Korea-Japan Conference in Algebraic Geometry

IBS Center for Complex Geometry

February 13-17 2023

Speaker: **Jinhyung Park** (KAIST, Korea)

Title: *Syzygies of tangent developable surfaces and K3 carpets via secant varieties*

Abstact: Recently, Aprodu-Farkas-Papadima-Raicu-Weyman and Raicu-Sam obtained new proofs of generic Green's conjecture by studying syzygies of tangent developable surfaces of rational normal curves and K3 carpets, respectively. These results extend Voisin's theorem to positive characteristics, and confirm a conjecture of Eisenbud-Schreyer. Using secant varieties of rational normal curves, we give simple geometric proofs of their results. As a consequence, we obtain a quick proof of generic Green's conjecture. We also discuss the syzygies of tangent developable surfaces of arbitrary smooth projective curves.

Speaker: **Shin-ichi Matsumura** (Tohoku University, Japan)

Title: *The nonvanishing problem for varieties with nef anticanonical bundle*

Abstact: In this talk, I discuss the nonvanishing problem in the framework of the "generalized" Minimal Model Program. I first explain a structure theorem for maximally rationally connected fibrations of projective klt pairs with nef anticanonical divisor, which generalizes Cao-Horing's result for smooth projective varieties. I also show that this structure theorem reduces the nonvanishing problem for nef anticanonical divisors to the rationally connected varieties, and the numerical class of the nef anticanonical bundle of projective 3-folds is represented by an effective divisor. The first part of this talk is joint work with Juanyong Wang (Chinese Academy of Sciences) and the latter part is joint work with Thomas Peternell (Bayreuth), Vladimir Lazic, Nikolaos Tsakanikas, Zhixin Xie (Saarbrucken).

Speaker: **Seung-Jo Jung** (Jeonbuk National U., Korea)

Title: *On Milnor numbers and Tjurina numbers of hypersurface singularities*

Abstact: The Milnor and Tjurina numbers are basic invariants of a hypersurface singularity. This talk introduces the Briançon-Skoda exponent which is the smallest integer k such that f^k is in the Jacobian ideal and provides

a result of joint work with I.-K. Kim, Morihiko Saito, and Y. Yoon. From this, we discuss a possible bound of the ratio of the Milnor and Tjurina numbers.

Speaker: **Yohsuke Matsuzawa** (Osaka Metropolitan U., Japan)

Title: *Zariski dense orbit conjecture and arithmetic degrees of cohomologically hyperbolic maps*

Abstact: A rational self-map on a projective variety is called cohomologically hyperbolic if there is p such that the p-th dynamical degree is strictly larger than others. I will introduce our recent results on Zariski dense orbit conjecture and Kawaguchi-Silverman conjecture for such maps. This talk will be based on joint work with Long Wang.

Speaker: **Yoshinori Gongyo** (Tokyo U., Japan)

Title: *Generalized complexities and the Mukai type conjecture*

Abstact: We discuss some variants of Mukai's conjecture for the characterization of products of projective spaces. We discuss the relation of the complexity of generalized pairs and such kind conjectures. This talk is based on the joint work with Joaquin Moraga.

Speaker: **Shou Yoshikawa** (RIKEN iTHEMS, Japan)

Title: *Quasi-F-splitting*

Abstact: In both commutative algebra and algebraic geometry of positive characteristic, the study of Frobenius maps have led to significant developments. The theory of Frobenius splitting, introduced by Mehta-Ramanathan, is one of such developments. It is known that Frobenius-splitting varieties have good properties, for example, the Kodaira vanishing holds on such varieties. Furthermore, Frobenius-splitting has the simple criterion proved by Fedder. Yobuko recently introduced the notion of quasi-F-splitting and F-split heights, which generalize and quantify the notion of Frobenius-splitting, and proved that F-split heights coincide with Artin-Mazur heights for Calabi-Yau varieties. In this talk, I will introduce recent developments of quasi-F-splitting. This talk is based on joint work with Tatsuro Kawakami, Teppei Takamatsu, Hiromu Tanaka, Jakub Witaszek and Fuetaro Yobuko.

Speaker: **Sukmoon Huh** (Sungkyunkwan U., Korea)

Title: *Torelli problem on logarithmic sheaves*

Abstact: A logarithmic sheaf associated to a divisor on a smooth projective variety is a differential one-form with logarithmic poles along the divisor. Ever since the logarithmic sheaf is introduced by P. Deligne to define the mixed

Hodge structure on the complement of a divisor, this sheaf has been one of the main objects in algebraic geometry, as a tool and also as a main subject on its own. Specifically when the divisor is an arrangement of hyperplanes in the projective space, its relationship with combinatorics has encouraged to study if the freeness of this sheaf is a combinatorial property, called the Terao conjecture. On the other hand, the problem if one can recover the divisor from the sheaf, called the Torelli problem, has been one theme, interesting to people working on vector bundles, specially related with the moduli problem. In this talk, we give a brief explanation on the history of the second problem on the logarithmic sheaf, and suggest a new approach/setting to consider the Torelli problem. This is a joint work with S. Marchesi, J. Pons-Llopis and J. Vallès.

