

## Wednesday 27.06.2012

08:30-09:20	Registration
09:20-09:30	Opening remarks
09:30-9:55	Rubén A. Hidalgo <i>On the connectivity of the branch locus in Schottky space</i>
09:55-10:20	Ara Basmajian <i>Non-simple closed geodesics on hyperbolic surfaces</i>
10:20-10:45	Rubí Rodríguez <i>Abelian varieties with Hecke algebra action</i>
10:45-11:15	COFFEE BREAK
11:15-11:40	Gareth Jones <i>Beauville surfaces and their automorphism groups</i>
11:40-12:05	Gabino González-Diez <i>Non-homeomorphic Galois conjugate surfaces I</i>
12:05-12:30	David Torres-Teigell <i>Non-homeomorphic Galois conjugate surfaces II</i>
12:30-14:30	LUNCH
14:30-14:55	Józef H. Przytycki <i>Quandle of Dehn twists and symplectic quandle</i>
14:55-15:20	Ewa Tyszkowska <i>The application of the theory of coverings in the study of NEC groups</i>
15:20-15:45	Milagros Izquierdo <i>Cyclic Trigonal Maps</i>
15:45-16:15	COFFEE BREAK
16:15-16:40	Klaus-Dieter Semmler <i>Hyperbolic Polygons and Hyperelliptic Riemann Surfaces</i>
16:40-17:05	Mattia Mecchia <i>Finite groups acting on 3-manifolds and cyclic branched coverings of knots</i>
17:05-17:30	Fedor Pakovich <i>On semiconjugate rational functions</i>
18:00 -	Welcome party

## Thursday 28.06.2012

09:30-9:55	Javier Cirre <i>The full real genus of cyclic groups</i>
09:55-10:20	Young Ho Kim <i>New approach to spheres and paraboloids</i>
10:20-10:45	Ján Karabáš <i>Group actions on orientable surfaces</i>
10:45-11:15	COFFEE BREAK
11:15-11:40	Hugo Parlier <i>Moduli spaces of large genus</i>
11:40-12:05	Victor González <i>Stable curves and threefolds</i>
12:05-12:30	Santiago López de Medrano <i>Some actions of <math>\mathbb{Z}_2^m</math> and other groups on compact surfaces</i>
12:30-14:30	LUNCH
14:30-14:55	Alexander Mednykh <i>Area formulae for non-Euclidean polygons through side lengths</i>
14:55-15:20	Błażej Szepietowski <i>A presentation for the mapping class group of a nonorientable surface</i>
15:20-15:45	Susumu Hirose <i>On the extendability of diffeomorphisms over non-orientable surfaces standardly embedded in the 4-sphere</i>
15:45-16:15	COFFEE BREAK
16:15-16:40	Michal Stukow <i>Hyperelliptic mapping class group of a nonorientable surface</i>
16:40-17:05	Juergen Wolfart <i>Dessins and complex multiplication</i>
17:05-17:30	Toshihiro Nakanishi <i>Parametrization for Teichmüller spaces by trace functions</i>
19:30 -	Conference dinner at Hotel Hanza restaurant

## Friday 29.06.2012

09:30-9:55	Gabriel Bartolini <i>Full automorphism groups of <math>p</math>-gonal Riemann surfaces</i>
09:55-10:20	Ilya Mednykh <i>On the upper bound in the de Franchise theorem for Riemann surfaces of low genera</i>
10:20-10:45	Gabriele Mondello <i>A cyclic extension of the earthquake flow</i>
10:45-11:15	COFFEE BREAK
11:15-11:40	Sebastian Reyes-Carocca <i>Field of moduli of Beauville Surfaces</i>
11:40-12:05	Jose Javier Etayo <i>On the minimum genus problem on bordered Klein surfaces of a given number of boundary components</i>
12:05-12:30	Peter Buser <i>Harmonic forms on degenerating Riemann surfaces</i>
12:30-14:30	LUNCH
14:30-14:55	Marston Conder <i>Distinguishing triangle groups by their finite quotients</i>
14:55-15:20	Mariela Carvacho <i>Non equivalent families of group actions on Riemann Surfaces</i>
15:20-15:45	Name <i>Title</i>
15:45-16:15	COFFEE BREAK
16:15 -	Excursion to the centre of Gdańsk and guided tour (by buses from the Institute of Mathematics - venue of the Workshop)

## LIST OF ABSTRACTS

**Gabriel Bartolini**  
**Linköping University, Sweden**

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*Talk title:* Full automorphism groups of  $p$ -gonal Riemann surfaces

*Abstract:*  $p$ -gonal Riemann surfaces have been widely studied. By using group cohomology we characterize the structures of the full groups of automorphisms of cyclic and real cyclic  $p$ -gonal Riemann surfaces with unique  $p$ -gonal morphism for odd primes  $p$ .

