can be seen as a  $L^2$ -torsion of a certain  $L^2$ -chain complex derived from the knot complement. It can also be built from the knot group, with Fox calculus, similarly as the Alexander polynomial, except that the operators act on infinite-dimensional Hilbert spaces. In my talk I will present this construction and show that this invariant detects the unknot.

---

## **Stephan Tillmann**

Tuesday, June 25, 14h15-14h45, Shannon Lecture Hall

### **Computing closed essential surfaces in 3-manifolds**

Normal surface theory was developed in the 1960's to algorithmically solve decision problems about triangulated 3-manifolds, such as the unknot recognition problem and the homeomorphism problem for 3-manifolds.

Normal surface theory has traditionally been regarded as very slow, both in theory and in practice. Algorithmic complexity and other bounds were

expected to be exponential at best, even for comparatively simple problems like unknot recognition, and with solutions to problems like the 3-manifold homeomorphism problem expected to run with time complexity an iterated exponential in terms of the number of tetrahedra in the input 3-manifolds.

In this talk we will look at how this perception is turning out to be unfounded in many cases. In particular I will discuss recent work with Ben Burton and Alexander Coward that determines which 3-manifolds in the Hodgson-Weeks census are Haken, and which complements of knots up to 12 crossings contain a closed essential surface. Both of these calculations would until recently have been regarded as completely infeasible.

### **Makoto Ozawa**

Tuesday, June 25, 14h15-14h45, Room 211

#### **Essential surfaces of non-negative Euler characteristic in genus two handlebody exteriors**

We provide a classification of the essential surfaces of non-negative Euler characteristic in the exteriors of genus two handlebodies embedded in the 3-sphere.

This is joint work with Yuya Koda.

### **Peter Feller**

Tuesday, June 25, 14h15-14h45, Room 212

#### **Adjacency of torus knot singularities**

We explore the connection between an algebraic notion of adjacency for singularities of curves in  $C^2$  and a geometric notion of adjacency for smooth knots in  $S^3$ .

---

## Vincent Colin

Tuesday, June 25, 15h-16h, Shannon Lecture Hall

### **An extension of Heegaard Floer homology to higher dimensions**

In dimension three, Heegaard Floer homology can be computed from the page and the monodromy of an open book decomposition supporting a contact structure. In a joint work in progress with Ko Honda, we explain how to extend its definition to contact manifolds of arbitrary odd dimension.

---

## Yi Ni

Tuesday, June 25, 16h30-17h30, Shannon Lecture Hall

### **Genus minimizing knots in rational homology spheres**

It has been known that the Donaldson-Floer type invariants for 3- and 4-manifolds can be used to give lower bound to the genus of surfaces representing a given homology class. In this talk, we will discuss a new type of genus bounds from Heegaard Floer homology, which gives a lower bound to the rational genus of all knots in a given torsion homology class. Such genus bounds are related to problems like lens space surgery, one-sided Heegaard splitting, and complexity of 3-manifolds. This talk is based on joint work with Zhongtao Wu and with Josh Greene.

---

## Sylvain Maillot

Tuesday, June 25, 17h45-18h15, Shannon Lecture Hall

### **Long time behaviour of Ricci flow on open 3-manifolds**

Let  $M$  be a compact, orientable 3-manifold with toral boundary. Thurston's hyperbolization conjecture, proved by Perelman in the closed case, and Thurston in the non-closed case, states that if  $M$  is irreducible and atoroidal, then  $M$  is hyperbolic or Seifert-fibered. We give a unified proof of this result by showing that Ricci flow with surgery on the interior of  $M$  is well-defined, and converges to a hyperbolic metric when  $M$  is not Seifert. This is joint work with Laurent Bessi eres and G erard Besson.

## Alexander Zupan

Tuesday, June 25, 17h45-18h15, Room 211

### **Strongly irreducible bridge surfaces versus essential surfaces in knot complements**

Borrowing from the theory of Heegaard splittings of 3-manifolds, we characterize the decomposition of a strongly irreducible bridge surface for a knot in a 3-manifold induced by cutting along a collection of essential surfaces. As an application, we prove several new results concerning bridge surfaces, as well as providing alternate proofs of some existing theorems.

## Adam Levine

Tuesday, June 25, 17h45-18h15, Room 212

### **Embeddings of non-orientable surfaces in $L(p, q) \times I$**

We use the Heegaard Floer homology correction terms to obstruct finding essential embeddings of closed, non-orientable surfaces in the product of a lens space and an interval. For a non-orientable surface  $F$  with sufficiently low genus (and conjecturally any genus), we show that if  $F$  embeds essentially in  $L(p, q) \times I$ , the genus and normal Euler number of the embedding are the same as those of a stabilization of a non-orientable surface embedded in  $L(p, q)$ .

