Preface

The conference *Moduli spaces in Algebraic Geometry and Applications* took place at the University of Campinas between July 26th and 31st, 2018 as a satellite of the International Congress of Mathematicians in Rio de Janeiro.

The programme consisted of 22 talks, 4 shorth communications and 11 posters, on topics covering most of modern algebraic geometry: moduli spaces of sheaves, geometry of irreducible holomorphic symplectic manifolds, enumerative algebraic geometry and curves. The present volume contains accounts of 12 of these contributions. There are 65 participants from all over the world including several young researchers and PhD students from UNICAMP, IMPA and UFF.

Everything ran smoothly during the conference due to the invaluable assistance from the staff of the Institute of Mathematics, Statistics and Scientific Computing (IMECC), where all lectures took place. I would like give special thanks to the members of the Scientific Committee (Eduardo Esteves, Rosa Maria Miró-Roig, Giorgio Ottaviani, Ravi Vakil) for their guidance, and to Simone Marchesi for his help with inumerous practical matters concerning the local organization.

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Moduli Spaces in Algebraic Geometry and Applications
University of Campinas, 26 - 31 July 2018

December 5, 2020

Scientific Committee:
Eduardo Esteves, Rosa Maria Miró-Roig,
Giorgio Ottaviani, Ravi Vakil

Local Organizers:
Marcos Jardim and Simone Marchesi

Talks

1. Valery Alexeev, Compact moduli and reflection groups.
2. Marian Aprodu, Green's conjecture and vanishing of Koszul modules.
3. Carolina Araujo, Moduli spaces of parabolic vector bundles on $\mathbb{P}^1$ and a special family of Fano manifolds.
4. Agnieszka Bodzenta, Categorifying non-commutative deformation theory.
5. Jim Bryan, Banana Manifolds, Donaldson–Thomas theory, and modular forms.
6. Juliana Coelho, Hurwitz schemes and gonality of stable curves.
7. Izzet Coskun, The cohomology and birational geometry of moduli spaces of sheaves on surfaces.
8. Ben Davison, Integrality of BPS invariants.

9. Daniele Faenzi, Families of Cohen–Macaulay modules on singular spaces.
10. Gavril Farkas, The Prym–Green conjecture.
11. Daniel Greb, Moduli of sheaves on higher-dimensional projective manifolds.
12. Victoria Hoskins, On the motive of the stack of vector bundles on a curve.
13. Jack Huizenga, Properties of general sheaves on Hirzebruch surfaces.
14. Klaus Hulek, The cohomology of moduli spaces of cubic threefolds.
15. Emanuele Macrì, The period map for polarized hyperkähler manifolds.
16. Jorge Vitório Pereira, Irreducible components of the space of codimension one foliations.
17. Evangelos Routis, Complete complexes and spectral sequences.
18. Giulia Saccà, Remarks on degenerations of hyper-Kähler manifolds.
19. Justin Sawon, Lagrangian fibrations by Prym varieties.
20. Benjamin Schmidt, Bridgeland stability and the genus of space curves.
21. Alexander S. Tikhomirov, Geography and geometry of the moduli spaces of semi-stable rank 2 sheaves on projective space.
22. Israel Vainsencher, Enumeration of singular hypersurfaces, old and new.

Communications

1. Aline Andrade, Orthogonal instanton bundles on $\mathbb{P}^n$.
2. Ignacio Barros, Geometry of the moduli of n-pointed $K3$ surfaces of small genus.
3. Inder Kaur, A Torelli-type theorem for moduli spaces of semistable sheaves over nodal curves.
4. Roberto Svaldi, On the boundedness of Calabi–Yau varieties in low dimension.

