Banff International Research Station
for Mathematical Innovation and Discovery

12w5027 Algebraic Stacks: Progress and Prospects
Arriving Sunday, March 25 and departing Friday, March 30, 2012

MEALS

*Breakfast (Buffet): 7:00–9:30 am, Sally Borden Building, Monday–Friday
*Lunch (Buffet): 11:30 am–1:30 pm, Sally Borden Building, Monday–Friday
*Dinner (Buffet): 5:30–7:30 pm, Sally Borden Building, Sunday–Thursday
*Coffee Breaks: As per daily schedule, in the foyer of the TransCanada Pipeline Pavilion (TCPL)
***Please remember to scan your meal card at the host/hostess station in the dining room for each meal.**

MEETING ROOMS

All lectures will be held in the TransCanada Pipelines Pavilion (TCPL). LCD projector and blackboards are available for presentations. LCD projector, overhead projectors and blackboards are available for presentations.

SCHEDULE

Sunday

16:00	Check-in begins (Front Desk - Professional Development Centre - open 24 hours)
17:30–19:30	Buffet Dinner, Sally Borden Building
20:00	Informal gathering in 2nd floor lounge, Corbett Hall (if desired) Beverages and small assortment of snacks available on a cash honour-system.

Monday

7:00–8:45	Breakfast
8:45–9:00	Introduction and Welcome to BIRS by BIRS Station Manager, Room 201, TCPL
9:00–9:50	Jim Bryan: Counting hyperelliptic curves on Abelian surfaces via orbifolds
10:00–10:30	Coffee Break, TCPL
10:30–11:20	Ravi Vakil: Stabilization of discriminants in the Grothendieck ring
11:30–13:00	Lunch
13:30–14:20	Jonathan Wise: Deformation theory and Grothendieck topologies
14:30–15:20	Matt Satriano: Stacky resolutions
15:30–16:00	Coffee Break, TCPL.
16:00–16:50	Anton Geraschenko: When is a variety a quotient of a smooth variety by a finite group?
17:30–19:30	Dinner

Tuesday

7:00–9:00 Breakfast
8:00–9:00 Guided Tour of The Banff Centre: meet in the 2nd floor lounge, Corbett Hall
9:00–9:50 Carlos Simpson: Homotopy theory of Higher categories
10:00–10:30 Coffee Break, TCPL
10:30–11:20 Angelo Vistoli: The Nori fundamental gerbe of algebraic stacks
11:30–13:30 Lunch
13:30–14:20 Hsian-Hua Tseng: On the geometry of étale gerbes
14:30–15:20 Behrang Noohi: Forms of algebraic stacks
15:30–16:00 Coffee Break, TCPL
16:00–16:50 Max Lieblich: The moduli space of supersingular K3 surfaces is uniruled
17:30–19:30 Dinner

Wednesday

7:00–9:00 Breakfast
9:00–9:50 Kai Behrend: The eigenvalue spectrum of the inertia operator on the K-group of stacks
10:00–10:30 Coffee Break, TCPL
10:30–11:20 Misha Kapranov: Higher Segal spaces
11:20–11:30 Group Photo: meet in foyer of TCPL (Photo taken outside, so please bring a jacket.)
11:30–13:30 Lunch
Free Afternoon
17:30–19:30 Dinner

Thursday

7:00–9:00 Breakfast
9:00–9:50 Roy Joshua: K-theory and G-theory of algebraic and dg-stacks
10:00–10:30 Coffee Break, TCPL
10:30–11:20 Dan Edidin: New products, Chern classes and power operations in orbifold K-theory
11:30–13:30 Lunch
13:30–14:20 Tyler Jarvis: Landau-Ginzburg Mirror symmetry for Orbifolded Frobenius Algebras
14:30–15:20 Jarod Alper: Existence of good moduli spaces for moduli stacks of A_k-curves
15:30–16:00 Coffee Break, TCPL
16:00–16:50 Amalendu Krishna: Equivariant Cobordism of schemes
17:30–19:30 Dinner

Friday

7:00–9:00 Breakfast
9:00–9:50 Etienne Mann:Quantum D module for toric nef hypersurfaces
10: 00–10:30 Coffee Break, TCPL
10:30–11:30 Fabio Perroni: Irreducibility of moduli spaces of curves with a fixed group of automorphisms:
11:30–13:30 Lunch
Checkout by 12 noon.

