

# Title and Abstract

**Florin Ambro**

**Title:** On Seshadri constants

**Abstract:** The Seshadri constant of a polarized variety  $(X,L)$  at a point  $x$  measures how positive is the polarization  $L$  at  $x$ . If  $x$  is very general, the Seshadri constant does not depend on  $x$ , and captures global information on  $X$ . Inspired by ideas from the Geometry of Numbers, we introduce in this talk successive Seshadri minima, such that the first one is the Seshadri constant at a point, and the last one is the width of the polarization at the point. Assuming the point is very general, we obtain two results: a) the product of the successive Seshadri minima is proportional to the volume of the polarization; b) if  $X$  is toric, the  $i$ -th successive Seshadri constant is proportional to the  $i$ -th successive minima of a suitable 0-symmetric convex body. Based on joint work with Atsushi Ito.

**Frederic Campana**

**Title:** Criterion for algebraicity of foliations, applications

**Abstract:** A foliation  $F$  on  $X$ , complex projective smooth, is showed to have algebraic leaves if its dual is not pseudo-effective. In the particular case where  $F$  has positive minimal slope with respect to some movable class on  $X$ , the closures of the leaves are rationally connected. Combined with the existence of Viehweg-Zuo sheaves, this permits to show several versions of the Shafarevich-Viehweg 'hyperbolicity conjecture'. In the general case (dual of  $F$  not pseudo-effective), the algebraicity result leads to several questions (with presently few answers) about projective manifolds having a non pseudo-effective cotangent bundle. (Joint with M. P\u00e9ru\u00e7in)

## **Junyan Cao**

**Title:** Variation of singular Kähler-Einstein metrics

**Abstract:** We study families of Kähler-Einstein metrics in various geometric situations and give some applications in complex geometry. First, we prove positivity of the variation of singular KE metrics in the general type case. Next, we analyze the log Calabi-Yau case and derive the local triviality of families of pairs for which the direct image of the log pluricanonical bundle is hermitian flat. It is a joint work with Henri Guenancia and Mihai Paun.

## **Paolo Cascini**

**Title:** Minimal Model Program for foliations

**Abstract:** I will discuss some recent results on the study of the birational geometry of foliations over complex projective threefolds. Joint work with C. Spicer.

## **Fabrizio Catanese**

**Title:** Hypersurfaces in Abelian Varieties : Moduli spaces and canonical maps.

**Abstract:** I shall mostly consider in my talk ample and smooth hypersurfaces  $X$  contained in an Abelian variety  $A$ , and investigate the open set of the moduli space of compact complex manifolds  $X'$  with ample canonical bundle which are topologically equivalent to  $X$  (this case is a special one of the more general investigation of Inoue type Varieties, initiated in joint work with Ingrid Bauer). Using recent joint work with Yongnam Lee on deformation to hypersurface embeddings, I shall show that not all such  $X'$  are again Hypersurfaces in an AV, but we can calculate their limits.

The classical theorem of Lefschetz gives sufficient conditions for the very ampleness of the linear system  $|X|$  on  $A$ , e.g. that the polarization is divisible by 3. Since the canonical divisor  $K_X$  of  $X$  is  $X$  restricted to  $X$ , we obtain very ampleness of the canonical system in the Lefschetz range.

As a consequence of the embedding obstructions (given by Severi's double point formulae),  $K_X$  cannot be very ample unless its dimension is at least  $2n + 1$ , where  $n = \dim X$ . This can be translated into an inequality for the Pfaffian  $p$  of the Chern form of the divisor  $X$ ,  $p \geq n+2$ .

At any rate, the canonical map of  $X$  is a finite map, and I will present several steps towards the proof of the Conjecture: Unless we have a principal polarization, then for general  $(A, X)$  the canonical map is birational onto its image.

I shall then mention the results obtained by Cesarano in his Ph D Thesis, proving very ampleness for a general  $(A, X)$  in case of a polarization of type  $(1, 2, 2)$ . His results motivates the following Question: if  $p \geq n+2$ , then for general  $(A, X)$  the canonical map is an embedding.

