

ABSTRACTS OF SEMINAR TALKS, FALL 2017

In this document, you can find the abstracts of the Algebraic Geometry Student Seminar talks from Fall 2017. They are listed from the more recent to the older ones.

DECEMBER 6

Speaker: Ziwen

Title: Stable Maps in Higher Dimensions

Abstract: I will present some results from a recent paper of Ruadhaí Dervan and Julius Ross about K-stability for maps between polarized varieties. This notion generalizes the definition of the usual K-stability when the target of the map is a point. We will look at some examples, in particular, we will see that in the canonically polarized case, K-stable maps are precisely those with semi-log canonical singularities. There also exists a projective moduli space of K-stable maps that generalizes the KSBA moduli space of stable pairs.

Reference: arXiv: 1708.09750 [math.AG]

NOVEMBER 29

Speaker: Huachen

Title: Non-commutative Hodge structures

Abstract: A non-commutative Hodge structure is a generalization of the usual one. As the de Rham cohomology of a compact Kähler manifold carries a usual Hodge structure, the quantum cohomology of a compact symplectic manifold underlies a non-commutative Hodge structure (conjecturally). I'll try to explain these in my talk.

NOVEMBER 22

Speaker: Yen-An

Title: Volume-Type Functions for Numerical Cycle Classes

Abstract: The volume function on $N^1(X)$ is one of the tools to know whether the line bundle is big or not. In this talk, I will introduce “big” k -cycles and some functions defined on $N_k(X)$ which can tell us the bigness of k -cycles and other similar properties to volume functions.

NOVEMBER 15

Speaker: Jihao

Title: The Sarkisov program

Abstract: In this talk I will introduce the Sarkisov Program. Sarkisov Program was first introduced by Sarkisov in order to study the relationship between different Mori fiber spaces that arise from running minimal model programs.

The short talk will be separated in two parts:

- 1 Introduction. I will start from the definitions that involve in the Sarkisov Program, especially the Sarkisov link. Then I will give some examples on how the Sarkisov link are used in some early papers that study the minimal model program.
- 2 Main Result. I will give a proof of the main result of the paper “The Sarkisov program” by Hacon and Mckernan, which shows that any two Sarkisov related \mathbb{Q} -factorial Kawamata log terminal pairs are connected by a sequence of Sarkisov links.

Reference: arXiv: 0905.0946 [math.AG]

NOVEMBER 8

Speaker: Kevin

Title: Étale homotopy

Abstract: When studying a complex algebraic variety X , one has access to a powerful tool - the associated complex analytic variety $X(\mathbb{C})$. This allows one to use tools from complex analysis, but also tools from topology, such as homotopy and singular (co)homology. In finite characteristic we can kiss any hope for a similar “analytic space” goodbye, but the theories of étale cohomology and the algebraic fundamental group suggest that maybe we can still find some sort of associated “nice topological space”. To this end, Artin and Mazur constructed an “étale homotopy type” associated to a scheme which is a pro-object in

the homotopy category of CW-complexes. In this talk I will sketch the construction of the étale homotopy type and give some first examples and applications to varieties over the complex and real numbers.

NOVEMBER 1

Speaker: Erjuan

Title: Primitive cohomology and the tube mapping

Abstract: In this talk, I will follow Christian Schnell’s paper “Primitive cohomology and the tube mapping”. Given a smooth complex projective variety X of dimension d , by the Lefschetz Hyperplane Theorem, the only piece of the cohomology of X that cannot be inferred from that of a smooth hyperplane section of X is the primitive cohomology of X in degree d . First, we will use the tube mapping to construct the primitive cohomology, and then if time allows, we can talk an application of this construction to Clemens’ potential function for Calabi-Yau threefolds.

Reference: arXiv: 0711.3927 [math.AG]

OCTOBER 25

Speaker: Takumi (U of M guest)

Title: Matsusaka’s big theorem

Abstract: A line bundle on a complete variety is ample if some tensor power of it is very ample, i.e., induces a closed embedding into projective space. One can then ask: can one give an effective bound for this tensor power? Matsusaka’s big theorem states that a bound exists that only depends on the Hilbert polynomial of the line bundle, hence polarized flat families of smooth projective varieties are projective. An effective version of Matsusaka’s theorem is also known due to work of Siu. We will present a simple proof of an effective Matsusaka-type result for smooth surfaces in characteristic zero due to Fernández del Busto, and will mention what difficulties exist in positive characteristic.

