Winter Young Algebraic Geometer Workshop

Titles and Abstracts

Huai-Liang Chang

Title: Recover Zinger g=1 GW via Mixed Spin P fields

Abstract: By mixing spin fields and P fields, all genus's quintic CY's Gromov Witten invariants can be evaluated by a localization algorithm. We will talk about a package of the algorithm that recover Zinger's formula, where each hypergeometric series term of the formula corresponds to a special type of graphs.

Qile Chen

Titile: Witten's r-spin class via logarithmic compactification

Abstract: Witten's top Chern class was constructed previously by Fan-Jarvis-Ruan and Chang-Li-Li. The authors proved that it can be represented by a Chow cycle supported on a proper locus inside a non-proper moduli space. In this talk, I will introduce a new approach aiming at a proper moduli space carrying a perfect obstruction theory whose associated virtual class is Witten's r-spin class. We expect our method can be further generalized to include many other interesting cases such as Witten's top Chern class. This is a joint work in progress with Felix Janda, Yongbin Ruan, Adrien Sauvaget, and Dimitri Zvonkine.

Honglu Fan

Title: Gromov-Witten invariants of hypersurfaces

Abstract: I will talk about a very simple idea relating GWI (Gromov-Witten invariants) of hypersurfaces to GWI of the ambient space. It almost determines all the GWI of hypersurface except some low degree invariants. On the other hand, it can be used to produce some relations on moduli of stable maps whose meaning is not yet understood. I will talk about these aspects and raise a few (hopefully interesting) questions. Some of the works are joint with Y.P. Lee and Ernst Schulte-Geers.

Bohan Fang

Title: Oscillatory integrals on Lagrangian branes and the Gamma II conjecture

Abstract: I will explain the oscillatory integrals on the Lagrangian branes in the Fukaya category -- in particular quasi-isomorphic objects are in the same relative homology class and give rise to the same integration result. Then by both genus 0 enumerative mirror symmetry and homological mirror symmetry this leads to a proof of Gamma II conjecture for toric varieties. This talk is based on the joint work in progress with Peng Zhou.

Zhi Jiang

Title: Decomposition theorems in generic vanishing theory

Abstract: I will describe the decomposition theorems in generic vanishing theory due to Jungkai Chen and myself, Pareschi-Popa-Schnell and explain, through several geometric applications, why such statements are very useful in the study of irregular varieties.

Changzheng Li

Title: On a conjectural Peterson isomorphism in quantum K-theory

Abstract: The Peterson's isomorphism says that the torus-equivariant of quantum cohomology of a complete flag variety is essential isomorphic to the torus-equivariant homology of the associated affine Grassmannian. In this talk, we will formulate a precise conjecture of the Peterson isomorphism on the level of quantum K-theory, and will provide some evidence. This is my joint work with Thomas Lam, Leonardo Mihalcea and Mark Shimozono.

Chunyi Li

Title: Higher rank clifford indices for curves on K3 surfaces

Abstract: The Clifford index Cliff_1(C) of curve C is the second most important invariant of C after the genus, measuring the complexity of the curve in its moduli space. The celebrated work by Lazarsfeld indicates that Cliff_1(C) is g-1-[g/2] when C\in|H| is on a polarized K3 surface (X,H). Inspired by the work of Mercat, an adequate generalization Cliff_r(C) for higher rank vector bundles has been defined by Lange and Newstead. Via the tool of Bridgeland stability condition, for curves on generic K3 surfaces we compute that Cliff_r(C)=2(g-1-[g/r])/r, when g\geq r^2\geq 4. In the talk, I will explain more details on this classical topic and how does stability condition help to solve them. This is a joint work with S. Feyzbakhsh.

Zhiyuan Li

Title: Tautological classes on moduli space of hyperkahler varieties

Abstract: In this lecture I will talk about recent development on the study of tautological ring of moduli space of hyperkahler varieties. This includes the construction of tautological classes in Chow groups/Cohomological groups, the proof of cohomological tautological conjecture in certain cases and our current work on studying the tautological ring on universal families. This is a joint work with N.Bergeron.

Yongqi Liang

Title: Strong Approximation for Certain abelian varieties punctured at torsion points.

Abstract: We study strong approximation properties for varieties defined over a number field k. The Brauer group gives an obstruction to such properties.

Let E be an elliptic curve of positive Mordell-Weil rank and let A be an abelian variety of positive dimension and of finite Mordell-Weil group. For an arbitrary set T of torsion points of E \times A, denote by X its complement. In this talk, we will give a complete description on strong approximation properties for X.

Yefeng Shen

Title: Landau-Ginzburg/Calabi-Yau correspondence in one dimension

Abstract: One way to understand Landau-Ginzburg/Calabi-Yau correspondence is to study Gromov-Witten theory of a Calabi-Yau variety (or orbifold) and Fan-Jarvis-Ruan-Witten theory of a counterpart LG model for a quasi homogeneous polynomial. When the target Calabi-Yau is one dimensional, their GW/FJRW invariants are controlled by tautological relations and WDVV equations. They are coefficients of expansions of appropriate quasi-modular forms at different points. As a consequence, we can relate these expansions by Cayley transformations. We will also compare this method with Milanov-Ruan's realization of LG/CY correspondence in orbifold cases.

