ARITHMETIC AND GEOMETRY OF ALGEBRAIC VARIETIES

WITH SPECIAL EMPHASIS ON

CALABI–YAU VARIETIES AND MIRROR SYMMETRY

APRIL 14–15, 2012

ABSTRACTS

Doran, Charles, F. (University of Algebra)

Modularity of Fano Varieties

Abstract : We prove that specific toric Landau-Ginzburg models for rank-1 Fano threefolds are families of Shioda-Inose surfaces, thereby explaining the observed modular properties of their associated regularized quantum differential equations. We conjecturally extend modularity to Fano varieties of any rank, and discuss this conjecture on toric examples.

Fontaine, Jean-Marc (Universié Paris-Sud/ The Fields Institute)

Vector bundles and p-adic Galois representations

Abstract : I'll give a survey of some aspects of my joint work with Laurent Fargues on the fundamental curve of p-adic Hodge theory. The crucial result may be viewed as a p-adic analogue of the Narasimhan-Sehsadri theorem: Let F be a field of characteristic $p > 0$ complete with respect to a non trivial absolute value. We associate to F a separated integral noetherian regular scheme X of dimension 1 over $\mathbf{Q}_p$. There is an equivalence of categories between continuous p-adic representations of the absolute Galois group of F and semi-stable vector bundles of slope 0 over the curve X.

Haessig, Doug (University of Rochester)

L-functions of families of exponential sums

Abstract: In this talk, I will discuss what it means for an L-function to come from a linear algebraic operation on relative p-adic cohomology of a family of exponential sums. These L-functions will be rational functions, and for certain families a bound on their degree and total degree will be presented. Other families may also be discussed. This is joint work with Steven Sperber.

Lewis, James (University of Alberta)

Abel–Jacobi equivalence and a variant of the Beilinson–Hodge conjecture

Abstract: We first explain a K_1 version of the Hodge conjecture for complex algebraic varieties, and based on some earlier ideas due to Jannsen (and Nori), we show that it is essentially equivalent to a motivic description of the kernel of the classical Abel-Jacobi map on K_0 of projective algebraic manifolds.

Long, Ling (Iowa State University)

Some supercongruences arising from K3 surfaces

Abstract: Atkin and Swinnerton-Dyer type congruences are some sort of p-adic analogues of Hecke recursions satisfied by the classical Hecke eigenforms. These congruences often relate combinatorial or arithmetic objects to the Hecke eigenvalues of automorphic forms. Supercongruences are Atkin and Swinnerton-Dyer type congruences that are stronger than those suggested by formal group laws. For instance, Rodriguez-Villegas conjectured some supercongruences arising from hypergeometric families of Calabi-Yau varieties.

One of them is: for each prime $p > 2$

$$\sum_{k=0}^{p-1} \frac{(\frac{1}{2})_k^3}{k!^3} \equiv a(p) \ mod \ p^2,$$

where $a(p)$ is the pth coefficient of a Hecke eigenform $(\eta(4z)^6)$ and $(\frac{1}{2})_k = \frac{1}{2} \cdot (\frac{1}{2}+1) \cdots (\frac{1}{2}+k-1)$. In this talk, we will discuss several supercongruences results that are related to K3 surfaces.

Mok, Chung Pang (McMaster University)

Endoscopic classification of automorphic representations on unitary groups and applications

Abstract: Recently Arthur has established the endoscopic classification of automorphic representations on orthogonal and symplectic groups (modulo stabilization of the twisted trace formula). In this talk we report on the current work on extending Arthur's results to unitary groups. Time allows we mention application to Hodge type conjectures for unitary Shimura varieties.

Pearlstein, Greg (Michigan State University)

Boundary components of Mumford-Tate domains

Abstract: Mumford-Tate groups arise as the natural symmetry groups of Hodge structures and their degenerations. In this talk, I describe recent work with Matt Kerr on computing the Mumford-Tate group of the limit mixed Hodge structure of the degeneration.

Plazas, Jorge (The Fields Institute)

Noncommutative Spaces and Monstrous Moonshine

Abstract : In this talk we begin to explore connections between moonshine theory and noncommutative geometry in the framework of quantum statistical mechanical systems. We aim at a better understanding of monstrous moonshine by studying its relation with spaces of commensurability classes of $\mathbf{Q}$-lattices.

Pym, Brent (University of Toronto)

Residues of Poisson structures and applications

Abstract: A Poisson variety is a variety which is foliated by symplectic leaves. The locus consisting of all leaves of dimension $2k$ or less is called the $2k^{th}$ degeneracy locus. In recent work with Marco Gualtieri, we explain that a Poisson structure has natural residues along its degeneracy loci, which are direct analogues of the Poincaré residue of a meromorphic volume form. As applications, we prove that the anti-canonical divisor along which a generically symplectic Poisson structure degenerates is singular in codimension two, and provide new evidence in favour of Bondal's conjecture that the $2k^{th}$ degeneracy locus of a Poisson Fano variety has dimension $\geq 2k+1$. These results suggest that Poisson structures may be a good source of highly singular Calabi-Yau varieties.

Noriko Yui (Queen's University)

Quadratic twists of rigid Calabi–Yau threefolds

Abstract: We consider rigid Calabi-Yau threefolds defined over the rationals, and the question of whether they admit quadratic twists. We give a precise geometric definition of the notion of a quadratic twists in this setting.

Every rigid Calabi-Yau threefold over the rationals is modular, so there is attached to it a certain modular form of weight 4 pm some $\Gamma_0(N)$. We show their quadratic twisting of a threefold corresponds to twisting the attached newform by quadratic character and illustrate with a number of examples.

The question is motivated by the deeper question of which newforms of weight 4 on some $\Gamma_0(N)$ and integral Fourier coefficients arise from rigid Calabi-yau threefolds over the rationals.

This is a joint work with Fernando Gouvêa and Ian Kiming.