Seventh Iberoamerican Congress on Geometry

Valladolid, Spain

January 22nd-26th, 2018

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Presentation

The wealth of mathematics to which Riemann surfaces and algebraic curves are central, as a tool is now stunning, in differential geometry, topology, algebraic geometry, singularities, mathematical physics, dynamics, hyperbolic geometry and other subjects constantly developing new techniques to work with curves, and applying them in ever changing and evolving directions. The Iberoamerican Congresses on Geometry (ICG's) are unique in bringing people from these diverse mathematical communities together, and fostering an exchange of ideas among mathematicians in different fields, united by Riemann surfaces and related constructions. The 7th congress will showcase the recent advances in a broad range of geometric subjects. The program consists of nine plenary talks, seven special sessions and a poster session. Plenary talks, about current issues and of historical interest, are by experts in such core areas traditionally represented at the ICG's as Teichmüller theory, Riemann surfaces, abelian varieties, dynamics, and foliations, but also in more differential-geometric pursuits of minimal surfaces and study of min-max surfaces, and topics in probability, tropical geometry, and mathematical physics. Topics of the special sessions are algebraic surfaces, abelian varieties, hyperbolic geometry and Teichmüller theory, algebraic and complex geometry, topology of singularities, geometry and physics, and holomorphic and algebraic foliations. Only two special sessions will run in parallel, and each session consists of talks of 40 minutes.

This Congress will be held at Valladolid University within the dates January 22nd-26th (2018).

Participants are expected to arrive to Valladolid in the afternoon of Sunday 21st, and the Congress will end in the evening on Friday 26th. Further details will be provided on the web page

`http://iberoamericangeometry2018.uva.es`

The seventh Iberoamerican Congress on Geometry is sponsored by

Committees

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Schedule

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09:25-10:00			Jihun Park
14:45-15:20	Alessandra Sarti	Carlos Rito	
15:25-16:00	Enrique Artal	Abel Castorena	
16:10-16:45	Giancarlo Urzúa	Cecília Salgado	
16:50-17:25	Kevin Tucker	Miguel Ángel Barja	

S2	`Monday` 22nd	`Tuesday` 23rd
08:45-09:20	Santiago López de Medrano	Eva Elduque
09:25-10:00	Pawel Borowka	Giulio Codogni
10:10-10:45	Juan Carlos Naranjo	Jennifer Paulhus
10:50-11:25	Paola Frediani	Sebastián Reyes-Carocca

S3	`Monday` 22nd	`Tuesday` 23rd	`Wednesday` 24th
08:45-09:20			Sudeb Mitra
09:25-10:00			Yunping Jiang
14:45-15:20	Marissa Loving	Cyril Lecuire	
15:25-16:00	Hiroshige Shiga	Joan Porti	
16:10-16:45	David Torres-Teigell	Funda Gultepe	
16:50-17:25	Antonio Costa	Javier Aramayona	

S4	`Thursday` 25th	`Friday` 26th
14:45-15:20	Fernando Sancho de Salas	Carlos Florentino
15:25-16:00	Milagros Izquierdo	Ignacio Luengo
16:10-16:45	Sándor Kovács	Claudia Reynoso Alcántara
16:50-17:25	Fernando Pablos Romo	Carlos Tejero Prieto

S5	`Monday` 22nd	`Tuesday` 23rd
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09:25-10:00	Agustín Romano	Ferran Dachs-Cadefau
10:10-10:45	María Pe Pereira	Pedro Daniel González Pérez
10:50-11:25	Edson Sampaio	Beatriz Pascual Escudero

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10:10-10:45	Didier Solís	Tomás L. Gómez
10:50-11:25	Klaus Kirsten	Magdalena Rodríguez
14:45-15:20	Gabriel Ruiz	Enrico Celeghini
15:25-16:00	Amir Babak Aazami	Mariano Santander
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16:50-17:25	Luis Álvarez-Consul	

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09:25-10:00	Antoni Ferragut	Jorge Olivares
10:10-10:45	Francisco Monserrat	Calum Spicer
10:50-11:25	David Marín	Daniel Panazzollo

Venue

All lectures:
Edificio Rector Tejerina
Plaza de Santa Cruz 6
47002 Valladolid

Plenary Zorich (Monday 22nd, 18:00):
Aula Triste
Palacio de Santa Cruz
Plaza de Santa Cruz 8
47002 Valladolid

Lunch:
Colegio Mayor Santa Cruz
C/ Cardenal Mendoza, 1
47002 Valladolid

Social dinner: Thursday January 25th, 21:15
Hotel Imperial
Calle del Peso 4
47001 Valladolid

Plenary lectures

Lefschetz structure on Vanishing Cohomology

Xavier Gómez-Mont

CIMAT, Mexico

Thursday 25, 18:00-19:00

The Hard Lefschetz Theorem and the Riemann-Hodge bilinear relations are deep theorems that structure the cohomology groups of projective varieties. Relative versions of these theorems can be formulated for smooth families of projective varieties, say over a disc, giving structure to the cohomology bundles, that have the flat Gauss-Manin connection . When we have a family of varieties over the disc $f : X \to D$, which is smooth over the punctured disc, besides the above structure on the cohomology bundle of the punctured disc, we have the monodromy map. The Monodromy Theorem asserts that the eigenvalues of the monodromy map are roots of unity, so after a suitable base change of the disc branched at 0 we obtain a family of varieties whose monodromy map is unipotent, and its logarithm N is a well defined nilpotent map acting in cohomology. This map N carries the information of the non-semisimple part of the monodromy action. There is an interesting interplay between the filtration induced by N, the Lefschetz and Hodge decomposition of cohomology and the bilinear form induced by cup product giving the Hodge-Riemann bilinear relations. On the algebraic side, when the singularity is isolated, we have the Jacobian Algebra, Grothendieck non degenerate bilinear pairing in the Jacobian Algebra and multiplication by f in the Jacobian Algebra. This setting allows also to do Lefschetz type decomposition, as above. The relation between the topological picture and the algebraic picture is via a Theorem of Varchenko, that asserts that N is multiplication by f when we take the graded module with respect to the Mixed Hodge structure in the Jacobian Algebra. The objective of the presentation will be to describe the topological picture, the algebraic picture, and compare both. This is joint work with M.A. de la Rosa, from Catedras CONACYT-UJAT.

Let's get Rational

Rubén Hidalgo

Universidad de La Frontera, Chile

Tuesday 23, 18:00-19:00

Due to Milnor, the moduli space M_d, of rational maps of degree $d \geq 2$, is known to have the structure of a complex orbifold of dimension $2(d-1)$. The **branch locus** $\mathcal{B}_d \subset \mathrm{M}_d$ is given by the classes of rational maps with non-trivial group of holomorphic automorphisms. Miasnikov, Stout and Williams have recently observed that every finite group of $\mathrm{PSL}_2(\mathbb{C})$ can be seen as the full group of holomorphic automorphisms of a suitable rational map and a description of these maps is provided in terms of the corresponding finite group.
Milnor also noted, by using the symmetric forms in the multipliers of the fixed points, that M_2 can be identified with $\mathbb{C}^2$. In this model, Fujimora noted that $\mathcal{B}_2$ corresponds to the cubic curve

$$2x^3 + x^2y - x^2 - 4y^2 - 8xy + 12x + 12y - 36 = 0.$$

If $d \geq 3$, $\mathcal{B}_d$ corresponds exactly to the sublocus of M_d where it fails to be a topological manifold. We observe that the branch locus $\mathcal{B}_d$ is always connected
The conjugation action on rational maps by the reflection $J(z) = \overline{z}$ provides of a **real structure** on M_d. The locus $\mathrm{M}_d^{\mathbb{R}}$ of real points of such a structure consists to those rational maps admitting antiholomorphic automorphisms. If a rational maps admits a reflection (antiholomorphic involution having fixed points) as an automorphism, then it is called **real**. A rational maps admitting antiholomorphic automorphisms, but none of them being a reflection, is called **pseudo-real**. The locus $\mathrm{M}_d(\mathbb{R}) \subset \mathrm{M}_d$ consisting of real rational maps is a connected real orbifold of real dimension $2(d-1)$. If we denote by $\mathcal{P}_d \subset \mathrm{M}_d$ the locus consisting of the pseudo-real rational maps, then $\mathrm{M}_d^{\mathbb{R}}$ is the disjoint union of $\mathrm{M}_d(\mathbb{R})$ and $\mathcal{P}_d$. Silverman noted that $\mathcal{P}_d = \emptyset$ if d is even and that, for $d \geq 3$ odd, $\mathcal{P}_d \neq \emptyset$. We show that (for $d \geq 3$ ood) the locus $\mathcal{P}_d$ is always disconnected and that $\mathrm{M}^{\mathbb{R}}$ is always connected. We also have provide a description of the rational maps admitting an antiholomorphic automorphism.
Given a rational map R, there is an associated field $\mathcal{M}_R$, called its **field of moduli** (this is an invariant under the action of the group $\mathrm{Gal}(\mathbb{C})$). By results due to Koizumi, $\mathcal{M}_R$ is the intersection of all the fields of definitions of R. Silverman observed that, for either d even or R equivalent to a polynomial, this field is a field of definition of R. In the case that R cannot be defined over its field of moduli (so $d \geq 3$ must be odd), we have seen that it can be defined over a suitable quadratic extension of it.
The field $\mathcal{M}_R$ is a subfield of $\mathbb{R}$ if and only if R is either real or pseudo-real. Also, R can be defined over the reals if and only if it is real. In particular, pseudo-real rational maps are examples of rational maps not definable over their field of moduli. Explicit examples of pesudo-real rational maps, with trivial group of holomorphic automorphisms were provided by Silverman. We observe that, for a pseudo-real rational map, its group of holomorphic automorphisms is either trivial or a cyclic group. For each $n \geq 2$, we present explicit examples of

pseudo-real rational maps with a cyclic group of order n as group of holomorphic automorphisms.

