

---

GÉOMÉTRIE BIRATIONNELLE DES VARIÉTÉS  
ALGÈBRIQUES COMPLEXES

BIRATIONAL GEOMETRY OF COMPLEX ALGEBRAIC  
VARIETIES

---

TITLES AND ABSTRACTS

**Ekaterina AMERIK (Orsay/Moscou)**

**Title.** — Negative classes and rational curves on hyperkähler manifolds.

**Abstract.** — We make some observations about rational curves on hyperkähler manifolds and their behaviour under deformations. In particular, let  $Z$  be an integral Beauville-Bogomolov negative second homology class. We say that  $Z$  is divisorial if some multiple of the dual cohomology class is effective, and stably extremal if it "generates an extremal ray up to birational equivalence and monodromy action" (this is to be made precise in the talk). We prove that these properties are preserved by deformations, as long as  $Z$  remains of type (1,1).

This is a joint work in progress with Misha Verbitsky.

**Carolina ARAUJO (IMPA, Rio de Janeiro)**

**Title.** — Tsen's Theorem and higher Fano manifolds.

**Abstract.** — In 1936 Tsen proved that a 1-dimensional family of hypersurfaces of degree  $d$  in complex projective  $n$ -space always admits a section provided that  $d \leq n$ . This simple statement has been generalized in many ways, and still inspires developments in algebraic geometry. In this talk I will survey the history of Tsen's Theorem, mostly from the geometric point of view, and describe current research toward new interpretations and generalizations. In particular, I will discuss a joint work with Ana-Maria Castravet about higher Fano manifolds and their connection to Tsen's Theorem.

**Jean-Benoît BOST (Orsay)**

**Title.** — Analytic and formal geometry on some pseudoconcave manifolds.

**Abstract.** — This talk will be devoted to some comparison theorems relating analytic and formal geometry in the neighborhood of a compact Riemann surface with ample normal bundle in a complex analytic surface. These results play a key role in the proof of some new algebraisation theorems in Arakelov geometry.

**Sébastien BOUCKSOM (Paris)**

**Title.** — Vanishing sequences on higher dimensional varieties.

**Abstract.** — I will describe a joint work with Küronya, Maclean and Szemberg in which we define and study a natural notion of vanishing sequence along a real valuation for sections of a line bundle on a projective variety, generalizing the classical case of curves. In particular, we prove an equidistribution result for large powers of the line bundle, and relate the limit measure to restricted volumes, in the case of a divisorial valuation.

**Fabrizio CATANESE (Bayreuth)**

**Title.** — Answer to some questions by Fujita on VHS.

**Abstract.** — In the first part of my talk, which shall describe joint work with Michael Dettweiler, I shall provide details for a theorem announced by Fujita 34 years ago.

**Theorem.** *If one has a family fibred over a curve  $B$ , then the direct image  $V$  of the relative dualizing sheaf is the direct sum of an ample vector bundle  $A$  and of a flat vector bundle  $W$ .*

I shall then describe a counterexample to a question raised by Fujita 31 years ago.

**Question :** Is  $V$  semi ample ?

In view of the previous theorem, the question is whether the flat bundle  $W$  corresponds to a finite representation of the fundamental group. While the answer is yes (Deligne) if we have a summand of  $W$  of rank one, or if the base has genus at most one, we show examples where we get a representation of infinite order.

**Ivan CHELTSOV (Edinburgh)**

**Title.** — Asymptotically log Fano varieties .

**Abstract.** — Motivated by the study of Fano type varieties we define a new class of log pairs that we call asymptotically log Fano varieties and strongly asymptotically log Fano varieties. We study their properties in dimension two under an additional assumption of log smoothness and give a complete classification of two dimensional strongly asymptotically log Fano varieties. Based on this classification we formulate an asymptotic logarithmic version of Calabi's conjecture for Del Pezzo surfaces for the existence of Kähler-Einstein edge metric in this regime. We make some initial progress toward its proof by demonstrating some existence and non-existence results. This is a joint work with Yanir Rubinstein.

**Jungkai A. CHEN (Singapour)**

**Title.** — Geography of threefolds of general type.

**Abstract.** — In the theory of algebraic surfaces, there are inequalities such as Bogomolov-Miyaoka-Yau Inequality, Noether Inequality govern the geography of surfaces of general type. The purpose of this talk is to introduce some similar feature for threefolds of general type. Most of the materials are extracted my joint work with Meng Chen.

**Stéphane DRUEL (Grenoble)**

**Title.** — Varieties of minimal rational tangents of codimension one on Fano manifolds.

**Abstract.** — If  $X$  is a uniruled smooth projective variety of dimension  $n$  with a locally unsplit dominating family of rational curves of anticanonical degree  $n+1$ , then it is known that  $X$  is isomorphic to a projective space. In this talk I will discuss Fano manifolds of dimension  $n$  with a locally unsplit dominating family of rational curves of anticanonical degree  $n$ . This is a joint work with Cinzia Casagrande.

**Philippe EYSSIDIEUX (Grenoble)**

**Title.** —  $L^2$  De Rham Cohomology of algebraic varieties.

**Abstract.** — In the early 1990s an idea of Gromov inspired several authors, among them F. Campana, to apply the techniques of the Atiyah  $L^2$  index theorem to problems in uniformization in several complex variables. The method was formalized in two independent works by Campana-Demailly and the speaker on coherent  $L^2$  cohomology. In this talk I will survey a work in progress with P. Dingoyan extending this construction to constructible and De Rham cohomology of D-modules and aiming at

developing an  $L^2$  version of Mixed Hodge Theory. If time permits, I will explain some conjectural applications.