** 5-day workshops are welcome to use the BIRS facilities (BIRS Coffee Lounge, TCPL and Reading Room) until 3 pm on Friday, although participants are still required to checkout of the guest rooms by 12 noon. **

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ABSTRACTS
(In alphabetic order by speaker surname)

Speaker: **Jarod Alper** (ANU)
Title: *Existence of good moduli spaces for moduli stacks of A_k-curves*
Abstract: We will prove a weak generalization of the Keel-Mori theorem giving conditions on a non-separated algebraic stack which guarantee the existence of a good moduli space. The main application is to prove the existence of proper good moduli spaces of the moduli stacks $M_{g,n}(A_k)$ for $k < 5$ parameterizing certain curves with at worst A_k-singularities. By intersection techniques, these good moduli spaces can be identified with log-canonical models of $M_{g,n}$. We thereby give an intrinsic argument providing moduli descriptions in the Hassett-Keel program for the first contraction and the first and second flip in the log-MMP of $M_{g,n}$ extending the work of Hassett and Hyeon on the log-MMP of M_g.

Speaker: **Kai Behrend** (UBC)
Title: *The eigenvalue spectrum of the inertia operator on the K-groups of stacks*
Abstract: TBA

Speaker: **Jim Bryan** (UBC)
Title: *Counting hyperelliptic curves on Abelian surfaces via orbifolds*
Abstract: Curves of geometric genus g on a polarized Abelian surface move in a g-2 dimensional family up to translation. Thus one expects a finite number of hyperelliptic curves (up to translation) and one can count them. We show, assuming the Crepant Resolution Conjecture relating the Gromov-Witten theories of an orbifold a crepant resolution, that the generating function for this counting problem (and its refinements) are given by q-expansions of certain explicit quasi-modular forms. This is based on the thesis of my student, Simon Rose.

Speaker: **Dan Edidin** (University of Missouri)
Title: *New products, Chern classes and power operations in orbifold K-theory*
Abstract: For a Deligne-Mumford quotient stack X we define an inertial pair (R, S) to be a bundle R on the double inertia stack I^2X and a class $S \in K(IX) \otimes Q$ satisfying certain compatibility conditions. Each inertial pair defines an associative product on both the K-theory and Chow theory of the inertia stack IX together with a Chern character homomorphism between these theories. For Gorentsein inertial pairs there is a corresponding theory of Chern classes and for *strongly Gorenstein* inertial pairs there are also power operations. When the stack is toric these operations can be used to define a new lambda-ring structure on $K(IX) \otimes Q$.

As an application we show that the virtual orbifold product defined by Lupercio, Uribe and Xicotencatl admits Chern classes and power operations. We also show that for the weight projective stack P(1,2) the completion of the virtual lambda ring structure is naturally isomorphic to the lambda ring structure on the natural resolution of singularities of the cotangent stack $T^*P(1, 2)$.

This is joint work with Tyler Jarvis and Takashi Kimura.

Speaker: **Anton Geraschenko** (Caltech)
Title: *When is a variety a quotient of a smooth variety by a finite group?*
Abstract: If a variety X is a quotient of a smooth variety by a finite group, it has quotient singularities—that is, it is *locally* a quotient by a finite group. In this talk, we will see that the converse is true if X is quasi-projective and is known to be a quotient by a torus (e.g. X a simplicial toric variety). Though the proof is stack-theoretic, the construction of a smooth variety U and finite group G so that $X = U/G$ can usually be made explicit purely scheme-theoretically. To illustrate the construction, I'll produce a smooth variety U with an action of $G = \mathbb{Z}/2$ so that U/G is the blow-up of $\mathbb{P}(1,1,2)$ at a smooth point. This example is interesting because even though U/G is toric, U cannot be taken to be toric.

We also characterize varieties which can be expressed a quotient of a smooth variety by a torus. This characterization can be used to show that the surface $\mathbb{P}^2/A_5$ cannot be expressed as a quotient of a smooth variety by a finite *abelian* group, even though it has abelian quotient singularities. This is joint work with Matthew Satriano.