Posters

1. Charles Almeida, Moduli space of torsion free sheaves on projective spaces.
2. Alana Cavalcante, Holomorphic distributions on Fano threefolds.
3. Douglas Guimarães, Connectedness of the punctual Hilbert and Quot schemes over the affine space $\mathbb{C}^3$
4. Changho Han, A birational model of moduli of genus 4 curves using stable log surfaces
5. César Lozano Huerta, Restrictions of base loci and the Severi divisor.
6. Rick Richster, Chamber decompositions for the effective cone of Mori dream spaces.
7. Frederico Sercio, Characterizing the gonality of two-component stable curves of compact type.
8. Helena Soares, Monads on projective varieties.
9. Jairo Menezes e Souza & Danielle Lara, On gonality, canonical models of curves and scrolls.
10. Naizhen Zhang, Multiplication maps of sections and higher rank Brill–Noether theory

Participants

1. Alex Massarenti
2. Ageu Freire
3. Amar Henni
4. Anand Deopurkar
5. André Contiero
6. Angel Carocca

7. Atoshi Chowdhury
8. Benjamin Bakker
9. Brady Ali Miliwska
10. Daniel Futata
11. Daniel Santana
12. Danilo Dias
13. Danilo Santiago
14. Ethan Cotterill
15. Ettore Turatti
16. João Paulo Figueredo
17. Johan Martens
18. José Eduardo Garcez
19. Juan Desimoni
20. Justin Sawon
21. Karl Christ
22. Lucas Braune
23. Luiz Carlos Sobral
24. Renan da Silva Santos
25. Renato Vidal Martins
26. Rodrigo von Flach
27. Takeshi Abe
28. Victor Pretti

Schedule

	Thursday 26	Friday 27	Saturday 28	Sunday 29	Monday 30	Tuesday 31
9h30	**Greb**	**Araujo**	**Farkas**	Discussion Session	**Alexeev**	**Macrì**
10h30	**Faenzi**	**Aprodu**	**Coskun**		**Schmidt**	**Davison**
11h30	Coffee Break	Coffee Break	Coffee Break		Coffee Break	Coffee Break
12h	**Bodzenta**	**Hoskins**	**Saccà**		**Coelho**	**Pereira**
13h	Lunch	Lunch	Lunch		Lunch	Lunch
15h	**Sawon**	**Tikhomirov**	**Vainsencher**	Barbecue	**Hulek**	Free Afternoon
16h	**Andrade**	**Barros**	**Kaur**		**Svaldi**	
16h30	Coffee Break	Coffee Break	Coffee Break		Coffee Break	
17h	**Bryan**	Poster Session	**Huizenga**		**Routis**	
19h	Conference Dinner					

Abstracts of Talks

Compact moduli and reflection groups

Valery Alexeev (University of Georgia, USA)

Abstract.

I will describe a class of varieties, related to reflection groups, whose moduli spaces admit functorial geometrically meaningful toroidal compactifications.

Green's conjecture and vanishing of Koszul modules

Marian Aprodu (University of Bucharest, Romenia)

Abstract

I report on a joint work in progress with G. Farkas, S. Papadima, C. Raicu and J. Weyman. Koszul modules are multi-linear algebra objects associated to an arbitrary subspace in a second exterior power. They are naturally presented as graded pieces of some Tor spaces over the dual exterior algebra. Koszul modules appear naturally in Geometric Group Theory, in relations with Alexander invariants of groups. We prove an optimal vanishing result for the Koszul modules, and we describe explicitly the locus corresponding to Koszul modules that are not of finite length. We use representation theory to connect the syzygies of rational cuspidal curves to some particular Koszul modules and we prove that our vanishing result is equivalent to the generic Green conjecture. We present some applications to Alexander invariants and other problems from Geometric Group Theory.

Moduli spaces of parabolic vector bundles on $\mathbb{P}^1$ and a special family of Fano manifolds

Carolina Araujo (IMPA, Brazil)

Abstract

In the first part of the talk, we will introduce moduli spaces of parabolic vector bundles on $\mathbb{P}^1$ and describe their automorphism groups. This is a joint work of Thiago Fassarella, Inder Kaur and Alex Massarenti. In the second part of the talk, we will explore the birational geometry of these moduli spaces to describe a special family of Fano manifolds, generalizing to arbitrary even dimension the classical double-manifestation of quartic del Pezzo surfaces: On one hand, they are blowups of $\mathbb{P}^2$ at 5 general points. On the other hand, they are complete

intersections of two quadric hypersurfaces in $\mathbb{P}^4$. This is a joint work with Cinzia Casagrande.

Categorifying non-commutative deformation theory

Agnieszka Bodzenta (University of Warsaw, Poland)

Abstract

We categorify non-commutative deformation theory by viewing underlying spaces of infinitesimal deformations of n objects as abelian categories with n simple objects. If the deformed collection is simple, we prove the ind-representability of the deformation functor. For an arbitrary collection we construct and ind-hull for the deformation functor. We use this hull to present the deformation functor as a non-commutative Artin stack.