**Ara Basmajian**  
**Graduate Center and Hunter College, City University of New York, USA**  
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*Talk title:* Non-simple closed geodesics on hyperbolic surfaces

*Abstract:* We investigate the relationship, in various contexts, between the self-intersection number of a closed geodesic and its length.

**Peter Buser**  
**Ecole Polytechnique Fédérale de Lausanne**  
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*Talk title:* Harmonic forms on degenerating Riemann surfaces

*Abstract:* The lecture is about joint work with Eran Makover and Björn Mützel that deals with harmonic 1 forms. We try to understand, from a geometric point of view, their behaviour on families of compact Riemann surfaces that converge to non compact ones.

**Mariela Carvacho**  
**Departamento de Matemática Universidad Técnica Federico Santa María, Valparaíso, Chile**

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*Talk title:* Non equivalent families of group actions on Riemann Surfaces

*Abstract:* In 1991, G. González-Diéz proved the following: if the automorphism group  $\text{Aut}(S)$  of a Riemann surface  $S$  of genus greater or equal than 2 contains cyclic groups  $H_1, H_2$  of same prime order and such that the quotient surfaces  $S/H_i$  ( $i = 1, 2$ ) are isomorphic to the Riemann sphere  $\widehat{\mathbb{C}}$ , then  $H_1$  and  $H_2$  are conjugate in  $\text{Aut}(S)$ . Later in 1997, G. González-Diéz and R. Hidalgo produced a family of closed Riemann surfaces  $S_\lambda$ , admitting two cyclic groups of conformal automorphism of order 8 and such that the quotient surfaces are isomorphic to  $\widehat{\mathbb{C}}$ , which are not conjugate in  $\text{Aut}(S_\lambda)$  but they are topologically conjugate. In this talk we will show families of closed Riemann surfaces, each one admitting two cyclic groups of conformal automorphism of order  $2^n$  ( $n \in \mathbb{N}$ ) with the same properties as the examples constructed by González-Diéz and Hidalgo. This shows that the subvariety  $\mathcal{M}_g(H_1)$  of moduli space  $\mathcal{M}_g$  consisting of the points representing the Riemann surfaces of genus  $g$  admitting a group of automorphism topologically conjugate to  $H_1$  (or, equivalently, to  $H_2$ ) is not a normal subvariety.

**Javier F. Cirre**  
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*Talk title:* The full real genus of cyclic groups

*Abstract:* We consider the problem of extending the action of a cyclic group on a compact bordered surface to the effective action of some larger group on the same surface. If the cyclic action is realized

by means of a non-maximal NEC signature then it turns out that the actions always extends and, accordingly, the full group of all automorphisms of the surface is not cyclic. A natural question arises: which is the the smallest algebraic genus of a bordered surface on which the cyclic group of order  $n$  acts with no further extension, that is, as the full automorphism group of the surface? We call this the full real genus of the cyclic group, following the definition by C.L. May of the real genus as the smallest algebraic genus of a bordered surface on which the cyclic group acts effectively. In this talk we will determine the full real genus of the cyclic group, distinguishing between actions on orientable and non-orientable surfaces.

This is joint work (in progress) with Emilio Bujalance and Marston Conder.