In the case of a real rational map, it is more difficult to check if it can or not be definable over its field of moduli. We present explicit examples of real rational maps which cannot be defined over the filed of moduli.

Acknowledgements: Partially supported by FONDECYT 1150003 and Anillo ACT 1415 PIA-CONICYT.

Analytic parameterizations of limit shapes

Richard Kenyon

Brown University, USA

Wednesday 24, 12:00-13:00

The "5 vertex model" is a certain probability measure on discrete interfaces in 2+1 dimensions. In the scaling limit (when mesh tends to zero) a random sample converges almost surely to a fixed nonrandom smooth surface called a "limit shape". These limit shapes satisfy a variational principle, minimizing an associated surface tension. We show that they can be parameterized by analytic functions. This is joint work with Jan de Gier and Sam Watson.

Wow, so many minimal surfaces!

André Arroja Neves

University of Chicago, USA

Friday 26, 12:00-13:00

Minimal surfaces are ubiquitous in Geometry but their existence theory is rather mysterious. For instance, Yau in 1982 conjectured that any 3-manifold admits infinitely many closed minimal surfaces but the best one knows is the existence of at least two.

In a different direction, Gromov conjectured a Weyl Law for the volume spectrum that was proven last year by Liokumovich, Marques, and myself.

I talk about recent my work with Irie and Marques: we combined Gromov's Weyl Law with the Min-max theory Marques and I have been developing over the last years to prove that, for generic metrics, not only there are infinitely many minimal hypersurfaces but they are also dense.

A parametrization of the moduli space of abelian 6-folds

Angela Ortega

Humboldt Universität, Germany

Thursday 25, 12:00-13:00

It has been known for over a century that the general abelian variety of dimension at most five is either a Jacobian, or a Prym variety. This allows one to reduce the study of abelian varieties of small dimension to the rich and concrete theory of curves.
In this talk we will discuss recent decisive progress on finding a structure theorem for abelian varieties of dimension six, as Prym-Tyurin varieties associated to coverings of curves with E_6-monodromy, and the implications this uniformization result has on the geometry of the moduli space $\mathcal{A}_6$.
This is a joint work with V. Alexeev, R. Donagi, G. Farkas ans E. Izadi.

Tropical motivic integration

Sam Payne

Yale University, USA

Monday 22, 12:00-13:00

I will present a new tool for the calculation of motivic invariants appearing in Donaldson-Thomas theory, such as the motivic Milnor fiber, starting from a theory of volumes of semi-algebraic sets introduced a decade ago by Hrushovski and Kazhdan. They key new result for applications is a tropical Fubini theorem-the invariants of interest can be computed by integrating the volumes of fibers of the tropicalization map with respect to Euler characteristic on the base.

Classification of spheres with constant mean curvature in homogeneous three-manifolds

Joaquín Pérez

Universidad de Granada, Spain

Wednesday 24, 10:30-11:30

Surfaces with constant mean curvature arise as solutions of the variational problem associated to the area functional with volume constraint (isoperimetric problem). Two central results about these surfaces are the classical theorems by Hopf and Alexandrov, that characterize round spheres in $\mathbb{R}^3$ among immersions of spheres and among compact embeddings with constant mean curvature, respectively. Abresch and Rosenberg generalized Hopf theorem to the case of ambient Thurston geometries, which are simply connected homogeneous three-manifolds with isometry group of dimension four. In this talk we will explain how to extend these results to any Riemannian homogeneous three-manifold.

This is joint work with William H. Meeks, Pablo Mira and Antonio Ros.

Higgs bundles, branes and applications

Laura Schaposnik

University of Illinois at Chicago

Tuesday 23, 12:00-13:00

Higgs bundles are pairs of holomorphic vector bundles and holomorphic 1-forms taking values in the endomorphisms of the bundle, and their moduli spaces carry a natural Hyperkahler structure, through which one can study Lagrangian subspaces (A-branes) or holomorphic subspaces (B-branes). Notably, these A and B-branes have gained significant attention in string theory. We shall begin the talk by first introducing Higgs bundles for complex Lie groups and the associated Hitchin fibration through which one can realize Langlands duality. We shall then look at natural constructions of families of subspaces which give different types of branes, and relate these spaces to the study of 3-manifolds, surface group representations and mirror symmetry.

Equidistribution of square-tiled surfaces, meanders, and Masur-Veech volumes

Anton Zorich

Institut Mathématiques de Jussieu, Paris, France

Monday 22, 18:00-19:00

We show how recent results of the authors on equidistribution of square-tiled surfaces of given combinatorial type allow to compute approximate values of Masur-Veech volumes of the strata in the moduli spaces of Abelian and quadratic differentials by Monte Carlo method.

We also show how similar approach allows to count asymptotical number of meanders of fixed combinatorial type in various settings in all genera. Our formulae are particularly efficient for classical meanders in genus zero.

We construct a bridge between flat and hyperbolic worlds giving a formula for the Masur-Veech volume of the moduli space of quadratic differentials in terms of intersection numbers (in the spirit of Mirzakhani's formula for Weil-Peterson volume of the moduli space of pointed curves).

Joint work with V. Delecroix, E. Goujard, P. Zograf.

Special Session 1: Algebraic Surfaces

Organizers: Margarida Mendes Lopes (Universidade de Lisboa, Portugal) and Francisco Monserrat (Universidad Politécnica de Valencia, Spain).

Conditions for a complete ideal to be a multiplier ideal in a rational surface singularity

Maria Alberich-Carramiñana

Universitat Politècnica de Catalunya, Spain

Wednesday 24, 08:45-09:20

The multiplier ideals of an ideal $\mathfrak{a} \subseteq \mathcal{O}_X$ are ideals $\mathcal{J}\left(X, \mathfrak{a}^c\right) = \pi_* \mathcal{O}_{X'}\left(\lceil K_\pi - cF \rceil\right)$ where c varies in $\mathbb{R}_{\geq 0}$. Here, K_π is the canonical divisor associated to a log-resolution $\pi : X' \to X$ of the pair $(X, \mathfrak{a})$, and F is the divisor with simple normal crossings support such that $\mathfrak{a} \cdot \mathcal{O}_{X'} = \mathcal{O}_{X'}(-F)$. In particular, they are all complete and contained in $\mathcal{J}(X, \mathcal{O}_X) = \mathcal{J}\left(X, \mathfrak{a}^0\right) = \pi_* \mathcal{O}_{X'}\left(\lceil K_\pi \rceil\right)$ (which is independent of $\mathfrak{a}$).

The purpose of this talk is to address the question, raised in [2], which asks if every integrally closed (complete) ideal which is contained in $\mathcal{J}(X, \mathcal{O}_X)$ is a multiplier ideal, when X is a complex surface which has a rational singularity. Hence a natural question is whether these conditions are also sufficient for an ideal to be a multiplier ideal, or more explicitly, whether any complete ideal $\mathfrak{a} \subset \mathcal{J}(X, \mathcal{O}_X)$ is of the form $\mathfrak{a} = \mathcal{J}\left(X, \mathfrak{b}^c\right)$ for suitable choices of c and $\mathfrak{b}$. On the one hand, this is true in the smooth case (Favre and Jonsson [1] ; Lipman and Watanabe [3]) and in the log-terminal one (Tucker [4]). Notice that log terminal singularities satisfy $\mathcal{J}(X, \mathcal{O}_X) = \mathcal{O}_X$ and are necessarily rational. On the other hand, Lazarsfeld and others proved a necessary condition for this to hold, and they constructed complete ideals on (highly) non-rational singularities (cones over smooth curves of positive genus) which are not multiplier ideals. In the present talk we will answer this question for rational surface singularities.

Bibliography

[1] C. Favre and M. Jonsson, Valuations and multiplier ideals. J. Amer. Math. Soc. 18 (2005), 655–684.

[2] R. Lazarsfeld, K. Lee, and K. E. Smith: Syzygies of multiplier ideals on singular varieties. Michigan Math. J. 57 (2008) 511-521. Special volume in honor of Melvin Hochster.
[3] J. Lipman and K.-i. Watanabe: Integrally closed ideals in two-dimensional regular local rings are multiplier ideals. Math. Res. Lett., 10 (2003), 423-434.
[4] K. Tucker: Integrally closed ideals on log terminal surfaces are multiplier

Coverings of rational ruled normal surfaces

Enrique Artal Bartolo

Universidad de Zaragoza, Spain

Monday 22, 15:25-16:00

In this talk, we treat the use of arithmetic, geometric, and combinatorial techniques to compute the cohomology of Weil divisors on a special class of normal surfaces, the so-called toric ruled surfaces. We study the behavior of Picard group under weighted blow-ups and we make use of generalized Riemann-Roch formulas, combined with combinatorial computations for weighted homogeneous polynomials. These computations are used to study the topology of cyclic coverings of such surfaces ramified along Q-normal crossing divisors. It is a joint work with J.I. Cogolludo and J. Martín-Morales.

New techniques on linear series on irregular surfaces

Miguel Ángel Barja

Universitat Politècnica de Catalunya, Spain

Tuesday 23, 16:50-17:25

I will explain new techniques for the study of linear series on surfaces of maximal Albanese dimension and how we can use them to give new geographical Severi-type inequalities and classify the limit cases. These are the initial step for an induction process to extend them to higher dimensions. This is a joint work with Lidia Stoppino and Rita Pardini.

