Structures and Symmetries in Algebraic Geometry

List of Abstracts

On the birational geometry of algebraically integrable foliations

Paolo Cascini

I will review recent progress on extending the Minimal Model Program to algebraically integrable foliations, focusing on applications such as the boundedness of Fano foliations.

Specialness and potential density. A conjectural equivalence.

Frederic Campana

A complex projective manifold X is 'special' if $\kappa(X, L) < p$ for each rank-one subsheaf of Ω^p_X and each $p > 0$. It is said to be 'weakly special' if there is no finite étale cover of X having a dominant rational map onto a positive-dimensional variety of general type. Specialness implies weak specialness, the converse being true for curves and surfaces, but no longer for threefolds in general. If X is defined over a number field, it is said to be 'potentially dense' if its set of rational points is Zariski dense after a finite extension of the base field. There are two conflicting conjectures (formulated independently around 2000) claiming that potential density is equivalent to specialness (resp. weak specialness) for any X defined over a number field. We use a weakly special, but non-special threefolds deduced from an example by G. Lafon in 2005 to show that the weak specialness version conflicts with the 'Orbifold Mordell' conjecture, which claims that rational points on orbifold curves over number fields are finite. It is open, but implied by abc. This is a joint work with F. Bartsch, A. Javanpeykar, and O. Wittenberg.

Boundary divisors in the moduli spaces of stable Horikawa surfaces with $K^2 = 2p_g - 3$

Ciro Ciliberto

In this talk I will describe the normal stable surfaces with $K^2 = 2p_g - 3$ whose only non canonical singularity is a cyclic quotient singularity of type $\frac{1}{4k}(1, 2k - 1)$ and the corresponding locus $\mathfrak{D}$ inside the KSBA moduli space of stable surfaces. The main result is the following: for $p_g \geq 15$, (1) a general point of any irreducible component of $\mathfrak{D}$ corresponds to a surface with a singularity of type $\frac{1}{4}(1, 1)$, (2) the closure of $\mathfrak{D}$ is a divisor contained in the closure of the Gieseker moduli space of canonical models of surfaces with $K^2 = 2p_g - 3$ and intersects all the components of such closure, and (3) the KSBA moduli space is smooth at a general point of $\mathfrak{D}$. Moreover $\mathfrak{D}$ has 1 or 2 irreducible components, depending on the residue class of p_g modulo 4. This is joint work with Rita Pardini.

Birational geometry of log schemes: a first sketch

Alessio Corti

I will start with summarising my work with Helge Ruddat on gtc (generically toroidal crossing) log structures. Then I will give some examples of log birational geometry and ask some questions.

The stability of normal bundles of Brill-Noether curves

Izzet Coskun

Given a smooth projective curve X, there are several naturally defined vector bundles on X such as the normal bundle of X or the restriction of the tangent bundle of projective space to X. Similarly given a branched covering of curves $f : Y \to X$, there are several natural vector bundles such as the Tschirnhausen bundle on X associated with the covering. In this talk, I will discuss the stability of normal bundles of Brill-Noether curves and Tschirnhausen bundles. The talk is based on joint work with Eric Larson, Isabel Vogt, Geoffrey Smith and Eric Jovinelly.

The Noether-Lefschetz locus in families of threefolds

Kristin DeVleming

For a fixed threefold X and very ample line bundle H, the Noether-Lefschetz locus parametrizes surfaces in X which are linearly equivalent to H and have Picard rank greater than that of X. We discuss the behavior of special components of the Noether-Lefschetz locus as we deform the pair (X, H), particularly when X is a singular Fano threefold. This is joint work with A. Grassi and J. Rana.

On local stability thresholds del Pezzo surfaces

Erroxe Etxabarri Alberdi

We give a short introduction to K-stability and the motivation behind it. We focus on the characterisation of K-stability using the stability threshold, which is an algebraic invariant. We give examples of how to compute in smooth cases and a list of results in the singular cases, and how it can be used to compute K-moduli.

Iskovskih's theorem for regular surfaces over imperfect fields

Andrea Fanelli

In this talk, I will present a project in collaboration with Stefan Schröer aimed at generalising Iskovskih's theorem, which describes minimal surfaces with no irregularity and no bigenus. With this in mind, we focus on regular surfaces over imperfect fields and develop the theory of inseparable pencils, with particular emphasis on the case of characteristic 2.

Normal split submanifolds in rational homogeneous spaces

Enrica Floris

Van de Ven proved in 1959 that submanifolds of the projective space with split normal sequence are linear subspaces. In a work in collaboration with Andreas Horing we proved a generalization of this result to rational homogeneous spaces: a submanifold of a rational homogeneous space with split normal sequence is rational homogeneous. In this talk, based on a second paper in collaboration with Andreas Horing, I will describe what happens in the case of subvarieties of codimension 1.