### **Marston Conder**

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*Talk title:* Distinguishing triangle groups by their finite quotients

*Abstract:* For positive integers  $p$ ,  $q$  and  $r$ , the ordinary  $(p, q, r)$  triangle group  $\Delta^\circ(p, q, r)$  is the abstract group with presentation

$$\langle x, y, z \mid x^p = y^q = z^r = xyz = 1 \rangle.$$

This group is finite, or infinite soluble, or infinite insoluble, according to whether  $1/p + 1/q + 1/r$  is greater than, equal to, or less than 1. As part of some work with Martin Bridson and Alan Reid on distinguishing Fuchsian groups, I will show how to prove that two triangle groups  $\Delta^\circ(p, q, r)$  and  $\Delta^\circ(p', q', r')$  have the same finite quotients if and only if they are isomorphic, that is, if and only if the triple  $(p', q', r')$  is a permutation of  $(p, q, r)$ . The proof involves distinguishing triangle groups mainly by their cyclic, dihedral and 2-dimensional projective quotients, plus direct products of these and extensions of abelian groups, and some elementary number theory.

### **Jose Javier Etayo**

**Universidad Complutense de Madrid, Spain**

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*Talk title:* On the minimum genus problem on bordered Klein surfaces of a given number of boundary components

*Abstract:* The minimum genus problem consists on determining the minimum algebraic genus of a surface on which a given group acts. For cyclic groups this problem on bordered Klein surfaces was solved in 1989. The next step is to fix the number of boundary components of the surface and to obtain the minimum algebraic genus, and so the minimum topological genus. It was achieved for cyclic groups of prime and prime-power order in the nineties.

In this work the corresponding results for cyclic groups of order  $N = pq$ , where  $p$  and  $q$  are different odd primes, is obtained. There appear different results depending on the orientability of the surface.

Finally we obtain general results when the number of boundary components is small, which are valid for any odd  $N$ .

### **Victor Gonzalez**

**Universidad Tecnica Federico Santa Maria, Chile**

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*Talk title:* Stable curves and threefolds

*Abstract:* We study some relations between smooth cubic threefolds with automorphisms and stable curves of genus four.

### **Gabino González-Diez**

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*Talk:* Non-homeomorphic Galois conjugate surfaces I

*Abstract:* A combination of Hodge theory and Serre's GAGA principle implies that the Betti numbers of a complex projective variety  $X$  agree with those of any of its Galois conjugates (i.e. obtained from  $X$  by applying Galois conjugation to the coefficients of its defining equations). Nevertheless in 1964 J-P. Serre constructed a projective variety possessing non-homeomorphic Galois conjugates.

About a decade ago Catanese introduced a kind of complex surfaces that provide a fertile source of examples of this phenomenon. They are called Beauville surfaces and arise as certain finite quotients of a product of two hyperbolic Riemann surfaces. The key point about them is that they are almost characterized by their fundamental groups. This and other deep facts were proved by Catanese within the framework of algebraic geometry. In my talk I will try to give a proof of this rigidity property from the point of view of uniformization (i.e. via Fuchsian groups) and explain why this property implies that these surfaces often possess non homeomorphic Galois conjugates.

**Ruben Hidalgo**

**Universidad Tecnica Federico Santa Maria, Chile**

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*Talk title:* On the connectivity of the branch locus in Schottky space.

*Abstract:* This is a joint work with Milagros Izquierdo. We consider the branched regular cover  $P : \mathcal{MS}_g \rightarrow \mathcal{S}_g$  between the marked Schottky space  $\mathcal{MS}_g$  and Schottky space  $\mathcal{S}_g$ , for  $g \geq 2$ . We prove that the branch locus of  $P$  is connected.

**Susumu Hirose**

**Tokyo University of Science, Japan**

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*Talk title:* On the extendability of diffeomorphisms over non-orientable surfaces standardly embedded in the 4-sphere

*Abstract:* It is known that a diffeomorphism over an orientable compact surface standardly embedded in 4-sphere is extendable to the ambient 4-sphere if and only if this diffeomorphism preserves the Rokhlin quadratic form. (For genus 1 case, shown by Montesinos, and, for genus  $>1$  case, shown by the speaker) On the other hand, Guillou and Marin generalized the Rokhlin quadratic form to compact surfaces which can be non-orientable. In this talk, we will show that, for a non-orientable closed surface standardly embedded in the 4-sphere, a diffeomorphism over this surface is extendable if and only if this diffeomorphism preserves the Guillou-Marin quadratic form of this embedded surface.

**Milagros Izquierdo**

**Linköping University, Sweden**

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*Talk title:* Cyclic Trigonal Maps

*Abstract:* A map on a Riemann surface  $X$  is called cyclic trigonal if it admits morphism of degree 3 on a planar map where the associated covering from  $X$  to the Riemann sphere is cyclic. We characterize cyclic trigonal maps in terms of Fuchsian groups. We also obtain infinite families of cyclic trigonal maps.