This is joint work with Danny Ruberman and Saso Strle.

## Wednesday June 26

9h-10h, Shannon Hall  
**Ian Agol**

10h-10h30  
Coffee break

10h30-11h30, Shannon Hall  
**Jessica Purcell**

11h45-12h15, Shannon Hall  
**David Bachman**

11h45-12h15, Room 211  
**Mark Bell**

11h45-12h15, Room 212,  
**Benjamin Audoux**

12h30-13h, Shannon Hall  
**Yoav Moriah**

12h30-13h, Room 211  
**Darlan Girao**

12h30-13h, Room 212  
**Richard Webb**

13h  
Lunch

18h  
Reception at the City Hall  
Salle des Illustres



# Abstracts

## Ian Agol

Wednesday, June 26, 9h-10h, Shannon Lecture Hall

### **Virtually special cube complexes**

We will discuss the proof of a conjecture of Dani Wise, that cube complexes with hyperbolic fundamental group are virtually special. We will spend more time discussing the group theory underlying this result than the application of this result to the virtual Haken conjecture and other properties of 3-manifolds.

---

## Jessica Purcell

Wednesday, June 26, 10h30-11h30, Shannon Lecture Hall

### **Quasifuchsian state surfaces**

In this talk, we will describe surfaces in knot complements that are determined by a Kauffman state of the diagram. We give conditions on the diagram that will ensure the surface is essential. For an essential surface, we show it will never be accidental, and we give conditions on the diagram that determine whether it is quasifuchsian or a fiber. These will be the only cases. Finally, for links with A or B-adequate diagrams, we will see that the geometric type of the surface can be read off of the Jones polynomial. This is joint work with David Futer and Efstratia Kalfagianni.

---

## David Bachman

Wednesday, June 26, 11h45-12h15, Shannon Lecture Hall

### **Normalizing Topologically Minimal surfaces**

Topologically minimal surfaces generalize several well-studied classes of surfaces in 3-manifolds, and provide a topological analogue to geometrically minimal surfaces. We show that there is a normal form for any such surface

with respect to a fixed triangulation. This provides striking analogues with results of Colding and Minicozzi, establishes Hatcher-like finiteness results, and is crucial to understanding how Heegaard splittings are effected by Dehn surgery..

## **Mark Bell**

Wednesday, June 26, 11h45-12h15, Room 211

### **The classification problem for mapping classes**

The Nielsen-Thurston classification theorem characterises mapping classes, isotopy classes of homeomorphisms, of a surface into three types: periodic, reducible and pseudo-Anosov. I will discuss an exponential time algorithm for deciding the type of a mapping class using ideal triangulations. This can be used to show that determining if a mapping class is pseudo-Anosov is a problem in co-NP.

## **Benjamin Audoux**

Wednesday, June 26, 11h45-12h15, Room 212

### **An application of Khovanov homology to quantum codes**

In classical data processing, any transmission of a message is likely to generate errors in this message. An error-correcting code is a means of coating the message so that small errors can be detected and perhaps even corrected. In quantum data processing, the problem is all the more crucial since the simple storage of a data is likely to alter it. Such error-correcting quantum codes have been known for about fifteen years. They are usually compared thanks to three parameters: the length (space taken to code), dimension (length of the initial message) and the minimum distance (roughly the number of elementary errors we expect to correct). In my talk, I will show how Khovanov homology, which comes from knot theory, can lead to some quantum codes with reasonable minimum distance.

## **Yoav Moriah**

Wednesday, June 26, 12h30-13h, Shannon Lecture Hall

### **Fat train tracks, waves and Heegaard splittings**

Fat train tracks are defined and used to give a combinatorial criterion for the Hempel distance of Heegaard splittings for closed orientable 3-manifolds.

## **Darlan Girao**

Wednesday, June 26, 12h30-13h, Room 211

### **Rank gradient of hyperbolic 3-manifolds**

An important line of research in 3-dimensional topology is the study of the behavior of the rank of the fundamental groups of the finite sheeted covers of an orientable hyperbolic 3-manifold. In this talk I will construct what seems to be the first examples of such manifolds which have co-final towers of finite sheeted covers in which the rank of the fundamental groups grow linearly with the degree of the covers.