Banana Manifolds, Donaldson–Thomas theory, and modular forms

Jim Bryan (University of British Columbia, Canada)

Abstract

Banana Manifolds are a class of compact Calabi–Yau threefolds which are fibered by Abelian surfaces and have singular fibers with banana configurations: three genus zero curves meeting each of the other in two points. We construct the basic banana manifold as well as some exotic ones which are rigid and have very small Hodge numbers. We compute in closed form the Donaldson–Thomas/Gromov–Witten partition function of Banana manifolds for fiberwise classes. We show that the genus g Gromov–Witten potential is an explicit genus 2 Siegel modular form of weight $2g-2$.

Hurwitz schemes and gonality of stable curves

Juliana Coelho (Universidade Federal Fluminense, Brazil)

Abstract

In its simplest form, the Hurwitz scheme $H_{k,g}$ is the moduli space of finite maps of degree k from a genus-g smooth curve to $\mathbb{P}^1$. In 1982 Harris and Mumford compactified this moduli space with the use of admissible covers. Mochizuki showed in 1995 that this compactified Hurwitz scheme is irreducible.

We introduce pointed compactified Hurwitz schemes, allowing us to consider clutching maps similar to those existing for the moduli space of stable curves. As

an application, we compare the gonality of a stable curve to that of its partial normalizations. This is a joint work with Frederico Sercio

The cohomology and birational geometry of moduli spaces of sheaves on surfaces

Izzet Coskun (University of Illinois at Chicago, USA)

Abstract

In the first half of this talk, I will discuss joint work with Jack Huizenga on computing the cohomology of the general sheaf in moduli spaces of stable sheaves on rational surfaces. This generalizes a celebrated theorem of Göttsche and Hirschowitz. As a consequence, we classify Chern characters on Hirzebruch surfaces such that the general bundle with that character is globally generated. In the second half, I will describe joint work with Matthew Woolf on the stabilization of the cohomology of moduli spaces of sheaves on surfaces.

Integrality of BPS invariants

Ben Davison (University of Edinburgh, Scotland)

Abstract

BPS numbers are certain invariants that "count" coherent sheaves on Calabi-Yau 3-folds. Because of subtleties in the definition, especially in the presence of strictly semistable sheaves, it is not a priori clear that the numbers are in fact integers. I will present a recent proof with Sven Meinhardt of this integrality conjecture. The conjecture follows from a stronger conjecture, namely that a certain constructible function on the coarse moduli space of semistable sheaves defined by Joyce and Song is integer valued. This conjecture in turn is implied by the stronger conjecture that this function is in fact the pointwise Euler characteristic of a perverse sheaf. We prove all of these conjectures by defining this perverse sheaf, and furthermore find that the hypercohomology of this sheaf, which categorifies the theory of BPS invariants, carries a natural Lie algebra structure, generalizing the theory of symmetrizable Kac–Moody algebras.

Families of Cohen-Macaulay modules on singular spaces

Daniele Faenzi (University of Bourgogne, France)

Abstract

The representation type of a variety expresses the complexity of the category of Cohen-Macaulay modules over the associated coordinate ring. The goal of this

talk is to show that almost all projective varieties are of "wild" type (meaning that this category is as complicated as possible) with a special focus on singular schemes including some classes of non-normal varieties, cones and certain reducible or non-reduced schemes

The Prym–Green Conjecture

Gavril Farkas (Humboldt University, Germany)

Abstract

By analogy with Green's Conjecture on syzygies of canonical curves, the Prym–Green conjecture predicts that the resolution of a general level p paracanonical curve of genus g is natural, that is, as "small" as the geometry of the curve allows. I will discuss a complete solution to this conjecture for odd genus, recently obtained in joint work with M. Kemeny.

