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## JOURNÉES COMPLEXES LORRAINES 2015

### TITRES ET RÉSUMÉS

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**Ekaterina AMERIK (Orsay/HSE, Moscou)**

**Titre.** — The cone conjecture for hyperkähler manifolds.

**Résumé.** — This is a joint work with Misha Verbitsky. Let  $M$  be an irreducible holomorphic symplectic manifold. We prove that the group of automorphisms of  $M$  has only finitely many orbits on the set of faces of the Kahler cone of  $M$ , provided that  $b_2(M)$  is not equal to 5. This is a version of « the cone conjecture » of Morrison and Kawamata which implies the original version when  $M$  is projective.

**Sébastien BOUCKSOM (Paris, École Polytechnique)**

**Titre.** — Degenerations of Calabi-Yau manifolds

**Résumé.** — I will present a joint work with Mattias Jonsson, in which we establish a weak measure-theoretic version of the Kontsevich-Soibelman conjecture on large complex structure limits of polarized Calabi-Yau manifolds. Our approach relies on a general construction due to Berkovich that combines complex analytic and non-Archimedean geometry.

**Ivan CHELTSOV (Edinburgh)**

**Titre.** — Rationality of nodal Fano threefolds.

**Résumé.** — I will describe the rationality problem for nodal quartic double solids and nodal quartic threefolds. In particular, I will prove that nodal quartic double solids with at most six singular points are irrational, and nodal quartic double solids with at least eleven singular points are rational.

I will also prove rationality of two nodal quartic threefolds in the family studied by Beauville, who prove the irrationality of the remaining quartic threefolds in this family (except Burkhardt and Igusa quartics).

**Jean-Pierre DEMAILLY (Grenoble)**

**Titre.** — Recent progress towards the Kobayashi and Green-Griffiths-Lang conjectures

**Résumé.** — The Green-Griffiths-Lang conjecture stipulates that for every projective variety  $X$  of general type over  $\mathbb{C}$ , there exists a proper algebraic subvariety of  $X$  containing all non constant entire curves  $f : \mathbb{C} \rightarrow X$ . Using the formalism of directed varieties, we will show that this assertion holds true in case  $X$  satisfies a strong general type condition that is related to a certain jet-semistability property of the tangent bundle  $T_X$ . It is then possible to exploit this result to investigate the long-standing conjecture of Kobayashi (1970), according to which every general algebraic hypersurface of dimension  $n$  and degree at least  $2n + 1$  in the complex projective space  $\mathbb{P}^{n+1}$  is hyperbolic.

**Alexandru DIMCA (Nice)**

**Titre.** — Nearly free divisors and rational cuspidal curves.

**Résumé.** — We introduce a class of complex projective plane curves, called nearly free curves, having properties similar to those of free curves. Conjecturally any rational cuspidal plane curve is either free or nearly free. This conjecture is proved in a number of cases by using a recent result due to Uli Walther, relating the above setting to the monodromy of the corresponding Milnor fibers.

**Stéphane DRUEL (CNRS, Grenoble)**

**Titre.** — On (regular) foliations with nef anti-canonical bundle

**Résumé.** — In recent years, techniques from the minimal model program have been successfully applied to the study of global properties of holomorphic foliations. In this talk I will discuss (regular) foliations with nef anti-canonical bundle.

**Philippe EYSSIDIEUX (Grenoble)**

**Titre.** — Groupes Kähleriens et structure du revêtement universel des variétés kähleriennes compactes.

**Résumé.** — On réduit la conjecture de Shafarevich de convexité holomorphe à une conjecture sur le problème de Serre.

**Daniel GREB (Essen)**

**Titre.** — Moduli spaces for sheaves that are semistable with respect to a real ample class.

**Résumé.** — I will explain the construction of moduli spaces of sheaves on projective threefolds that are Gieseker-semistable with respect to a real ample class. This is achieved by embedding the moduli problem for sheaves into a moduli problem for representations of a certain quiver. This is joint work with Julius Ross and Matei Toma.

**Julien GRIVAUX (CNRS, Marseille)**

**Titre.** — The structure sheaf of derived self-intersections.

**Résumé.** — Many properties of a complex manifold  $X$  are reflected by the geometry of its diagonal  $\Delta_X$ . One important property of  $\Delta_X$  is that its derived self-intersection is a formal object in the derived category of coherent sheaves on  $X$ , a specific isomorphism being given by the so-called Hochschild-Kostant-Rosenberg (HKR) isomorphism. Recently, this isomorphism has been extended by Arinkin and Căldăraru to special families of closed immersions. In this talk we will present a new proof of this result, as well as a complete description of the structural sheaf of the derived intersection (without any assumption on the corresponding submanifold).