Semistable fibrations over an elliptic curve with only one singular fibre

Abel Castorena

UNAM, Mexico

Tuesday 23, 15:25-16:00

In this talk we describe a construction which give rise to the existence of semistable fibrations over an elliptic curve with a unique singular fibre. For this construction we use the monodromy of certain ramified (non Galois) covers $C \to E$, where E is an elliptic curve.

Super-rigid Affine Fano Varieties

Jihun Park

IBS / POSTECH, South Korea

Wednesday 24, 09:25-10:00

Let X be a projective normal $\mathbb{Q}$-factorial variety of Picard number 1 and S be a prime divisor on X. The affine variety $X \setminus S$ is called an affine Fano variety if the pair (X, S) has purely log terminal singularities and $-(K_X + S)$ is ample. Furthermore, the affine Fano variety $X \setminus S$ is said to be super-rigid if the following two conditions hold.

- For every affine Fano variety $X' \setminus S'$ with completion X' and boundary S', if there exists an isomorphism $\phi\colon X \setminus S \cong X' \setminus S'$, then ϕ is induced by an isomorphism $X \cong X'$ that maps S onto S'. In particular, one has $\mathrm{Aut}(X \setminus S) = \mathrm{Aut}(X, S)$.

- The affine Fano variety $X \setminus S$ does not contain relative affine Fano varieties over varieties of positive dimension.

In this talk, examples and non-examples of super-rigid affine Fano varieties are demonstrated. In particular, we will mainly consider del Pezzo surfaces in 3-dimensional weighted projective spaces. These examples lead us to a folklore conjecture that every automorphism of the complement of a smooth cubic surface in $\mathbb{P}^3$ comes from the automorphism group of $\mathbb{P}^3$.
This is a joint work with Ivan Cheltsov and Adrien Dubouloz.

A surface with $p_g = q = 2$ and $K^2 = 8$ which is not uniformized by the bidisk

Carlos Rito

Universidade do Porto, Portugal

Tuesday 23, 14:45-15:20

Complex algebraic surfaces of general type with the lowest possible value of the holomorphic Euler characteristic $\chi = 1$ are far from being classified. For these surfaces the geometric genus p_g equals the irregularity q, and the Bogomolov-Miyaoka-Yau inequality implies $K^2 \leq 9$, where K is a canonical divisor. The ones in the line $K^2 = 9$ are known to be quotients of the complex unit ball by a lattice in $PU(2, 1)$.
All the examples of surfaces with $\chi = 1$ and $K^2 = 8$ known so far are uniformized by the bidisk $\mathbb{H} \times \mathbb{H}$, where $\mathbb{H}$ is the Poincaré upper half-plane.
In this talk I will explain the construction of a surface with $p_g = q = 2$ and $K^2 = 8$ which is not uniformized by the bidisk.
This is joint work with F. Polizzi and X. Roulleau.

Elliptic fibrations on K3 surfaces and linear systems of curves on rational surfaces

Cecília Salgado

Universidade Federal do Rio de Janeiro, Brazil

Tuesday 23, 16:10-16:45

Let X_0 be a rational elliptic surface and X a K3 surface given by a double cover of it. Then X admits a non-symplectic involution ι, namely the double cover involution. Moreover, X admits at least one elliptic fibration, which is induced by the fibration on X_0. We analyze the other elliptic fibrations on X by studying linear systems of curves on X_0. We will discuss how the effect of ι on the elliptic fibrations influences the possible outcomes for linear systems of curves on the rational elliptic surface. (This is joint work with A. Garbagnati).

Complex Ball quotients and hyperkähler fourfolds

Alessandra Sarti

Université de Poitiers, France

Monday 22, 14:45-15:20

In a famous paper of 2011 Allcock, Carlson and Toledo describe the moduli space of smooth cubic threefolds as a 10-dimensional ball quotient. We show how the 10-dimensional ball quotient can also be described as the moduli space of certain hyperkähler fourfolds with a non-symplectic automorphism of order three. We then completely describe the hyperkähler fourfolds and we identify them with the Fano variety of lines of cubic fourfolds that are triple covers of the 4 dimensional complex projective space ramified on a smooth cubic threefold. We finally describe degenerations of the hyperkähler fourfolds which are related to degenerations of the smooth cubic threefolds to the nodal and the chordal locus in the complex ball quotient. This is a joint work in progress with S. Boissière and C. Camere.

p_g Vector Bundles on Normal Surfaces

Kevin Tucker

University of Illinois, Chicago, USA

Monday 22, 16:55-17:30

It is well-known that complete (or integrally closed) ideals on a rational surface singularities satisfy a number of special properties – for example, a product of complete ideals is complete. While similar statements fail for general normal surfaces, they hold for a special class of complete ideals introduced by Okuma-Watanabe-Yoshida called p_g ideals. In this talk, I will discuss a higher-rank generalization of these concepts, called p_g vector bundles and some of their basic properties. This is joint work with Lawrence Ein.

Optimal bounds for T-singularities in stable surfaces

Giancarlo Urzúa

Pontificia Universidad Católica de Chile, Chile

Monday 22, 16:10-16:45

Kollár and Shepherd-Barron (1988) introduced a natural compactification to the Gieseker moduli space of surfaces of general type, which is analogous to the Deligne-Mumford (1969) compactification of the moduli space of curves of genus g¿1. This compactification is coarsely represented by a projective scheme (due to Kollár 1990) because of Alexeev's proof of boundedness (1994). Thus we have a proper KSBA moduli space of stable surfaces, which includes classical canonical surfaces of general type. In particular, after fixing the self-intersection of the canonical class, we have a finite list of singularities appearing on stable surfaces. It is hard to write down that list.

T-singularities are cyclic quotient singularities of the form $1/dn^2(1, dna-1)$(with $\gcd(n, a) = 1, n > 1$). This is a remarkable set of singularities in stable surfaces, since they are the key singularities showing up in normal degenerations of surfaces in the KSBA compactification. When $d = 1$, they are also called Wahl singularities (i.e. cyclic quotient singularities having a smoothing with Milnor number equal to zero).

In a jointly work with Julie Rana, we explicitly bound T-singularities on normal projective stable surfaces W with one singularity. This bound depends on K^2, and it is optimal when W is not rational. We classify and realize surfaces attaining the bound for each Kodaira dimension of the minimal resolution of W. This talk will be about that work.

Special Session 2: Abelian Varieties

Organizers: Herbert Lange (FAU, Germany) and Anita Roja (Universidad de Chile, Chile).

Hyperelliptic curves on abelian surfaces

Pawel Borowka

Jagiellonian University, Kraków, Poland

Monday 22, 09:25-10:00

Let A be a general abelian surface and let C be a smooth complex hyperelliptic curve embedded in A. A simple computation shows that the only possibilities for this to occur is when the genus $g(C) = 2, 3, 4, 5$ and A is of type $(1, g-1)$. The cases $g = 2$ and $g = 3$ are classical. They correspond to the embedding of a genus 2 curve in its Jacobian and the construction of an étale double covering of a genus 2 curve. In the talk we focus on the two remaing cases. We show that indeed for general $(1, 3)$ and $(1, 4)$ polarised surfaces one can find unique hyperelliptic curves up to translation. We give some geometric description of the curves. The $(1, 3)$ case is a joint work with G. Sankaran and the $(1, 4)$ case is a joint work with A. Ortega.

Gauss map, singularities of the theta divisor and trisecants

Giulio Codogni

École Polytechnique Fédérale de Lausanne, Switzerland

Tuesday 23, 09:25-10:00

The Gauss map is a finite rational dominant map naturally defined on the theta divisor of an irreducible principally polarised abelian varieties.
In the first part of this talk, we study the degree of the Gauss map of the theta divisor of principally polarised complex abelian varieties. Thanks to this analysis, we obtain a bound on the multiplicity of the theta divisor along irreducible components of its singular locus. We spell out this bound in several examples,

and we use it to understand the local structure of isolated singular points. We further define a stratification of the moduli space of ppavs by the degree of the Gauss map. In dimension four, we show that this stratification gives a weak solution of the Schottky problem, and we conjecture that this is true in any dimension. This is a joint work with S. Grushevsky and E. Sernesi.
In the second part of this talk, we will study the relation between the Gauss map and trisecant of the Kummer variety. Fay's trisecant formula shows that the Kummer variety of the Jacobian of a smooth projective curve has a four dimensional family of trisecant lines. We study when these lines intersect the theta divisor of the Jacobian, and prove that the Gauss map of the theta divisor is constant on these points of intersection, when defined. We investigate the relation between the Gauss map and multisecant planes of the Kummer variety as well. This is a joint work with R. Auffarth and R. Salvati Manni.

On the signed Euler characteristic property for subvarieties of abelian varieties

Eva Elduque

University of Wisconsin-Madison, USA

Tuesday 23, 08:45-09:20

Franecki and Kapranov proved that the Euler characteristic of a perverse sheaf on a semi-abelian variety is non-negative. This result has several purely topological consequences regarding the sign of the (topological and intersec- tion homology) Euler characteristic of a subvariety of an abelian variety, and it is natural to attempt to justify them by more elementary methods. In this talk, well explore the geometric tools used recently in the proof of the signed Euler characteristic property. Joint work with Christian Geske and Laurentiu Maxim.

On Shimura subvarieties of A_g contained in the Prym locus

Paola Frediani

Università di Pavia, Italy

Monday 22, 10:50-11:25

I will present some results obtained in collaboration with E. Colombo, A. Ghigi and M. Penegini on Shimura subvarieties of A_g generically contained in the Prym locus.
I will explain the construction of $1-$dimensional families of double covers compatible with a fixed group action on the base curve C such that the quotient of C by the group is the projective line. I will give a simple criterion for the image of these families under the Prym map to be a Shimura curve. I will show that this criterion allows us to construct several examples of Shimura curves

generically contained in the Prym locus in A_g for $g < 13$.