## **Richard Webb**

Wednesday, June 26, 12h30-13h, Room 212

### **Slim unicorns and uniform hyperbolicity**

The curve graph of a surface has applications in hyperbolic geometry, mapping class groups, Teichmüller theory and 3-manifolds. Hyperbolicity of the curve graph is one of its key properties. We shall give a short proof that arc graphs are 7-hyperbolic and deduce that curve graphs are 17-hyperbolic, using unicorn paths and elementary methods.

This is joint work with Sebastian Hensel and Piotr Przytycki.

## Thursday June 27

9h30-10h30, Shannon Hall  
**Daryl Cooper**

10h30-11h Coffee break

11h-12h, Shannon Hall  
**Steven Kerckhoff**

12h15-12h45, Shannon Hall  
**Daciberg Gonçalves**

12h15-12h45, Room 211  
**Neil Hoffman**

12h15-12h45, Room 212  
**André de Carvalho**

12h45-14h15  
Lunch Break

14h15-14h45, Shannon Hall  
**Sergey Matveev**

14h15-14h45, Room 211  
**Jeffrey Meier**

14h15-14h45, Room 212  
**Pere Menal Ferrer**

15h-16h, Shannon Hall  
**François Guéritaud**

16h-16h30  
Coffee break

16h30-17h30, Shannon Hall  
**Danny Calegari**

17h45-18h15, Shannon Hall  
**Martin Lustig**

17h45-18h15, Room 211  
**Ana Garcia Lecuona**

17h45-18h15, Room 212  
**Anastasiia Tsvietkova**

19h30, Upsidum  
Buffet

## Abstracts

### Daryl Cooper

Thursday, June 27, 9h30-10h30, Shannon Lecture Hall

#### **Projective structures on manifolds**

A strictly convex orbifold is the quotient of a strictly convex domain in projective space by a discrete group of projective transformations which preserve the domain. The Hilbert metric is a Finsler metric on the domain that is preserved by the group. In the case the domain is an ellipsoid this is the hyperbolic metric. This talk will survey our state of knowledge in the finite volume case.

---

### Steven Kerckhoff

Thursday, June 27, 11h-12h, Shannon Lecture Hall

#### **Bieberbach Soul Theorem**

This will be a discussion of a structure theorem for noncompact Euclidean cone manifolds. It can be viewed as a generalization of the Bieberbach theorem for Euclidean manifolds and the soul theorem for noncompact Riemannian manifolds with non-negative curvature. Joint work with Daryl Cooper and Craig Hodgson.

---

### Daciberg Gonçalves

Thursday, June 27, 12h15-12h45, Shannon Lecture Hall

#### **Double coverings of Solmanifolds and the Borsuk-Ulam theorem**

Given a closed 3-manifolds which admits Sol-geometry in most cases we describe all classes of free involutions. Then using a recent result by Hillmann we describe for which involutions the Borsuk-Ulam type theorem for maps with values in  $R^n$  holds. The answer will depend on the integer  $n$  which can be restricted to the values 2 and 3.

## Neil Hoffman

Thursday, June 27, 12h15-12h45, Room 211

### Generalized Berge knot complements

The Berge Conjecture provides a classification of one cusped manifolds that are known to admit an  $S^3$  and a lens space surgery. A positive solution to this conjecture would say this list is complete. In this talk, I will present a partial classification of one cusped manifolds known to admit at least two lens space surgeries, providing a generalization of the Berge Conjecture. In particular, we will focus on one cusped manifolds that admit exactly three lens space surgeries. This is joint work with Ken Baker and Brandy Guntel Doleshal.

## André de Carvalho

Thursday, June 27, 12h15-12h45, Room 212

### Convergence in dynamics and hyperbolic geometry

A family of sequences of braids on  $n$  strands is presented for which two associated dynamic-geometric structures converge as  $n$  goes to infinity: the associated pseudo-Anosov (pA) maps and the associated hyperbolic 3-manifolds. The convergences happen in the uniform and the geometric topology, respectively. However, whereas all sequences of associated pA maps converge to a single generalized pA map (the so-called tight horseshoe), each sequence of associated 3-manifolds converges to a different limiting hyperbolic 3-manifold. We will discuss how to (try to) reconcile these differences using algebraic limits of infinitely generated groups. This is joint work with Sylvain Bonnot.

---

## Sergey Matveev

Thursday, June 27, 14h15-14h45, Shannon Lecture Hall

### Prime decomposition of knots in thickened surfaces

We prove that if a nontrivial knot  $K$  in a thickened surface  $F \times I$  determines the trivial element of  $H_1(F; Z_2)$ , then  $K$  has a unique decomposition into prime factors. The condition  $[K]$  in  $H_1(F; Z_2)$  is essential, but all counterexamples admit an explicit description.

