Abstracts

Alexander Berglund (Stockholm University)
Title: Lie models and tautological classes for automorphisms of fiber bundles
Abstract: I will construct differential graded Lie algebra models, in the sense of Quillen's rational homotopy theory, for classifying spaces of automorphisms of fiber bundles. A key feature is that explicit Chevalley-Eilenberg cocycles representing generalized Miller-Morita-Mumford classes can be written down in these models. I will discuss how this points to a new approach to tautological rings for simply connected manifolds and I will discuss how it sheds new light on the characteristic classes of block bundles associated to homology classes of automorphism groups of free groups that were introduced by Ib Madsen and myself in earlier work.

Carel Faber (Utrecht University)
Title: Teichmüller modular forms and the cohomology of moduli spaces of curves
Abstract: Teichmüller modular forms are sections on $M_g$ of the bundles obtained by applying a Schur functor for $GL(g)$ to the Hodge bundle. For genus at least 3, they extend to the Deligne-Mumford compactification. In genus 3, Teichmüller modular forms can be understood in terms of Siegel modular forms and the scalar-valued form of weight 9 studied in detail by Ichikawa, and alternatively in terms of concomitants for plane quartics. In general, there is a precise relation between certain spaces of Teichmüller cusp forms and the middle cohomology of symplectic local systems (pulled back from $A_g$). We illustrate this in detail for genus 3 and we also present interesting examples for higher genus. Joint work with Bergström, Cléry, and Van der Geer.

Benson Farb (University of Chicago)
Title: Topology of resolvent problems
Abstract: In this talk I will explain a topological approach to some problems about algebraic functions due to Klein and Hilbert. As a sample application of these methods, I will explain a solution to the following problem of Felix Klein: Let $\Phi_{g,n}$ be the algebraic function that assigns to a (principally polarized) abelian variety its $n$-torsion points. What is the minimal number of variables $d$ such that, after a rational change of variables, $\Phi_{g,n}$ can be written as an algebraic function of $d$ variables? I'll explain how this relates to Hilbert's 13th Problem, to the 27 lines on a smooth cubic surface, and more. This is joint work with Mark Kisin and Jesse Wolfson.

Ezra Getzler (Northwestern University)
Title: Characteristic classes in derived geometry
Abstract: Toën and Vezzosi constructed rational characteristic classes of perfect complexes in derived geometry, as a corollary of the cobordism hypothesis. (The analogue of the trace property in derived geometry is equivariance with respect to a circle action.) We give an explicit formula for the Chern character for an explicit model of the derived stack of perfect complexes developed in
collaboration with Kai Behrend, show that it is the unique such extension, and that it is furthermore compatible with the Hodge filtration.

**Paul Gunnells** (University of Massachusetts)

**Title:** On the growth of torsion in cohomology of arithmetic groups

**Abstract:** Let $G$ be a semisimple Lie group with associated symmetric space $D$, and let $\Gamma$ be a cocompact arithmetic group of $G$. Bergeron and Venkatesh recently gave a precise conjecture about the growth of the order of the torsion subgroup $H_i(\Gamma_{k})_{\text{tors}}$ as $\Gamma_{k}$ ranges over a tower of congruence subgroups of $\Gamma$. In particular they conjectured that the ratio $(\log |H_i(\Gamma_{k})_{\text{tors}}|)/(|\Gamma : \Gamma_{k}|)$ should tend to a nonzero limit if and only if $i= (\dim(D)-1)/2$ and $G$ is a group of so-called deficiency 1; such groups include for instance $\text{SL}_n(\mathbb{R})$ for $n=3$ and 4. Furthermore, Bergeron and Venkatesh gave a precise expression for the limit.

In this talk, we describe our computational investigation of this phenomena. We consider the cohomology of several (non-cocompact) arithmetic groups, including $\text{GL}_n(\mathbb{Z})$ for $n=3,4,5$ and $\text{GL}_2$ over various rings of integers, and observe the growth of torsion as a function of level. In all cases where our dataset is sufficiently large, we observe excellent agreement with the same limit as in the predictions of Bergeron-Venkatesh. Our data also prompts us to make two new conjectures on the growth of torsion not covered by the Bergeron-Venkatesh conjecture. This is joint work with Avner Ash, Mark McConnell, and Dan Yasaki.

**Richard Hain** (Duke University)

**Title:** Johnson Homomorphisms, the Goldman–Turaev Lie bialgebra and GRT

**Abstract:** Torelli groups are important as they control, to some degree, the difference between the geometry of curves and that of their jacobians. The Johnson homomorphism is a tool for understanding these mysterious groups. The Goldman-Turaev Lie bialgebra of a hyperbolic surface is the free abelian group spanned by the closed geodesics on the surface. It is endowed with a geometrically defined bracket (Goldman) and cobracket (Turaev). In this talk I will explain how the problem of determining the image of the Johnson homomorphism is related to the problem of determining Drinfeld’s group GRT. The Goldman-Turaev Lie bialgebra mediates this relationship.