Moduli of sheaves on higher-dimensional projective manifolds

Daniel Greb (University of Duisburg-Essen, Germany)

Abstract

Moduli of sheaves on surfaces come in (at least) three different flavours: Gieseker moduli spaces (constructed using GIT), moduli of slope-semistable sheaves (constructed using determinant line bundles), and the Donaldson–Uhlenbeck compactification of the analytic moduli space of slope-stable vector bundles (constructed using gauge theory). In my talk, I will report on projects with various co-authors that extend the construction as well as the interplay between these different moduli spaces to higher dimensions. Special emphasis will be laid upon the construction of complex structures on gauge-theoretical moduli spaces and if time permits on the construction of Gieseker moduli spaces for sheaves that are semistable with respect to stability conditions not coming from an ample line bundle.

On the motive of the stack of vector bundles on a curve

Victoria Hoskins (Freie Universität Berlin, Germany)

Abstract

Following Grothendieck's vision that a motive of an algebraic variety should capture many of its cohomological invariants, Voevodsky introduced a triangulated category of motives which partially realises this idea. After describing some of

the properties of this category, we explain how to define the motive of certain algebraic stacks. We show that the motive of the moduli stack of vector bundles on a smooth projective curve can be described in terms of the motive of this curve and its symmetric powers by using Quot schemes of torsion quotient sheaves. If there is time, I will also describe work in progress on proving a formula for the motive of this stack. This is all joint with Simon Pepin Lehalleur.

Properties of general sheaves on Hirzebruch surfaces

Jack Huizenga (Pennsylvania State University, USA)

Abstract

Let X be a Hirzebruch surface. Moduli spaces of semistable sheaves on X with fixed numerical invariants are always irreducible by a theorem of Walter. Therefore it makes sense to ask about the properties of a general sheaf. We consider two main questions of this sort. First, the weak Brill-Noether problem seeks to compute the cohomology of a general sheaf, and in particular determine whether sheaves have the "expected" cohomology that one would naively guess from the sign of the Euler characteristic. Next, we use our solution to the weak Brill-Noether problem to determine when a general sheaf is globally generated. A key technical ingredient is to consider the notion of prioritary sheaves, which are a slight relaxation of the notion of semistable sheaves which still gives an irreducible stack. Our results extend analogous results on the projective plane by Gottsche-Hirschowitz and Bertram-Goller-Johnson to the case of Hirzerbruch surfaces. This is joint work with Izzet Coskun.

The cohomology of moduli spaces of cubic threefolds

Klaus Hulek (Leibniz Universität Hannover, Germany)

Abstract

The moduli space of cubic threefolds admits different compactifications, depending on the point of view one takes. These include the GIT quotient, the ball quotient model due to Allcock, Carlson and Toledo, the partial and full Kiran blow-up and the wonderful compactification. In this talk we will discuss the cohomology and the intersection cohomology of these spaces and applications. This is joint work with S. Casalaina-Martin, S. Grushevsky and R. Laza.

The period map for polarized hyperkähler manifolds

Emanuele Macrì (Northeastern University, USA)

Abstract

The aim of the talk is to study smooth projective hyperkähler manifolds which are deformations of Hilbert schemes of points on K3 surfaces and are equipped with a polarization of fixed type. These are parametrized by a quasi-projective 20-dimensional moduli space and Verbitsky's Torelli theorem implies that their period map is an open embedding when restricted to each irreducible component. Our main result is that the complement of the image of the period map is a finite union of explicit Heegner divisors that we describe. The key technical ingredient is the description of the nef and movable cone for projective hyperkähler manifolds (deformation equivalent to Hilbert schemes of points on K3 surfaces) by Bayer, Hassett, and Tschinkel.

As an application we will present a new short proof (by Bayer and Mongardi) for the celebrated result by Laza and Looijenga on the image of the period map for cubic fourfolds.

If time permits, as second application, we will show that infinitely many Heegner divisors in a given period space have the property that their general points correspond to projective hyperkähler manifolds which are isomorphic to Hilbert schemes of points on K3 surfaces.

This is joint work with Olivier Debarre.

Irreducible components of the space of codimension one foliations

Jorge Votório Pereira (IMPA, Brazil)

Abstract

This talk will discuss old and new results on the structure of the moduli space of codimension one holomorphic foliations on a given projective manifold. In particular, it will be discussed how the study of deformations of rational curves along foliations can be used to describe foliations of low degree on projective spaces.

