Algebraic Geometry
Géométrie algébrique

(Org: **Nathan Ilten-Gee** (Simon Fraser University) and/et **Kalle Karu** (University of British Columbia))

KAI BEHREND, UBC

The motivic weight of the stack of bundles

I will talk about a new approach to computing the motivic weight of the stack of G-bundles on a curve. The idea is to associate a motivic weight to certain ind-schemes, such as the affine Grassmannian and the scheme of maps $X \to G$, where X is an affine curve, using Bittner's calculus of 6 operations. I hope that this will eventually lead to a proof of a conjectural formula for the motivic weight of the stack of bundles in terms of special values of Kapranov's zeta function.

JIM BRYAN, UBC

Rigid Calabi-Yau Banana Manifolds

We construct new rigid Calabi-Yau threefolds with small Hodge numbers : $h^{1,1} = 4, h^{1,2} = 0$. These threefolds are fibered by Abelian surfaces and have singular fibers containing Banana configurations of rational curves. We have proven that the genus g Gromov-Witten potential $F_g(Q_0, Q_1, Q_2, Q_3)$, when specialized to $Q_0 = 0$, is given by an explicit genus 2 Siegel modular form of weight $2g - 2$.

JIM CARRELL, UBC

Lifting Group Actions From Torus Fixed Points to Cohomology

We describe lifting the action of a finite group W on the fixed point set of a torus action (T, X) to the torus equivariant cohomology algebra $H_T^*(X)$ and describe the representation of W on the ordinary cohomology algebra $H^*(X)$.

SABIN CAUTIS, UBC

The derived structure of the Springer resolution

The simplest (nontrivial) instance of the Springer resolution is the affinization map of the cotangent bundle of P^1. I will discuss the derived structure of the Springer resolution while focusing on this explicit example. The answer has applications in various fields such as homological knot invariants.

AJNEET DHILLON, University of Western Ontario

The motive of BG.

Given an algebraic stack stratified by quotient stacks one can define a class in the dimensional completion of the K-ring of varieties. Let G be a linear algebraic group. One can ask if it is the case that the class of G is the inverse of the class of BG in this ring. In this talk we will discuss some results by Bergh, Pirsi, Scavia, Talpo, Vistoli and Young pertaining to this question.

CHARLES DORAN, University of Alberta

Mirror Symmetry for Lattice Polarized del Pezzo Surfaces

We describe a notion of lattice polarization for rational elliptic surfaces and weak del Pezzo surfaces, and describe the complex moduli of the former and the Kähler cone of the latter. We then propose a version of mirror symmetry relating these two objects, which should be thought of as a form of Fano-LG correspondence. Finally, we relate this notion to other forms of mirror symmetry, including Dolgachev-Nikulin-Pinkham mirror symmetry for lattice polarized K3 surfaces and the Gross-Siebert program. This is joint work with Alan Thompson.

DAVID FAVERO, University of Alberta
The Batyrev-Nill Conjecture

In the early 90s, Batyrev and Borisov provided a combinatorial construction of mirror families in toric varieties. Essentially this means pairs (X, Y) of families of Kahler manifolds such that the complex and symplectic behavior was exchanged through a duality known as mirror symmetry. However, as it turned out, this duality required certain non-canonical choices to be made, leading to examples of multiple mirrors $(X, Y_1), (X, Y_2)$ for the same X. Inspired by Kontsevich's homological mirror symmetry conjecture, Batyrev and Nill conjectured that these multiple mirrors were related through birational geometry and the derived category. I will talk about the Batyrev-Borisov construction, give some examples of this phenomenon and explain the theorem of myself and Tyler Kelly proving the Batyrev-Nill conjecture.

JAVIER GONZÁLEZ-ANAYA, University of British Columbia
Constructing Mori dream spaces and non-Mori dream spaces via prime characteristic methods

We consider the problem of finite generation of the Cox ring for blowups of weighted projective planes at a generic point of the torus.

By a result of Cutkosky, finite generation for these spaces is equivalent to the existence of two different curves in the varieties: (1) a "negative curve" different from the exceptional curve and (2) another curve disjoint from the previous one. Toric geometry gives us control over condition (1). By work of Kurano and Nishida, the second condition can be tested by considering the problem in positive characteristic for all primes big enough.

In this talk we'll describe this reduction method to prime characteristic as well as the obstructions to lift the solutions back to characteristic zero. We'll conclude by presenting our results and the open problems in the area. This is joint work with J. L. González and K. Karu.

JOHANNES HOFSCHEIER, McMaster University
Generalized flatness constants, spanning lattice polytopes, and the Gromov width

In this talk, I will present joint work in progress with Averkov, Balletti and Nill where we motivate some new directions of research regarding the lattice width of convex bodies. We show that convex bodies of sufficiently large width contain a unimodular copy of a standard simplex and discuss relations to recent results on spanning lattice polytopes. Our result can be viewed as the starting point for studying generalized flatness constants. Regarding symplectic geometry we point out how the lattice width of a Delzant polytope is related to upper and lower bounds on the Gromov width of its associated symplectic toric manifold.