## Jeffrey Meier

Thursday, June 27, 14h15-14h45, Room 211

### Seifert fibered surgery on hyperbolic pretzel knots

We will discuss the classification of Seifert fibered surgeries on hyperbolic pretzel knots. This is the last step in the classification of exceptional surgeries on hyperbolic pretzel knots. We will also discuss work in progress to complete the last remaining step in the classification of Seifert fibered surgeries on Montesinos knots, which would complete the classification of exceptional surgeries on arborescent knots.

## Pere Menal-Ferrer

Thursday, June 27, 14h15-14h45, Room 212

### Torsion of arithmetic hyperbolic 3-manifolds

Given a hyperbolic 3-manifold  $M$  and a positive integer  $n$ , we can consider  $n$ -dimensional complex linear representations of  $\pi_1 M$  obtained as the composition of a lift of the holonomy representation of  $M$  and the  $n$ -th fundamental representation of  $\mathrm{SL}(2, \mathbf{C})$ . In this talk, motivated by the recent work of Marshall and Mueller, I will discuss the existence and characterization of lattices  $L_n \subset \mathbf{C}^n$  that are invariant under  $\pi_1 M$ ; their corresponding homology groups  $H_*(M; L_n)$  will be discussed as well. Not surprisingly, the existence of such lattices is very related to the arithmetic of  $M$ ; however, it is quite remarkable that the amount of torsion in the groups  $H_1(M; L_n)$  is related to the volume of  $M$ . Marshall and Mueller studied these questions when  $M$  is closed; in this talk, I will discuss at what extent this can be generalized to cusped manifolds.

---

## François Guéritaud

Thursday, June 27, 15h-16h, Shannon Lecture Hall

### Flat spacetimes via the arc complex

Margulis gave examples of properly discontinuous affine actions on  $R^3$  by free groups, answering a question of Milnor. I will show how to interpret

such actions in terms of perturbations of hyperbolic surfaces, via a deformation procedure similar to earthquakes – except that tectonic plates move perpendicularly to (rather than along) fault lines. Such examples are naturally parametrized by the arc complex of a surface with boundary, and I will sketch a proof that there are essentially no others. Joint work with Jeff Danciger and Fanny Kassel.

---

## Danny Calegari

Thursday, June 27, 16h30-17h30, Shannon Lecture Hall

### Random groups contain surface subgroups

A random group contains many quasiconvex surface subgroups. This is joint work with Alden Walker.

---

## Martin Lustig

Thursday, June 27, 17h45-18h15, Shannon Lecture Hall

### The classification problem for mapping classes

For any hyperbolic fully irreducible (= iwip) automorphism  $\phi \in \text{Out}(F_N)$  the mapping torus group  $G_\phi = F_N \rtimes_\phi \langle t \rangle$  is hyperbolic, and the embedding  $\iota : F_N \hookrightarrow G_\phi$  induces a continuous,  $F_N$ -equivariant and surjective *Cannon-Thurston map*  $\hat{\iota} : \partial F_N \rightarrow \partial G_\phi$ .

We prove that for any  $\phi$  as above, the map  $\hat{\iota}$  is finite-to-one and that the preimage of every point of  $\partial G_\phi$  has cardinality  $\leq 2N$ .

We also prove that every point  $S \in \partial G_\phi$  with  $\geq 3$  preimages in  $\partial F_N$  is rational and has the form  $(wt^m)^\infty$  where  $w \in F_N, m \neq 0$ , and that there are at most  $4N - 5$   $F_N$ -orbits of such points in  $\partial G_\phi$  (for the translation action of  $F_N$  on  $\partial G_\phi$ ).

We show that, by contrast, for  $k = 1, 2$  there are uncountably many points  $S \in \partial G_\phi$  with exactly  $k$  preimages in  $\partial F_N$ .

This is joint work with I. Kapovich.



## **Ana Garcia Lecuona**

Thursday, June 27, 17h45-18h15, Room 211

### **On surgeries between $S^1 \times S^2$ and lens spaces**

We consider knots in  $S^1 \times S^2$  with a Dehn surgery to a lens space and how this parallels what happens for knots in  $S^3$ . The Cyclic Surgery Theorem enables a classification for non-longitudinal surgeries, while Berge's families of doubly primitive knots in  $S^3$  motivate our conjectural classification for longitudinal surgeries. We will compare this conjectural picture with the Berge Conjecture and propose a means of relating the two.