Complete Complexes and Spectral Sequences

Evangelos Routis (Kavli IPMU, the University of Tokyo, Japan)

Abstract

The space of complete collineations is an important and beautiful chapter of algebraic geometry, which has its origins in the classical works of Chasles, Giambieli,

Hirst, Schubert, Tyrell and others, dating back to the 19th century. It provides a 'wonderful compactification' (i.e. smooth with normal crossings boundary) of the space of full-rank matrices between two (fixed) vector spaces. More recently, the space of complete collineations has been studied intensively and has been used to derive groundbreaking results in diverse areas of mathematics. One such striking example is L. Lafforgue's compactification of the stack of Drinfeld's shtukas, which he subsequently used to prove the Langlands correspondence for the general linear group. In joint work with M. Kapranov, we look at these classical spaces from a modern perspective: a complete collineation is simply a spectral sequence of a two term complex of vector spaces. We then develop a theory involving more full-fledged (simply graded) spectral sequences of complexes of vector bundles with arbitrarily many terms. We prove that the set of such spectral sequences has the structure of a smooth projective variety, the 'variety of complete complexes', which provides a desingularization, with normal crossings boundary, of the 'Buchsbaum-Eisenbud variety of complexes', i.e. a 'wonderful compactification' of the union of its maximal strata.

Remarks on degenerations of hyperkähler manifolds

Giulia Saccà (Massachusetts Institute of Technlogy, USA)

Abstract

After an overview of the role of Lagrangian fibrations in the theory of hyperkähler manifolds, I will focus on the relation with O'Grady's 10 dimensional example and give some recent applications of the study of degenerations of hyperkähler manifolds to Lagrangian fibrations.

Lagrangian fibrations by Prym varieties

Justin Sawon (University of North Carolina at Chapel Hill, USA)

Abstract

The Hitchin systems are Lagrangian fibrations on moduli spaces of Higgs bundles. Their compact counterparts are Lagrangian fibrations on compact holomorphic symplectic manifolds, such as the integrable systems of Beauville–Mukai, Debarre, Arbarello–Ferretti–Saccà, Markushevich–Tikhomirov, and Matteini. The GL-Hitchin system and the Beauville–Mukai system are both fibrations by Jacobians of curves. Thus they are isomorphic to their own dual fibrations. Moreover, Donagi–Ein–Lazarsfeld showed that the Beauville–Mukai system can be degenerated to a compactification of the GL-Hitchin system. The other Hitchin systems

and the other compact integrable systems mentioned above are fibrations by Prym varieties. In this work, we explore the relations between these different Lagrangian fibrations. In particular, we describe degenerations of the compact examples to compactifications of SL-, PGL-, SO-, and Sp-Hitchin systems. We also describe dual fibrations of certain Lagrangian fibrations by Prym varieties.

Derived categories and the genus of curves

Benjamin Schmidt (University of Texas at Austin, USA)

Abstract

A 19th century problem in algebraic geometry is to understand the relation between the genus and the degree of a curve in complex projective space. This is easy in the case of the projective plane, but becomes quite involved already in the case of three dimensional projective space. I will talk about generalizing classical results on this problem by Gruson and Peskine to other threefolds. This includes principally polarized abelian threefolds of Picard rank one and some Fano threefolds. The key technical ingredient is the study of stability of ideal sheaves of curves in the bounded derived category.

Geography and geometry of the moduli spaces of semi-stable rank 2 sheaves on projective space

Alexander S. Tikhomirov (High School of Economics, Russia)

Abstract

We give an overview of recent results on the geography and geometry of the Gieseker–Maruyama moduli scheme $M = M(2; c_1, c_2)$ of rank 2 semi-stable coherent sheaves with first Chern class $c_1 = 0$ or -1 and second Chern class c_2 on the projective space $\mathbb{P}^3$. We enumerate all currently known irreducible components of the of M for small values of c_2, and present the constructions of new series of components of M for arbitrary c_2. We discuss the problem of connectedness of M and also the problem of rationality of some series of components of M.

Enumeration of singular hypersurfaces, old and new

Israel Vainsencher (Universidade Federal de Minas Gerais, Brazil)

Abstract

There are 3 singular conics through 4 general points. Likewise, the number

of singular plane curves of degree d passing through the appropriate number $(d(d+3)/2-1)$ of points is expressed by the degree, $3(d-1)^2$, of the discriminant. Imposing a finite number of singular points to a hypersurface in arbitrary dimension leads to polynomial formulas, some of which are explicit. The case of non-isolated singularities will also be reviewed.

