ARITHMETIC AND GEOMETRY OF ALGEBRAIC VARIETIES
WITH SPECIAL EMPHASIS ON
CALABI–YAU VARIETIES AND MIRROR SYMMETRY
MARCH 19–20, 2011

ABSTRACTS

Xi Chen (University of Alberta)

Picard-Fuchs Ideals and Normal Functions

By exploring Gauss-Manin derivative on the normal functions coming from regulator maps, we are able to show, roughly, the transcendental regulator of a general member of a family is nontrivial if the corresponding real regulator is. Among other things, this simplifies the proof of the known fact that the transcendental regulator of a general K3 surface is nontrivial. This is a joint work with J. Lewis, C. Doran and M. Kerr.

Yasuhiro Goto (Hokkaido University of Education at Hakodate)

Arithmetic of Calabi-Yau threefolds of Voisin and Borcea

We discuss Calabi-Yau threefolds of Voisin and Borcea over a finite field. These threefolds are constructed from the product of K3 surfaces and elliptic curves by some involution. We discuss their geometry, such as singularities and resolutions, and compute their zeta-functions for some particular choices of K3 surfaces and elliptic curves.

This is a joint work (in progress) with R. Livne and N. Yui.

Doug Haessig (University of Rochester)

On some results ofChevalley-Warning type

The Chevalley-Warning theorem,conjectured by Emil Artin in 1935, provides conditions whichguarantee that a multivariable polynomial has a zero over a finite field in terms of the polynomial's degree and number of variables. This was generalized by Ax in 1964 in such a way that it gave a divisibility result for eigenvalues of the Frobenius on cohomology. We will discuss this and a further generalizations.

Andrew Harder (Queen's University)

Period spaces of abelian surfaces and period spaces of K3 surfaces

Via the wedge product on Hodge structures, one may relate the moduli and period spaces of abelian surfaces. This map has been studied before, notably by Peters and by Shioda. I will discuss their results and present some calculations relating the period space of lattice polarized abelian surfaces to the moduli spaces of abelian surfaces with quaternionic multiplication and real multiplication. I will also discuss some applications to the period space of K3 surfaces and their Picard-Fuchs differential equations."

Sheldon Joyner (University of Western Ontario)

The modular group and the Grothendieck-Teichmuller group

The absolute Galois group of the rational numbers is known to embed into a certain profinite group known as the Grothendieck-Teichmuller group, GT. In this talk, I will discuss the way in which the relations on GT may be related to those on the modular group.

James Lewis (University of Alberta)

Arithmetic Normal Functions and Filtrations on Chow Groups

We give an explicit geometric characterization of a candidate i Bloch-Beilinson filtration due to Asakura and M. Saito, in a special case situation, in terms of (reduced) arithmetic normal functions.

Dermot McCarthy (Texas A& M University)

Hypergeometric Functions and the Number of Points on Algebraic Varieties over Finite Fields

We discuss results which relate the number of points on certain algebraic varieties over finite fields to special values of hypergeometric functions. In particular, we introduce Greene's hypergeometric function over finite fields which features in many of these results. We highlight a limitation of this function and explain how this may be overcome by extending the function to the p-adic setting.

Hector Pasten (Queen's University)

Polynomials of degree n representing n-th powers

Soon after Hilbert tenth problem (H10) was solved in 1970, J. R. Buchi proved in an unpublished work that a positive answer to the problem below would imply a strong improvement to the negative answer to H10. The question is: Is it true that if the integer squares $x_1^2, \dots, x_5^2$ have second difference constant and equal to two, then actually they are consecutive squares? One can easily show that this problem is equivalent to the following one: Is it true that, if the polynomial $f(t) = t^2 + bt + c \in \mathbf{Z}[t]$ satisfies that $f(1), \dots, f(5)$ are integer squares then actually $f(t) = (t + a)^2$ for some integer a? This problem is open, and it is not known even if there exists some fixed M such that every polynomial f as above representing M consecutive integer squares necessarily is itself a square (Buchi believed that $M = 5$ should work). The existence of such M not necessarily equal to 5 would have the same consequences in Logic. In 2000, Vojta showed that Bombieri-Lang conjecture implies the existence of such fixed M, and he also solved (unconditionally) the analogous problem for complex meromorphic functions and function fields of curves in characteristic zero (as coefficients b, c of the polynomial f in the above formulation).

In this talk we will survey the state of this problem, and the techniques available to deal with the analogue problem for other structures (mainly algebraic geometry and value distribution theory).

One can generalize this problem to higher powers, and it becomes a question about monic polynomials of degree n representing 'too many' n-th powers. We will also summarize the known results in this direction with some comments about the meaning in Logic.

Greg Pearlstein (Michigan State University)

Normal functions and the Hodge conjecture

I will summarize recent work on the Hodge conjecture using normal functions, and the relationship with archimedean heights.

Adam Sierakowski (The Fields Institute)

Purely infinite C*-algebras arising from crossed products

In this talk, we study conditions that will ensure that a crossed product of a C*-algebra by a discrete exact group is purely infinite. We are particularly interested in the case of a discrete non-amenable exact groups acting on a commutative C*-algebra, where sufficient conditions can be phrased in terms of paradoxicality of subsets of the spectrum of the abelian C*-algebra. As an application, we show that every discrete countable non-amenable exact group admits a free amenable minimal action on the Cantor set such that the corresponding crossed product C*-algebra is a Kirchberg algebra in the UCT class.

This is a backup talk in the event of emergency.

Noriko Yui (Queen's University)

Update on the modularity of Calabi-Yau varieties over Q

According to the Langlands Philosophy, every algebraic variety defined over the rationals or a number field should be modular (automorphic).

In this talk, I will concentrate on a special class of algebraic varieties, called Calabi-Yau varieties (of dimension at most three), defined over the rationals, and report on the current status of their modularity (automorphy).