**Peter HEINZNER (Bochum)**

**Titre.** — Kählerian Structure on the symplectic reduction of Kähler manifolds

**Résumé.** — We consider a Kählerian manifold  $X$  endowed with an action of a group  $G$  of holomorphic Kähler isometries. We also assume that the action is Hamiltonian. This is a relatively mild condition on the action at hand and is given by the existence of a  $G$ -equivariant map  $m$  from  $X$  to the dual of the Lie algebra of  $G$ . If  $X$  is a compact manifold, then the group  $G$  is compact and it is well known that such action are generalizations of actions of complex reductive group which appears in Mumford's Geometric Invariant Theory. It is well known that Mumford quotients in the compact projective case are in a one to one correspondence with the quotients  $M/G$  where  $M$  denotes the zero fiber of  $m$ .

Our motivation is to generalize the main results from Geometric Invariant Theory to the case of general actions of groups of holomorphic isometries on Kähler manifolds which are Hamiltonian. In the talk I will explain the proof of the first important step in this direction. We prove that the symplectic reduction  $M/G$  has a natural structure of a complex space and moreover that the Kähler structure on  $X$  induces a natural Kähler structure on  $M/G$  (based on a joint work with B. Stratmann).

**Andreas HÖRING (Nice)**

**Titre.** — Rational curves on compact Kähler manifolds.

**Résumé.** — Rational curves play a crucial role in the classification of projective manifolds via the minimal model program (MMP). The construction of these curves on projective manifolds or low-dimensional Kähler manifolds is based on deformation theory of curves and, in the projective case, reduction to positive characteristic. In this talk I will present a new strategy to construct rational curves via a « subadjunction formula for adjoint cohomology classes ». This is joint work with Junyan Cao.

**Stefan KEBEKUS (Freiburg)**

**Titre.** — Higgs sheaves on singular spaces and the Miyaoka-Yau Inequality for minimal varieties of general type.

**Résumé.** —

**Gianluca PACIENZA (Strasbourg)**

**Titre.** — Deformations of singular symplectic varieties and termination of the log minimal model program.

**Résumé.** — I will report on a joint work with Christian Lehn in which we generalise to the singular setting Huybrechts' theorem on deformation equivalence of birational irreducible symplectic manifolds. More precisely, under suitable natural hypotheses, we show that two birational symplectic varieties are locally trivial deformation of one another. As an application we show the termination of any log-minimal model program for a pair  $(X, \Delta)$  of a projective irreducible symplectic manifold  $X$  and an effective  $\mathbb{R}$ -divisor  $\Delta$ . To prove this result we follow Shokurov's strategy and show that LSC and ACC for mld's hold for all the models appearing along any log-MMP of the initial pair.

**Mihai PĂUN (KIAS, Séoul)**

**Titre.** — Kodaira dimension of algebraic fiber spaces over abelian varieties.

**Résumé.** — We will report on a joint work with J. Cao. Our main result gives a proof of the Iitaka conjecture for algebraic fiber spaces whose base is an abelian variety.

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

**Titre.** — Compact leaves of holomorphic foliations.

**Résumé.** — The talk will focus on codimension one foliations on projective manifolds having a compact leaf (free of singularities). It will discuss the following problems : existence of a foliation having as a leaf a given hypersurface with topologically torsion normal bundle, study of foliations having a compact leaf whose holonomy is abelian (resp. solvable) and factorization results. (joint work with B. Claudon, F. Loray and F. Touzet)

**Thomas PETERNELL (Bayreuth)**

**Titre.** — The nef and the pseudo-effective cone of a Calabi-Yau threefold.

**Résumé.** — I will discuss the Morrison-Kawamata cone conjecture, the nef cone, the movable cone and the pseudo-effective cone on a Calabi-Yau threefold, in particular in connection with automorphisms and birational automorphisms.

Special emphasis will be laid on the problem to which extent nef line bundles are semiample.