Abstracts of Communications

Orthogonal instanton bundles on $\mathbb{P}^n$

Aline V. Andrade (Universidade Federal de Viçosa, Brazil)

Abstract

In order to obtain existence criteria for orthogonal instanton bundles on $\mathbb{P}^n$, we provide a bijection between equivalence classes of orthogonal instanton bundles with no global sections and symmetric forms.

Using such correspondence we are able to provide explicit examples of orthogonal instanton bundles with no global sections on $\mathbb{P}^n$ and prove that every orthogonal instanton bundle with no global sections on $\mathbb{P}^n$ and charge $c \geq 3$ has rank $(n-1)c$. We also prove that $\mathcal{M}^{\mathcal{O}}_{\mathbb{P}^n}(c)$, the coarse moduli space of orthogonal instanton bundles with no global sections on $\mathbb{P}^n$, with charge $c \geq 3$ and rank $(n-1)c$ is affine.

Last, we construct Kronecker modules to determine the splitting type of the bundles in $\mathcal{M}^{\mathcal{O}}_{\mathbb{P}^n}(c)$.

Joint work with Simone Marchesi and Rosa M. Miró-Roig.

Geometry of the moduli of n-pointed K3 surfaces of small genus

Ignacio Barros (Humboldt Universität zu Berlin, Germany)

Abstract

We prove that the moduli space of polarized $K3$ surfaces of genus eleven with n marked points is unirational when $n \leq 6$ and uniruled when $n \leq 7$. As a consequence, we settle a long standing but not proved assertion about the unirationality of $\mathcal{M}_{\infty\infty,\setminus}$ for $n \leq 6$. We also prove that the moduli space of polarized $K3$ surfaces of genus eleven with 9 marked points has non-negative Kodaira dimension. We extend this to other genera.

A Torelli-type theorem for moduli spaces of semistable sheaves over nodal curves

Inder Kaur (IMPA, Brazil)

Abstract

In 1968 Mumford and Newstead proved that the second Intermediate Jacobian of the moduli space of rank 2 semistable sheaves with fixed determinant over a smooth, projective curve is isomorphic to the Jacobian of the curve. In joint work with S. Basu and A. Dan we prove a similar statement in the case when the underlying curve is irreducible nodal.

On the boundedness of Calabi-Yau varieties in low dimension

Roberto Svaldi (University of Cambridge, England)

Abstract

I will discuss new results towards the birational boundedness of low-dimensional elliptic Calabi-Yau varieties, joint work with Gabriele Di Cerbo. Recent work in the minimal model program suggests that pairs with trivial log canonical class should satisfy some boundedness properties. I will show that 4-dimensional Calabi-Yau pairs which are not birational to a product are indeed log birationally bounded. This implies birational boundedness of elliptically fibered Calabi-Yau manifolds with a section, in dimension up to 5. I will explain how one could adapt our strategy to try and generalize the results in higher dimension. I will also discuss a first approach towards boundedness of rationally connected CY varieties in low dimension (joint with G. Di Cerbo, W. Chen, J. Han and, C. Jiang).

Abstracts of Posters

Moduli space of torsion free sheaves on projective spaces

Charles Almeida (Universidade Estadual de Campinas, Brazil)

Abstract

We describe irreducible components of the moduli spaces of rank 2 torsion free sheaves on $\mathbb{P}^3$ with prescribed singularities, and prove that the number of such irreducible components grows as the second Chern class of the sheaves grows. Additionaly, we study the case where the second Chern class of the sheaves are small, computing the exact number of irreducible components of the moduli

space for particular cases. This is a joint work with Marcos Jardim, Alexander S. Tikhomirov.

Holomorphic distributions on Fano threefolds

Alana Cavalcante (Universidade Federal de Ouro Preto, Brazil)

Abstract

In my Phd thesis, we studied holomorphic distributions of dimension and codimension one on smooth weighted projective complete intersection Fano threedimensional manifolds, with Picard number equal to one.

The goal of this work is to characterize those distributions whose tangent and conormal sheaves are arithmetically Cohen Macaulay (aCM), i.e. have no intermediate cohomology. In addition, we also studied the properties of their singular schemes and we construct examples of codimension one distributions on X.

