

WINTERBRAIDS VII

School on braids and low-dimensional topology

Université de Caen
27th February-2nd March, 2017

Organizing committee:
P. Bellingeri, V. Florens, J.B. Meilhan, E.Wagner

– Programme –

Amphitheater S3-049 (Monday, Tuesday and Thursday)
Amphitheater S3-057 (Wednesday) building S3, first floor
Registration will be held in room S3-247, building S3, second floor

	Monday 27th	Tuesday 28th	Wednesday 1st	Thursday 2nd
9h00-9h30	Registration	McCammond I	Vertesi III	Porti III
9h30-10h00	Rolfsen I			
10h00-10h30		Coffee break	Coffee break	Coffee break
10h30-11h00	Coffee break	Rolfsen II	McCammond II	McCammond III
11h00-11h30	Porti I			
11h40-12h10		Vertesi II	Benhedi	McLeay
12h15-12h45	Bénard		Silvero	Gobet
<i>Lunch</i>				
15h-16h	Vertesi I	Porti II	Rolfsen III	
<i>Coffee break</i>				
16h30-17h00	Blasco	Serrano	Limouzineau	
17h00-17h30	Spano	Toffoli	Robert	

- Abstracts -

Mini courses

McCammond Jon (UC Santa Barbara)
The mysterious geometry of Artin groups

Artin groups are easy to define but are, in most cases, notoriously hard to understand. In particular, for most Artin groups we do not even know how to solve the word problem. And what makes the situation a bit mysterious is that it can be a little difficult to pinpoint the exact reason *why* they are currently hard to understand. The primary goal of this short course is to highlight exactly where the problems begin.

In the first talk I review the close connection between Artin groups and Coxeter groups and the associated topological spaces used to investigate them. In the second talk I summarize exactly which Artin groups we understand (meaning we have an explicit solution to the word problem) and which ones we don't. And in the third talk I turn my attention to those Artin groups (and their relatives) that are not currently understood but which we are likely to understand sometime soon.

Porti Joan (UA Barcelona)
Character varieties and knot symmetries

The set of homomorphisms of the fundamental group of a three manifold in $SL(2, \mathbb{C})$ is called the variety of representations. The variety of characters encodes the conjugacy classes of the representations. Both varieties are key tools to study the geometry and topology of three manifolds.

I will start introducing the basic definitions and properties. I plan to put emphasis on explicit computations and examples. I will also survey some of its applications. Then I will focus in a joint work with Luisa Paoluzzi, on the different behavior of the variety of characters of knots with symmetries according to the kind of symmetry, whether it is free or has fixed points (also called period).

Rolfen Dale (University of British Columbia)
Ordering braids, knot groups and beyond

This will be a series of three talks on application of ordered groups to topology and vice-versa. My interest in the subject began when I learned about Patrick Dehornoy's beautiful proof that the braid groups are left-orderable. This has the nice consequence (for some calculations I was doing at the time) that the group ring $Z[B_n]$ has no zero divisors. Because of this proof I became hooked on orderable groups for many years since then!

Vertesi Vera (University of Strasbourg)
Braids in contact structures

This will be a series of three lectures on the properties of braids respecting contact structures.

A *contact structure* on a 3-manifold is a plane field that is not tangent to any open surface. Contact structures can be traced back to the works of Sophus Lie in 1872. The standard contact structure in \mathbb{R}^3 is the plane field given as the kernel of the one form $dz - r^2 d\theta$. In the beginning of the lecture series I will explain the famous theorem of Bennequin stating that \mathbb{R}^3 has nonstandard contact structures. The proof uses braids that are transverse to the contact structure, such knots are called *transverse knots*. Braid theory for transverse knots is interesting in its own right; I will describe a transverse version of Markov and Alexander theorem. If time permits I will talk about our recent work with J. Etnyre concerning braid representations of knots that are tangent to the contact structure, called *Legendrian knots*.

Short talks

Bénard Léo (Université Paris VI)

Reidemeister torsion form on the character variety

We define the Reidemeister torsion as a rational differential form on the character variety of a 3-manifold M with toric boundary. Then we study the singularities of this differential form, there are two cases : the singularities at finite points and at ideal points;. The latter are related, by the Culler-Shalen theory, to incompressible surfaces in the variety M . The main result provides a relation between the vanishing order of the torsion at an ideal point and the Euler characteristic of the related surface.

Benheddi Mounir (Université de Genève)

On Khovanov homology of infinite torus links

Khovanov homology is a homology theory that associates to any link a bi-graded vector space and whose Euler characteristic is the Jones polynomial. There exists an explicit formula for the Jones polynomial of any torus link $T_{p,q}$, and it is thus natural to try and compute their respective Khovanov homology. However such precise computations quickly become unmanageable due to the size of the chain complex, which grows exponentially on the number of crossings. By fixing p and letting q grow to infinity, one obtains an 'infinite p -torus link' and, as shown by Stosic, a corresponding well-defined 'limit' vector space. More often than not, these limit homologies tend to have more structure than their finite counterparts. In this talk, we will endow the Khovanov homology of the infinite p -torus link with a structure of commutative algebra and describe it explicitly for $p=2,3,4$.