### **Ivan Cheltsov**

**Title:** Smooth Fano threefolds of degree 22 with infinite automorphism groups

**Abstract:** This talk is about smooth Fano threefolds of Picard rank one and anticanonical degree 22 that have infinite automorphism groups. Donaldson conjectured that all but one of them must be Kahler-Einstein, see <https://arxiv.org/abs/0803.0985>.

I will explain how to use equivariant birational geometry of these threefolds to prove Donaldson's conjecture (with 2 possible explicitly described exceptions).

This is a joint work with Costya Shramov from Moscow, see <https://arxiv.org/abs/1803.02774>.

Our proof is based on recent results by Sasha Kuznetsov and Yura Prokhorov obtained in <https://arxiv.org/abs/1711.08504>.

### **Jungkai Chen**

**Title:** Pluricanonical systems in dimension three and higher

**Abstract:** In this talk, we will survey some recent developments and techniques in pluricanonical systems of threefolds.

Also, we will discuss some possible approach to consider pluricanonical systems in general higher dimension  $n$ .

### **Olivier Debarre**

**Title:** On the image of the period map for polarized hyperkähler manifolds

**Abstract:** The period map for hyperkähler manifolds was shown by Verbitsky and Markman to be an open embedding. We show that its image is the complement of the union of finitely many divisors that we explicitly describe.

This is joint work with Emanuele Macrì.

## **Stephane Druel**

**Title:** Codimension one foliations with numerically trivial canonical class on singular spaces

**Abstract:** In this talk, I will describe the structure of codimension one foliations with canonical singularities and numerically trivial canonical class on varieties with terminal singularities, extending a result of Loray, Pereira and Touzet to this context.

## **Baohua Fu**

**Title:** On Fano manifolds of Picard number one with big automorphism groups

**Abstract:** It was conjectured by Hwang-Mok that the dimensions of automorphism groups of  $n$ -dimensional Fano manifold of Picard number one are bounded from above. We shall classify those with  $\dim \text{Aut}(X) \geq n(n+1)/2$  under the assumption that  $X$  is covered by lines and of index bigger than  $(n+2)/2$ . This is a joint work with Wenhao Ou and Junyi Xie.

## **Osamu Fujino**

**Title:** On quasi-log canonical pairs

**Abstract:** The notion of quasi-log canonical pairs was introduced by Florin Ambro. It is a kind of generalizations of that of log canonical pairs. Now we know that quasi-log canonical pairs are ubiquitous in the theory of minimal models. In this talk, I will explain some basic properties and examples of quasi-log canonical pairs. I will also discuss some new developments around quasi-log canonical pairs.

## **Yoshinori Gongyo**

**Title:** Nef anti-canonical divisors and rationally connected fibrations

**Abstract:**

We study the Iitaka–Kodaira dimension of nef relative anti-canonical divisors. As a consequence, we prove that given a complex projective variety with klt singularities, if the anti-canonical divisor is nef, then the dimension of general fibres of maximal rationally connected fibration is at most the Iitaka-Kodaira dimension of the anti-canonical divisor. This is a joint work with Sho Ejiri.

## Andreas Hoering

**Title:** Regular foliations with nef anticanonical bundle

**Abstract:** In the last years the classification theory of foliations on projective varieties, in analogy to the minimal model program for varieties, has seen some important progress. In this talk I will focus on the following problem: let  $X$  be a complex projective manifold, and let  $F$  be an integrable subbundle of  $T_X$ . What can we say about the geometry of the leaves if  $-K_F = \det F$  is nef? This is work in progress with Junyan Cao.

## Atsushi Ito

**Title:** On Loewy filtrations and K-stability of Fano varieties with non-reductive automorphism groups

**Abstract:** It is known that the automorphism group of a K-polystable Fano manifold is reductive.

Codogni and Dervan construct a canonical filtration of the section ring, called Loewy filtration, and conjecture that the Loewy filtration destabilizes any Fano variety with non-reductive automorphism group.

