# Algebra, Geometry and K-Theory

## Conference Handbook

*Sun Yat-sen University, Guangzhou*

*2025.11.24-28*

## Venue:

Room 209, New Math Building, Sun Yat-sen University.

## Speakers:

**Grigory Andreychev** (Morningside Center of Mathematics)
**Jin Cao** (University of Science and Technology Beijing)
**Baptiste Calmès** (Universitè d'Artois)
**Peng Du** (Zhejiang Normal University)
**Jean Fasel*** (Université Grenoble Alpes) [1]
**Thomas Geisser** (Rikkyo University)
**Jens Hornbostel** (Bergische Universität Wuppertal)
**Wenchuan Hu** (Sichuan University)
**Thomas Hudson** (Daegu Gyeongbuk Institute of Science and Technology)
**Takeshi Ikeda** (Waseda University)
**Fangzhou Jin** ( Tongji University)
**Adeel Khan** (Academia Sinica)
**Tomoo Matsumura** (International Christian University)
**Satoshi Naito** (Institute of Science Tokyo)
**Hourong Qin** (Nanjing University)
**Marco Schlichting** (University of Warwick)
**Guoping Tang** (University of Chinese Academy of Sciences)
**Zhiyu Tian** (Peking University)
**Nanjun Yang** (Beijing Institute of Mathematical Sciences and Applications)
**Yigeng Zhao** (Westlake University)
**Weizhe Zheng** (Chinese Academy of Sciences)

## Organizers:

**Jianxun Hu** (Sun Yat-sen University)
**Changzheng Li** (Sun Yat-sen University)
**Heng Xie** (Sun Yat-sen University)

[1]* To be confirmed

| | Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|---|
| Morning Session | 9:30- 9:40 Opening | 8:40-9:30 Qin | 8:40- 9:30 Tian | 8:40- 9:30 | 8:40- 9:30 |
| | 9:40 - 10:30 Geisser | 9:40 - 10:30 Calmès | 9:40 - 10:30 Zheng | 9:40 - 10:30 Khan | 9:40 - 10:30 Andreychev |
| | 10:30-11:00 Tea Break | 10:30-11:00 Tea Break | 10:30-11:00 Tea Break | 10:30-11:00 Tea Break | 10:30-11:00 Tea Break |
| | 11:00-11:50 Ikeda | 11:00-11:50 Schlichting | 11:00-11:50 Fasel* | 11:00-11:50 Cao | 11:00-11:50 Hornbostel |
| Lunch | 11:50-14:10 | 11:50-14:10 | 11:50-14:10 | 11:50-14:10 | 11:50-14:10 |
| Afternoon Session | 14:10-15:00 Matsumura | 14:10-15:00 Jin | Free Discussion | 14:10-15:00 Zhao | Free Discussion |
| | 15:00–15:30 Tea Break | 15:00–15:30 Tea Break | | 15:00–15:30 Tea Break | |
| | 15:30–16:20 Naito | 15:30–16:20 Du | | 15:30–16:20 Tang | |
| | 16:35–17:25 Hu | 16:35–17:25 Yang | | 16:35–17:25 Hudson | |
| | 17:45-20:00 Dinner | 18:00-20:30 Banquet | | 17:45-20:00 Dinner | |

Lunch: Zijing Garden
Dinner: SYSU Hotel (Kaifeng)
Banquet: Songtao Garden (5th floor)

**Thomas Geisser (Rikkyo University)**

Title: Brauer groups and Neron-Severi groups of surfaces over finite fields.
Abstract: For a smooth and proper surface over a finite field, the formula of Artin and Tate relates arithmetic invariants, like the order of the Brauer group and the discriminant D of the intersection pairing on the Neron-Severi group. We give a version which equates invariants only depending on the Brauer group to invariants only depending on the Neron-Severi group. In particular, we explain how D modulo squares only depends on the zeta-function, i.e. can be determined by pointing points on the surface.

**Takeshi Ikeda (Waseda University)**

Title: Torus-Equivariant K-homology of the affine Grassmannian and K-theoretic double $k$-Schur functions
Abstract: We study the torus-equivariant K-homology ring of the affine Grassmannian $\mathrm{Gr}_G$ , where $G$ is a connected reductive linear algebraic group. In type A, we introduce equivariantly deformed symmetric functions, called K-theoretic double $k$-Schur functions, which serve as the Schubert basis. These functions are constructed via Demazure operators acting on the equivariant parameters. As an application, we provide a Ginzburg–Peterson type realization of the torus-equivariant K-homology ring of $\mathrm{Gr}_{SL_n}$ as the coordinate ring of a centralizer family for $PGL_n(\mathbb{C})$. If time permits, we will also discuss applications of these constructions to the quantum K-ring of the flag variety. The main part of this talk is based on joint work with Mark Shimozono and Kohei Yamaguchi.