There are more types of Fano threefolds. By considering the restriction $\mathrm{Pic}(X) \simeq \mathbb{Z}$, one obtains 18 families. Now, the objective is to complete these characterizations for any Fano Threefold with Picard number one, for smooth hyperquadrics Q^n, with $n \geq 4$, and for Grassmannians. Joint work with Maurício Corrêa.

Refined invariants for framed sheaves on $\mathbb{P}^3$, and their asymptotics

Alberto Cazzaniga (AIMS-SA, Stellenbosch University, South Africa)

Abstract

The moduli space of sheaves on the projective space framed along a plane can be realised as the moduli space of representations of the three-loop quiver with relations induced by a superpotential. We study the generating series of a refinement of Donaldson-Thomas invariants for these moduli spaces, obtaining a closed product formula and an explicit description in terms of weighted 3D-partitions. Finally, we describe the asymptotics of the generating series. Work in collaboration with Dr. D. Ralaivaosaona.

Connectedness of the punctual Hilbert and Quot schemes over $\mathbb{C}^3$

Douglas Guimarães (Universidade Estadual de Campinas, Brazil)

Abstract

We exhibit a bijection between the Quot scheme of n points over the affine space

$\mathbb{C}^d$ and the space of d nilpotent n by n matrices commuting with each other and satisfying a stability condition modulo the $GL_n(\mathbb{C})$ action given by conjugation. With that done, we show the irreducibility of the punctual Quot scheme over the affine space $\mathbb{C}^2$, which was done also by Baranovsky and, after that, we study the connectedness of the Quot scheme in some particular cases of d and n.

A birational model of moduli of genus 4 curves using stable log surfaces

Changho Han (Harvard University, USA)

Abstract

Ever since the discovery of Deligne and Mumford, people considered many different ways to compactify moduli of curves. Vast majority of the known modular constructions rely on imposing singularity conditions on curves, which were shown to fit into Hassett and Keel's minimal model program on the DM compactification. Instead, I will instead showcase a birational moduli of genus four covers by degenerating a pair of canonical genus 4 curves and a unique quadric surface containing it, inspired by the work of Hassett. Then I will explain the geometry of this moduli space and state conjectures about relations to Hassett-Keel program. This is a joint work in with Anand Deopurkar.

Chamber decompositions for the effective cone of Mori dream spaces

Rick Rischter (Universidade Federal de Itajubá, Brazil)

Abstract

In this poster I will give examples of Mori Dream Spaces with distinct stable base locus and Mori chamber decompositions of its effective cone. I will also discuss sufficient conditions for the two decompositions to coincide. This is a work in progress with Alex Massarenti and Antonio Laface.

Characterizing the gonality of two-component stable curves of compact type

Frederico Sercio (UFF, Brazil)

Abstract

It is a well-known result that a stable curve of compact type with two components is hyperelliptic if and only if both components are hyperelliptic and the point of intersection is a Weierstrass point for each of them. We generalize this

characterization for higher gonality with the use of admissible covers. This is a joint work with Juliana Coelho.

Monads on projective varieties

Helena Soares (ISCTE-IUL, Portugal)

Abstract

We generalise Floystad's theorem on the existence of monads on the projective space to a larger set of projective varieties. We consider a variety X, a line bundle L on X, and a base-point-free linear system of sections of L giving a morphism to the projective space whose image is either arithmetically Cohen-Macaulay (ACM), or linearly normal and not contained in a quadric. We give necessary and sufficient conditions on integers a, b, and c for a monad of type

$$0 \to (L^\vee)^a \to \mathcal{O}_X^b \to L^c \to 0$$

to exist. We show that under certain conditions there exists a monad whose cohomology sheaf is simple. We furthermore characterise low-rank vector bundles that are the cohomology sheaf of some monad as above. Finally, we obtain an irreducible family of monads over the projective space and make a description on how the same method could be used on an ACM smooth projective variety X. We establish the existence of a coarse moduli space of low-rank vector bundles over an odd-dimensional X and show that in one case this moduli space is irreducible. Joint work with Simone Marchesi and Pedro Macias Marques.

Campinas, 30 November 2020

Marcos Jardim