ALGEBRAIC VARIETIES, HODGE THEORY AND MOTIVES

MARCH 19–22, 2018

ABSTRACTS

Arapura, Donu (Purdue University)

Hodge theory of the universal genus two curve

Abstract: The universal stable genus two curve with fixed fine enough level structure is a smooth projective fourfold defined over a number field. It can be thought of as a higher genus analogue of an elliptic modular surface. Here is what I can prove about this variety: the Picard ranks are as large as possible, the Mordell-Weil groups of the family of Jacobians have rank 0, and the Hodge and Tate conjectures hold for it. The proofs are not hard, and mainly consist in showing the potentially complicated parts of the Leray spectral sequence are in fact trivial.

Gallardo, Patricio (WUSTL)

On double covers and their degenerations

Abstract: We discuss different compactifications of the moduli space of smooth plane curves, explicit-descriptions of the singular objects they parametrize, and applications for understanding the degenerations of double covers branching along them.

Goswami, Souvik (Texas A& M University)

Higher arithmetic Chow groups

Abstract: We give a new definition of higher arithmetic Chow groups for smooth projective varieties defined over a number field, which is similar to Gillet and Soulé's definition of arithmetic Chow groups. We also give a compact description of the intersection theory of such groups. A consequence of this theory is the definition of a height pairing between two higher algebraic cycles, of complementary dimensions, whose real regulator class is zero. This description agrees with Beilinson's height pairing for the classical arithmetic Chow groups. We also give examples of the higher arithmetic intersection pairing in dimension zero that, assuming a conjecture by Milnor on the independence of the values of the dilogarithm, are non zero. This is a joint work with José Ignacio Burgos-Gil from ICMAT, Spain.

Goto, Yasuhiro (Hokkaido University of Education)

Calabi-Yau threefolds of Delsarte type and their formal groups

Abstract: We discuss the arithmetic and formal groups of Calabi-Yau threefolds of Delsarte type. We work out some details of the formal groups, such as their height and logarithms, in various cases, and find some interesting examples.

Keast, Ryan (Fields Institute/University of Toronto))

Integral and Absolute Hodge Classes

Abstract: We will discuss the interplay between integral and absolute hodge classes. The Hodge conjecture implies that all hodge classes are absolute. The (false) integral hodge conjecture predicts that under galois conjugation an integral hodge class remains integral. We give an examples where the integral hodge conjecture fails, but where integrality is still always preserved under the Galois group action.

Le, Daniel (University of Toronto)

Weights of mod p Galois representations

Abstract: The Fontaine-Mazur conjecture suggests that motives over number fields should be the same as geometric p-adic Galois representations, introducing the advantageous notion of congruences. One key step in proofs of modularity is to use congruences between Galois representations of different Hodge numbers. We describe a notion of Hodge numbers for mod p Galois representations coming from the Langlands program and modular representation theory and survey some recent results obtained with B. Le Hung, B. Levin, and S. Morra.

Lewis, James (University of Alberta)

Differential equations associated to normal functions, and the transcendental regulator for a K3 surface and its self-product

Abstract: Using Gauss-Manin derivatives of generalized normal functions, we arrive at results on the non-triviality of the transcendental regulator for K_m of a very general projective algebraic manifold. Our strongest results are for the transcendental regulator for K_1 of a very general $K3$ surface and its self-product. (This is based on a joint [Crelle] paper by Xi Chen, C. Doran, M. Kerr, and J. Lewis.)

Li, Muxi (WUSTL)

Integral Regulators for Higher Chow Complexes

Abstract: In this talk, I will introduce the history of regulators of cycles and show the existence of integral regulator on higher Chow cycles. M. Kerr, J. Lewis and S. Muller introduced the rational regulators and under the instruction of M. Kerr, I proved the existence of integral regulators by doing turbulation on the branch cut of $\log(z_i)$.

Long, Ling (Louisiana State University)

Computing certain L-values of modular forms with complex multiplication (CM)

Abstract: In this talk we illustrate two explicit methods which lead to special L-values of CM modular forms, motivated in part by properties of L-functions obtained from Calabi-Yau manifolds defined over $\mathbf{Q}$. This is a joint project with Wen-Ching Winnie Li and Fang-Ting Tu.

Pearlstein, Greg (Texas A& M University)

Torelli theorems for special Horikawa surfaces and special cubic 4-folds

Abstract: We will discuss recent work with Z. Zhang on Torelli theorems for bidouble covers of a smooth quintic curve and 2 lines in the plane, and cubic 4-folds arising from a cubic 3-fold and a hyperplane intersecting transversely in $\mathbf{P}^4$.

Sasaki, Tokio (WUSTL)

Limits and Singularities for K_1 cycles on Algebraic Surfaces

Abstract: On a projective complex variety, the rational regulator map to the Deligne cohomology gives a transcendental invariant of the motivic cohomology. By considering a family of rational regulator values on a family of such varieties, we obtain a generalization of the normal functions of Poincar and Griffiths, which is called a higher normal function. Its asymptotic behavior along the discriminant locus of the family is described by the "singularity invariant, or if it vanishes, limit invariant .

When we consider the projection of the rational regulator value to the Deligne cohomology with coefficients in $\mathbf{R}$, we obtain the real regulator map. This map plays a central role in Beilinsons Hodge-$\mathcal{D}$-conjecture. In this talk, we observe how the singularity and limit invariants appear in families of real regulators, and in

particular, how to detect **R**-regulator indecomposable K_1 cycles for certain types of algebraic surfaces in $\mathbf{P}^3$. For degree 4 surfaces of this type, these indecomposable cycles give an explicit proof of Hodge-$\mathcal{D}$-conjecture.

Sacca, Giulia (MIT)

Remarks on degenerations of hyperkähler manifolds and OG10

Abstract: I will present some applications of joint work with J. Kollär, R. Laza, and C. Voisin which studies degenerations of hyperkähler (HK) manifolds. I will show how these results give a new proof that the HK compactification of the Intermediate Jacobian fibration associated to a cubic fourfold is deformation equivalent to O'Grady's 10-dimensional exceptional example (OG10). Finally, I will show how these results, together with Beauville's method for counting curves on K3 surfaces can be used to obtain a very quick calculation of the Euler number of OG10.

Yang, Yifan (National Taiwan University)

Rational torsion on the generalized Jacobian of a modular curve with cuspidal modulus

Abstract: In this talk we consider the rational torsion subgroup of the generalized Jacobian of the modular curve $X_0(N)$ with respect to a reduced divisor given by the sum of all cusps. When $N = p$ is a prime, we find that the rational torsion subgroup is always cyclic of order 2 (while that of the usual Jacobian of $X_0(p)$ grows linearly as p tends to infinity, according to a well-known result of Mazur). Subject to some unproven conjecture about the rational torsions of the Jacobian of $X_0(p^n)$, we also determine the structure of the rational torsion subgroup of the generalized Jacobian of $X_0(p^n)$. This is a joint work with Takao Yamazaki.

Yeats, Karen(University of Waterloo)

Recent progress on an arithmetic graph invariant with applications in quantum field theory

Abstract: The c_2 invariant of a graph is a graph invariant investigated principally by Brown and Schnetz which comes from counting points on the hypersurface defined by the Kirchhoff polynomial of a graph. This invariant predicts many properties of the Feynman integral of the graph. It connects with deep things like modular forms. Many computations involving it come down to playing around with polynomials defined from the graph and so its also combinatorial. I will discuss some of the context and some recent results.