Generalizations, computations and symmetries of Vafa-Witten invariants

Lothar Göttsche

Vafa-Witten invariants are invariants of algebraic surfaces defined using moduli of Higgs bundles. Based on the physics paper of Vafa and Witten they were given a mathematical definition by Tanaka and Thomas. We will review these invariants, and then introduce their twist by a line bundle. We then explain two generalizations of these invariants, (1) invariants with μ-classes, which interpolate between the Donaldson invariants and the Vafa-Witten invariants (2) and Vafa-Witten invariants twisted by a line bundle. The connection of these invariants conjecturally allows to compute them in many cases in terms of modular functions and uncovers remarkable symmetries.

Mori dreamness of Blowups of $\mathbb{P}^3$ along curves

Tiago Guerreiro

Mori dream spaces are a very special kind of varieties introduced in 2000 by Hu and Keel that enjoy very good properties with respect to the minimal model program. In this talk, we focus on blowups of $\mathbb{P}^3$ along space curves and study how Mori dreamness varies along the Hilbert scheme of curves of fixed genus and degree. This is joint work with Sokratis Zikas.

On singular Fano varieties of low dimension and Picard number

Jurgen Hausen

We survey recent classification work on singular Fano varieties of low dimension and Picard number (with and without torus action).

Real enumerative invariants relative to the toric boundary

Ilia Itenberg

The talk is devoted to real enumerative invariants of the projective plane (and, more generally, of certain toric surfaces) that arise from appropriate signed enumeration of real algebraic curves of genus 1 and 2. It turns out that two different rules of signs in the enumeration lead to the same collection of invariants. The proof of this surprising fact uses the tropical counterparts of the invariants under consideration. This is a joint work with Eugenii Shustin.

Symmetries of Fano varieties

Lena Ji

Work of Prokhorov–Shramov and Birkar proves the uniform Jordan property for automorphism groups of complex Fano varieties of fixed dimension. In particular, in each dimension n, there is an upper bound on the size of semisimple groups (i.e., those with no nontrivial normal abelian subgroups) acting on n-dimensional complex Fano varieties. In this talk, we investigate the action by a particular semisimple group: the symmetric group. This work is joint with Louis Esser and Joaquin Moraga.

Some applications of theory of atoms

Ludmil Katzarkov

In this talk we will give examples of the use theory of atoms to high dimensional non-rationality and G-non-rationality questions.

Projective manifolds with big tangent bundles

Jeong-Seop Kim

After Mori's solution to Hartshorne's conjecture regarding ample tangent bundles, a series of questions has arisen concerning various positivity of tangent bundles. In the first part of the talk, I will introduce some results focused on the question of big tangent bundles, with recent progress initiated by A. Höring, J. Liu, and F. Shao. I will then present various examples and counterexamples of projective manifolds with big tangent bundles, including Fano threefolds, projective bundles, and weak del Pezzo surfaces. This talk is based on joint work with Hosung Kim and Yongnam Lee.

Perverse schobers and the McKay correspondence

Tim Logvinenko

I will talk about constructing a perverse schober, a poor man's perverse sheaf of triangulated categories, in the context of the classical McKay correspondence for $G \subset SL_2(C)$. The braid group of the corresponding ADE type acts on the derived category D(Y) of the minimal resolution Y of C^2/G by spherical twists in the exceptional curves. This braid group is the fundamental group of the open stratum of $\mathfrak{h}/W$, the quotient of the ADE Cartan algebra by the Weil group action, so its action on D(Y) can be thought of as a local system of triangulated categories on this open stratum. A perverse schober extends this structure to the higher codimension stratas. We actually construct a W-equivariant schober on $\mathfrak{h}$ by using an instance of the McKay correspondence – the root hyperplane arrangement in $\mathfrak{h}$ coincides with the wall-and-chamber structure in the GIT stability space for the construction of Y as the moduli space of the McKay quiver representations. The schober we construct on the GIT stability space neatly packages up all the GIT wall-crossing equivalences and more. Our work is motivated by wanting to eventually tackle dim=3 case, where h/W picture no longer exists, however, it might still be possible to construct a similar schober on the GIT stability space. This is a joint work with Arman Sarikyan (LIMS).

Real loci of rational Fano threefolds

Frederic Mangolte

From the classification of real rational surfaces worked out by Comessatti at the beginning of the 20th century we get the following striking characterization of real rational surfaces: a geometrically rational real surface is rational if and only if its real locus is non-empty and connected. The analogous assertion fails in higher dimension. In a work in progress with Andrea Fanelli, we explore real loci of geometrically rational Fano threefolds in relation to their rationality.