**Alexander Kupers** (Harvard University)

**Title:** Destabilization and the rational homotopy groups of diffeomorphisms of disks

**Abstract:** We will report on joint work-in-progress with Oscar Randal-Williams, concerning the topological group of diffeomorphisms of an even-dimensional disk $D^{2n}$ fixing the boundary pointwise. The main observation is that this group is the difference between the diffeomorphisms of $D^{2n} \# (S^{n} \times S^{n})^{\# g}$ and certain spaces of self-embeddings. The former can studied using the homological stability and homology results of Galatius and Randal-Williams, and latter using embedding calculus.

**Eduard Looijenga** (Utrecht University and Tsinghua University)

**Title:** Mapping class group representations from curves with symmetry

**Abstract:** If a closed oriented surface of genus at least 2 is endowed with a faithful action of a finite group, then we obtain a virtual representation of the mapping class group of the associated orbifold. We address some natural questions that can be asked in this situation, such as whether the
representations in question are arithmetic. This is mostly an account of joint work with Marco Boggi.

**Sam Payne** (University of Texas at Austin)

Title: Tropical curves, graph homology, and top weight cohomology of \( M_g \)

Abstract: I will discuss the topology of a space of stable tropical curves of genus \( g \) with volume 1. The reduced rational homology of this space is canonically identified with the top weight cohomology of \( M_g \) and also with the homology of Kontsevich's graph complex. As one application, drawing on results of Brown and Willwacher from Grothendieck-Teichmüller theory, we show that \( H^{4g-6}(M_g) \) grows exponentially with \( g \). Joint work with M. Chan and S. Galatius.

**Dan Petersen** (Stockholm University)

Title: Tautological classes with twisted coefficients

Abstract: Richard Hain has defined an "enlarged" tautological ring, which is a subalgebra of the cohomology ring of the moduli space of smooth curves \( M_g \) with coefficients in the algebraic coordinate ring of the symplectic group. Understanding this ring in fixed genus is equivalent to understanding all tautological rings of all fibered powers of the universal curve over \( M_g \) simultaneously. In joint work with Tavakol and Yin we calculated this ring completely in genus up to 4, and obtained partial results also in higher genera. I will discuss these and some other more structural results about this ring, and also give a description of it in the stable (large genus) range.

**Andrew Putman** (University of Notre Dame)

Title: The stable cohomology of the moduli space of curves with level structures

Abstract: I will prove that in a stable range, the rational cohomology of the moduli space of curves with level structures is the same as that of the ordinary moduli space of curves: a polynomial ring in the MMM classes. This can be viewed as a version of the Borel Stability Theorem for the moduli space of curves.

**Steven Sam** (University of California, San Diego)

Title: Representations of surjections and compactifications of moduli spaces

Abstract: Recently, the (co)homology of families of moduli spaces (e.g., configuration spaces, moduli space of curves with \( n \) marked points) have been fruitfully studied using the technology of FI-modules (functors on the category of finite sets and injective functions) to uncover patterns and stabilization results. However, many of these moduli spaces admit natural compactifications for which these techniques fail to be useful. I will explain some recent work which repairs this deficiency by using the category of finite sets and surjective functions.

**Orsola Tommasi** (University of Padova)

Title: Stable cohomology of complements of discriminants

Abstract: The discriminant of a space of functions is the closed subset consisting of the functions which are singular in some sense. For instance, for complex polynomials in one variable the
discriminant is the locus of polynomials with multiple roots. In this special case, it is known by work of Arnol'd that the cohomology of the complement of the discriminant stabilizes when the degree of the polynomials grows, in the sense that the k-th cohomology group of the space of polynomials without multiple roots is independent of the degree of the polynomials considered. A more general set-up is to consider the space of non-singular sections of a very ample line bundle on a fixed non-singular variety. In this case, Vakil and Wood proved a stabilization behaviour for the class of complements of discriminants in the Grothendieck group of varieties. In this talk, I will discuss a topological approach for obtaining the cohomological counterpart of Vakil and Wood's result and describe stable cohomology explicitly for the space of complex homogeneous polynomials in a fixed number of variables and for spaces of smooth divisors on an algebraic curve.

**Karen Vogtmann** (University of Warwick)

**Title:** The rational Euler characteristic of Out(F_n)

**Abstract:** The group Out(F_n) shares many properties with both arithmetic groups and mapping class groups. The rational Euler characteristic of an arithmetic group can be expressed in terms of values of zeta functions and, in a surprising twist, Harer and Zagier showed that the same is true for surface mapping class groups. This talk will discuss recent joint results with M. Borinsky about the rational Euler characteristic of Out(F_n) and its relation to zeta functions.

**Craig Westerland** (University of Minnesota)

**Title:** Homology of Hurwitz spaces and Malle’s conjecture for function fields

**Abstract:** In 2002, Malle conjectured an asymptotic (in discriminant) enumeration of number fields with prescribed Galois data; very few non-abelian cases of Malle’s conjecture have been established. Translating this conjecture into the setting of function fields, it becomes a question about enumeration of points over finite fields on certain Hurwitz moduli schemes of branched covers. In recent joint work with Ellenberg and Tran, we established an upper bound for this asymptotic (consonant with Malle’s prediction) using some coarse bounds on the Betti numbers of the complex points of these schemes. I’ll explain some of this work, along with some recent ongoing work which aims to refine these cohomological computations, leading to better understanding of the first and second order terms in the point count.