Barron, Tatyana (University of Western Ontario)

Vector-valued automorphic forms and submanifolds of ball quotients

Abstract: Vector-valued automorphic forms are ubiquitous. They appear in work of R. Borcherds on singular Howe correspondence, work of S. Kudla on arithmetic cycles, physics-related work by T. Gannon, G. Mason and others. The space of Jacobi forms is isomorphic to a space of vector-valued modular forms. I will talk about explicit constructions of vector-valued automorphic forms on bounded symmetric domains and some estimates for the case when the domain is a ball. This is joint work in progress with my Ph.D. student N. Alluhaibi.

Crooks, Peter (University of Toronto)

Equivariant Contact Geometry and the LeBrun-Salamon Conjecture

Abstract: Fano contact varieties have received considerable attention in the research literature, largely due to their importance in quaternionic Kähler geometry. Notably, the long-standing LeBrun-Salamon Conjecture proposes that any such variety having second Betti number 1 is isomorphic to the projectivization of the minimal nilpotent orbit in a simple complex Lie algebra. Beauville, Boothby, and others have shown the conjecture to hold in a number of important instances. I will discuss joint work with S. Rayan, in which we use Lie-theoretic techniques to classify equivariant contact structures on partial flag varieties in type $ADE$. (As expected, our results are consistent with the LeBrun-Salamon Conjecture.) I will subsequently explain how our work affords an intrinsic description of the unique $SO_{2n}(\mathbb{C})$-invariant contact structure on the Grassmannian of isotropic 2-planes in $\mathbb{C}^{2n}$.

Fei, Teng (MIT)

Some new solutions to the Strominger system

Abstract: The Strominger system is a system of PDEs derived by Strominger in his study of compactification of heterotic strings with torsion. It can be thought of as a generalization of Ricci-flat metrics on non-Kähler Calabi-Yau 3-folds. We present some new solutions to the Strominger system on a class of noncompact Calabi-Yau 3-folds constructed by twistor technique. These manifolds include the resolved conifold $\text{Tot}(\mathcal{O}(-1, -1) \to \mathbb{P}^1)$ as a special case.

Garcia-Fritz, Natalia (University of Toronto)

Powers with constant second differences

Abstract: In this talk we will show that if we fix an integer $k > 2$, then the Bombieri-Lang conjecture for surfaces implies that sequences of rational $k$-th powers with constant second differences have length bounded only in terms of $k$. We do this by finding all the curves of genus 0 or 1 on certain general type surfaces associated to this problem. As a consequence we obtain a result towards Mohanty’s problem, which asks for the maximal length of an arithmetic progression on the $y$-coordinates of rational points of Mordell’s elliptic curves $y^2 = x^3 + b$. 
Genival da Silva Jr. (Washington University in St. Louis)

On the arithmetic of Landau-Ginzburg models of a certain class of threefolds

Abstract: In this talk, I’ll use higher normal functions to compute Apery constants associated to quantum differential equations.

Kerr, Matt (Washington University of St. Louis)

Normal functions over locally symmetric varieties

Abstract: An algebraic cycle homologous to zero on a variety leads to an extension of Hodge-theoretic data, and in a variational context to a family of extensions called a normal function. These may be viewed as "horizontal" sections of a bundle of complex tori, and are used to detect cycles modulo algebraic (or rational) equivalence. Conversely, the existence of normal functions can be used to predict that interesting cycles are present...or absent: a famous theorem of Green and Voisin states that for projective hypersurfaces of large enough degree, there are no normal functions (into the intermediate Jacobian bundle associated to these hypersurfaces) over any etale neighborhood of the coarse moduli space.

Inspired by recent work of Friedman-Laza on Hermitian variations of Hodge structure and Oort’s conjecture on special (i.e. Shimura) subvarieties in the Torelli locus, R. Keast and I wondered about the existence of normal functions over etale neighborhoods of Shimura varieties. Here the function is supposed to take values in a family of intermediate Jacobians associated to a representation of a reductive group. In this talk I will explain our classification of the cases where a Green-Voisin analogue does *not* hold and where one therefore expects interesting cycles to occur, and give some evidence that these predictions might be "sharp".

Molnar, Alex (Queen’s University)

On the converse modularity problem for rigid Calabi–Yau threefolds

Abstract: Based on the recent work of Khare, Wintenberger and Kisin, proving Serre’s residual modularity conjecture, Gouvea–Yui and Dieulafait have proved the modularity of rigid Calabi–Yau threefolds defined over $\mathbb{Q}$ - that their $L$-series are determined by weight 4 modular forms. The converse question has been asked by Mazur and van Straten: given modular forms of weight 4 with integral Fourier coefficients, are there rigid Calabi–Yau threefolds defined over $\mathbb{Q}$ whose $L$-series are the $L$-series prescribed by the modular forms?

In this talk, we address this question in the simplest case, for rigid Calabi–Yau threefolds of CM-type.

Pearlstein, Greg (Texas A & M University)

The Geometry of Nilpotent Orbits

Abstract: I will discuss recent work with P. Brosnan and C. Robles which describes the possible local monodromy cones attached to a variation of mixed Hodge structure.

Sala, Francesco (University of Western Ontario)

(K-theoretic) Hall algebras and sheaves on stacks

Abstract: Hall algebras play a prominent role in the geometric realizations of quantum groups. Their K-theoretical version has a deep connection with quantum loop algebras. In the present talk I will describe in detail K-theoretic Hall algebras associated with stacks of torsion sheaves over surfaces and their main properties. (Work in progress with Olivier Schiffmann)
Thompson, Alan (University of Waterloo)

Elliptic Surfaces and K3-fibred Threefolds

Abstract: In comparison to the well-understood theory of elliptic surfaces, the theory of K3-fibred
threefolds is still in its infancy. However, when the K3 surface fibres are polarized by lattices of high rank, a
surprising number of parallels may be drawn between these two theories: in particular, there are analogues
of the functional and homological invariants, formulae for invariants, etc. I will present a selection of results
in this area, with a focus on the case where the threefold is Calabi-Yau. This project is joint work with C.
Doran, A. Harder and A. Novoseltsev.

Yui, Noriko (Queen’s University)

Enumerative geometry and modular forms

Abstract: Modular forms of various kinds show their (unexpected) appearance in the landscape of
enumerative geometry. This includes, counting numbers of rational points on algebraic varieties defined over
number fields, counting covers of elliptic curves, counting nodal curves on K3 surfaces, counting Gromow–
Witten invariants, Donaldson–Thomas invariants and generalized invariants. These numbers are concocted
to the generating functions. In many instances, these generating functions are expressed in terms of modular
forms of various kinds. I will try to explain the recurring phenomena by several examples. Ultimately, we
would like to understand “why” modular.

Zhou, Jie (Perimeter Institute)

Mirror symmetry for plane cubics and PEL structure

Abstract: I will review the construction for the mirror manifolds of elliptic curves and plane cubics,
emphasizing the arithmetic aspect. In particular, I will show how structures like polarization, level structure
play a role in mirror construction. These structures affect the moduli spaces in consideration and are
responsible for the modularity type in the Gromov-Witten theory of some related geometries.

Lewis, James (University of Alberta)

The business of height pairings

Abstract: In algebraic geometry there is the notion of a height pairing of algebraic cycles, which lies at
the confluence of arithmetic, Hodge theory and topology. After explaining a motivating example situation,
we introduce new directions in this subject.