BIRS Workshop
Recent Trends in Higher Dimensional Geometry
Apri 1-6

MEALS

Breakfast (Continental): 7:00 - 9:00 am, 2nd floor lounge, Corbett Hall, Sunday - Thursday
*Lunch (Buffet): 11:30 am - 1:30 pm, Donald Cameron Hall, Sunday - Thursday
*Dinner (Buffet): 5:30 - 7:30 pm, Donald Cameron Hall, Saturday - Wednesday
Coffee Breaks: As per daily schedule, 2nd floor lounge, Corbett Hall
***Please remember to scan your meal card at the host/hostess station in the dining room for each lunch and dinner.**

MEETING ROOMS

All lectures are held in the main lecture hall, Max Bell 159.
Please note that the meeting space designated for BIRS is the lower level of Max Bell, Rooms 155-159. Please respect that all other space has been contracted to other Banff Centre guests, including any Food and Beverage in those areas.

SCHEDULE

	Sat.	Sunday	Monday	Tuesday	Wednesday	Thursday
7:00-9:00		Continental Breakfast, 2nd floor lounge, Corbett Hall				
Chair		McKernan	Corti	Ingalls	X. Chen	Kovács
9:00-9:45		Shokurov	de Jong	Van den Bergh	Mella	Brion
10:00-10:45		Smith	Hacking	Schwede	Küronya	Heier
10:45-11:15		Coffee Break[3]	Coffee Break[3]	Coffee Break[3]	Coffee Break[3]	Coffee Break[3]
11:15-12:00		de Fernex	Blickle	L. Chen	van Opstall	Grushevsky
12:00-12:15			Group Photo[1]			
12:00-13:30		Buffet Lunch		Donald Cameron Hall		
13:00-14:00			Guided Tour[2]			
14:30-15:15		Kebekus	Cascini	free time	Castravet	
15:15-15:45		Coffee Break[3]	Coffee Break[3]		Coffee Break[3]	
15:45-16:30		Hacon	La Nave		Farkas	
17:30-19:30		Buffet Dinner, Donald Cameron Hall				

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[1] A group photo will be taken on Monday at 12:01 pm, directly after the last lecture of the morning. Please meet on the front steps of Corbett Hall.

[2] A free guided tour of The Banff Centre is offered to all participants and their guests on Monday starting at 1:00 pm. The tour takes approximately 1 hour. Please meet in the 2nd floor lounge in Corbett Hall.

[3] Coffee Breaks are held in the 2nd floor lounge, Corbett Hall

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ABSTRACTS
(in alphabetic order by speaker surname)

Speaker: **Manuel Blickle** (Universität Essen)
Title: *Witt-rational singularities (and rational points)*
Abstract: I am reporting on joint work with Hélène Esnault. In this talk I will outline the basic properties of a newly introduced class of singularities for varieties in positive characteristic, called Witt-rational singularites. I will attempt to explain how this notion naturally arises in the context of generalizing results on congruences of rational points of a smooth variety over a finite field beyond the smooth case. In fact, our main result roughly states that a Witt-rational and rationally connected variety has a rational point. Examples of (non) Witt-rational varieties will be discussed as well as the relation of Witt-rational to a Hodge-theoretic consequence of rational singularities in characteristic zero.

Speaker: **Michel Brion** (Université de Grenoble)
Title: *On the geometry of wonderful varieties*
Abstract: Wonderful varieties are smooth projective varieties where a semisimple group acts with finitely many orbits, whose closures look like the coordinate subspaces of some affine space. Examples include flag manifolds and complete symmetric varieties. The classification of wonderful varieties, initiated by Luna, is still an open problem.

The talk will present this problem, Luna's approach via combinatorial invariants, and a geometric approach via the cone of effective divisors. Applications to the automorphism group and total coordinate ring of wonderful varieties will be discussed.

Speaker: **Paolo Cascini** (University of California, Santa Barbara)
Title: *Kähler-Ricci Flow and the Minimal Model Program for Projective Varieties*
Abstract: One of the most important problems in Algebraic Geometry is the quest for a Minimal Model for an algebraic variety which would generalize the classification of algebraic surfaces to higher dimensions. When the variety is of general type then from a minimal model one can produce the canonical model which is a birational model whose canonical bundle is ample or positive. On the other hand around the 1980's building on the foundational work of Hamilton in the Riemannian case H. D. Cao studied the Kähler-Ricci flow for canonical metrics on manifolds with definite first Chern class reproving in particular Calabi's conjecture and the existence of Kähler-Einstein metrics in case $c_1 < 0$.