Automorphism groups of rational surfaces

Jesus Martinez Garcia

While the Cremona group of the plane is a well-understood invariant, the automorphism group of rational surfaces (understood as models over Hirzebruch surfaces) is less studied. In this talk, we will present work in progress on the classification of the identity component of the automorphism groups of rational surfaces. This is joint work with my PhD student Lufeng Li.

On the unirationality of conic bundles with eight singular fibers

Alex Massarenti

We will review the state of the art and some recent results on the unirationality of conic bundles, and we will discuss the unirationality of surface conic bundles with eight singular fibers.

Tropical trigonometry: wave fronts and caustics

Grigory Mikhalkin

We study angles by means of wave front propagation in the tropical plane. Joint work with Mikhail Shkolnikov.

Local inequality for cA points

Takuzo Okada

The failure of birational rigidity of a given Fano 3-fold of Picard rank 1 implies the existence of a mobile linear system on the Fano 3-fold that is has high multiplicity along a subvariety. We give a lower bound of the multiplicity of the effective 1-cycle defined as the intersection of two general members of such a mobile linear system at a compound Du Val singular point of type A. I also explain the application of this local inequality to sextic double solids with cA points. This is a joint work with Igor Krylov and Eric Paemurru.

Simply connected positive Sasakian 5-manifolds and log del Pezzo surfaces

Jihun Park

Sasakian geometry is a vibrant field at the intersection of differential geometry, topology, complex geometry, and algebraic geometry, with applications ranging from theoretical physics to geometric analysis. In this talk, we explore closed simply connected 5-manifolds capable of hosting positiveSasakian structures.

On deformations of monomial schemes

Andrea Petracci

Deformation theory is a well-established part of algebraic geometry and is essential to study local properties of moduli spaces. Nonetheless explicitly computing deformations of algebraic varieties (affine or projective) is usually very hard, and most of the times impossible. In this talk, I will present some partial results of work in progress with Nathan Ilten and Francesco Meazzini about (even derived) deformation theory of affine varieties defined by monomial ideals. The combinatorics of monomial ideals and the torus action allow us to reduce certain deformation-theoretic computations about differential graded Lie algebras and about the cotangent complex to combinatorial computations.

Non-linearizability of the icosahedral group acting on smooth quadric 3-fold

Antoin Pinardin

Finite subgroups of Cremona have been extensively studied over the fields of complex numbers. Nevertheless, finding out which ones are conjugated to a subgroup of biregular automorphisms of the projective space is an open and active question. A full answer was recently provided in dimension two. In this talk, we will present the answer for a natural case to start with in dimension three - the icosahedral group acting on smooth quadrics. This is a joint work with Zhijia Zhang.

Solvable groups of algebraic transformations

Andriy Regeta

Based on the joint work with C. Urech and I. van Santen I will discuss the solvable groups of birational transformations. More precisely, I will present the following result: a closed connected solvable subgroup of the group of birational transformations Bir(X) of an algebraic variety X has derived length less than or equal to 2dim X and the equality holds iff X is rational. Moreover, all Borel subgroups (maximal connected solvable subgroups) of Bir($\mathbb{P}^n$) of derived length 2n are conjugate. Furthermore, Borel subgroups of Bir($\mathbb{P}^n$) of derived length stricktly smaller than 2n exist, but essentially nothing is known about them if n is stricktly bigger than 2. In contrast I will (briefly) discuss the Borel subgroups of Aut($\mathbb{A}^n$) where much more is known thanks to the resent joint work with S. Cantat, H. Kraft and I. Van Santen.

Linear operators preserving volume polynomials

Hendrik Suess

We study linear operators preserving the property of being a volume polynomial. More, precisely we show that a linear operator preserves this property if the associated symbol is itself a volume polynomial. This can be seen as an analogue to theorems by Borcea-Branden and Brenden-Huh for stable polynomials and Lorentzian polynomials, respectively.

Perfect ideals and root systems

Jerzy Weyman

I will discuss the perfect ideals of codimension 3. Their structure turns out to be related to root systems of type $T_{p,q,r}$. In the case when $T_{p,q,r}$ is of type ADE one gets the full classification of such ideals. In other cases one can still classify the perfect ideals in the linkage class of a complete intersection. Similar results are true for Gorenstein ideals of codimension 4. This is a joint work with Lorenzo Guerrieri and Xianglong Ni.

Some applications of the Sarkisov program in dimension 2

Egor Yasinsky

The Sarkisov program is a tool that has become classical, allowing one to decompose a birational transformation between Mori fiber spaces into a composition of "elementary" ones. I will talk about several recent results and open problems surrounding this program, focusing on the case of surfaces defined over an arbitrary field.