TSUDA COLLEGE MINI-WORKSHOP ON CALABI–YAU VARIETIES:ARITHMETIC, GEOMETRY AND PHYSICS

AUGUST 7–8, 2014

TSUDA COLLEGE

Nakajima Memorial Hall 7101

Organized by Noriko Yui (Queen's University)

PROGRAMME

AUGUST 7, 2014

10:00am **Tokunaga, Hiroo**, Tokyo Metropolitan University
Geometry of sections and bisections on rational elliptic surfaces

11:00am **Matsuno, Kazuo**, Tsuda College
Ranks of elliptic curves in the cyclotomic $\mathbf{Z}_2$-extensions of $\mathbf{Q}$

12:00pm **Lunch**

2:00pm **Ohashi, Hisanori**, Tokyo University of Science
Non-semi-symplectic automorphisms of Enriques surfaces

3:00pm **Goto, Yasuhiro**, Hokkaido University of Education at Hakodate
Formal groups of Calabi-Yau threefolds of Borcea-Voisin type

4:00pm **Ito, Hiroyuki**, Tokyo University of Science
On the quotient singularities in positive characteristic

5:00pm **Ogata, Shoetsu**, Tohoku University
Projective normality of toric weak Fano 3-folds

7:00pm **Workshop Dinner**

AUGUST 8, 2014

10:00am **Whang, Junho Peter**, Princeton University
Crystalline cohomology and Tate's conjecture for finite-height K3 surfaces

11:00am **Nakayashiki, Atsushi**, Tsuda College
An application of the theory of tau functions to theta functions

12:00 **Lunch**

2:00pm **Kimura, Kenichiro**, Tsukuba University
Hodge realization of mixed Tate motives via period integrals

3:00pm **Hosono, Shinobu**, University of Tokyo
Mathematical aspects of two sphere partition functions

4:00pm **Toda, Yukinobu**, IPMU
Generalized Donaldson-Thomas invariants on the local projective plane

5:00pm **Yui, Noriko**, Queen's University
Updates on modularities of Calabi–Yau varieties

7:00pm **Informal Dinner**

NB: The lecture hall is equipped with white boards as well as electronic equippments (e.g., document camera, OHP, computer presentation)

TSUDA COLLEGE MINI-WORKSHOP

CALABI–YAU MANIFOLDS:ARITHMETIC, GEOMETRY AND PHYSICS

AUGUST 7–8, 2014

ABSTRACTS

Goto, Yasuhiro (Hokkaido University of Education at Hakodate)

Formal groups of Calabi–Yau threefolds of Borcea–Voisin type

Abstract: We consider Calabi Yau threefolds of Borcea–Voisin type which are constructed from the products of elliptic curves and K3 surfaces with non-symplectic involution. We discuss them over a field of finite characteristic and calculate their one-dimensional formal groups.

Hosono, Shinobu (University of Tokyo)

Mathematical aspects of two sphere partition functions

Abstract: For the last two years, there have been many interesting developments on the two sphere partition functions of gauged linear sigma models in physics. In this talk, mostly based on the papers by Morrison et al (2012, 2013) and Hori, Romo (2013), I will try to summarize mathematical conjectures made in these papers, in particular, shedding light on some properties of (cohomology valued) hypergeometric series.

Ito, Hiroyuki (Tokyo University of Science, Noda)

On the quotient singularities in positive characteristic

Abstract: In charactersitic 0, quotient singularities in dimension two are well-studied by various people, and many results are known related with the fundamental groups, the dual graphs, rationality, defining equations, etc. But in positive characteristic, the situation is very different, especially, wildness causes many peculiar phenomena about the fundamental groups, dual graphs, rationality, tautness, etc. as usual in positive characteristic. In my talk, I am going to report recent progress on 2-dimensional wild quotient singularities from the view point of connecting the Artin–Schreier and Frobenius quotients.

Kimura, Kenichiro (Tsukuba University)

Hodge realization of mixed Tate motives via period integrals

Abstract: I will talk on the concrete construction of the Hodge realization functor on Bloch–Kriz category of mixed Tate motives. A crucial ingredient is the construction of a certain topological chain complex using semi-algebraic sets. This is a joint work with Tomohide Terasoma and Masaki Hanamura.

Matsuno, Kazuo (Tsuda College)

Ranks of elliptic curves in the cyclotomic $\mathbf{Z}_2$-extnesions of $\mathbf{Q}$

Abstract: We discuss a construction of elliptic curves whose Mordell–Weil ranks increase at some layer in the cyclotomic $\mathbf{Z}_2$-extension of $\mathbf{Q}$.

Nakayashiki, Atushi (Tsuda College)

An application of the theory of tau functions to theta functions

Abstract: Using the property of the tau functions of the KP-hierarchy we prove a refined version of the Riemann's singularity theorem for theta functions of algebraic curves.

Ogata, Shoetsu (Tohoku University)

Projective normality of toric weak Fano 3-folds

Abstract: We show that all ample line bundles on a nonsingular toric weak Fano 3-fold are always normally generated.

Ohashi, Hisanori (Tokyo University of Science)

Non-semi-symplectic automorphisms of Enriques surfaces

Abstract: Non-symplectic automorphisms of K3 surfaces have been extensively studied by many researchers. For Enriques surfaces, we have the notion of being semi-symplectic and we can show that an automorphism is semi-symplectic if and only if (one of) its lift(s) to the K3-cover is symplectic. In the talk, we will classify finite non-semi-symplectic automorphisms. As a result, we see that there are few such automorphisms compared to the richness of non-symplectic automorphisms for K3 surfaces.

Toda, Yukinobu (Kavli IPMU)

Generalized Donaldson-Thomas invariants on the local projective plane

Abstract: In this talk, I show that the generating series of generalized Donaldson–Thomas invariants on the local projective plane with any positive rank is described in terms of modular forms and theta type series for indefinite lattices.

Tokunaga, Hiroo (Tokyo Metropolitan University)

Geometry of sections and bisections on rational elliptic surfaces

Abstract: We consider geometry and (elementary) arithmetic for sections and bisections on rational elliptic surfaces. We apply our result in constructing Zariski N-plet for arrangement of curves of low degrees via dihedral covers.

Whang, Junho Peter (Princeton University)

Crystalline cohomology and Tate's conjecture for finite-height K3 surfaces

Abstract: In this expository talk, we present the Nygaard–Ogus (1985) proof of Tate's conjecture for finite-height K3 surfaces over finite fields using crystalline cohomology. The proof is based on construction of quasi-canonical liftings, and we will focus on the case of base field characteristic $p \geq 13$ which is easier. Time permitting, we will also sketch the idea of proof for the general case.

Yui, Noriko (Queen's University)

Updates on modularities of Calabi–Yau varieties

Abstract: There are two types of modularity questions concerning Calabi–Yau varieties: arithmetic modularity versus geometric modularity. The former case is concerned with Calabi Yau varieties defined over $\mathbf{Q}$ or a number field, and the modularity of the Galois representations associated to them. The latter is concerned with families of Calabi–Yau varieties, and the modularity of generating functions of various invariants (e.g., Gromov–Witten, Gopakummer Vafa, Donaldon–Thomas and their variants/generalizations), or modular properties (if any) of mirror maps. In both cases, modular forms (of various kinds) play prominent roles.