Varieties with symmetries and the Discrete Fourier Transform matrix

Santiago López de Medrano

Instituto de Matemáticas, UNAM, Mexico

Monday 22, 08:45-09:20

In the study of a certain type of intersections of real quadrics with dihedral symmetry a relation was stablished between their smoothness and the minors of the Vandermonde matrix with the n-th roots of unity as entries, also known as the Discrete Fourier Transform (DFT) matrix.
In this talk we consider the analogous situation of complex projective varieties with cyclic or dihedral symmetry, for which their smoothness is precisely equivalent to the fact that certain minors of the DFT matrix do not vanish. This question turned out to be very difficult to answer in general and we have obtained only some partial results.
From numerical evidence we arrived to some conjectures and results about those minors. It turned out that our conjectures were true, one of them by and old theorem by Chebotaryov stating that in the case n is prime all the minors are non-zero. The other one we proved ourselves. Recently we have obtained some results for the case where n is a prime power.
This question is of interest in the field of Signal Recognition, starting from work by Terry Tao who rediscovered and applied Chebotaryov's theorem. This was followed by papers in Electrical Engineering journals, among them some recent ones that contain part of our results.
An important part of this research is joint work with Matthias Franz.

Generic Torelli for the Prym map of ramified coverings

Juan Carlos Naranjo

University of Barcelona, Spain

Monday 22, 10:10-10:45

In this talk we will report on a work in collaboration with Angela Ortega. We consider the two remaining open cases on the behaviour of the Prym map of ramified coverings. Namely, let

$$P_{r,g} : \mathcal{R}_{g,r} \longrightarrow \mathcal{A}^{\delta}_{g-1+\frac{r}{2}}$$

be the map sending an irreducible double covering $\pi : D \longrightarrow C$ of a curve C of genus g with $r > 0$ ramification points to the abelian variety $P(D, C) := Ker : JD \longrightarrow JC$, called the Prym variety of the (ramified) covering. The generic

Torelli theorem states that $P_{r,g}$ is generically injective when the dimension of the space of coverings is less or equal to the dimension of the space of polarized abelian varieties. In a fundamental paper Marcucci and Pirola proved this theorem except for the bielliptic case (solved later by Marcucci and Naranjo), the case $r = 4, g = 3$ when the degree is 3 (already considered in the literature) and two isolated cases: $P_{5,2}$ and $P_{2,6}$. We will present the proof of the generic Torelli theorem in these two last situations. In the first we use the base locus of the linear system attached to the theta divisor in combination with some techniques of vector bundles on curves. Instead, in the second case we relate our map with the étale Prym map and we study the fibre along the locus of the intermediate Jacobians of cubic threefolds.

Completely decomposable Jacobian varieties

Jennifer Paulhus

Grinnell College, Iowa, USA

Tuesday 23, 10:10-10:45

Jacobian varieties which can be factored into the product of elliptic curves have interesting applications to rank and torsion questions. Given a curve X with automorphism group G, idempotent relations in the group ring $\mathbb{Q}[G]$ lead to decompositions of the Jacobian of X. In this talk we discuss some recent results obtained from these techniques. Particularly, new computational advances and the study of intermediate covers allow us to determine these decompositions for curves in high genus, and we use that to find many new examples of completely decomposable Jacobians, including families of such curves.

On the connectedness of the singular locus of the moduli space of principally polarized abelian varieties

Sebastián Reyes-Carocca

Universidad de La Frontera, Chile

Tuesday 23, 10:50-11:25

Let $\mathcal{A}_g$ denote the moduli space of principally polarized abelian varieties of dimension $g \geq 3$. In this talk we shall discuss the connectedness of the singular sublocus of $\mathcal{A}_g$ consisting of those abelian varieties which possess an involution different from $-id$. This is a joint work with Rubí E. Rodríguez.

Special Session 3: Hyperbolic Geometry and Teichmüller Theory

Organizers: Gabino González Díez (Universidad Autónoma de Madrid, Spain) and Christopher J. Leininger (University of Illinois at Urbana-Champaign, USA).

The first cohomology group of mapping class groups

Javier Aramayona

Universidad Autónoma de Madrid, Spain

Tuesday 23, 16:50-17:25

We will discuss the existence or non-existence of homomorphisms from (pure) mapping class groups to the group of integers, depending on the topology of the underlying surface. This is joint with P. Patel and N. Vlamis.

Topological singular points in the moduli space of Riemann surfaces

Antonio Costa

UNED, Spain

Monday 22, 17:00-17:35

In 1962 E. H. Rauch established the existence of points in the moduli space of Riemann surfaces not having a neighbourhood homeomorphic to a ball. These points are called topologically singular. We give a different proof of some of the results of Rauch and also determine the topologically singular and non-singular points in the branch locus of some equisymmetric families of Riemann surfaces.

A Cannon-Thurston map for survival curve complex of a punctured surface

Funda Gultepe

Université du Luxembourg, Luxembourg

Tuesday 23, 16:10-16:45

Using Birman exact sequence for mapping class groups, we construct a universal Cannon-Thurston map for the boundary of a curve complex of a surface with punctures, which we call *surviving curve complex*. This is a joint work with Chris Leininger and Witsaruo Pho-on.

Winding Number, Monodromy, and Extension in Holomorphic Motion and Lifting in Teichmueller Theory

Yunping Jiang

CUNY, New York, USA

Wednesday 24, 09:25-10:00

In this talk, I will give a review of our work in the study of holomorphic motions of subsets in the Riemann sphere over hyperbolic Riemann surfaces. I will introduce the zero-winding number condition and the trivial monodromy condition for such a holomorphic motion. I will also introduce the lifting problem in Teichmueller theory and the extension problem in holomorphic motion. After that I will show that both conditions are necessary for a fully extendable holomorphic motion of a subset in the Riemann sphere over a hyperbolic Riemann surface. I will use an explicit counter-example to show that the zero-winding number condition is not sufficient for a fully extendable holomorphic motion of a subset in the Riemann sphere over a hyperbolic Riemann surface. Furthermore, by using the relation between the lifting in Teichmueller theory and the extension in holomorphic motion, I will show that the trivial monodromy condition is indeed sufficient for a fully extendable holomorphic motion of a subset in the Riemann sphere over a hyperbolic Riemann surface. Some other conditions will be also mentioned. This talk is based on the work of my long-time cooperation with Mike Beck, Fred Gardiner, Sudeb Mitra, Hiroshige Shiga, and Zhe Wang.

Quasi-isometric rigidity of 3-manifold groups

Cyril Lecuire

Université Paul Sabatier, France

Tuesday 23, 14:45-15:20

We will discuss the quasi-isometric rigidity of 3-manifold groups: A finitely generated groups that roughly (when viewed from far away) looks like the fundamental group of a compact 3-manifold contains a finite index subgroup iso-

morphic to thefundamental group of a compact 3-manifold. This a joint work with Peter Haissinsky.

Least Dilatation of Pure Surface Braids

Marissa Loving

University of Illinois, USA

Monday 22, 14:45-15:20

The n-stranded pure surface braid group of a genus g surface can be described as the subgroup of the pure mapping class group of a surface of genus g with n-punctures which becomes trivial on the closed surface. I am interested in the least dilatation of pseudo-Anosov pure surface braids. For the n=1 case, upper and lower bounds on the least dilatation were proved by Dowdall and AougabÑTaylor, respectively. In this talk, I will describe the upper and lower bounds I have proved as a function of g and n.

Real-analytic sections for Teichmueller curves

Sudeb Mitra

CUNY, New York, USA **Wednesday 24, 08:45-09:20**

We use a fundamental result of Douady and Earle to explicitly construct some real-analytic sections of Teichmueller curves. This gives an alternative approach to a paper of Cliff Earle.

We conclude with a brief discussion on real-analytic section for the Teichmueller space of a closed set in the Riemann sphere.

Volume forms on the SL(N,C)-moduli space of surfaces with boundary

Joan Porti

Universitat Autònoma de Barcelona, Spain

Tuesday 23, 15:25-16:00

For an oriented surface of finite type, we consider the moduli space of representations in a simply connected reductive Lie group (eg SL(N,C)), and also the moduli space relative to the boundary. We relate the complex valued volume forms in those moduli spaces, the relative and the absolute one. This is joint work with M. Heusener.

Thick parts of the moduli space of Riemann surfaces and pseudo-Anosov maps

Hiroshige Shiga

Tokyo Institute of Technology, Japan **Monday 22, 15:25-16:00**

Let R be a hyperbolic Riemann surface of finite type. The moduli space $M(R)$ of R is considered as a metric space with the Techmüller metric. Sometimes, it has properties similar to those of a hyperbolic Riemann surface with punctures. In this talk, we show some properties of $M(R)$ related to closed geodesics, which are given by pseudo-Anosov self-maps of R.

Modular forms cutting out Gothic Teichmüller curves

David Torres-Teigell

Universität des Saarlandes, Germany

Monday 22, 16:10-16:45

Teichmüller curves arise as the projection to the moduli space of certain orbits of the action of SL(2,R) on the space of flat surfaces. By results of Möller, the Jacobian of points in Teichmüller curves always contains a subvariety that admits real multiplication so that, in particular, there exists certain Prym-Torelli map that allows us to see the Teichmüller curve inside a Hilbert modular variety parametrising abelian varieties with real multiplication. In this talk we will introduce the Gothic Teichmüller curves, discovered by McMullen-Mukamel-Wright, and describe their Prym-Torelli images inside a Hilbert modular surface. Our main objective is to cut this image out as the vanishing locus of some Hilbert modular form and use this description to calculate their Euler characteristics. This is joint work with M. Möller.