**Gareth A. Jones**

**School of Mathematics, University of Southampton, UK**

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*Talk title:* Beauville surfaces and their automorphism groups

*Abstract:* Beauville surfaces are complex algebraic surfaces which have recently attracted considerable attention from both algebraic geometers and group theorists. I will describe how a Beauville surface  $S$  is constructed as the quotient of the product of two quasiplatonic complex algebraic curves

(compact Riemann surfaces) by a finite group  $G$  acting freely on the product. I shall explain how the automorphism group  $\text{Aut}(S)$  has a normal subgroup  $\text{Inn}(S)$  isomorphic to the centre of  $G$ , with a quotient isomorphic to a subgroup of the wreath product of  $S_3$  by  $S_2$ . I shall use results of Lucchini on generators of special linear groups to show that every finite abelian group can appear as  $\text{Inn}(S)$ .

**Ján Karabáš**

**Matej Bel University, Slovakia**

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*Talk title:* Group actions on orientable surfaces

*Abstract:* Lists of discrete group actions have many applications in different fields of mathematics. In combinatorics they can be used to derive lists of highly symmetrical maps of fixed genus: regular maps, vertex-transitive maps, Cayley maps or edge-transitive maps. The classification of actions of cyclic groups play the crucial role for enumeration problems of combinatorial objects, i.e. maps, graphs and others. Classification results can be used as an experimental material for further research, as well. The problem of classification of discrete actions of groups on orientable surfaces of genus  $g \geq 2$  is considered. The classification of groups acting on the sphere is a classical part of crystallography. In case of torus the situation is known in general, though there are infinitely many group actions. Due to Riemann-Hurwitz equation (Hurwitz bound) we know that for higher genera there are just finitely many finite groups acting on a surface of a given genus. Published lists of actions go up to genus five (Broughton; Bogopolskij; Kuribayashi and Kimura). For small genera, the the classification can be done with help of computer algebra systems. Using Magma we derived the list of actions of discrete groups on surfaces of genus  $2 \leq g \leq 24$ .

The presented work is the joint work with Roman Nedela.

**Young Ho Kim**

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*Talk title:* New approach to spheres and paraboloids

*Abstract:* We establish a characterization of spheres in  $E^3$  with respect to a surface area property of regions with the aid of a new meaning of Gaussian curvature. Furthermore, with respect to a volume property of regions, we characterize elliptic paraboloids in arbitrary dimensional Euclidean spaces.

**Santiago López de Medrano**

**Instituto de Matemáticas, UNAM, Mexico.**

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*Talk title:* Some actions of  $Z_2^m$  and other groups on compact surfaces.

*Abstract:* I will show different ways of representing compact orientable surfaces as intersections of quadrics in real affine space. Depending on the symmetry of the equations one gets actions of various groups on the corresponding surfaces. Among other cases, we obtain an action of  $Z_2^n \times D_n$  on the surface of genus  $2^{n-3}(n-4)+1$ , where  $D_n$  is the dihedral group. Only half of the elements preserve orientation.

**Mattia Mecchia**

**Universita di Trieste, Italy**

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*Talk title:* Finite groups acting on 3-manifolds and cyclic branched coverings of knots

*Abstract:* We consider the problem of the existence of an universal upper bound on the number of distinct knots in  $S^3$  having the same 3-manifold as cyclic branched covering of odd order. Our approach is based on the analysis of finite groups acting orientation-preservingly on 3-manifolds (in particular finite groups containing an involution with nonempty connected fixed point set).

**Alexander Mednykh**

**Sobolev Institute of Mathematics, Novosibirsk, Russia**

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*Talk title:* Area formulae for non-Euclidean polygons through side lengths

*Abstract:* The Heron formula (c. 60 BC) relates the area of an Euclidean triangle to its side lengths. Indian mathematician and astronomer Brahmagupta, in the seventh century, gave the analogous formulas for a convex cyclic quadrilateral. German mathematician Carl Bretschneider (1842) related the area of an arbitrary Euclidean quadrilateral to its side lengths and the sum of two opposite angles. Several non-Euclidean versions of the Heron theorem are known for a long time. In this lecture we consider a convex hyperbolic quadrilateral inscribed in a circle, horocycle or one branch of equidistant curve. This is a natural hyperbolic analog of the cyclic quadrilateral in the Euclidean plane. We find a few versions of the Brahmagupta formula for such quadrilaterals and consider some generalizations of the Bretschneider theorem for hyperbolic and spherical cases.

