ARITHMETIC AND GEOMETRY OF ALGEBRAIC VARIETIES
WITH SPECIAL EMPHASIS ON
CALABI–YAU VARIETIES AND MIRROR SYMMETRY
MARCH 7–8, 2009

ABSTRACTS

Yasuhiro Goto (Hokkaido University of Education at Hakodate)

On the L-series of some Calabi-Yau threefolds over the rationals

We consider Calabi-Yau threefolds obtained by resolving singularities of weighted Delsarte threefolds. We describe their zeta-functions and L-series over the rationals and discuss various arithmetic properties related to them.

Doug Haessig (University of Rochester)

Mirror symmetry and quotients of zeta functions

In 2002 - 03, Candelas, de la Ossa, and Rodriguez-Villegas considered the quotient of the zeta function of a quintic Calabi-Yau variety and the zeta function of its mirror. This quotient turned out to be a polynomial, pure of weight 1. The purity suggested that the quotient came from a variety of dimension 1. These (Euler) curves were identified. In 2006, using ℓ-adic techniques, Wan extended the divisibility and purity results to higher dimensions. In this talk, we will recall these facts, discuss some p-adic aspects of this quotient, and pose the question of extending this study to the zeta function of divisors.

Bill Hoffman (Louisiana State University)

Infinitesimal structure of Chow groups

The Chow groups $CH^p(X)$ of codimension p algebraic cycles modulo rational equivalence, of a smooth quasiprojective algebraic variety X, are among the most basic, and, and when $p \geq 2$, most mysterious objects in algebraic geometry. This talk is a report on work in progress on the study of the tangent spaces (suitably defined) $TCH^p(X)$ and higher order tangents, the formal completion $\widehat{CH}^p(X)$. This study involves ideas from K-theory, and the recent applications of Hodge theory to understand the conjectural Bloch–Beilinson filtrations on Chow groups proposed by a nubmer of people (Murre, S. Saito, M. Saito, Green/Griffiths, J. Lewis). In particular, we have extended some of the results of Stienstra and Green/Griffiths on $TCH^p(X)$ to $\widehat{CH}^p(X)$. This talk will be in part expository in that some of the background and also future deirection will be discussed.

Sheldon Joyer (University of Western Ontario)

Zeta functions as iterated integrals

The iterated integrals of Chen may be generalized by interpolation of the integer number of times which forms are iterated in path integrals, to complex values in certain half-planes. These generalized iterated integrals satisfy an additive iterative property along with a product and comultiplication formula. In integration over a certain path in $P^1\ 0, 1, \infty$, a non-classical multiplicative iterative property holds, which gives rise to a family of iterated integral expressions for the Riemann zeta func tion among which the Mellin transform of the theta function appears. The complex iterated integral formalism can be used to give a direct proof of the monodromy of polylogarithm functions and to prove that irrationality of the residue of the Dedekind zeta function at $s = 1$ is an obstruction to the existence of a contour integral proof of the functional equation for such functions in the style of Riemann's contour integral proof of the functional equation for the Riemann zeta function.

James Lewis (University of Alberta)

An Archimedean Height Pairing on the Equivalence Relation Defining Bloch's Higher Chow Groups

The existence of a height pairing on the equivalence relation defining Bloch's higher Chow groups is a surprising consequence of some recent joint work by myself and Xi Chen on a nontrivial K_1-class on a self-product of a general K3 surface. I will explain how this pairing comes about.

Ling Long (Iowa State University)

Modularity of Galois representations attached to an elliptic modular surface

We consider an elliptic modular surface which gives rise to a compatible family of 4-dimensional l-adic Galois representations. We will show that this family of representations is modular. Moreover, an application of the modularity result to the three-term Atkin and Swinnerton-Dyer congruence relations satisfied by a space of noncongruence cuspforms will be demonstrated. This is a joint work with Jerome W. Hoffman and Helena Verrill.

Steven Lu (UQAM, Montreal)

Picard theorems for holomorphic curves in varieties with maximal albanese dimension and the resolution of a conjecture of Lang

We resolve completely the strongest possible version of Lang's conjecture concerning the behavior of holomorphic curves (entire images of C) in any quasi-projective variety that admits a morphism with non-trivial jacobian determinant to a semi-abelian variety (of the same dimension). This would serve as possibly the most important model for attacking the conjecture in general.

Gregory Pearlstein

The zero locus of an admissible normal function

I will discuss recent work with Patrick Brosnan (UBC) on proving that the zero locus of an admissible normal function on a smooth complex algebraic variety S is an algebraic subvariety of S.

David Ploog (University of Toronto)

Kleinian and Fuchsian singularities

This is a joint work with Wolfgang Ebeling. For these two types of singularity, one can usually studies their root lattices and derives invariants like Poincare series from them. It turns out that it is useful to try to lift everything from the level of K-groups (i.e. the root lattices) to derived categories. This makes for a nicer, uniform proof of formerly disjoint results and allows for a more geometric interpretation, having connections to homological mirror symmetry (of singularities, i.e. Landau-Ginzburg models in this case).

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)

CM–liftings of abelian varieties

An abelian variety A over a field k of dimension d is said to have sufficiently many complex multiplication if there is an order R of a commutative semi-simple $\mathbf{Q}$-algebra of rank $2d$ operating on A. The talk concerns if such an abelian variety over a field of characteristic $p > 0$ can be lifted to an abelian scheme together with complex multiplication over an integral domain of characteristic 0.