In this talk, I will explain some examples related to Loewy filtrations.

## Chen Jiang

**Title:** Anti-canonical geometry of Fano 3-folds

**Abstract:** We are interested in the explicit geometry of Fano 3-folds given by the pluri-anti-canonical systems. For a  $\mathbb{Q}$ -factorial terminal Fano 3-fold of Picard number 1, we show that the 39-th pluri-anti-canonical map is birational onto its image. For a canonical weak Fano 3-fold, we show that the 97-th pluri-anti-canonical map is birational, and 52-th pluri-anti-canonical map is birational if changed by a birational model. I will explain some ideas of the proof and further applications. This talk is based on joint works with Meng Chen.

## JongHae Keum

**Title:** Algebraic surfaces with minimal Betti numbers

**Abstract:**

Among algebraic curves the projective line is the unique curve with minimum genus  $g=0$ .

In dimension 2, there are infinitely many families of surfaces with minimum invariants  $p_g=q=0$ .

The algebraic surfaces in the title are those with the Betti numbers of the complex projective plane, and are called Q-homology projective planes.

If such an algebraic surface has only quotient singularities, then its minimal resolution is a smooth surface with  $p_g=q=0$ .

Fake projective planes and the complex projective plane are smooth examples of a Q-homology projective plane.

There are many families of singular examples.

I will begin with basic definitions and examples and then describe recent progress in the study of such surfaces, singular ones and fake projective planes.

## Shigeyuki Kondō

**Title:** Enriques surfaces and the Leech lattice.

**Abstract:** The Picard lattices of some K3 surfaces (e.g. a generic Jacobian Kummer surface, the supersingular K3 surface with the Artin invariant 1 in characteristic 2) can be embedded into an even unimodular lattice  $L=U+\Lambda$  where  $U$  is the hyperbolic plane and  $\Lambda$  is the Leech lattice. By using this, one can find finite polyhedrons in the ample cones of these K3 surfaces and give generators of their automorphism groups.

In this talk I will discuss an analogy in case of Enriques surfaces. This is a joint work with S. Brandhorst and I. Shimada.

## Radu Laza

**Title:** Monodromy and degenerations for K-trivial varieties

**Abstract:** One of the fundamental results for K3 surfaces is the properness of the period map. This is equivalent to saying that suitably normalized 1-parameter degenerations of K3 surfaces have finite monodromy iff the central fiber has ADE singularities. I will discuss higher dimensional analogues of this statement - going into two directions: Hyperkahler manifolds, and Calabi-Yau threefolds respectively.

## Yongnam Lee

**Title:** On dominant rational maps from some surfaces of general type

**Abstract:** In this talk we consider dominant rational maps from some surfaces  $X$  of general type to algebraic surfaces  $Y$ . Especially, we treat surfaces  $X$  of general type which are very general hyperplane sections of Fano 3-folds or products of very general curves. This is a joint work with Gian Pietro Pirola.

## Wenfei Liu

**Title:** On accumulation points of volumes of log surfaces

**Abstract:** A feature of the geography of (projective) log surfaces is that the canonical volumes are only fractional numbers and there can be accumulation points. It is a deep result of Valery Alexeev that the set of volumes of log canonical surfaces satisfies the descending chain condition (DCC), provided that the coefficients of the boundary divisors are from a given DCC set. Albeit examples constructed by Blache, Kollár, and more recently by Urzúa and Yañez, the overall picture of accumulation points of volumes is unknown.

In this talk, I will report on a recent progress on the topic. We realize the accumulation points of volumes as the volumes of log canonical surfaces whose boundary divisors have coefficients in an enlarged but controlled set. As a consequence, we confirm a conjecture of Blache that the accumulation points of volumes of log terminal surface without boundary are rational. We also obtain an explicit lower bound for the accumulation points. This is a joint work with Valery Alexeev.