KIUMARS KAVEH, University of Pittsburgh
Spherical amoebae and K-orbits in spherical varieties

The amoeba of a subvariety Y in the algebraic torus $(\mathbb{C}^*)^n$ is its image in $\mathbb{R}^n$ under the logarithm map. It is well-known that the amoeba of Y approaches its tropical variety as the base of logarithm goes to 0. In this talk we address the question of extending the above from subvarieties in a torus to subvarieties in a reductive algebraic group G or more generally a spherical homogeneous space G/H. This naturally becomes related to the problem of parametrizing K-orbits in G/H (for a maximal compact subgroup K in G) and can be considered as a generalization of the well-known Cartan decomposition (singular value decomposition) and Iwasawa decomposition in Lie theory. I will briefly cover some necessary background. This is a joint work in progress with Victor Batyrev, Megumi Harada and Johannes Hofscheier.

CHRIS MANON, University of Kentucky
Classification of toric bundles on toric varieties

In 1989 Klyachko gave a combinatorial classification of toric vector bundles on toric varieties. In joint work with Kiumars Kaveh we find two more classifications of toric vector bundles, the first in terms of piecewise linear maps to spherical Tits buildings, and the second in terms of prevaluations on vector spaces taking values in a certain semialgebra of piecewise linear functions. The first classification allows us to reinterpret DiRocco, Jabbusch, and Smith's positivity results on toric vector bundles in terms of convexity properties of buildings, and it allows us to generalize Klyachko's classification to toric principal bundles, where the fiber of the bundle is a connected reductive group. The second classification result also generalizes, in this case to toric flat families of varieties, and yields interesting connections with tropicalization and the theory of Newton-Okounkov bodies.

JENNA RAJCHGOT, University of Saskatchewan
Double Grassmannians, certain symmetric varieties, and type D quiver representation varieties

Consider the following three families of varieties: (a) B-orbit closures in double Grassmannians $G/P_1 \times G/P_2$, where $B \leq G$ is a Borel subgroup acting diagonally, (b) B-orbit closures in symmetric varieties G/K, where $G = GL(p+q)$ and $K = GL(p) \times GL(q)$, and (c) GL-orbit closures in type D quiver representation varieties, where GL is the base change group acting by conjugation.

After recalling some background and history, I will explain how certain questions about geometry and combinatorics of the varieties in one of these families can be studied by considering the corresponding questions for varieties in either of the other two families.

This is joint work with Ryan Kinser.

MATT SATRIANO, University of Waterloo
A counter-example to the finiteness conjecture of Kawaguchi and Silverman

Let f be a dominant rational self-map of a smooth projective variety X defined over $\overline{\mathbb{Q}}$. For each point $P \in X(\overline{\mathbb{Q}})$ whose forward f-orbit is well-defined, Silverman introduced the arithmetic degree $\alpha_f(P)$, which measures the growth rate of the heights of the points $f^n(P)$. Kawaguchi and Silverman conjectured that $\alpha_f(P)$ is well-defined and that, as P varies, the set of values obtained by $\alpha_f(P)$ is finite. Based on constructions of Bedford–Kim and McMullen, we give a counterexample to this conjecture when $X = \mathbb{P}^4$. This is joint work with John Lesieutre.

SERGIO DA SILVA, University of Manitoba
On the Gorensteinization of Schubert varieties via boundary divisors

A variety being Gorenstein can be a useful property to have when considering questions in birational geometry. Although Schubert varieties are Cohen-Macaulay, they are not Gorenstein in general. I will describe a convenient way to find a "Gorensteinization" for a Schubert variety by considering only one blow-up along its boundary divisor. We start by reducing to the local question, one involving Kazhdan-Lusztig varieties. These affine varieties can be degenerated to a toric scheme defined using the Stanley-Reisner ideal of a subword complex. The blow-up of this toric scheme along its boundary divisor is Gorenstein, so carefully choosing a degeneration to it extends this result to Schubert varieties in general.

FRANK SOTTILE, Texas A&M University
Galois Groups for Systems of Equations

Camille Jordan observed that Galois groups arise in enumerative geometry, and we now also understand them as monodromy groups. A study of this question in the Schubert calculus has determined many such Galois groups, all known Schubert Galois groups are either the full symmetric group or are imprimitive. Recently, Esterov considered this question for systems of sparse polynomials and proved this dichotomy in that setting. While this classification identifies polynomial systems with imprimitive Galois groups, it does not identify the groups.

I will sketch the background, before explaining Esterov's classification and ongoing work identifying some of the imprimitive Galois groups for polynomial systems.