## **Anastasiia Tsvietkova**

Thursday, June 27, 17h45-18h15, Room 212

### **Invariants of hyperbolic links from link diagrams**

W. Thurston demonstrated that every link in  $S^3$  is a torus link, a satellite link or a hyperbolic link and these three categories are mutually exclusive. The talk will briefly introduce an alternative method for computing the hyperbolic structure of the complement of a hyperbolic link, based on ideal polygons bounding the regions of a diagram of the link rather than decomposition of the complement into ideal tetrahedra. We will show how this allows to compute various invariants directly from link diagrams, including the exact hyperbolic volume for some families of links, and some arithmetic invariants (e.g. the invariant trace field).

This is based on joint work with M. Thistlethwaite, and on joint work with W. Neumann.

## Friday June 28

9h-10h, Shannon Hall  
**Stefan Friedl**

10h-10h30  
Coffee break

10h30-11h30, Shannon Hall  
**David Gabai**

11h45-12h45, Shannon Hall  
**Peter Shalen**

12h45  
Lunch

## Abstracts

### Stefan Friedl

Friday, June 28, 9h-10h, Shannon Lecture Hall

#### **Twisted Alexander polynomials, fiberedness and the Thurston norm**

We show that twisted Alexander polynomials detect whether a 3-manifold is fibered and they detect the Thurston norm of most 3-manifolds.

---

### David Gabai

Friday, June 28, 10h30-11h30, Shannon Lecture Hall

#### **Topologies of the curve complex**

TBA.

---

### Peter Shalen

Friday, June 28, 11h45-12h45, Shannon Lecture Hall

#### **Diameter and homology of hyperbolic 3-manifolds**

The Mostow rigidity theorem implies that the topological type of a closed, orientable hyperbolic  $n$ -manifold  $M$  determines  $M$  up to isometry. Hence any quantitative geometric invariant of a hyperbolic  $n$ -manifold is in principle a topological invariant. This raises the question of how these geometrically defined invariants compare with more classical topological invariants. For example, if we define the covering radius of  $M$  at a point  $p$  to be  $\text{cov}_p M = \max_{x \in M} \text{dist}(p, x)$ , a standard elementary argument shows that  $\text{rank} \pi_1(M) \leq B \exp(2 \min_{p \in M} \text{cov}_p M)$  for some universal constant  $B$ . (The rank of  $\pi_1(M)$  is defined to be its minimal number of generators.) This in particular gives a bound for  $\text{diam} M = \max_{p \in M} \text{cov}_p M$  in terms of  $\text{rank}(\pi_1(M))$ .

## Some suggestions for evening meals

### **Inexpensive** (i.e. less than 20 euros)

African Queen (African), 14 Rue des Paradoux, ☎: +33 (0)5 61 25 99 52  
Coeur d'Amande (North African), 49 rue Pierre Paul Riquet, ☎: +33 (0)5 34 42 97 15  
L'Entrecôte (steacks), 15 Boulevard de Strasbourg, ☎: +33 (0)5 61 21 87 18  
La Faim des Haricots (vegetarian), 3 Rue du Puits Vert, ☎: +33 (0) 61 22 49 25  
La Gouaille (French), 6 Rue Joutx Aigues, ☎: +33 (0) 61 25 65 66  
Le Marrakech (North African), 11 Place Arnaud Bernard, ☎: +33 (0) 61 23 82 52  
Le May (French), 4 Rue du May, ☎: +33 (0) 61 23 98 76  
La Pastasciutta (Pizzas), 35Bis Rue Gabriel Péri, ☎: +33 (0) 61 62 69 39  
Chez Raymond (French), 9 place Jean-Diebold, ☎: +33 (0) 61 42 77 56  
Saveurs Vietnam (Vietnamese), 8 rue denfert rochereau, ☎: +33 (0) 61 57 03 89  
Vecchio (Pizzas), 22 Allée Jean Jaurès, ☎: +33 (0) 62 73 34 73

### **More expensive** (but still less than 30 euros without wine)

Le Bistrot de l'Etoile (French), 6 Rue de l'étoile, ☎: +33 (0) 61 63 13 43  
La Madeleine de Proust (French), 11 Rue Riquet, ☎: +33 (0) 61 63 80 88  
Chez Navarre (French), 49 Grande Rue Nazareth, ☎: +33 (0) 62 26 43 06  
Ô Boui Boui Lao (Lao), 30 r ue Palaprat, ☎: +33 (0) 62 72 28 03  
La Rotisserie des Carmes (French), 38 Rue des Polinaires, ☎: +33 (0) 61 53 34 88  
Zio (African), 25 Rue des Moulins, ☎: +33 (0) 61 55 19 02