## Steven Lu

**Title:**  $C^n$ -dominability of hyperkahler manifolds

**Abstract:** Complex projective or compact kähler manifolds with trivial canonical class are up to a finite unramified cover, a product of simple hyperkähler manifolds, Calabi-Yau manifolds and compact complex tori, the former two types being simply connected. Not much is known concerning the lack of hyperbolicity of these simply connected manifolds besides the case of K3-surfaces. One expectation is that entire holomorphic curves can be Zariski dense in any such variety, i.e. fails to be algebraically degenerate. The only known method for showing this failure is to construct dominating meromorphic or holomorphic maps from  $C^n$  and so far this has only been done for certain classes of K3 surfaces.

In this talk, I will show how to construct such dominating maps for certain well-known

classes of hyperkahler manifolds. The method combines a basic algebro-geometric result of Claire Voisin and Frederic Campana and a result on Fatou-Bieberbach domains of Buzzard-Hubbard from complex dynamical systems.

This is joint work with Ljudmila Kamenova.

### **James McKernan**

**Title:** The broken arrow

**Abstract:** We describe an approach to showing that unstable rank two bundles on projective space split. This approach leads to the study of zero dimensional schemes. We compare and contrast the punctual Hilbert scheme to the moduli space of curves and point out some interesting similarities and differences.

### **Yusuke Nakamura**

**Title:** Dual complex of Fano varieties and a vanishing theorem of Witt vector cohomology

**Abstract:** I will explain that the dual complex of a log Fano pair is simply connected. As a corollary, we can get a vanishing theorem of Witt vector cohomology for log canonical Fano threefolds. This is an analogy of the Ambro-Fujino vanishing theorem in characteristic zero.

### **Keiji Ogusio**

**TBA**

### **Giuseppe Pareschi**

**Title:** Derived invariants from the Albanese map

**Abstract:** I will illustrate a joint work with Federico Caucci proving the derived invariance of the dimensions of the cohomology groups - as well as of all Green-Lazarsfeld loci - of the pushforward of the canonical bundle under the Albanese map. For varieties of maximal Albanese dimension this yields conjectures of Popa and Lombardi-Popa and, in particular, the derived invariance of the Hodge numbers  $h^{0,i}$ . I will discuss also some partial results concerning varieties of submaximal Albanese dimension.



## **Jihun Park**

**Title:** Del Pezzo 3-folds of degree 1 with 28 nodes and smooth plane quartic curves.

**Abstract:** I will explain how to construct a del Pezzo 3-fold of degree 1 with 28 nodes from a given smooth plane quartic curve. The construction is based on a  $j$ -invariant function defined by the given plane quartic curve. In the construction, the 28 bitangent lines of the smooth quartic curve yield 28 nodes on the del Pezzo 3-fold, which result from 21 lines and 7 twist cubic curves determined by general 7 points in  $\mathbb{P}^3$ . This is a joint work with Ahmadinezhad, Cheltsov, and Shramov.

## **Zsolt Patakfalvi**

**Title:** Positivity of the Chow-Mumford line bundle for families of  $K$ -stable  $\mathbb{Q}$ -Fano varieties

**Abstract:**

The Chow-Mumford (CM) line bundle is a functorial line bundle on the base of any family of polarized varieties, in particular on the base of families of  $\mathbb{Q}$ -Fano varieties (that is, Fano varieties with klt singularities). It is conjectured that it yields a polarization on the conjectured moduli space of  $K$ -semi-stable  $\mathbb{Q}$ -Fano varieties. This boils down to showing semi-positivity/positivity statements about the CM-line bundle for families with  $K$ -semi-stable/ $K$ -polystable  $\mathbb{Q}$ -Fano fibers. I present a joint work with Giulio Codogni where we prove the necessary semi-positivity statements in the  $K$ -semi-stable situation, and the necessary positivity statements in the uniform  $K$ -stable situation, including in both cases variants assuming  $K$ -stability only for very general fibers. Our statements work in the most general singular situation (klt singularities), and the proofs are algebraic, except the computation of the limit of a sequence of real numbers via the central limit theorem of probability theory. I also present a birational geometry application to the classification of Fano varieties.