We propose to draw a connection between the two theories for projective varieties. In particular we show that the flow detects in finite time the contraction of any extremal ray and we analyze the singularities of the metric in the case of divisorial contractions for varieties of general type. In particular in complex dimension two the Kähler-Ricci flow produces the canonical model generalizing Cao's result.

Speaker: **Ana-Maria Castravet** (University of Texas)
Title: *Hilbert's 14th problem and Cox rings*

Abstract: I will describe the generators of the total coordinate ring of the blow-up of P^n in any number of points lying on a rational normal curve of degree n. As a corrollary I will show that the algebra of invariants of the action of a two-dimensional additive group introduced by Nagata is finitely generated by some explicit determinants. This is joint work with E. Tevelev.

Speaker: **Linda Chen** (Ohio State University)
Title: *Enumeration of rational plane curves tangent to a smooth cubic*
Abstract:

Speaker: **Tommaso de Fernex** (University of Utah)
Title: *Adjunction beyond thresholds and birationally rigid hypersurfaces*
Abstract: We give an affirmative answer to a conjecture of Pukhlikov, proving that for N greater or equal to 4, all smooth hypersurfaces of degree N in the N-dimensional projective space are birationally superrigid. The case $N = 4$ of this result is the celebrated theorem of Iskovskikh and Manin, which in fact started this whole direction of research; other cases were established in papers by Pukhlikov, Cheltsov, and Ein, Mustata and myself. The main new ingredient to obtain the complete result is an adjunction formula for singularities of pairs under restriction that, under suitable conditions, generalizes to higher codimensions the well-known formula for hyperplane sections derived from Shokurov's connectedness principle.

Speaker: **Aise Johan De Jong** (Columbia University)
Title:
Abstract:

Speaker: **Gavril Farkas** (University of Texas)
Title: *Exceptional divisors on moduli spaces*
Abstract: We describe a very general method of constructing exceptional effective divisors on moduli spaces of varieties of various types using the syzygies of the parametrized objects. For 1-dimensional objects, applications of this construction include:

- a proof that the moduli space of Prym varieties of genus > 12 is of general type,

- a proof that the moduli space of curves of genus 22 is of general type,

- an infinite sequence of counterexamples to the Harris-Morrison Slope Conjecture, and

- a formula for the class of the so-called Petri (resp. Prym-Petri) loci in the moduli space of curves (resp. Prym varieties).

Speaker: **Samuel Grushevsky** (Princeton University)
Title: *Birational geometry of A_g*
Abstract: We construct a new effective geometric divisor on A_g (the moduli space of principally polarized g-dimensional complex abelian varieties) and use it to show that A_6 is of general type. Since the work of Tai, Mumford, Clemens, Donagi, and others in the 1980s, this has remained the only g for which the Kodaira dimension of A_g was unknown. To introduce and motivate our result and construction, a broad survey of the study of the geometry of A_g will be given, and all necessary constructions will be introduced and explained. (Joint work with David Lehavi.)

Speaker: **Paul Hacking** (Yale University)
Title: *Deformations of moduli spaces*
Abstract: Kapranov has proposed the following informal principle: begin with a variety $X = X(0)$, and let $X(1)$ be the moduli space of deformations of $X(0)$, $X(2)$ the moduli space of deformations of $X(1)$, and so on. Then this process should stop after $d = \dim X$ steps, i.e., $X(d)$ should be rigid (no deformations).

We prove a precise formulation of this principle in the case $d = 1$: we show that the moduli stack of stable curves of genus g with n marked points is rigid for each g and n. We also describe some ideas and examples for the case $d = 2$.

Speaker: **Christopher Hacon** (University of Utah)
Title: *Boundedness of varieties of general type*
Abstract: A smooth complex projective variety X is of general type if the sections of some sufficiently big multiple of the canonical line bundle define a birational map.

It is well known that for curves of general type, $|3K|$ always defines a birational map and for surfaces of general type $|5K|$ always defines a birational map. The generalization to higher dimensions has been elusive.

Following ideas of Tsuji, I will show that for any integer $n > 0$, there exists an integer $r(n) > 0$ such that for any variety X of general type and dimension n, the pluricanonical maps determined by $|rK_X|$ are birational for all $r > r(n)$.

Speaker: **Gordon Heier** (University of Michigan)
Title: *On finite type, the effective Nullstellensatz and estimates*
Abstract: In the theory of pseudoconvex domains of finite type, algebra and analysis meet in a very interesting way. To illustrate this, we will present an application of the notion of finite type to the effective Nullstellensatz. In the other direction, we will discuss how to apply algebra and geometry to obtain Sobolev and Hoelder estimates for solutions of the complex Neumann problem and the d-bar equation for certain special domains.