Speaker: **Tyler Jarvis** (Brigham Young University)
Title: *Landau-Ginzburg Mirror Symmetry for Orbifolded Frobenius Algebras*
Abstract: I will discuss recent work with Drew Johnson, Amanda Francis, and Rachel Suggs on the Landau-Ginzburg Mirror Symmetry Conjecture for orbifolded Frobenius algebras for a large class of invertible singularities, including arbitrary sums of loops and Fermats with arbitrary symmetry groups. Specifically, we show that for a quasi-homogeneous polynomial W and an admissible group G within the class, the Frobenius algebra arising in the FJRW theory of the orbifold $[W/G]$ is isomorphic (as a Frobenius algebra) to the orbifold Milnor ring of $[W^T/G^T]$, associated to the dual polynomial W^T and dual group G^T.

Speaker: **Roy Joshua** (Ohio State University)
Title: *The K-theory and G-theory of algebraic and dg-stacks*
Abstract: In this survey talk, we will discuss in some detail the K-theory and G-theory of algebraic stacks as well as of dg-stacks. We will discuss some of the basic properties and results first for algebraic stacks and then their extensions to dg-stacks.

Speaker: **Misha Kapranov** (Yale University)
Title: *Higher Segal spaces*
Abstract: The talk, based on joint work in progress with T. Dyckerhoff, will discuss simplicial structures (e.g. simplicial sets, algebraic varieties etc.) satisfying certain gluing properties of a $2-$ dimensional nature. Such structures give rise to associative algebras generalizing Hall algebras.

Speaker: **Amalendu Krishna** (Tata Institute)
Title: *Equivariant cobordism of schemes*
Abstract: We shall define the algebraic analogue of the equivariant cobordism for schemes with group action. We shall show how the equivariant cobordism is related to the other equivariant cohomology theories. We shall how one can use the equivariant cobordism to study some conjectures of Totaro about the cycle class map for the classifying spaces.

Speaker: **Max Lieblich** (University of Washington)
Title: *The moduli space of supersingular K3 surfaces is uniruled*
Abstract: It is known that the moduli space of K3 surfaces in characteristic 0 admits no non-constant maps from the affine line. By contrast, in characteristic p it turns out that the locus of K3 surfaces of Picard number 22 is uniruled. I will explain how to see this using moduli spaces of sheaves twisted by the universal element of the formal Brauer group.

Speaker: **Etienne Mann** (Université de Montpellier II)
Title: *Quantum D module for toric nef hypersurfaces*

Abstract: On a smooth toric projective variety X, Iritani proves that its quantum D module is isomorphic to the GKZ system associated to X. We generalize this result to the pair (X,L) where L is an ample line bundle. More precisely, denote by Z the hypersurface defined by a generic section. We define the twisted quantum D-module which is a vector bundle with a flat connection, a flat pairing and a natural integrable structure. An appropriate quotient of it is isomorphic to the ambient part of the quantum D-module of Z. As X is toric, these quantum D-modules are cyclic. The twisted quantum D-module can be presented via mirror symmetry by the GKZ system associated to the total space of the dual line bundle L*. A question is to know what is the system of equations that define the ambiant part of the quantum D-module of Z. We construct this system as a quotient ideal of the GKZ system. This work is done with Thierry Mignon (Montpellier, France)

Speaker: **Behrang Noohi** (University of London)
Title: *Forms of algebraic stacks*
Abstract: We use techniques from higher group theory to give a method for constructing and classifying forms of algebraic stacks over a field k. As an application, we discuss classification of forms of weighted projective stacks ("Brauer-Severi stacks"), and classification of smooth Deligne-Mumford curves.

Speaker: **Fabio Perroni** (Universitaet Bayreuth)
Title: *Irreducibility of moduli spaces of curves with a fixed group of automorphism*
Abstract: Given a finite group G, consider the locus $M_g(G)$, in M_g, consisting of curves which admit an effective action by G. We propose numerical invariants of the G-action to distinguish irreducible components of $M_g(G)$. These invariants take into account the local monodromies at the branch points of the associated Galois cover and certain classes in $H_2(G, Z)$, and extend those already introduced to study the case of abelian groups. When $G = D_n$, the dihedral group of order $2n$, we show that these invariants are in one-to-one correspondence with the irreducible components of $M_g(D_n)$. For general groups, we expect a bijection between irreducible components and numerical invariants only after stabilization, when the genus g tends to infinity. This is a joint work (in progress) with Fabrizio Catanese and Michael Loenne.