Blasco Ruben (Universidad de Zaragoza)

Some properties on even Artin groups

Artin groups are an interesting family of groups from both an algebraic and a topological point of view. In my talk I will focus on a special subfamily: even Artin groups, and I will present some interesting results about their algebraic and topological properties.

Gobet Thomas (Université de Lorraine) joint with B. Baumeister

On simple dual braids and Mikado braids of type D_n

We explain how to relate simple dual braids and Mikado braids of type D_n to those of type B_n by using a suitable embedding of Artin-Tits groups of type D_n inside a quotient of an Artin-Tits group of type B_n . This allows to show that any simple dual braid of type D_n is a Mikado braid.

Limouzineau Maelys (Université Paris VI)

Cobordism and concordance of Legendrian knots contour of generating functions

I will describe some explicit constructions related with cobordisms of Legendrian knots (in the sense of V.I. Arnold). I will focus on those knots which possess a generating function. After recalling the basic definitions and the main motivations, I will show how to define a concordance group of Legendrian knots equipped with a generating function.

McLeay Alan (University of Glasgow)

Ivanov's Metaconjecture: Automorphism Groups of Sufficiently Rich Complexes of Regions for Surfaces with Punctures

It is a well-known and fundamental result of Ivanov that the curve complex of an orientable surface with punctures has automorphism group isomorphic to the extended mapping class group of the surface. It was subsequently shown that the equivalent statement is true for a number of other complexes, among them the pants complex (Margalit) and the separating curve complex (Brendle-Margalit, Kida). Such results led Ivanov to make a meta-conjecture: all sufficiently rich complexes related to the surface will have automorphism group isomorphic to the extended mapping class group. A result by Brendle-Margalit shows this to be true for a broad class of complexes for closed surfaces. In this talk I will give the more general result for complexes relating to surfaces with punctures.

Robert Louis-Hadrien (Universität Hamburg) joint with E. Wagner

Categorification of MOY calculus

MOY calculus has been introduced in the 90s to compute combinatorially the quantum link invariant associated with the Hopf algebra $U_q(\mathfrak{sl}_N)$. It associates to any decorated graph a Laurent polynomial in q . I will describe a TQFT-like functor which categorifies the MOY calculus and provides a new description of the $U_q(\mathfrak{sl}_N)$ -homology. Finally, I will explain how this sheds a new light on the structures of cohomology rings of partial flag varieties.

Serrano de Rodrigo Juan (Universidad de Zaragoza) joint with V.Florens and G.Massuyeau

A Functorial Extension of the Magnus Representation to the Category of three--dimensional Cobordisms

Let R be an integral domain and G be a subgroup of its group of units. We consider the category Cob_G of 3-dimensional cobordisms between oriented surfaces with connected boundary, equipped with a representation of their fundamental group in G . Under some mild conditions on R , we construct a monoidal functor from Cob_G to the category pLagr_R consisting of "pointed Lagrangian relations" between skew-Hermitian R -modules. We call it the "Magnus functor" since it contains the Magnus representation of mapping class groups as a special case. Our construction is inspired from the work of Cimasoni and Turaev on the extension of the Burau representation of braid groups to the category of tangles. It can also be regarded as a G -equivariant version of a TQFT-like functor that has been described by Donaldson. The study and computation of the Magnus functor is carried out using classical techniques of low-dimensional topology.

Silvero Casanova Marithania (Universidad de Sevilla)

A new realization of extreme Khovanov homology

Khovanov homology is a link invariant introduced in 2000 by Mikhail Khovanov. This bigraded homology categorifies Jones polynomial and it has been proved to detect the unknot. In this talk we present a new approach to extreme Khovanov homology in terms of a specific graph constructed from the link diagram. With this point of view, we pose a conjecture related to the existence of torsion in extreme Khovanov homology and show some examples where the conjecture holds.

Spano Gilberto (Université de Grenoble Alpes)

Twisted Gromov and Lefschetz invariants associated with bundles

Given a 3-manifold Y , we define a twisted version of the Reidemeister torsion of Y associated with a choice of a surface bundle over Y . We show how this bundle-twisted Reidemeister torsion is related to some standard twisted Reidemeister torsions of Y associated with a choice of a representation of its fundamental group. We define then a twisted version of the Gromov invariants for symplectic 4-manifolds and we give examples that relate these new invariants to some twisted Reidemeister torsions in dimension 3.

Toffoli Enrico (University of Regensburg)

Multivariable signatures and link concordance

In 2005, Cimasoni and Florens introduced a multivariable generalization of the Levine-Tristram signature of a link. This invariant can be defined using generalized Seifert surfaces, but a more abstract approach is often useful. In this talk, we will present a way to define the multivariable signature of a given link as the twisted signature of a suitable class of 4-manifolds. We will then discuss applications to link concordance.