Special Session 4: Algebraic and Complex Geometry and Applications

Organizers: Francisco J. Plaza Martín (Universidad de Salamanca, Spain) and Emma Previato (Boston University, USA).

Geometry and Topology of character varieties

Carlos Florentino

Universidade de Lisboa, Portugal

Friday 26, 14:45-15:20

Character varieties are spaces of representations of finitely presented groups F into Lie groups G. In some cases, notably when F is the fundamental group of a surface, these spaces can be interpreted as moduli spaces of G-Higgs bundles over Riemann surfaces, recently studied in connection with the geometric Langlands program, and with mirror symmetry.

When G is a complex algebraic group, character varieties are algebraic and have interesting geometry and topology. There are also more refined invariants such as Deligne's mixed Hodge structures, which provide relevant arithmetic information, but are typically very difficult to compute.

In this seminar, we present explicit computations of the mixed Hodge-Deligne polynomials, and of so-called E-polynomials, of G-character varieties of free, and free abelian groups, when G is a group such as SL(n,C), (P)GL(n,C) or Sp(n,C). We also comment on interesting relations between the free case and some formulas by Mozgovoy-Reineke on counting quiver representations over finite fields.

This is joint work with A. Nozad, J. Silva and A. Zamora.

A new approach to rational singularities

Sándor Kovács

University of Washington, USA

Thursday 25, 16:10-16:45

I will discuss a new point of view on rational singularities. This consists of two essential elements: replacing the use of resolutions of singularities with Macaulayfication (which is known to exist under very mild assumptions) and a Kempf-type criterion for rational singularities using these Macaulayfications. This new view-point allows the study of rational singularities in situations where resolution of singularities is not known to exist and it agrees with the traditional approach when resolutions do exist. In particular, this leads to new results in both zero and positive characteristic.

On the Connectivity of Branch Loci of Moduli Spaces of Riemann Surfaces

Milagros Izquierdo

Linköping University, Sweden

Thursday 25, 15:25-16:00

The moduli spaces of Riemann and Klein surfaces can be considered as orbifolds where the singular locus is formed by Riemann surfaces with automorphisms, *the branch loci*.

In this talk we see the different behavior of the moduli spaces of Riemann surfaces, where with a few exceptions the branch loci is disconnected and consists of many connected components, and Klein surfaces whose branch loci are, with a few exceptions, connected.

We will also present an example of an infinite family of genera g where the branch locus of the completion of the moduli spaces of Riemann surfaces of genus g is still disconnected.

The results are joint work with Antonio F. Costa, Hugo Parlier and Ana Porto.

Post-quantum cryptography with polynomials

Ignacio Luengo

Universidad Complutense de Madrid, Spain

Friday 26, 15:25-16:00

Post-quantum cryptography is the public-key cryptography resistant to future quantum computers. In this talk we will talk about a post-quantum cryptosystem based on multivariate polynomial applications that we have developed (using ideas of Algebraic Geometry), patented and present it to the NIST contest to choose the future post-quantum cryptography standard.

Recent proofs of Weil's reciprocity law

Fernando Pablos Romo

Universidad de Salamanca, Spain

Thursday 25, 16:50-17:25

In 1938 A. Weil proved in [6] a reciprocity law for meromorphic functions of a Riemann surface. In fact, if X is a complex Riemann surface, A. Weil proved that

$$f((g)) = g((f))\,,$$

for all funcions $f, g \in \Sigma_X$, and being

$$(f) = \sum_{x \in X} v_x(f) \cdot x\,.$$

By generalizing to the multiplicative case the genial proof of J. Tate of the Residue Theorem -[5]-, in 1989 E. Arbarello, C. de Cocini and V.G Kac offered a proof of the Weil's reciprocity law from the finiteness of the cohomology of a complete algebraic curve over an algebraically closed field -[1]-. In this talk, we present several proofs of the Weil's reciprocity law obtained during the last 15 years in the Department of Mathematics of the University of Salamanca: a generalization of the Arbarello-De Concini-Kac proof for complete curves over perfect fields -[4]-, a global proof using Sato Grassmannians -[2]- and a proof as a particular case of a general reciprocity law on arbitrary vector spaces -[3]-.

References

[1] Arbarello, E.; de Concini, C.; Kac, V.G., *The Infinite Wedge Representation and the Reciprocity Law for Algebraic Curves*, Proc. of Symposia in Pure Mathematics, Volume **49,** Part I, A.M.S., (1989) 171-190.

[2] Muñoz Porras, J.M., Pablos Romo, F., *Generalized reciprocity laws*, Trans. Amer. Math. Soc. **360 (7)** (2008) 3473–3492.

[3] Pablos Romo, F., *A general reciprocity law for symbols on arbitrary vector spaces*, J. Alg. Appl., to appear in 2018.

[4] Pablos Romo, F., *On the Tame Symbol of an Algebraic Curve*, Comm. Algebra **30(9),** (2002) 4349–4368.

[5] Tate, J. T., *Residues of Differentials on Curves*, Ann. Scient. Éc. Norm. Sup., 4a série **1,** (1968) 149–159.

[6] Weil, A., *Généralisation des fonctions abéliennes*, J. Math. Pures et Appl. **17,** (1938) 47–87.

Hilbert scheme of points and foliations on $\mathbb{CP}^2$

Claudia Reynoso Alcántara

CIMAT, Guanajuato, Mexico

Friday 26, 16:10-16:45

The Hilbert scheme of points in the projective plane can be stratified through the Hilbert function. A stratum correponds to an open set of the space of foliations on $\mathbb{CP}^2$. We will describe this correspondence and we will use the geometry of the singular scheme to say something about the singular points and solutions of some special foliations. In particular we will give new examples of foliations without algebraic solutions.

Finite Spaces

Fernando Sancho de Salas

Universidad de Salamanca, Spain

Thursday 25, 14:45-15:20

We will show how finite ringed spaces naturally appear in several branches of mathematics, in general, and in algebraic geometric, in particular.

Derived equivalences of Abelian varieties and symplectic isomorphism

Carlos Tejero Prieto

Universidad de Salamanca, Spain

Friday 26, 16:50-17:25

We study derived equivalences of Abelian varieties in terms of their associated symplectic data. For simple Abelian varieties over an algebraically closed field of characteristic zero we prove that the natural correspondence introduced by Orlov, which maps equivalences to symplectic isomorphisms, is surjective.

Special Session 5: Topology of Singularities and Complex Spaces

Organizers: Javier Fernández de Bobadilla (BCAM, Bilbao, Spain) and Ann Lemahieu (Université Nice Sophia Antipolis, Nice, France).

Multiplier Ideals and Jumping Numbers in Higher dimensions

Ferran Dachs-Cadefau

Universität Halle, Germany

Tuesday 23, 09:25-10:00

Multiplier ideals and jumping numbers are invariants that encode relevant information about the structure of the ideal to which they are associated. The aim of this talk is to present an algorithm to compute jumping numbers on varieties of dimension at least 3. We will present a way to find a small subset of the 'classical' candidate jumping numbers of an ideal, containing all the jumping numbers. Moreover, many of these numbers are automatically jumping numbers, and in many other cases, it can be easily checked.
The presented results are part of a joint work with Hans Baumers.

The Euler-Chow series and Cox rings

Javier Elizondo

UNAM, Mexico

Monday 22, 08:45-09:20

In this talk I will explain briefly the definition of the series and give a short summary of what is known about it, in particular I will mention the motivic version of it. Finally, the relation of the series and Cox rings will be shown and some examples are presented to show this relation. At first, the series had the propose to compute the Euler characteristic of Chow varieties, but after a while the series started having some properties that resembles other very

important series, as the Hilbert or the Weil zeta series. This gives a glimp of the importance the series can be.

Blowing up of monomial ideals and the Semple-Nash modification on toric varieties

Pedro Daniel González Pérez

Universidad Complutense de Madrid, Spain

Tuesday 23, 10:10-10:45

The blowing up of a monomial ideal in the affine space is non necessarily normal. It is covered by affine charts determined by certain semigroup algebras. We explain how one can generalize this example to define toric varieties without the normality assumption. Gonzalez-Sprinberg proved that the Semple-Nash modification on a toric variety is described by the blowing up of certain monomial ideal. We study some properties of this modification in terms of monomial valuations. This is a joint work with B. Teissier.

Explicit description of the multiplier ideals associated to plane curve singularities

Manuel González Villa

CIMAT, Mexico

Tuesday 23, 08:45-09:20

Multiplier ideals and their jumping numbers are a powerful tool to study the singularities of an ideal on complex algebraic variety with mild singularities. Jumping numbers of (analytically) irreducible plane curve singularities have been independently computed and studied by Jarvilehto, Naie and Tucker. We will report on an explicit description of the multiplier ideals associated to irreducible plane curve singularities, developed in collaboration with Xavier Gómez-Mont and Carlos Rodrigo Guzmán (CIMAT). Alternative approaches have been recently pursued by Alberich Carramiñana, Blanco, Dachs-Cadefau and Álvarez-Montaner, and González-Pérez and Robredo-Bruces.