### **No limit**

Anges et Démons (French), 1 Rue Perchepinte, ☎: +33 (0) 61 52 66 69  
La Braisière (French), 42 Rue Pharaon, ☎: +33 (0) 61 52 37 13  
Le Genty Magre (French), 3 Rue Genty Magre, ☎: +33 (0) 61 21 38 60  
L'Empereur de Hué (Vietnamese), 17 Rue des couteliers, ☎: +33 (0) 61 53 55 72  
Le Pic Saint-Loup (French), 7, rue Saint-Léon, ☎: +33 (0) 61 53 81 51

## Participants

Norbert A'Campo <norbert.acampo@unibas.ch>  
Colin Adams <cadams@williams.edu>  
Ian Agol <ianagol@math.berkeley.edu>  
Yinghua Ai <yhai@math.tsinghua.edu.cn>  
Lorena Armas-Sanabria <lorenaarmas089@gmail.com>  
Djomako Tchuangou Armel Chrislain <djomako@uy1.uninet.cm>  
Benjamin Audoux <audoux@cmi.univ-mrs.fr>  
Sebastian Baader <sebastian.baader@math.unibe.ch>  
David Bachman <bachman@pitzer.edu>  
Mark Baker <mark.baker@univ-rennes1.fr>  
Cheryl Balm <balmcher@math.msu.edu>  
Jean-François Barraud <barraud@math.univ-toulouse.fr>  
Christophe Bavard <Christophe.Bavard@math.u-bordeaux1.fr>  
Mark Bell <m.c.bell@warwick.ac.uk>  
Fathi Ben Aribi <benaribi@math.jussieu.fr>  
Maxime Bergeron <mbergeron@math.ubc.ca>  
Laurent Bessières <laurent.bessieres@math.u-bordeaux1.fr>  
Gérard Besson <G.Besson@ujf-grenoble.fr>  
Michel Boileau <michel.boileau@math.univ-toulouse.fr>  
Corentin Boissy <corentin.boissy@latp.univ-mrs.fr>  
Dmitry Bolotov <bolotov@ilt.kharkov.ua>  
Francis Bonahon <fbonahon@math.usc.edu>  
Steven Boyer <boyer.steven@uqam.ca>  
Danny Calegari <dannyc@math.uchicago.edu>  
Richard Canary <canary@umich.edu>  
Matias Carrasco <matias.carrasco@math.u-psud.fr>  
Robert Castellano <castellano@math.columbia.edu>  
Guillem Cazassus <guillem.cazassus@math.univ-toulouse.fr>  
Benoît Chevallier <chevalli@univ-tlse2.fr>  
Sangbum Cho <scho@hanyang.ac.kr>  
Adam Clay <adamjosephclay@gmail.com>  
Moshe Cohen <cohenm10@macs.biu.ac.il>  
Vincent Colin <vincent.colin@univ-nantes.fr>  
Daryl Cooper <cooper@math.ucsb.edu>  
Octav Cornea <cornea@dms.umontreal.ca>  
François Dahmani <francois.dahmani@ujf-grenoble.fr>  
André de Carvalho <andre@ime.usp.br>  
Pierre Dehornoy <pierre.dehornoy@gmail.com>