Wenhao Ou

Title: Rational connectedness of manifolds with strictly nef anticanonical classes

Abstract: A divisor L on a complex projective manifold X is said to be strictly nef if it has strictly positive intersection number with any curve in X. An ample divisor is strictly nef, but the converse is not true in general, as shown in an example of Mumford. Nevertheless, Campana and Peternell conjectured that if the anticanonical divisor $-K_X$ is strictly nef, then it should be ample. This conjecture is known to be true if the dimension of X is at most three. In this talk, we provide some evidence for this conjecture in higher dimensions. We show that if $-K_X$ is strictly nef, then the manifold X is rationally connected. This is joint with Duo Li and Xiaokui Yang.

You Qi

Title: On the center of small quantum groups.

Abstract: We will report some recent progress on the problem of determining the centers of small quantum groups at a root of unity. This is joint work with A. Lachowska.

Yuan Wang

Title: Characterization of Abelian varieties for log pairs

Abstract: Let X be a projective variety. A celebrated theorem of Kawamata says that if X is smooth and κ(X) = 0, then the Albanese morphism of X is an algebraic fiber space. Thus κ(X) = 0 and dim X being equal to the dimension of Alb(X), the Albanese variety of X, implies that X is birational to an abelian variety. Later it was shown by Chen and Hacon that if dim X = dim(Alb(X)), then as long as one of h^0(X, ω_X)^{\otimes m}), the plurigenera of X, is 1 for some m ≥ 2, X is birational to an abelian variety. In this talk I will discuss the case where X is not necessarily smooth. I consider a pair (X, ∆) with certain singularities and found out that in this case, the Kodaira dimension and the log plurigenera of (X, ∆), and the dimension of Albanese variety of X can still characterize abelian varieties up to birational equivalence. In particular, in this talk I will present a result that generalizes Kawamata's result beyond the log canonical case and another one that generalizes the result of Chen and Hacon to klt pairs.

Qizheng Yin

Title: Motivic aspects of the tautological ring of M_g.

Abstract: We discuss the use of motives in studying the tautological ring of M_g. The motivic approach not only produces tautological relations (conjecturally, all of them), but also reveals more structures of the tautological ring. In particular, we determine the tautological ring of arbitrary products of the universal curve in genus up to 4. We also locate a potential failure of the Faber conjecture in genus 5. This is joint work with Dan Petersen and Mehdi Tavakol.

Fenglong You

Title: A mirror theorem for toric stack bundles

Abstract: We study the orbifold Gromov-Witten theory of toric stack bundles and prove a mirror theorem. More precisely, we study Givental's Lagrangian cone for the quantum orbifold cohomology of toric stack bundles. Using Gromov-Witten invariants of the base

and combinatorics of the toric stack fibers, we construct an explicit slice, called the I-function, of the Lagrangian cone defined by the genus zero Gromov-Witten theory of a toric stack bundle. This is joint work with Yunfeng Jiang and Hsian-Hua Tseng.

Xiaolei Zhao

Title: Derived categories of K3 surfaces, O'Grady's filtration, and zero-cycles on holomorphic symplectic varieties

Abstract: The Chow group of 0-cycles on K3 surfaces is known to be huge. On the other hand, the 0-cycles arising from intersections of divisors and the second Chern class of the tangent bundle all lie in a one dimensional subgroup. In my talk, I will first recall some recent attempt to generalize this property to hyper-Kahler varieties. Then I will prove a conjecture of O'Grady using methods from derived category, and explain a connection between the K3 surface case and the case of moduli of sheaves. If time permits, I will also discuss some consequences, together with a generalization to Fano varieties of lines on a cubic fourfold containing a plane. This talk is based on a joint work with Junliang Shen and Qizheng Yin, and one with Alina Marian.

Zijun Zhou

Title: Quantum K-theory of hypertoric varieties

Abstract: Okounkov's quantum K-theory can be defined for any hyperk\"ahler quotient via counting parameterized quasimap with genus-zero domain. The construction yields many interesting results in geometric representation theory. In the case of hypertoric varieties, calculations can be made explicitly due to the nice combinatoric structure. In particular, the information of K-theoretic quantum product can be extracted from the saddle point equation of an integral presentation of the vertex function. If time permits, I will also talk about the phenomenon of symplectic duality in this context.

Zhengyu Zong

Title: Gromov-Witten/Donaldson-Thomas correspondence for local gerby curves

Abstract: In 2004 and 2005, the work of Bryan-Pandharipande and Okounkov-Pandharipande build the Gromov-Witten/Donaldson-Thomas correspondence for local curves. In this talk, I will discuss an ongoing project on the Gromov-Witten/Donaldson-Thomas correspondence for local gerby curves, which is an orbifold generalization of the above work. More concretely, we will consider a Z_{n+1}-gerbe C over a smooth genus g curve. Let L_1 and L_2 be two orbifold line bundles over C such that the isotropy group Zn+1 acts on them via fiberwisely multiplication by exp(2.\pi i/n + 1). and exp(-2.\pi i/n + 1). respectively. We will study the Gromov-Witten/Donaldson-Thomas correspondence for the total space of X := L_1\oplus L_2. The strategy of the proof is to apply degeneration formula to X to reduce the problem to the case of cap, cylinder, and pair of pants. This work is joint with Zijun Zhou.

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