Invariants of singularities via arcs and the Nash Multiplicity Sequence

Beatriz Pascual Escudero

Universidad Autónoma de Madrid, Spain

Tuesday 23, 10:50-11:25

Arc spaces are useful in the study of singularities, since they detect properties of algebraic varieties, including smoothness. They also let us define numerous invariants. In particular, the Nash multiplicity sequence is a non-increasing

sequence of positive integers attached to an arc in the variety which stratifies the arc space. This sequence gives rise to a series of invariants of singularities which turn out to be strongly related to those that we use for constructive resolution of singularities for varieties defined over fields of characteristic zero. Moreover, these invariants defined by means of arc spaces do not rely on the peculiarities of the characteristic zero case, so they pose interesting questions for the case of varieties defined over perfect fields, regardless of their characteristic.

Tête-à-tête graphs and quasi-periodic diffeomorphisms

María Pe Pereira

Universidad Complutense de Madrid, Spain

Monday 22, 10:10-10:45

I will report about a joint work with J. Fernández de Bobadilla and P. Portilla. Norbert A'Campo defined tête-à-tête graphs and showed that if the monodromy of a plane branch is periodic then it is a generalized Dehn twist along a tête-à-tête graph.
We have characterized periodic orientable diffeomorphisms of surfaces with non-empty boundary as those induced by a generalized Dehn twist along a tête-à-tête graph. In this sense we generalize a result by Christian Graf.
We also propose a generalization of tête-à-tête graphs that allow to codify many quasi-periodic diffeomorphisms of surfaces with boundary.

Acknowledgements: The author is supported by Caja Madrid.

Some results about mixed singularities

Agustín Romano

Universidad del País Vasco, Spain

Monday 22, 09:25-10:00

A mixed function is a complex valued function $f\colon \mathbb{C}^n \to \mathbb{C}$ expanded in a convergent power serie of variables z_i and $\bar{z}_i$ for $i \in \{1, \ldots, n\}$,

$$f(z_1, \ldots, z_n) = \sum_{\mu,\nu} c_{\mu,\nu} \mathbf{z}^{\mu} \bar{\mathbf{z}}^{\nu}.$$

In this talk we present some results about mixed functions with an isolated singularity. In particular:

- We present a classification of polar weighted homogeneous polynomials with isolated critical point. These are real analytic maps which generalize complex weighted homogeneous polynomials, they are polynomials weighted homogeneous with respect to an $\mathbb{R}^+$-action and also with respect to a $\mathbb{S}^1$-action. Our classification it is a generalization of the families of complex weighted homogeneous polynomials given by Orlik and Wegreich.

- We introduce the "'embedding method"' to study mixed polynomials. The idea relays on a geometric method which allows us to prove new results and to generalize some properties from the complex case as an example of this method we define a GSV-index for mixed polynomials.

Joint work with José Luis Cisneros-Molina.

Tangent cones of Lipschitz normally embedded sets are Lipschitz normally embedded

Edson Sampaio

Universidade Federal do Ceará, Brazil

Monday 22, 10:50-11:25

We prove that tangent cones of Lipschitz normally embedded sets are Lipschitz normally embedded. We also extend to real subanalytic sets the notion of reduced tangent cone and we show that subanalytic Lipschitz normally embedded sets have reduced tangent cones. In particular, we get that Lipschitz normally embedded complex analytic sets have reduced tangent cones. This is a work joint with Alexandre Fernandes.

Special Session 6: Geometry and Physics

Organizers: Luis Miguel Nieto Calzada (Universidad de Valladolid, Spain), Miguel Sánchez Caja (Universidad de Granada, Spain) and Carlos Tejero Prieto (Universidad de Salamanca, Spain).

Kähler metrics from Lorentzian geometry in dimension four

Amir Babak Aazami

Clark University, Massachussets, USA

Thursday 25, 15:25-16:00

Given a Lorentzian 4-manifold (M, g) with two distinguished vector fields satisfying properties determined by their shear, twist and various Lie bracket relations, a family of Kähler metrics g' is constructed, defined on an open set in M, which coincides with M in many typical examples. Under certain conditions g and g' share various properties, such as a Killing vector field or a vector field with geodesic flow. Many examples are described, including de Sitter spacetime, gravitational plane waves, and Kerr spacetime.
This is joint work with Gideon Maschler.

Kähler-Yang-Mills equations and gravitating vortices

Luis Álvarez-Cónsul

ICMAT, Madrid, Spain

Thursday 25, 16:50-17:25

In this talk, we first introduce the Kähler-Yang-Mills equations for a compact manifold of Kähler type, equipped with a holomorphic bundle. They emerge from a natural extension of the theories for constant scalar curvature Kähler metrics and Hermitian-Yang-Mills connections. We construct solutions to these equations by applying dimensional reduction methods to the product of the complex projective line with a compact Riemann surface. The resulting equations on the Riemann surface, that we call gravitating vortex equations, describe abelian vortices coupled to a metric on the surface. In genus zero, they

include as a particular case the Einstein-Bogomol'nyi equations, that physically correspond to Nielsen-Olesen cosmic strings in the Bogomol'nyi phase. Based on joint work with M. García-Fernández, O. García-Prada and V. P. Pingali.

Hermite-Gauss functions and Fourier series

Enrico Celeghini

Istituto Nazionale di Fisica Nucleare, Italy and Universidad de Valladolid, Spain

Friday 26, 14:45-15:20

Hermite-Gauss functions play a fundamental role in the theory of Fourier Transform as they are eigenvectors of Fourier Transform, a basis of the L^2 functions on $\mathbb{R}$ and a representation of the Lie algebra $h(1)$.
We exhibit that, with an appropriate discretization and periodization, Hermite-Gauss functions cover the same role for the Fourier Series and its inverse, the Discrete Time Fourier Transform. Discretized Hermite-Gauss functions are indeed a basis in $\mathbb{Z}$, while periodized Hermite-Gauss functions are a basis for periodic functions in $\mathbb{R}$. By inspection, the two sets are related by Fourier Transform and its inverse. Moreover, the position operator X-consistently defined as the operator conjugate of the derivative- allows the construct again a representation of the algebra $h(1)$ in both spaces of discrete and periodic functions.

On a fully nonlinear version of the Min-Oo Conjecture

José M. Espinar

IMPA, Brazil

Friday 26, 08:45-09:20

In this talk, we prove that the Min-Oo's conjecture holds if we consider a compact connected locally conformally flat manifold with boundary such that the eigenvalues of the Schouten tensor satisfy a fully nonlinear elliptic inequality, and the mean curvature of the boundary is controlled bellow by the mean curvature of a geodesic ball in the standard unit-sphere. This is a joint work with E. Barbosa and M.P. Cavalcante.

The Schwinger Mechanism in Kaluza-Klein Manifolds

Guglielmo Fucci

East Carolina University, North Carolina, USA

Thursday 25, 08:45-09:20

In this talk we will present some recent results regarding the rate of particle creation for scalar fields due to a uniform electric field in Kaluza-Klein manifolds.

In particular, we utilize spectral zeta function regularization techniques in order to compute the one-loop effective action of the system and its corresponding imaginary part. The analysis relies heavily on explicit formulas obtained by the author concerning the Hurwitz zeta function of imaginary second argument. We will show that the presence of the extra-dimensions and their specific geometric characteristics, influence the rate at which pairs of particles and anti-particles are generated. The results presented could lay the foundations of an indirect method for detecting extra-dimensions.

Canonical metrics on (string) holomorphic Courant algebroids

Mario García Fernández

ICMAT, Madrid, Spain

Thursday 25, 16:10-16:45

Yau's solution of the Calabi Conjecture implies, in particular, that every projective Calabi-Yau manifold X admits a metric with holonomy contained in $SU(n)$, and that these metrics are parametrized by the Kähler cone on $H^2(X, R)$. In this talk I will give evidence of an extension of Yau's theorem to non-Kähler manifolds, where the Calabi-Yau manifold is replaced by a pair (X, Q), given by a compact complex manifold with vanishing first Chern class and a (string) holomorphic Courant algebroid. Holomorphic Courant algebroids appear naturally in conformal field theories in physics and are intimately related to Hitchin's theory of generalized geometry. Joint work with Roberto Rubio, Carlos Shahbazi and Carl Tipler.

Stability of the Poincaré bundle for the stack of principal G-bundles

Tomás Luis Gómez

ICMAT, Madrid, Spain

Friday 26, 10:10-10:45

Let X be a smooth projective curve of genus at least two. Let G be an almost simple affine algebraic group. The universal principal G-bundle is called the Poincaré bundle. It is a principal G-bundle on the product of the curve and the moduli stack of principal G-bundles. We prove that it is stable with respect to any polarization (joint work with I. Biswas and N. Hoffmann).

Submersions with positive sectional curvature

David González Álvaro

University of Fribourg, Switzerland

Thursday 25, 09:25-10:00

In this talk we will review some classical results concerning manifolds with positive sectional curvature, and we will discuss some related open problems. In particular we will study potential obstructions to the existence of Riemannian submersions between positively curved manifolds, based on joint work with Luis Guijarro and Marco Radeschi.

Gluing formulas and the Casimir effect

Klaus Kirsten

Baylor University, Waco, Texas, USA

Thursday 25, 10:50-11:25

Let M_1 and M_2 be two Riemannian manifolds each of which have the boundary N. Consider the Laplacian on M_1 and M_2 augmented with Dirichlet boundary conditions on N. A natural question to ask is if there is any relation between spectral properties of the Laplacian on M_1, M_2, and the Laplacian on the manifold M (without boundary) obtained gluing together M_1 and M_2, namely $M = M_1 \cup_N M_2$. A partial answer is given by the Burghelea-Friedlander-Kappeler-gluing formula for zeta-determinants. This formula contains an (in general) unknown polynomial which is completely determined by some data on a collar neighborhood of the hypersurface N. In this talk I present results for the polynomial in terms of suitable geometric tensors on N. Choosing M_1, M_2 and M suitably, a gluing formula for Casimir energies results. This relates Casimir forces to the Dirichlet-to-Neumann map, providing a completely new perspective.