## **Yuri Prokhorov**

**Title:**  $\mathbb{Q}$ -Fano threefolds with divisible anticanonical class.

**Abstract:** I will discuss birational approach to the classification of Fano threefolds with terminal singularities. Basically I concentrate on varieties with divisible anticanonical class. Many examples will be considered.

## Taro Sano

**Title:** Construction of non-Kähler Calabi-Yau 3-folds by smoothing normal crossing varieties

**Abstract:** Kawamata--Namikawa proved that a normal crossing Calabi-Yau variety with some conditions can be deformed to a smooth Calabi-Yau manifold.

By using this, we can construct Calabi-Yau manifolds starting from a normal crossing variety.

I will explain construction of some non-Kähler Calabi-Yau 3-folds which are topologically unbounded.

This talk is based on joint work with Kenji Hashimoto.

## Stefan Schreieder

**Title:** Stably irrational hypersurfaces of small slopes

**Abstract:** We show that over any uncountable field of characteristic different from two, a very general hypersurface of dimension  $n > 2$  and degree at least  $\log_2(n) + 2$  is not stably rational. This significantly improves earlier results of Kollár and Totaro. As a byproduct of our proof, we obtain new counterexamples to the integral Hodge conjecture, answering a question of Voisin and Colliot-Thélène-Voisin.

## De-Qi Zhang

**Title:** Derived length of zero entropy groups acting on compact Kähler manifolds

**Abstract:**

Let  $X$  be a compact Kähler manifold of dimension  $n$ . Let  $G$  be a group of zero entropy automorphisms of  $X$ . Let  $G_0$  be the set of elements in  $G$  which are isotopic to the identity. We prove that after replacing  $G$  by a suitable finite-index subgroup,  $G/G_0$  is a unipotent group of derived length at most  $n-1$ . This is a corollary of an optimal upper bound of length involving the Kodaira dimension of  $X$ . We also study the algebro-geometric structure of  $X$  when it admits a group action with maximal derived length  $n-1$ .

This is a joint work with Tien-Cuong Dinh and Keiji Oguiso.

## Lei Zhang

**Title:** Nonvanishing for 3-folds in char  $p > 5$

**Abstract:** During the past five years, minimal model program for 3-folds in char  $p > 5$  has been established by Hacon, Xu and Birkar and etal. Along this direction, the main remaining problem is abundance, which has been proved for 3-folds with  $q(X) > 0$  last year in char  $p > 5$ . We attempt to prove abundance for 3-folds with  $q=0$ , and recently we can prove non-vanishing, which is an important step.

In this talk, we will explain the strategy to prove nonvanishing for 3-folds in char  $p > 5$ . Analogous result in char 0 was proved by Miyaoka and Kawamata 30 years ago. In char  $p$ , to carry out the approach in char 0, we meet some strange stimulating phenomena, which cause some difficulties. This is joint work with Chenyang Xu.

## Tong Zhang

**Title:** Fibrations of maximal Albanese dimension and a relative Severi inequality

**Abstract:** For a fibration  $f: X \rightarrow Y$  between two projective varieties  $X$  and  $Y$ , I will introduce the notion for  $f$  being of maximal Albanese dimension. For such a fibration  $f$ , when  $Y$  is a curve and  $f$  is relatively minimal, we establish a sharp relative Severi inequality that  $K_f^n \geq 2n! \chi_f$  ( $n = \dim X$ ), which was conjecturally formulated by Barja under a slightly stronger assumption. It also provides an alternative proof of the (absolute) Severi inequality, and such a proof has already been considered by Pardini, Mendes Lopes, Barja and Stoppino in the past decade. Moreover, when the equality holds in the above and  $\chi_f > 0$ , we prove that the "relative irregularity" equals  $n-1$ . More results will be presented if time permits. This is a joint work with Yong Hu.