Speaker: **Kenta Sato** (Kyushu U., Japan)

Title: *General hyperplane section of log canonical threefolds in positive characteristic*

Abstact: In this talk, we prove that if a 3-dimensional quasi-projective variety X over an algebraically closed field of characteristic $p > 3$ has only log canonical singularities, then so does a general hyperplane section H of X. In the course of the proof, we give a sufficient condition for log canonical surface singularities over a field to be geometrically log canonical.

Speaker: **WonTae Hwang** (Jeonbuk National U., Korea)

Title: *Jordan constants of groups in connection with abelian varieties in positive characteristic*

Abstact: We compute the Jordan constants of the multiplicative subgroups of the endomorphism algebras of simple abelian surfaces over fields of positive characteristic, with the aid of a similar computation on the Jordan constants of some arithmetic objects. As a recent update, we also briefly record a similar result on the case of simple abelian fourfolds over finite fields.

Speaker: **Tasuki Kinjo** (IPMU, Tokyo, Japan)

Title: *Euler characteristic for stacks*

Abstact: In this talk, I will propose a conjectural definition of the Euler characteristic for stacks of the form $[V/G]$ where V is a representation of a reductive group G. Our approach is motivated by Joyce's motivic invariant for moduli stacks of objects in abelian categories. We will see that the stacky Euler characteristic is well-defined for the classifying stack BG and give an explicit formula for it. If time permits, I will also explain a conjectural extension of the stacky Euler characteristic to general Artin stacks admitting the good moduli space.

This talk is based on a joint work in progress with Chenjing Bu.

Speaker: **Junho Choe** (KIAS, Korea)

Title: *Various parallels between projective varieties and secant varieties*

Abstact: Projective varieties and secant varieties share many parallel algebraic structures, and so do higher secant varieties. In this talk we discuss such phenomena: (1) minimal free resolutions of extremal and subextremal objects among higher secant varieties and (2) determinantal presentation of the extremal objects. Moreover, we introduce some related research subjects in progress, e.g., (3) a generalization of the gonality conjecture via higher secant varieties. This talk is based on joint works with Prof. Sijong Kwak.

Speaker: **Tatsuki Kuwagaki** (Kyoto U., Japan)

Title: *Some examples of Hodge-Fukaya theory*

Abstact: The category of mixed Hodge modules can be considered as a decoration of the category of constructible sheaves. On the other hand, in the recent study of symplectic geometry, we view the category of constructible sheaves as a special case of Fukaya category. In this talk, I would like to explain some nontrivial examples of the combination of these two viewpoints.

Speaker: **Joonyeong Won** (Ehwa Womans U., Korea)

Title: *Twisted Kaehler-Einstein metric on del Pezzo surfaces*

Abstact: The existence of twisted Kaehler-Einstein metric for an arbitrary polarized variety can be determined by delta invariant of their polarization. We discuss complete classification of the existence of twisted Kaehler-Einstein metric of polarized smooth del Pezzo surfaces by plt blow up. This is work in progress with In-kyun Kim.

Speaker: **Kenta Hashizume** (Kyoto U., Japan)

Title: *On effective base point freeness for klt pairs*

Abstact: For a projective klt pair whose log canonical divisor is nef, the abundance conjecture predicts the semi-ampleness of the log canonical divisor. Assuming the abundance conjecture, then it is natural to study the integer m by which the multiple of log canonical divisor is base point free. This is called the effectivity of the base point freeness. In this talk, I will explain a recent result on this topic.

Speaker: **Yeongrak Kim** (Pusan National U., Korea)

Title: *Ulrich bundles on cubic fourfolds*

Abstact: A coherent sheaf E on an n-dimensional projective subscheme X embedded in a projective N-space is Ulrich if the pushforward by a general linear projection along an $(N-n-1)$-dimensional center splits as a direct sum of structure sheaves. Ulrich sheaves appear in several places, together with connections to various topics in mathematics. Eisenbud and Schreyer asked whether every projective subscheme carries an Ulrich sheaf, and if yes, what will be the smallest possible rank – often called Ulrich complexity. When X is a hypersurface, the Ulrich complexity problem asks the minimal size of set-theoretic determinantal representation of X. In this talk, I will explain a construction of rank 6 Ulrich bundles on a smooth cubic fourfold over an algebraically closed field of characteristic > 2, which is the optimal answer for general cubic fourfolds. This is a joint work with Daniele Faenzi.

Speaker: **Yonghwa Cho** (IBS-CCG, Korea)

Title: *Nodal (hyper-)surfaces*

Abstact: We consider hypersurfaces with only nodes as singularities. Particularly interesting cases are surfaces with many nodes. One of the most famous examples are Kummer quartics, which are quartics containing 16 nodal singularities. For the degrees higher than four, the behavior of those surfaces gets more complicated, though there are plenty of intriguing properties that are analogous to Kummer quartics. In this talk, I will introduce our recent results in the case of degree six. This talk is based on the joint works with Fabrizio Catanese, Stephen Coughlan, Davide Frapporti, Michael Kiermaier, and Sascha Kurz.