Speaker: **Mathew Satriano** (University of Michigan)
Title: *Stacky resolutions*
Abstract: It is a well-known result of Vistoli that if X has quotient singularities, then there is a canonical way to add stacky structure to X to obtain a smooth Deligne-Mumford stack. It is natural to ask if this result can be extended to worse kinds of singularities. In this talk, we set up a general framework for "stacky resolutions" and show that they exist for toric singularities as well as local quotients by linearly reductive group schemes. We give applications of these stacky results to two purely scheme-theoretic problems: a generalization of the classical Chevalley-Shephard-Todd theorem, and a Hodge-theoretic result for certain singular schemes in characteristic p.

Speaker: **Carlos Simpson** (University of Nice)
Title: *Homotopy theory of higher categories*
Abstract: The aim of this talk is to provide an introduction to the theory of higher categories, in particular to explain the basic idea of the construction of a model category of higher categories in my book of the same name. We will emphasize aspects most closely related to higher stacks.

Speaker: **Hsian-Hua Tseng** (Ohio State University)
Title: *On the geometry of étale gerbes*
Abstract: A G-gerbe over a base B is roughly speaking a fiber bundle whose fibers are the classifying orbifold BG of the group G. Gerbes occur naturally in the theory of orbifolds. For example every orbifold with nontrivial generic stabilizers is a gerbe over another orbifold. Gerbes are also very important in other subjects, such as the theory of non-abelian cohomology. It is conjectured by physicists that for finite groups G the geometry of a G-gerbe is equivalent to the geometry of a disconnected space with a U(1)-twist. The

purpose of this talk is to explain what this conjecture means, and why one should believe this conjecture. Much of this is joint work with Xiang Tang of Washington University in St. Louis.

Speaker: **Ravi Vakil** (Stanford University)
Title: *Stabilization of discriminants in the Grothendieck ring*
Abstract: We consider the "limiting behavior" of *discriminants*, by which we mean informally the closure of the locus in some parameter space of some type of object where the objects have certain singularities. We focus on the space of partially labeled points on a variety X, and linear systems on X. These are connected — we use the first to understand the second. We describe their classes in the "ring of motives", as the number of points gets large, or as the line bundle gets very positive. They stabilize in an appropriate sense, and their stabilization can be described in terms of the motivic zeta values. The results extend parallel results in both arithmetic and topology. I will also present a conjecture (on "motivic stabilization of symmetric powers") suggested by our work. Although it is true in important cases, Daniel Litt has shown that it contradicts other hoped-for statements. This is joint work with Melanie Wood.

Speaker: **Angelo Vistoli** (Scuola Normale Superiore di Pisa)
Title: *The Nori fundamental gerbe of algebraic stack*
Abstract: I will report about joint work with Niels Borne. I will discuss the fundamental gerbe, an extension of Nori's fundamental group scheme to schemes, and stacks, over fields, that don't necessarily have a base rational point. I will also explain its tannakian interpretation; our formalism is more direct than Nori's, and works more generally; in particular, it does not use semistable bundles.

Speaker: **Jonathan Wise** (Stanford University)
Title: *Deformation theory and Grothendieck topologies*
Abstract: The cotangent complex of a sheaf of commutative rings controls its first-order deformation theory. In his original paper on the subject, which treated the case of a commutative ring (not a sheaf), Quillen showed that the cotangent complex represents cohomology in a suitable Grothendieck topology. He hoped to extend this approach to define the cotangent cohomology of a sheaf of commutative rings but he abandoned it when Illusie achieved a construction by simplicial methods. I will describe at least one Grothendieck topology that Quillen could have used to make a definition in the same generality as Illusie's. Conveniently, this point of view makes the connection between cotangent cohomology and deformation theory more transparent and suggests a simplified approach to the deformation theory of flat group schemes.