**Erwan ROUSSEAU (Marseille)**

**Titre.** —  $ABC$  inequalities.

**Résumé.** — According to conjectures of Vojta,  $ABC$  inequalities should hold on varieties of log-general type. In the case of moduli spaces, works of M. Kim give such estimates for the moduli spaces of principally polarized abelian varieties with level structures. I will explain how one can obtain  $ABC$  inequalities in the case of moduli spaces of abelian varieties with real multiplication. (Joint work with F. Touzet).

**Christian SCHNELL (Stony Brook)**

**Titre.** — Limit Hodge classes.

**Résumé.** — Suppose that we have a family of smooth projective varieties (or, more generally, a variation of Hodge structure of even weight) on  $X - D$ . Roughly speaking, "limit Hodge classes" are integral cohomology classes in the fibers near  $D$  that become Hodge classes in the limit at  $D$ ; the vanishing cycle in a family of surfaces acquiring an ordinary double point is a good example. I will explain how to turn this idea into a rigorous definition, and how to prove a version of the famous algebraicity theorem of Cattani-Deligne-Kaplan for the set of limit Hodge classes.

**Andrei TELEMAN (Marseille)**

**Titre.** — Analytic cycles in flip passages and in instanton moduli spaces over non-Kählerian surfaces.

**Résumé.** — Let  $\mathcal{M}^{\text{st}}$  ( $\mathcal{M}^{\text{pst}}$ ) be a moduli space of stable (polystable) bundles with fixed determinant on a complex surface with  $b_1 = 1$ ,  $p_g = 0$ , and let  $Z \subset \mathcal{M}^{\text{st}}$  be a pure  $k$ -dimensional analytic set. We prove a general formula for the homological boundary  $\delta[Z]^{BM} \in H_{2k-1}^{BM}(\partial\hat{\mathcal{M}}^{\text{pst}}, \mathbb{Z})$  of the Borel-Moore fundamental class of  $Z$  in the boundary of the blow up moduli space  $\hat{\mathcal{M}}^{\text{pst}}$ . The proof is based on the holomorphic model theorem (proved in a recent article), which identifies a neighborhood of a boundary component of  $\hat{\mathcal{M}}^{\text{pst}}$  with a neighborhood of the boundary of a "blow up flip passage".

Using this result we prove geometric properties of the moduli space used in our programme to prove existence of curves on class VII surfaces.

**Misha VERBITSKY (HSE, Moscou)**

**Titre.** — Transcendental Hodge algebra

**Résumé.** — Let  $M$  be a projective manifold. Transcendental Hodge lattice of weight  $p$  is the smallest rational Hodge substructure in  $H^p(M)$  containing  $H^{p,0}(M)$ . Transcendental Hodge lattice is a birational invariant of  $M$ . I will prove that the direct sum of all transcendental Hodge lattices for  $M$  is an algebra, and compute it (using Yu. Zarhin’s theorem) explicitly for all hyperkahler manifolds. This result has many geometric consequences. In particular, I will show that dimension  $d$  of a family of hyperkahler manifolds containing a symplectic torus of dimension  $m$  satisfies  $m \leq 2^{d/2-1}$ .

**Claire VOISIN (CNRS, IMJ-PRG)**

**Titre.** — New stable birational invariants.

**Résumé.** — The Lüroth problem asks whether a unirational threefold must be rational. The stable version asks whether it must be stably rational. Although many obstructions are known for rationality starting from dimension 3, in the stable case, only the Artin-Mumford invariant had been used until recently. I will describe a new cohomological (or Chow-theoretic ) invariant that is more powerful and allows to show that many unirational threefolds (eg smooth quartic double solids) are not stably rational.

**Jörg WINKELMANN (Bochum)**

**Titre.** —  $h$ -principle and specialness.

**Résumé.** — This is joint work with F. Campana. A complex space  $X$  is said to satisfy the  $h$ -principle if, for every Stein manifold  $S$  and every continuous map  $g : S \rightarrow X$  there is a holomorphic map  $f : S \rightarrow X$  homotopic to  $g$ . This notion, which was introduced by Gromov, is known to be satisfied for “elliptic” complex manifolds, a class which contains in particular every homogeneous complex manifold.

We investigate this property for compact complex projective manifolds, in particular exploring relationships with algebro-geometric properties. The main result is that the  $h$ -principle may hold only if  $X$  is *special*. In particular this implies that a variety of general type never satisfies the  $h$ -principle.

We also prove that the  $h$ -principle is not satisfied for any compact complex manifold which is hyperbolic in the sense of Kobayashi.