

ARITHMETIC AND GEOMETRY OF ALGEBRAIC VARIETIES
WITH SPECIAL EMPHASIS ON
CALABI–YAU VARIETIES AND MIRROR SYMMETRY
NOVEMBER 1–2, 2008

ABSTRACTS

Matthew Ballard (University of Pennsylvania)

Understanding derived categories of sheaves on singular projective varieties

Much work has gone into understanding and exploiting the rich relationship between a smooth projective variety and its bounded derived category of coherent sheaves. But, little has been written or spoken about the case where the variety may be singular. In this talk, I will discuss how to think about the categories involved in the singular case and outline the extension, to singular varieties, of results for smooth varieties.

Chris Brav (University of Toronto)

Tilting in derived categories

We give an exposition of tilting theory in derived categories and discuss some geometric examples in which the derived category of quasi-coherent sheaves on a variety is equivalent to the derived category of a differential-graded algebra.

Tatyana Foth (University of Western Ontario)

Varieties of complex Lie algebras

Varieties of structure constants of complex n -dimensional Lie algebras dge conjecture and Calabi-Yau varieties were studied by Kirillov, Neretin, and others. Let G be a finite abelian group. Following work of Moody and Patera, one can consider algebraic varieties parametrizing G -graded Lie algebra structures on a fixed (G -graded) finite-dimensional complex vector space. I will report on joint work with M. Tvalavadze, where we prove, in particular, that $H_1(M) = 0$ for certain irreducible components of these varieties.

Fernando Gouvêa (Colby College/Queen's University)

Rigid Calabi–Yau threefold over \mathbb{Q} are modular

Recent results on Galois representations of degree two yield a simple proof that if X is a rigid Calabi-Yau threefold defined over \mathbb{Q} , then the two-dimensional Galois representation given by its third étale cohomology "comes from" an elliptic modular form of weight four. We will explain the argument and explore related questions.

Su-Jeong Kang (University of Alberta)

The general Hodge conjecture and Calabi-Yau varieties

Abstract : If X is a complex smooth projective variety for which the general Hodge conjecture(GHC) holds, then one can ask if the Generalized Hodge Conjecture (GHC) holds for any smooth projective variety that is birationally equivalent to X . While this should be true if the GHC is true, we do not have a proof in general. In this talk, I will show this holds in case of Calabi-Yau varieties. This talk is based on my joint work with Donu Arapura.

James Lewis (University of Alberta)

Biextensions associated to algebraic cycles, I

Let X be a smooth complex projective variety. We provide a description of a biextension and archimedean height pairing of two cycles whose classes belong to a certain filtration level in the Chow group of X .

Steven Lu (UQAM, Montreal)

On the structure of algebraic varieties and holomorphic curves (the case of nef $-K$)

We will look at a general structure theorem for algebraic varieties, its relation to the Kobayashi metric and focus on the structure and role played by those with nef anticanonical bundle.

Andrey Novoseltsev (University of Alberta)

Closed form expressions for Hodge numbers of Calabi-Yau complete intersections

In 1996 Batyrev and Borisov obtained a combinatorial formula for the generating function of (stringy) Hodge numbers of a Calabi-Yau variety X arising as a complete intersection in toric varieties. They used it to show that Hodge numbers of X are symmetric to those of its mirror under Batyrev-Borisov construction. It can be also used for actual computation of Hodge numbers, but the formula is highly recursive. We were able to obtain a non-recursive formulas for Hodge numbers of a Calabi-Yau 3-fold in a 5-dimensional toric variety in terms of lattice points of corresponding Cayley polytopes, similar to known formulas in the hypersurface case. This is joint work in progress with Charles F. Doran.

Andrey Todorov (University of California Santa Cruz)

Holomorphic Metrics, Flat Connections on the Moduli Space of Hodge Structures and Proof of the Global Torelli Theorem for polarized CY manifolds

Ferarra introduced locally a flat structure on the moduli space of CY three folds. We will describe a holomorphic metric whose Levi-Chivita connection coincides with Ferarra construction. We generalize Ferarra construction from point of view of Griffiths domain. We will describe the geodesics of the holomorphic metric. By using the description of the geodesics we will prove global Torelli for polarized CY manifolds.

Noriko Yui (Queen's University)

On the modularity of certain K3 surfaces with non-symplectic group actions

This is a joint work with Ron Livné (Jerusalem) and Matthias Schütt (Copenhagen). We consider complex K3 surfaces with a non-symplectic group acting trivially on the algebraic cycles. Vorontsov and Kondo classified those K3 surfaces with transcendental lattice of minimal rank. The purpose of this talk is to study the Galois representations associated to these K3 surfaces. The rank of transcendental lattices is even and varies from 2 to 20, excluding 8 and 14. We show that these K3 surfaces are dominated by Fermat surfaces and hence they are all of CM type. We establish the modularity of the Galois representations associated to the transcendental parts of these K3 surfaces. Time permitting, we briefly discuss mirror symmetry for these K3 surfaces.

Ying Zong (University of Toronto/The Fields Institute)

Hypersymmetric abelian varieties

Motivated by Oort's Hecke-orbit conjecture, Chai introduced hyper-symmetric points in the study of fine structures of modular varieties in positive characteristics. We prove a necessary and sufficient condition to determine which Newton polygon stratum of PEL-type contains at least one such point.