**Ilya Mednykh**

**Sobolev Institute of Mathematics, Novosibirsk, Russia**

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*Talk title:* On the upper bound in the de Franchise theorem for Riemann surfaces of low genera

*Abstract:* We obtain an upper bound for the number of holomorphic mappings of a genus 3 Riemann surface onto a genus 2 Riemann surface in a series of important cases. In particular, we establish that the number of holomorphic mappings of an arbitrary genus 3 Riemann surface onto an arbitrary genus 2 Riemann surface is at most 48. We show that this bound is sharp and find all pairs of Riemann surfaces for which it is attained.

**Gabriele Mondello**

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*Talk title:* A cyclic extension of the earthquake flow

*Abstract:* An earthquake is a deformation of a hyperbolic metric concentrated on a measured geodesic lamination. In this talk we will describe deformations of hyperbolic metrics whose intensity is parametrized by another hyperbolic metric. This allows us to define an  $S^1$ -flow on the product of two copies of Teichmüller space that specializes to the earthquake flow when one of the metrics degenerates to a measured lamination. This flow admits a complex extension that specializes to the complex earthquake. This is joint work with F. Bonsante and J.M. Schlenker.

**Toshihiro Nakanishi**

**Shimane University, Japan**

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*Talk title:* Parametrization for Teichmüller spaces by trace functions

*Abstract:* Every marked Fuchsian group of type  $(g,0,0)$  is determined by the traces of  $6g-5$  matrices in the group. This result was first proved by P. Schmutz in 1994. We review this result and consider the parametrization of the Teichmüller space of Fuchsian groups of type  $(g,m,n)$  by trace functions. We consider also the action of mapping class group on the Teichmüller space. We show that the mapping class group of the genus 2 surface can be represented by a group of rational transformations. (A joint work with Gou Nakamura.)

**Józef H. Przytycki**

**George Washington University, USA**

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*Talk title:* Quandle of Dehn twists and symplectic quandle



*Abstract:* J.Zablow (partially following D.Yetter) noticed that simple closed curves on a surface with Dehn twist operation form a quandle. The quandle structure descends to homology group of the surface or more generally allows us to describe quandle structure on any abelian group with an alternating form. We show few applications of the these to knot theory, in particular to interpretation of the fundamental quandle of the trefoil knot.

**Fedor Pakovich**

**Ben Gurion University, Israel**

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*Talk title:* On semiconjugate rational functions

*Abstract:* A classification of commuting rational functions, that is of rational solutions of the functional equation  $A(X)=X(A)$ , was obtained in the beginning of the past century by Fatou, Julia, and Ritt. In the talk we will present a solution of a more general problem of description of semiconjugate rational functions, that is of rational solutions of the functional equation  $A(X)=X(B)$  in terms of groups acting properly discontinuously on the Riemann sphere or complex plane.

**Hugo Parlier**

**University of Fribourg, Switzerland**

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*Talk title:* Moduli spaces of large genus

*Abstract:* The talk will be about the relationship between the geometry of surfaces and the geometry of the associated moduli spaces for surfaces of large genus.

**Sebastian Reyes-Carocca**

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*Talk title:* Field of moduli of Beauville Surfaces

*Abstract:* Given a complex projective algebraic variety, we may try to compute its field of moduli and to study when it is a field of definition. In general, these problems seem to be difficult. In this talk, we consider certain classes of complex surfaces called Beauville's surfaces and give a criteria in order to decide when it is defined over its field of moduli.

