TSUDA COLLEGE MINI-WORKSHOP

CALABI–YAU MANIFOLDS:ARITHMETIC, GEOMETRY AND PHYSICS

AUGUST 5–7, 2015

ABSTRACTS

Goto, Yasuhiro (Hokkaido University of Education at Hakodate)

Formal groups of various Calabi-Yau varieties

Abstract: Calabi-Yau varieties are associated with one-dimensional formal groups and such formal groups are determined by the height. We consider various Calabi-Yau varieties defined by explicit equations and try to compute the height of their formal groups.

Inoue, Daisuke (University of Tokyo)

On Calabi-Yau 3-folds and homogeneous vector bundles over Grassmannians

Abstract: In 1995, Kuechle classified the Fano 4-folds which are zeroes of general sections in homogeneous vector bundles over Grassmannians. We have made a similar list in the case of Calabi-Yau 3-folds. In this talk, we focus on these Calabi-Yau 3-folds of Picard number one and explain how to compute their I-functions. This is a joint work with Atsushi Ito and Makoto Miura.

Ito, Hiroyuki (Tokyo University of Science, Noda)

Are rational double points quotient singularities even in positive characteristic?

Abstract : It is a famous characterization for RDPs over the complex number field that these are Gorenstein quotient singularities. Moreover, the quotients are taking by finite subgroup of $SL(2, \mathbf{C})$. Unfortunately, this is not true in positive characteristic anymore. And even though there is a classification table of RDPs for all positive characteristic in the equation level, we do not know whether these are quotient singularities or not in any sense. On the talk, we extend the notion of "quotients" as quotients by finite group schemes, and we check whether each RDP in positive characteristic is quotient singularity or not, case by case. Finally, we want to conclude whether RDPs in positive characteristic are quotient singularities or not.

Kawahigashi, Yasuyuki (University of Tokyo)

From vertex operator algebras to operator algebras and back

Abstract: We have two mathematical approach to chiral conformal field theory. One is based on vertex operator algebras and the other is on operator algebras. From a vertex operator algebra satisfying some natural small assumptions, we construct an operator algebraic counterpart and we also go backwards in this construction. Various examples including the Moonshine vertex operator algebra are covered.

Kimura, Kenichiro (University of Tsukuba)

Semi-algebraic chains and the Hodge realization of mixed Tate motives

Abstract: Last year I discussed absolute convergence of certain logarithmic differential forms on compact semi-algebraic sets. I will explain how to use this to the construction of the Hodge realization functor of Bloch-Kriz mixed Tate motives. This is a joint work in progress with Tomohide Terasoma and Masaki Hanamura.

Koike, Kenji (Yamanashi University)

Hypergeometric periods for a family of cyclic 7-gonal curves

Abstract: I will give the Schwarz inverse of the hypergeometric period map for an 1-dimensional family of cyclic 7-gonal curves, which is regarded as the period map for related elliptic K3 surfaces.

Ma, Shouhei (Tokyo Institute of Technology)

Modular forms of weight $3m$ and elliptic modular surfaces

Abstract: We prove that the graded ring of modular forms of weight divisible by 3 is naturally isomorphic to a certain log canonical ring of the corresponding elliptic modular surface.

Milanov, Todor (Kavli IPMU)

LG/CY mirror symmetry for Fermat type orbifold hypersurfaces

Abstract: In a joint work with H. Iritani, Y. Ruan, and Y. Shen we proved a mirror symmetry correspondence between certain orbifold quotients of the Fermat type CY hypersurfaces and K. Saito's theory of primitive forms associated with an appropriate Fermat polynomial. In my talk I would like to explain how one can use our results to determine the analytic continuation of the Gromov–Witten (GW) invariants with respect to the Kahler parameters. In particular, our approach allows us to investigate the quasi-modular properties of the GW invariants.

Nakayashiki, Atsushi (Tsuda College)

On a combinatorial structure of some D-modules on Abelian varieties

Abstract: Let J be the Jacobian variety of a hyperelliptic curve and D the ring of global differential operators on J. We study the space L of meromorphic sections of a flat line bundle on J with a pole only on the theta divisor as a D-module. We introduce some filtration on L and compute the character of L. The result suggests that if L is not a trivial bundle L is a free D-module, and its rank equals to the Euler characteristics of the theta divisor. This research is motivated by constructing commuting partial differential operators with matrix coefficients.

Oda, Takayuki (Okinawa Institute of Science and Technology)

Some simple examples of relative invariant of ternary homogeneous forms of low degree

Abstract: The mathematicians of 19-th century utilized invariants of homogeneous forms under $GL(n)$ (but mainly for $n = 2$). This way was given up in the 20-th century except for the works by Jun-ichi Igusa. We present here some examples of invariant related to the moduli spaces of K3 surfaces. We want to have methods to get invariant, which is not simply results of computer program.

Remark. This is still in the process of computation. Here is the current status of computation. I have some examples (there are two examples of degree 3, and 4 invariants), for ternary homogeneous forms of degree 6 (sextic, in correct Latin?), which defines a plane curve of genus 10 generically. The case of plane curves of degree 4 (i.e., genus 3) is handled by some number of peoples more than one hundred years ago (there is a book by a former student of Cayley). The most recent one is a paraphrase by Dolgachov of the classical writing by Coble; but it is still a hearsay for me.

Shimada, Ichiro (Hiroshima University)

Automorphisms of supersingular K3 surfaces and Salem polynomials

Abstract: We present a method to generate many automorphisms of a supersingular K3 surface in odd characteristic. As an application, we show that, if p is an odd prime less than or equal to 7919, then every supersingular K3 surface in characteristic p has an automorphism whose characteristic polynomial on the NéronSeveri lattice is a Salem polynomial of degree 22.

Terasoma, Tomohide (University of Tokyo)

A construction of an algebraic surface with a big higher Chow group

Abstract: A higher Chow group is considered as the obstruction for the exactness for the localization sequence for a Chow group. It is an interesting problem to construct an algebraic variety with a big higher Chow group. In this talk we construct surfaces and elements on them and then prove the independence of them. For this reason, we consider the Chern class map for a higher Chow group and prove the independence of the images of these elements.

Yang, Yifan (National Chiao-Tung University, Taiwan)

Quaternionic loci in Siegel's modular threefold

Abstract: An abelian surface is said to have quaternionic multiplication (QM) by an order $\mathcal{O}$ in an indefinite quaternion algebra over $\mathbf{Q}$ if its endomorphism ring contains $\mathcal{O}$.

In this talk we will give a thorough description of the set of moduli points in Siegel's modular threefold whose corresponding abelian surfaces have QM by $\mathcal{O}$ in the case when $\mathcal{O}$ is a maximal order.

Yu, Jeng-Daw (National University of Taiwan)

Irregular Hodge filtrations: properties

Abstract: I will discuss the irregular Hodge structure arising from a pair of a complex smooth variety with a regular function on it. Such a pair appears, for example, in Landau-Ginzburg models. We focus on the basic cohomological properties and examples of such Hodge structures.

Yui, Noriko (Queen's University)

Enumerative geometry and modular forms (Queen's University)

Abstract: Modular forms of various kinds show their (unexpected) appearance in the landscape of enumerative geometry. This includes, counting numbers of rational points on algebraic varieties defined over number fields, counting covers of elliptic curves, counting nodal curves on K3 surfaces, counting Gromow–Witten invariants, Donaldson–Thomas invariants and generalized invariants. These numbers are concocted to the generating functions. In many instances, these generating functions are expressed in terms of modular forms of various kinds. I will try to explain the recurring phenomena by several examples. Ultimately, we would like to understand "why" modular.