Pierre Derbez <pderbez@gmail.com>  
 Jerome Dubois <dubois@math.jussieu.fr>  
 Mario Eudave-Muñoz <mario@matem.unam.mx>  
 Peter Feller <peter.feller@math.unibe.ch>  
 Thomas Fiedler <fiedler@math.univ-toulouse.fr>  
 Stefano Francaviglia <stefano.francaviglia@unibo.it>  
 Stefan Friedl <sfriedl@gmail.com>  
 David Gabai <gabai@princeton.edu>  
 Mauricio Garcia <mauriciogtec@gmail.com>  
 Ana Garcia Lecuona <ana.lecuona@latp.univ-mrs.fr>  
 Matthieu Gendulphe <matthieu@gendulphe.com>  
 Slavyana Geninska <geninska@math.univ-toulouse.fr>  
 Paolo Ghiggini <paolo.ghiggini@univ-nantes.fr>  
 Darlan Girao <dgirao@mat.ufc.br>  
 Fabio Gironella <fabio.gironella@ens.fr>  
 Daciberg Gonçalves <dlgoncal@ime.usp.br>  
 Cameron Gordon <gordon@math.utexas.edu>  
 Christian Graf <christian.graf@unibas.ch>  
 Joshua Greene <joshuaevangreene@gmail.com>  
 John Guaschi <john.guaschi@unicaen.fr>  
 Vincent Guedj <vincent.guedj@math.univ-toulouse.fr>  
 François Guéritaud <francois.gueritaud@math.univ-lille1.fr>  
 Peter Haissinsky <phaissin@math.univ-toulouse.fr>  
 Abdelbasset Hasni <abdelbasset.hasni@gmail.com>  
 Claude Hayat <hayat@math.univ-toulouse.fr>  
 Michael Heusener <michael.heusener@math.univ-bpclermont.fr>  
 Arnaud Hilion <arnaud.hilion@univ-amu.fr>  
 Neil Hoffman <nhoffman@mpim-bonn.mpg.de>  
 Thomas Jaeger <tcjaeger@syr.edu>  
 Yeonhee Jang <yeonheejang@cc.nara-wu.ac.jp>  
 Kate Juschenko <kate.juschenko@gmail.com>  
 Will Kazez <will@math.uga.edu>  
 Steve Kerckhoff <spk@math.stanford.edu>  
 Sungwoon Kim <sungwoon@kias.re.kr>  
 Paul Kirk <pkirk@indiana.edu>  
 Teruaki Kitano <kitano@soka.ac.jp>  
 Martine Klughertz <martine.klughertz@math.univ-toulouse.fr>  
 Rostyslav Kravchenko <rkchenko@gmail.com>  
 Pradip Kumar <pmishra@hri.res.in>  
 Emily Landes <erlandes@gmail.com>

Kyle Larson <klarson@math.utexas.edu>  
 François Laudenbach <francois.laudenbach@univ-nantes.fr>  
 Oleg Lazarev <olazarev@math.stanford.edu>  
 Cyril Lecuire <lecuire@math.univ-toulouse.fr>  
 Eon-Kyung Lee <eonkyung@sejong.edu>  
 Sang-Jin Lee <sangjin@konkuk.ac.kr>  
 André Legrand <andre.legrand@math.univ-toulouse.fr>  
 Adam Levine <levinea@brandeis.edu>  
 Gilbert Levitt <levitt@unicaen.fr>  
 Tao Li <taoli@bc.edu>  
 Guogang Liu <guogang.liu@univ-nantes.fr>  
 Jerome Los <los@cmi.univ-mrs.fr>  
 Martin Lustig <MartinLustig@gmx.de>  
 Sylvain Maillot <smaillot@math.univ-montp2.fr>  
 François Malabre <francois.malabre@gmail.com>  
 Bruno Martelli <martelli@dm.unipi.it>  
 Gregor Masbaum <masbaum@math.jussieu.fr>  
 Daniel Matignon <matignon@latp.univ-mrs.fr>  
 Sergey Matveev <matveev@csu.ru>  
 Greg McShane <greg.mcshane@gmail.com>  
 Jeffrey Meier <jmeier@math.utexas.edu>  
 Pere Menal-Ferrer <menalov@gmail.com>  
 Filip Misev <filip.misev@math.unibe.ch>  
 Mahan Mj <mahan.mj@gmail.com>  
 Yoav Moriah <ymoriah@tx.technion.ac.il>  
 Takayuki Morifuji <morifuji@z8.keio.jp>  
 Michele Mulazzani <michele.mulazzani@unibo.it>  
 Alexey Muranov <muranov@math.univ-toulouse.fr>  
 Emmy Murphy <e\_murphy@math.mit.edu>  
 Stefan Müller <mueeller@psu.edu>  
 Matthias Nagel <matthinagel@gmx.net>  
 Inasa Nakamura <inasa@math.gakushuin.ac.jp>  
 Duc-Manh Nguyen <duc-manh.nguyen@math.u-bordeaux1.fr>  
 Tien Zung Nguyen <tienzung@math.univ-toulouse.fr>  
 Yi Ni <yini@caltech.edu>  
 Klaus Niederkrüger <niederkr@math.univ-toulouse.fr>  
 Abdul Rauf Nizami <arnizami@ue.edu.pk>  
 João Miguel Nogueira <nogueira@mat.uc.pt>  
 Jean-Pierre Otal <otal@math.univ-toulouse.fr>  
 Makoto Ozawa <w3c@komazawa-u.ac.jp>