A Plateau problem at infinity for minimal surfaces in $\mathbb{H}^2 \times \mathbb{R}$

Magdalena Rodríguez

Universidad de Granada, Spain

Friday 26, 10:50-11:25

In this talk we will discuss some existence and non-existence results for properly embedded minimal annuli with prescribed boundary at infinity. This is a joint work with Leonor Ferrer, Francisco Martín and Rafe Mazzeo.

Timelike surfaces in Minkowski space with a canonical null direction

Gabriel Ruiz

UNAM, Mexico

Thursday 25, 14:45-15:20

Given a constant vector field Z in Minkowski space, a timelike surface is said to have a canonical null direction with respect to Z if the projection of Z on the tangent space of the surface gives a lightlike vector field. For example, in the three-dimensional Minkowski space: a surface has a canonical null direction if and only if it is minimal and flat. When the ambient has arbitrary dimension, if a surface has a canonical null direction and has parallel mean curvature vector then it is minimal. We give different ways for building these surfaces in the four-dimensional Minkowski space. We describe several properties in the non ruled general case in four-dimensional Minkowski space.

A tale of two geometric gravitation theories: From Newton-Cartan's to Einstein's?

Mariano Santander

Universidad de Valladolid, Spain

Friday 26, 15:25-16:00

As a matter of historical fact, Einstein's theory of gravitation (ETG) was a complete breakthrough in our understanding of gravitation, for if compared to its antecedent, the newtonian theory (NTG), the realm of ideas involved in both theories seems to be worlds apart. Starting with Cartan in the 1920s, there has been a gradually growing realization that Newton's theory can be reinterpreted also as a theory of curvature of the (newtonian) space-time, reformulation which is known as Newton-Cartan (NC) gravity.

In the first part of this talk I will briefly review the Newton-Cartan interpretation of the NTG, paying attention to the fact that there are different newtonian connections compatible with the 'degenerate' metric and cometric in the NC theory. This can be also reformulated in terms of the infinite-dimensional group of rigid motions, which provides the context to single out a connection which describes the inertial and gravitational effects which are actually present in any reference frame.

The second part deals with a contrafactual question, to be seen as an example of fictional history with a moral. The question is: Had Einstein 1908-1915 been not there, could a physicist working in the 1920s and knowleadgeable about the then recent contributions of Levi-Civita and Cartan, as well about the basic role of the action principle, have reformulated the ordinary newtonian theory of gravitation in a geometric mood? Or, in other words, could things have happened so that newtonian gravitation was reformulated as a geometric theory *before the creation of the ETG*?

Folk wisdom says, probably rightly, that had Einstein not built the TEG en 1908-1915, no one would have done *as he did* in the next 20 or 30 years. But the Newton-Cartan's to Einstein's fictional path provides a plausible way to go from the old Newton's theory to the new ETG theory in a manner slightly different from the one Einstein actually did. In the talk I will explore these questions.

Constant angle hypersurfaces in semi-riemannian space-forms

Didier A. Solís Gamboa

Universidad Autónoma de Yucatán, Mexico

Thursday 25, 10:10-10:45

One of the main fields of study in classical differential geometry consists of the analysis and classification of submanifolds that satisfy certain geometric constraints. These conditions are often related to both curvature and structures present in the ambient space. In this talk we present some classification results for hypersurfaces immersed in semi-riemannian space-forms having a constant angle with respect to a closed and conformal vector field.

A characterization of the grim reaper cylinder

Eddygledson Souza Gama

Universidade Federal do Ceará, Brazil

Friday 26, 09:25-10:00

In this lecture, we will talk about a characterization of the grim reaper cylinder as the only translating soliton by mean curvature flow in R^n which is C^1-asymptotic to two parallel half-hyperplanes outside a cylinder. In fact, a stronger result of characterization holds: the grim reaper cylinder and the hyperplane are the unique examples of translating solitons in R^n which are C^1-asymptotic to two half-hyperplanes outside a cylinder.

Special Session 7: Holomorphic and Algebraic Foliations

Organizers: Carlos Galindo Pastor (Universidat Jaume I, Castellón, Spain) and Jorge Vitório Pereira (IMPA, Brazil).

What holomorphic singularities of foliations are realized by algebraic foliations?

Gabriel Calsamiglia

Universidade Federal Fluminense, Brazil

Thursday 25, 08:45-09:20

I will discuss the problem of deciding when a germ of holomorphic foliation on a complex surface occurs - up to a local change of coordinates - as germ of foliation of the projective plane, or, more generally, of some algebraic foliation of a projective surface.

Reduction of Singularities of Singular Holomorphic Foliations

Felipe Cano

Universidad de Valladolid, Spain

Friday 26, 08:45-09:20

We give the know results in the global and local uniformization cases. We also give a conjecture about the expected global statement. Some applications as the Local Brunella Conjecture will be presented.

Planar polynomial differential systems, algebraic limit cycles and plane Cremona maps

Antoni Ferragut

Universitat Jaume I, Castellón, Spain

Thursday 25, 09:25-10:00

Dynamical systems have evolved in the latter years. We see many solved problems and new techniques, and there is a large literature about the subject. However, there are some stalled problems that have remained at the same point for many years. It seems that we need new and fresh techniques, or different points of view, to go further.

In this talk we present some tools coming from the Algebraic Geometry, specially the Cremona transformations, that are allowing us to evolve a little bit more in some specific problems. Concretely, we show how we can transform accurately quadratic systems into new quadratic systems after some kind of birational transformations, the quadratic plane Cremona maps. We apply afterwards these transformations to the families of quadratic differential systems having an algebraic limit cycle. As a consequence, we provide a new family of quadratic systems having an algebraic limit cycle of degree 5. Moreover we show how the known families of quadratic differential systems having an algebraic limit cycle of degree greater than four are obtained using these transformations.

Furthermore, the use of plane Cremona maps allow us to obtain new examples of families having specific and new features, such as 90 (new) cubic differential systems having algebraic limit cycles of degrees from 2 to 10 and a cubic differential system, not Liouville integrable, having an invariant algebraic curve of degree 22.

This talk is the result of joint work with Maria Alberich-Carramiñana (UPC) and Jaume Llibre (UAB).

Foliations and webs with continuous symmetries on complex projective surfaces

David Marín

Universitat Autònoma de Barcelona, Spain

Thursday 25, 10:45-11:25

We will describe the structure of foliations and webs on complex projective surfaces which are invariant by a germ of birational flow.

We will discuss in detail the case of the projective plane, characterizing planar projective webs with many infinitesimal symmetries. This is a joint work with Marcel Nicolau.

A class of planar vector fields with polynomial first integral

Francisco Monserrat

Universidad Politécnica de Valencia, Spain

Thursday 25, 10:10-10:45

The talk is based on joint work with A. Ferragut and C. Galindo. We give an algorithm for deciding whether a planar polynomial differential system has a first integral which factorizes as a product of defining polynomials of curves with only one place at infinity. In the affirmative case, our algorithm computes a minimal first integral. In addition, we solve the Poincaré problem for the class of systems which admit a polynomial first integral as above in the sense that the degree of the minimal first integral can be computed from the reduction of singularities of the corresponding vector field.

Foliations by curves uniquely determined by minimal subschemes of its singularities

Jorge Olivares

CIMAT, Guanajuato, Mexico

Friday 26, 09:25-10:00

Let $\mathbb{P}^n = \mathbb{P}^n_{\mathbf{K}}$ be the projective space of dimension $n \geq 2$ over an algebraically closed ground field $\mathbf{K}$, let $\Theta_{\mathbb{P}^n}$ be its tangent sheaf and let

$$\mathbf{E} = \mathbf{E}(n, r-1) = \mathrm{H}^0(\mathbb{P}^n, \Theta_{\mathbb{P}^n}(r-1)).$$

A *foliation* (by curves, with singularities) of degree r in $\mathbb{P}^n$ is the class $[s] \in \mathbb{P}\mathbf{E}$ of a global section $s \in \mathbf{E}$.
The singular scheme $([s])_0$ of $[s]$ is the scheme of zeroes of $[s]$. We say that $[s]$ has isolated singularities if $\dim ([s])_0 = 0$.
It is well-known that a foliation with isolated singularities $[s]$ of degree $r \geq 2$ in $\mathbb{P}^n$ is uniquely determined by its singular scheme $([s])_0$.
In the talk, we will show that the set of foliations which are uniquely determined by a subscheme (of *minimal* degree) of its singular scheme, contains a non-empty Zariski-open subset.
This is a joint work with Antonio Campillo (Valladolid).

Torus actions and singular foliations

Daniel Panazzolo

Université de Haute-Alsace, France

Friday 26, 10:50-11:25

We will show that torus actions appear naturally in several problems related to the local theory of singular foliations, such as normal form theory, invariant

varieties and resolution of singularities.

Foliations and Mori theory

Calum Spicer

Imperial College, London, UK

Friday 26, 10:10-10:45

In the case of varieties, the development of Mori theory has given a flexible and powerful framework to study both the global birational geometry of varieties, as well as the local geometry of singularities. I will explain some aspects of the application of the ideas of Mori theory to foliations, in particular indicating some recent work on corank 1 foliations on threefolds and time permitting show how these ideas can be used to understand both the global and local geometry of foliations.

Poster Session

Adaptive models for Envelope Generation from 3D Video

Daniel Camazón Portela

Universidad de Valladolid, Spain

This poster introduces preliminary results in the dynamic modeling of actors in motion from irregularly distributed sparse data. This data has been captured from synchronized color and depth cameras (RGB-D). Once processed and analyzed, this data provides geometric and radiometric primitives to be managed in 3D video. The first step involves the resolution of technological issues concerning synchronization, signal conversion, process parallelization, or information fusion arising from different sensors, among others.