OCTOBER 18

Speaker: Franco

Title: A stab at homological mirror symmetry

Abstract: We'll make an attempt at introducing some of the ideas around mirror symmetry and the homological mirror symmetry conjecture, first stated by Kontsevich. We start illustrating mirror symmetry at the level of Hodge numbers for the Fermat quintic. Then, following a survey by Ballard, we aim to illustrate a concrete example of homological mirror symmetry in the case of the projective line.

Notes: A stab at homological mirror symmetry

OCTOBER 4

Speaker: Christian

Title: Motivating Motives

Abstract: Grothendieck introduced the category of pure motives as a way towards a proof of the Weil conjectures. I will talk about various cohomology theories in algebraic geometry, and how motives can be viewed as a universal cohomology theory.

SEPTEMBER 27

Speaker: Allechar

Title: Regular Primes and Fermat's Last Theorem

Abstract: In March of 1847, Gabriel Lamé presented a proof of Fermat's last theorem assuming incorrectly unique factorization in cyclotomic extensions of \mathbb{Q} . A few weeks later, Kummer wrote a correct proof for a set of primes that allows unique factorization, these are called regular primes. I will present Kummer's proof in contemporary notation and a reformulation of the proof using class field theory.

SEPTEMBER 20

Speaker: Marin

Title: Stability conditions and Brill-Noether

Abstract: The well known Lazarsfeld's result is that a generic curve of a fixed genus on a K3 surface behaves like a generic curve (in Brill-Noether sense). Bayer reproves this result using wall-crossing methods of stability conditions. In this talk I will introduce Bridgeland stability and explain some ideas from Bayer's paper.

Reference: arXiv: 1604.08261 [math.AG]

SEPTEMBER 13

Speaker: You-Cheng

Title: Generalized Lamé equation with finite monodromy

Abstract: In this talk, I would like to talk about my undergraduate thesis. I will focus on the study of the finite monodromy problem of the Lamé equation. I will introduce the main tool used, which is Grothendieck correspondence, that gives a bijection between Belyi pairs and design d'enfants. Together with Klein's theorem, the problem is then translated into the construction of the corresponding dessin d'enfants. If time permits, I will talk about generalized case.

Reference: arXiv: 1611.06643 [math.AG]

SEPTEMBER 6

Speaker: José

Title: Characterization of Kollár surfaces

Abstract: In this talk I will introduce Kollár hypersurfaces, which correspond to certain hypersurfaces in n -dimensional weighted projective spaces. We will see that these hypersurfaces correspond to birational models of cyclic coverings of the projective space totally branched along hyperplanes in general position, and I will give a more detailed classification for the case of Kollár surfaces in terms of p_g , their geometric genus. If there is time left, I will show how we can use these surfaces to find examples of accumulation points for the volumes of log canonical pairs.

AUGUST 30

Speaker: Joaquín

Title: An analytic proof of Nadel vanishing

Abstract: We will introduce some analytic geometry techniques in order to give a sketch of the proof of Nadel vanishing for analytic varieties. If the time is with us, I will explain how to apply Nadel vanishing to lift sections from subvarieties, making connections with the first talk of this seminar.

AUGUST 23

Speaker: Stefano

Title: Adjunction and inversion of adjunction

Abstract: Among the techniques in birational geometry, adjunction theory is one of the most powerful tools. It allows to relate the geometry, and in particular the singularities, of the ambient variety with the one of appropriate subvarieties. In this talk, I will first recall the notion of pair, and review the adjunction formula on singular varieties and the notion of different. Then, following the treatment in Kollár-Mori, I will illustrate adjunction and inversion of adjunction in the plt-klt case. Time permitting, I will mention recent developments due to Kawakita and Hacon, leading to the full theory in the log canonical setup.

Notes: Adjunction and inversion of adjunction