Alexandre Paiva Barreto <alexandre@dm.ufscar.br>  
 Frederic Palesi <frederic.palesi@univ-amu.fr>  
 Luisa Paoluzzi <paoluzzi@cmi.uni-mrs.fr>  
 Emmanuel Paul <emmanuel.paul@math.univ-toulouse.fr>  
 Frédéric Paulin <frederic.paulin@math.u-psud.fr>  
 Carlo Petronio <petronio@dm.unipi.it>  
 Joan Porti <porti@mat.uab.cat>  
 Leonid Potyagailo <leonid.potyagailo@univ-lille1.fr>  
 Jessica Purcell <jpurcell@math.byu.edu>  
 Julio Rebelo <rebelo@math.univ-toulouse.fr>  
 Alan Reid <areid@math.utexas.edu>  
 Helena Reis <hreis@fep.up.pt>  
 Claire Renard <claire.renard@cmla.ens-cachan.fr>  
 Claude André Roche <claire.roche@math.univ-toulouse.fr>  
 Pascale Roesch <pascaleroesch@gmail.com>  
 Dale Rolfsen <rolfsen@math.ubc.ca>  
 Martin Rosalie <martin.rosalie@coria.fr>  
 Joachim Hyam Rubinstein <rubin@ms.unimelb.edu.au>  
 Eliane Salem <salem@math.jussieu.fr>  
 Antonio Salgueiro <ams@mat.uc.pt>  
 Nabil Sayari <nabil.sayari@umoncton.ca>  
 Martin Scharlemann <mgscharl@math.ucsb.edu>  
 Saul Schleimer <s.schleimer@warwick.ac.uk>  
 Jean-Marc Schlenker <jmschlenker@gmail.com>  
 Peter Shalen <shalen@math.uic.edu>  
 Vladimir Shchur <vlshchur@gmail.com>  
 Kyler Siegel <ksiegel@math.stanford.edu>  
 Juan Souto <jsouto@math.ubc.ca>  
 Gilberto Spano <gilberto.spano@univ-nantes.fr>  
 Mark Spivakovsky <mark.spivakovsky@math.univ-toulouse.fr>  
 Michel Thomé <michelmthome@free.fr>  
 Stephan Tillmann <tillmann@maths.usyd.edu.au>  
 Bulent Tosun <tosun@cirget.ca>  
 Jérémy Toulisse <jeremytoulisse@gmail.com>  
 David Trotman <trotman@cmi.univ-mrs.fr>  
 Anastasiia Tsvietkova <tsvietkova@lsu.edu>  
 Vladimir Verchinine <vershini@math.univ-montp2.fr>  
 Vera Vertesi <vvertesi@gmail.com>  
 Bronislaw Wajnryb <dwajnryb@prz.edu.pl>  
 Genevieve Walsh <geneveive.walsh@tufts.edu>



Shicheng Wang <wangsc@math.pku.edu.cn>  
Richard Webb <r.c.h.webb@warwick.ac.uk>  
Claude Weber <claudeweber@unige.ch>  
Richard Weidmann <weidmann@math.uni-kiel.de>  
Chris Wendl <c.wendl@ucl.ac.uk>  
Wenyan Yang <yabziz@gmail.com>  
Alexandr Zamorzaev <alzaor@math.stanford.edu>  
Ahmed Zeriahi <zeriahi@math.univ-toulouse.fr>  
Alexander Zupan <zupan@math.utexas.edu>

## Organisation

The Organising Committee consists of Jean-François Barraud, Claude Hayat, Cyril Lecuire, Alexey Muranov, Klaus Niederkrüger (Toulouse), John Guaschi (Caen), Luisa Paoluzzi (Marseille) and Joan Porti (Barcelona).

The Scientific Committee consists of Norbert A'Campo (Basel), Gérard Besson (Grenoble), Francis Bonahon (Los Angeles), Steven Boyer (Montréal), Cameron Gordon (Austin), Gilbert Levitt (Caen), Jean-Pierre Otal (Toulouse), Shicheng Wang (Beijing), Claude Weber (Geneva).

This conference form part of the scientific activities of the thematic month Topology, Symplectic and Contact Geometry in Toulouse, organised by the International Center of Mathematics and Computer Science in Toulouse (CIMI).

The meeting also received financial support from the Toulouse Mathematics Institute, the CNRS, Paul Sabatier University, the GDR "Tresses", the GEAR Network, the Région Midi-Pyrénées, and the three ANR projects Extension of Teichmueller-Thurston theories, Contact topology in higher dimensions and Geometry of subgroups.