Speaker: **Stefan Kebekus** (Universität zu Köln)
Title: *Rationally connected foliations*
preprint math.AG/0505222, with Luis Solá Conde und Matei Toma
    Abstract: We discuss sufficient criteria to guarantee that a given foliation on a normal variety has algebraic and rationally connected leaves. Following ideas from a preprint of Bogomolov-McQuillan, we give a clean, short and simple proof of previous results that does not make any reference to the more involved properties of foliations in characteristic p. We also give a new sufficient condition to ensure that all leaves are algebraic.

The results are then applied to relate instability of the tangent bundle of Fano manifolds with sequences of partial rational quotients

Speaker: **Alex Küronya** (Budapest University of Technology and Economics)
Title: *The interior structure of the effective cone and asymptotic cohomology*
Abstract: Ample divisors have several different characterizations, in particular, one can describe them in terms of cohomology, geometry, and numerical positivity. We consider these possibilities to go beyond the ample cone and see to what extent we can use them to explore the structure of the effective cone.

Speaker: **Gabriele La Nave** (Lehigh University and Courant Institute)
Title: *Singularities of the Kähler-Ricci flow and the Minimal Model Program*
Abstract: In recent work with P. Cascini we determined that the Kähler-Ricci flow detects, in finite time, the contraction of an extremal ray. Our most recent work, analyzes the singularities that develop in a much finer way. We will describe how the Kähler-Ricci flow determines a smooth groupoid structure on an extremal neighborhood and how flips could be recovered from this, in a vein that should be thought of as an analytic analogue of M. Reid's proposed description of flips as GIT quotients.

Speaker: **Massimiliano Mella** (Universita di Ferrara)
Title: *Rational cubic hypersurfaces*
Abstract: All known explicit rationality constructions for smooth cubic hypersurfaces are based on varieties

with one apparent double point. This force the dimension of the hypercubic to be even. A sligth change in this approach allows to construct rational smooth hypercubic in any dimension greater or equal to 7. This leads to different perceptions of the rationality problem for cubic hypersurfaces.

Speaker: **Karl Schwede** (University of Washington)
Title: *On F-Injective and Du Bois singularities*
Abstract: For over 25 years, it has been known that there is a certain correspondence between singularities defined by the action of Frobenius in characteristic p,and those that appear in birational geometry. In the 1990s it was shown that log terminal singularities are equivalent to F-regular singularities, that rational singularities are equivalent to F-rational singularities, and that F-Pure singularities are log canonical (the converse to this last statement being unknown in general). I will discuss extending this correspondence to F-injective and Du Bois singularities and will show that F-injective singularities are Du Bois under certain hypotheses. I will also discuss certain new properties of Du Bois singularities which are motivated by characteristic p behavior but can be proven independently of any such relationship.

Speaker: **Vyacheslav Shokurov** (Johns Hopkins University)
Title:
Abstract:

Speaker: **Paul Smith** (University of Washington)
Title: *Symplectic reflection algebras and resolutions of deformations of symplectic quotient singularities*
Abstract: (joint with Iain Gordon) We give an equivalence of triangulated categories between the derived category of finitely generated representations of symplectic reflection algebras associated with wreath products (with parameter $t = 0$) and the derived category of coherent sheaves on a crepant resolution of the spectrum of the centre of these algebras. The spectrum is a flat deformation of the symplectic quotient singularity $\mathbb{C}^{2n}/G$ where G is the semi-direct product of the nth power of a finite subgroup of $SL(2,\mathbb{C})$ with the symmetric group S_n. A baby case ($n = 1$) includes deformations of the Kleinian surface singularities. Symplectic reflection algebras, invented by Etingof and Ginzburg, are a class of non-commutative algebras having a rich representation theory.

Speaker: **Michel Van den Bergh** (Universiteit Hasselt)
Title: *Non-commutative resolution of the generic determinant*
Abstract: This is joint work with Graham Leuschke and Ragnar Buchweitz. The generic determinant is the hypersurface given determinant of a generic matrix. We construct a Cohen-Macaulay module over the generic determinant whose endomorphism ring has finite global dimension.

Speaker: **Michael van Opstall** (University of Utah)
Title: *Variation of hyperplane sections*
Abstract: I discuss the question of whether the family of hyperplane sections of a smooth hypersurface varies maximally in moduli. In arbitrary characteristic, I will prove this for a general hypersurface, but it is known that there examples in positive characteristic with no variation (Beauville).