**Osamu FUJINO (Kyoto)**

**Title.** — Some applications of the semi-positivity theorems.

**Abstract.** — We explain some generalizations of Fujita-Kawamata semi-positivity theorem. As applications, we can prove the projectivity of moduli spaces of (smoothable) stable varieties, the finite generation of canonical rings for compact Kähler manifolds, and so on.

**Jun-Muk HWANG (KIAS, Séoul)**

**Title.** — Fano manifolds of Picard number 1 with isotrivial VMRT-structure.

**Abstract.** — Let  $X$  be a nonsingular subvariety in projective space covered by lines. For a point  $x$  in  $X$ , denote by  $C_x$  the subvariety of the projectivized tangent space of  $X$  at  $x$ , corresponding to the set of lines through  $x$  lying on  $X$ . When the family  $C_x$  is isotrivial as  $x$  varies over general points of  $X$ , we say that  $X$  has isotrivial VMRT-structure. We will discuss the question : "is a Fano manifold of Picard number 1 with isotrivial VMRT-structure quasi-homogeneous?" We will give an affirmative answer when  $C_x$  satisfies certain conditions, which hold for complete intersections of dimension bigger than 1 and of multi-degree different from  $(2,2)$ ,  $(2,3)$ ,  $(2,2,2)$ . This implies that a Fano complete intersection of index bigger than 3 and multi-degree different from  $(2)$ ,  $(3)$ ,  $(2,2)$ ,  $(2,2,2)$  cannot have isotrivial VMRT-structure.

**Yujiro KAWAMATA (Tokyo)**

**Title.** — Derived category of a weighted projective space.

**Abstract.** — I will consider the bounded derived category of a weighted projective space as two forms of smooth stacks and a singular variety.

**Stefan KEBEKUS (Freiburg)**

**Title.** — The geometry of singularities in the Minimal Model Program and applications to singular spaces with trivial canonical class.

**Abstract.** — This talk surveys recent results on the singularities of the Minimal Model Program and discusses applications to the study of varieties with trivial canonical class. Comparing the étale fundamental group of a klt variety with that of its smooth locus, we show that any flat holomorphic bundle, defined on the smooth part of a projective klt variety is algebraic and extends across the singularities. This allows to generalise a famous theorem of Yau, which states that any Ricci-flat Kähler manifold with vanishing second Chern class is an étale quotient of a torus. This is joint work with Daniel Greb and Thomas Peternell.

**James MCKERNAN (MIT)**

**Title.** — TBA.

**Abstract.** — TBA.

**Michäel MCQUILLAN (Roma 2 Tor Vergata)**

**Title.** — Elementary homotopy theory of champs.

**Abstract.** — The talk will cover, in some order to be decided, at least the following : representability of mapping spaces of topological champs, consequences in homotopy theory, and pro-finite versions (valid in the algebraic setting) of the above.

**Mircea MUSTAŢĂ (Michigan)**

**Title.** — Birational geometry in positive characteristic.

**Abstract.** — I will survey various recent results concerning linear systems in positive characteristic and discuss the role that the Frobenius morphism is playing in the proofs.

**Keiji OGUIO (Osaka)**

**Title.** — Unirationality of Ueno-Campana's threefold.

**Abstract.** — This is a joint work with Professor Fabrizio Catanese and Doctor Tuyen Truong. We shall show that Ueno-Campana's threefold is unirational. This affirmatively answers a question asked by Professor Campana. Our method is elementary but is valid over any field containing a primitive 4<sup>th</sup> root of unity. We will also explain why Ueno-Campana's threefold, a very special threefold, is interesting from two points of view : birational geometry and complex dynamics, together with relevant examples.

**Jorge Vitório PEREIRA (IMPA, Rio de Janeiro)**

**Title.** — Representations of quasi-projective fundamental groups and the structure of transversely projective foliations.

**Abstract.** — Corlette and Simpson classified Zariski dense rank-two representations of fundamental groups of quasi-projective manifolds under the additional assumption that the representation is quasi-unipotent at infinity. I will explain how to avoid such extra assumption, and how to obtain a similar classification for singular transversely projective foliations on projective manifolds (joint work with Frank Loray and Frédéric Touzet).

**Erwan ROUSSEAU (Marseille)**

**Title.** — Foliations and the Green-Griffiths-Lang conjecture.

**Abstract.** — Since the works of Bogomolov (resp. McQuillan) on algebraic curves (resp. entire curves) in surfaces of general type with positive second Segre number, foliations are known to be an important tool in the study of the Green-Griffiths-Lang conjecture.

We will show how foliations can be used to exhibit counter-examples to the approach using base loci of jet differentials. Then we will explain how to generalize these counter examples to the situation where there are no foliations.

In the positive direction, we will present a new criterion ensuring that a surface with general type has a big cotangent bundle, therefore extending the results of Bogomolov and McQuillan to a larger class of surfaces of general type.

These are partly joint works with S. Diverio and, independently, X. Roulleau.

**Jörg WINKELMANN (Bochum)**

**Title.** — Specialness, hyperbolicity and  $h$ -principle.

**Abstract.** — We investigate relations between the algebraic-geometric notion of specialness introduced by Campana and the notions related to the  $h$ -principle of Gromov and discuss in particular to which extend specialness and « ellipticity » (validity of  $h$ -principle) are equivalent for projective complex manifolds.