Modeling of human motion is a highly complex problem, augmented in those scenes with more than one actor. From the early years of the 21st century, kinematic modeling of mobile actors have been accomplished with different 3D video techniques applied to multimedia sectors. In our case, 3D video will be used to generate 3D representations of evolving actors in a structured scene from a finite collection of synchronized fixed cameras. Most models are centered in adjusting PL-structures or PS-structures to evolving clouds of points. This publication intends to provide some insights for the required algebraic models.

From a more theoretical viewpoint, there are a lot of unsolved mathematical problems related to 3D+1d modeling of actors. The inputs are related with the discrete nature of the point clouds with variable density depending on the relative orientation of the cameras, the illumination conditions, the clothes of the actors and the characteristics of the performance. In order to simplify, we will constraint ourselves to a scene with two actors performing slow motions with basic garment, avoiding finer details as those related with gestures or wrinkles.

The most relevant aspects concerning the *static analysis* (geometric initialization) include the following tasks: Clustering points following geometric and radiometric constraints. Automatic generation of local quadrangular meshes for well-defined clusters beyond a threshold. Local adjustment of low-degree surfaces for each quadrangular mesh. Overlapping of common regions (observed from different localizations of cameras) by using projective transformations. Generation of local algebraic models by using generalized B-spline

surfaces of bidegree (d_1, d_2). Propagation of well-defined low-degree pieces by using parabolic flows to fill out unnatural holes. Matching by imposing low order contact conditions in the space of deformations. Optimization by using curvature flows for matched static pieces. Regularity constraints give a Zariski open set of generalized splines as ambient space for the above constructions. However, the presence of "events" (supported on Discriminant Loci for each projection map), motivates the need of considering low corank and low codimension singularities for finer moduli spaces. At the current state, our research only considers local models with singularities linked to generic projections of surfaces.

Motion is geometrically translated in evolving algebraic surfaces (a slice for each time step). This leads to more complicated singularities in a space-time representation. A coarse-to-fine approach allows to manage variable information. This approach stars with generic properties of surface fibrations (Hurewicz) but then it studies the "descent" to more restricted algebraic surfaces giving a fibration of an algebraic threefold with ordinary singularities (stable by deformations).

Coauthors: Francisco Javier Delgado del Hoyo, Javier Finat Codes.

Robust Mathematical Modeling for Motion from Video Sequences with a hand-held camera

Francisco Javier Delgado del Hoyo

Universidad de Valladolid, Spain

Visual odometry plays an important role in Simultaneous Localization and Mapping. The main goal is to compute the camera pose using only passive sensor. More specifically, monocular tracking is focused only on sequences captured with a single lens camera. The sparse approach to the problem consists in abstracting the image in a finite collection of features matched in real-time (around 25 fps). The hand-held camera moves along a static environment (indoor or traffic scenes, e.g.) to achieve autonomous navigation.

There exist partial solutions to the problem which have been already applied in automatic navigation. However, to achieve a more robust (in regard to the scene), and adaptive (in regard to possible events) solution, it is necessary to solve some mathematical issues, such as: (1) detection, tracking and clustering of trajectories linked to salient mobile features with geometric (corners, e.g.) or radiometric information (light intensity, e.g.); (2) estimation of kinematics with a feedback between real 3D+1d scene flow Φ and apparent 2D+1d image flow $\phi = \pi(\Phi)$; (3) prediction of different events which are modeled as singularities of (scalar, vector, tensor) fields.

Our approach to solve the problem is based on tracking and clustering these features in adaptive packs of trajectories. The development of a structural kinematic model allows to integrate different probabilistic, geometric, algebraic,

and topological traits in a common framework. More especifically, and by following a coarse-to-fine approach, we have considered:

Probabilistic traits, which approximate localization of point clouds with similar kinematic behavior. Local trajectories fulfilling "contact constraints" are used, generating coarse envelopes after outliers removal, and evaluating statistical measures of global (energy vs entropy) functionals.

Geometric traits, which coarse reconstructions generated by a "weighted" combination of homographies (relative to perspective models in structured scenes) and fundamental matrices (for non-structured scenes). The introduction of total variation methods (reminiscent of the total energy functional) provides a key to evaluate the "proximity" between partially reconstructed models and a first validation. To achieve an intrinsic presentation it is necessary to incorporate actions groups linked to the feedback between rigid structure of the scene (Euclidean Group) and evolving appearances (Special Linear Group).

Algebraic traits, which provide invariant representation (linked to the coadjoint action) for some meaningful classical groups. This representation is based on a feedforward strategy between $SL(n) \ltimes \mathbb{R}^n$ (for apparent deformations in the image and scene flow up to scale) and $E(n) := SO(n) \ltimes \mathbb{R}^n$ (for robust euclidean information). The transference of information is performed on the common universal covering for their complex version.

Topological traits, which model "small deformations" for regular variation of packages of trajectories (invariants of the homotopy class of maps between successive images). Alternately, "sudden events" can be modeled in terms of singularities of (scalar, vector, tensor) fields.

Coauthors: Javier Finat Codes, Belén Palop del Río.

Moduli of Hypersurfaces in P^3

Kristin DeVleming

University of Washington, USA

We define a compactification of the moduli space of degree d hypersurfaces H in P^3 using pairs (X, D) corresponding to degenerations of (P^3, H). We show that strictly slc Fano varieties have a certain form and use that classification to show that the moduli space is a proper Deligne-Mumford stack for odd degree d and that the pairs appearing have at worst slt singularities. Most of this work relies on the study of singularities and the minimal model program.

Humbert-Edge curves

Bosco Frías-Medina

Universidad Nacional Autónoma de México and Universidad Autónoma de Zacatecas, Mexico

We discuss W. L. Edge's approach to Humbert's curves as a canonical genus 5 curve that is a complete intersection of three diagonal quadrics. Moreover, the contributions of Edge to the study of projective curves in $\mathbb{P}^n$ that are complete intersection of $n-1$ quadrics are explained and we present some results complementary to the Edge's exposition.

Coauthor: Alexis García-Zamora.

Local information of difference equations

Moisés Herradón Cueto

University of Wisconsin, Madison, USA

The theory of algebraic differential equations on the affine line is very well-understood. In particular, there is a well-defined notion of restricting a differential equation (which we think of as a D-module) to a formal neighborhood of a point, and D-modules over a formal neighborhood over a point are completely described by two vector spaces, called vanishing cycles and nearby cycles, and some maps between them. We give an analogous notion of "restriction to a formal disk" for difference equations that satisfies several desirable properties: first of all, a difference module can be recovered uniquely from its restriction to the complement of a point and its restriction to a formal disk around this point. Secondly, it gives rise to a notion of vanishing cycles that is compatible with the Mellin transform, in that vanishing cycles of a difference module are determined by nearby cycles of its Mellin transform, which is a D-module on the torus. This relation is the local Mellin transform, which is analogous to the local Fourier transform for D-modules.

Vertex algebras and Hodge estructures

Mohammad Reza Rahmati

CIMAT, Mexico

In this short note we discuss some natural inter-relations between Hodge structures and vertex algebras of conformal field theory. Some part of this on a correspondence between Higgs bundles and opers already is known in the literature as non-abelian Hodge theorem due to C. Simpson. The same kind of correspondence has been well studied over flag manifolds of semisimple Lie groups known as Beilinson-Bernstein localization. Our goal is to explain how the data of a variation of Hodge structure as a solution of a regular holonomic system is matched with similar system of vertex algebra modules arising in

conformal field theory. The result of the discussion is an analogue of the Bernstein correspondence over a local manifold. We associate to flat connections of mixed Hodge structures a generalized version of Harish-Chandra modules called Wakimoto modules and a generalized Harish-Chandra homomorphism. Therefore the map of correspondence is a more developed form of Harish-Chandra isomorphism. This text mainly proposes to motivates some ideas of representations of vertex algebras into Hodge theory. We have brought the basic ideas in the two fields close to each other. We enclose with an explanation of geometric Langlands correspondence as a generalization of the discussion.

On volumes of complements of periodic geodesics

José Andrés Rodríguez Migueles

IRMAR, Université de Rennes I, France

Every closed geodesic γ on a surface has a canonically associated knot $\hat{\gamma}$ in the projective unit tangent bundle. We study, for γ filling, the volume of the associated knot complement with respect to its unique complete hyperbolic metric.

Adler-Moser potentials and Differential Galois Theory

Raquel Sánchez Cauce

Universidad Autónoma de Madrid, Spain

We consider Schrödinger equation

$$(L - E)\phi = -\phi_{xx} + (u - E)\phi = 0$$

with Adler-Moser potentials defined in [AM]. We compute explicit fundamental matrices of this equation for two particular Adler-Moser potentials and show how these fundamental matrices are related performing Darboux transformations. Finally, applying Thm 2.2 of [JMSZ], we show that their differential Galois groups are the same and time-independent.

This argument can be generalized for all Adler-Moser potentials, and hence we can compute their differential Galois groups.

This is a joint work with Sonia Jiménez, Juan J. Morales Ruiz and María-Ángeles Zurro.

References

[AM] M. Adler, J. Moser, *On a class of polynomials connected with the Korteweg-deVries equation*, Communications in Mathematical Physics 61 (1) (1978) 1-30.

[JMSZ] S. Jiménez, J.J. Morales-Ruiz, R. Sánchez-Cauce, M.A. Zurro, *Differential Galois theory and Darboux transformations for Integrable Systems*, Journal of Geometry and Physics 115 (2017) 75-88.