**Rubí Rodríguez**

**P. Universidad Católica de Chile**

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*Talk title:* Abelian varieties with Hecke algebra action

*Abstract:* The action of a finite group  $G$  on an abelian variety  $\mathcal{A}$  induces a decomposition of  $\mathcal{A}$  into factors related to the rational irreducible representations of  $G$ , the so called isotypical decomposition of  $\mathcal{A}$ ; when  $\mathcal{A} = JZ$  is the Jacobian variety of a curve  $Z$  with  $G$ -action, for every subgroup  $H$  of  $G$  there is an induced canonical action of the corresponding Hecke algebra  $\mathbb{Q}[H \backslash G / H]$  on the Jacobian of the quotient curve  $Z_H = Z/H$ , and a corresponding isotypical decomposition of  $JZ_H$ . These results have provided geometric and analytic information on the factors appearing in the isotypical decomposition of  $JZ$  and  $JZ_H$ . In this paper we show that similar results hold for any abelian variety  $\mathcal{A}$  with  $G$ -action: for every subgroup  $H$  of  $G$  there is a natural abelian subvariety  $\mathcal{A}_H$  of  $\mathcal{A}$  fixed by  $H$ , such that the Hecke algebra  $\mathbb{Q}[H \backslash G / H]$  acts on  $\mathcal{A}_H$ . We find the associated isotypical decomposition of  $\mathcal{A}_H$ , and the decomposition of the analytic and the rational representations of the action on  $\mathcal{A}_H$ .

**Klaus-Dieter Semmler**

**EPF Lausanne, Switzerland**

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*Talk title:* Hyperbolic Polygons and Hyperelliptic Riemann Surfaces

*Abstract:* Hyperbolic polygons can be viewed as generating a group of hyperbolic isometries. What are the properties to guarantee, that this group acts discontinuously, and what can be said about the quotient. We try to extend the knowledge acquired in many years by various authors in genus 2 to higher genus. We will present new advances in the subject related to the work of Gilman, Costa, and Buser.

**Michał Stukow**

**Gdańsk University, Poland**

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*Talk title:* Hyperelliptic mapping class group of a nonorientable surface.

*Abstract:* The hyperelliptic mapping class group is a very interesting and important subgroup of the mapping class group of an orientable surface. In our talk we will present some basic facts about the hyperelliptic mapping class groups of a nonorientable surface  $N$ . In particular we will show how to obtain a presentation for this group and how to compute its first homology with coefficients in  $H_1(N; Z)$ .

**Błażej Szepietowski**

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*Talk title:* A presentation for the mapping class group of a nonorientable surface.

*Abstract:* Although finite presentations of mapping class group of all compact orientable surfaces have been known for a long time, such presentations were known, until present, only for a few nonorientable surfaces of low genera. In this talk we describe an explicit finite presentation for the mapping class group of a nonorientable surface of any genus, either closed or with a connected boundary, obtained from the action of this group on the complex of curves. This is a joint work with Luis Paris.

**David Torres-Teigell**

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*Talk title:* Non-homeomorphic Galois conjugate surfaces II

*Abstract:* The dimensions of the cohomology groups  $H^i(X, \mathbb{C})$  of a complex projective variety  $X$  are invariant under Galois action. In particular the most common topological invariants (Betti numbers and signature) are Galois invariant, and this fact is enough in dimension one to ensure that the curves  $X$  and  $X^\sigma$  are always homeomorphic. However, in 1964 J. P. Serre constructed an example of two Galois conjugate varieties which are non-homeomorphic. In this talk we will construct two complex surfaces which, forming a complete orbit under the action of the absolute Galois group  $\text{Gal}(\overline{\mathbb{Q}}/\mathbb{Q})$ , are non-homeomorphic. These will be Beauville surfaces: quotients of the product  $S_1 \times S_2$  of two quasiplatonic curves by the free action of a finite group  $G$ .

(joint work with Gabino González-Diéz)

**Ewa Tyszkowska**

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*Talk title:* The application of the theory of coverings in the study of NEC groups

*Abstract:* We present a new method for determining the presentation of a normal subgroup of given NEC group, which is based on the theory of coverings.

**Juergen Wolfart**

**Mathematisches Seminar der Universitaet Frankfurt a.M., Germany**

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*Talk title:* Dessins and complex multiplication

*Abstract:* A "dessin d'enfant" on an orientable compact surface determines a unique conformal structure on the surface, so all relevant properties of this Riemann surface should be encoded somehow in the dessin. However, decoding is difficult! Here we concentrate on the question how to distinguish - using dessins - elliptic curves (genus 1 Riemann surfaces) with complex multiplication from those without complex multiplication. It turns out that elliptic curves with CM have "more" dessins than others, in a sense which can be made precise.

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