**Tomoo Matsumura (International Christian University)**

Title: Orbit Harmonics and Equivariant Cohomology
Abstract: My talk is based on the joint work arXiv:2410.02105 with Raymond Chou and Brendon Rhoades. The topic includes the computation of the equivariant cohomology ring of the space $X_{n,k,d}$ of n-tuples of lines in $C^k$ that span d-dimensional subspaces. Our work is a continuation of the earlier work by Paylowski and Rhoades, which introduced and studied the $k = d$ case, $X_{n,k,k}$, to identify a certain generalized covariant ring appearing in the Delta conjecture. I will mention open problems of the subjects, including some related to K-theory of the space.

**Satoshi Naito (Institute of Science Tokyo)**

Title: On positivity of 3-point K-theoretic Gromov-Witten invariants of full flag manifolds
Abstract: In this talk, we give an explicit description of certain 3-point K-theoretic Gromov-Witten invariants of full flag manifolds for which one component is the line bundle class associated to a (not necessarily dominant) minuscule weight; the other components are Schubert and opposite Schubert classes. In this description (given in terms of the quantum Bruhat graph), we can see that a positivity result holds. Also, in the case that one component is a Schubert divisor class (instead of a line bundle class), we show that a quantum K-theoretic divisor axiom holds under a certain mild condition, which implies another (slightly different) positivity result.

**Wenchuan Hu (Sichuan University)**

Title: The structure of Chow varieties
Abstract: Let $C_{p,d}(\mathbb{P}^n)$ denote the Chow variety of effective $p$-cycles of degree $d$ in the complex projective space $\mathbb{P}^n$. A result established by Chow and van der Waerden demonstrates that $C_{p,d}(\mathbb{P}^n)$ carries the structure of a closed complex algebraic variety. Chow varieties are fundamental in algebraic geometry, providing a geometric framework for studying algebraic cycles.
In this talk, we will first review known results on the structure of $C_{p,d}(\mathbb{P}^n)$ and then talk about questions and our recent progress on Chow varieties, which are jointed with Youming Chen.

**Baptiste Calmès (Université d'Artois)**

Title: Karoubi-Grothendieck-Witt theory
Abstract: I'll report on joint work with E. Dotto, Y. Harpaz, F. Hebestreit, M. Land, K. Moi, D. Nardin, T. Nikolaus and W. Steimle about Karoubi-Grothendieck-Witt theory, which is to hermitian K-theory what Bass K-theory is to Quillen K-theory. The Karoubi-Grothendieck-Witt functor to spectra satisfies a universal property analogous to that of the Grothendieck-Witt functor, with the additional constraint that it does not see idempotent completion of (Poincaré) categories. In the context of algebraic geometry, it satisfies sheaf properties, for instance Zariski descent with respect to an open covering, contrary to the ordinary hermitian K-theory functor. It also satisfies a generalisation of the Bass-Heller-Swan theorem decomposing the K-theory of the multiplicative group over a base.

**Marco Schlichting (University of Warwick)**

Title: Symmetric versus genuine symmetric forms in Hermitian K-theory
Abstract: In their work on Hermitian K-theory of Poincare infinity categories, Calmès-Dotto-Harpaz-Hebestreit-Land-Moi-Nardin-Nikolaus-Steimle [CDH+] introduced a new version of Hermitian K-theory based on a homotopical notion of symmetric forms. The new theory, (somewhat confusingly) called Hermitian K-theory of symmetric forms, has many good properties, among which are Nisnevich descent and homotopy invariance on regular rings. In this talk, I will discuss the comparison map from the classical Hermitian K-theory of genuine symmetric forms to that of symmetric forms of [CDH+] and show that for finite dimensional regular Noetherian rings that contain a field or are smooth over a Dedekind domain, the comparison map is an isomorphism in degrees $\geq -1$ and a monomorphism in degree $-2$, generalising the comparison result of [CDH+] from fields to a large class of regular rings. In particular, the spaces of Hermitian K-theory of genuine symmetric forms and the symplectic K-theory space are homotopy invariant for such rings and are representable in Morel-Voevodsky's A1-homotopy theory. This is based on my preprint available at arXiv:2503.14288

**Fangzhou Jin (Tongji University)**

Title: Milnor-Witt cycle modules and the homotopy t-structure
Abstract: Milnor-Witt cycle modules are quadratic analogues of Rost cycle modules, which can be used to define Chow-Witt groups using elementary arithmetic operations on residue fields. We introduce Milnor Witt cycle modules over a base scheme and discuss their relations with the homotopy t-structure on the motivic stable homotopy category. This is a joint work with F. Déglise and N. Feld.

**Peng Du (Zhejiang Normal University)**

Title: Isotropic points in the Balmer spectrum of stable motivic homotopy categories
Abstract: I will discuss the tensor-triangulated geometry of the stable motivic homotopy category SH(k) and a big family of the so-called isotropic realisation functors, parameterized by the choices of a Morava K-theory and an extension of the base field k (of characteristic zero). By studying the target category of such an isotropic realisation functor, we are able to construct the so-called isotropic Morava points of the Balmer spectrum Spc(SH(k)c) of the stable motivic homotopy category SH(k). This is based on a joint work with A. Vishik.

**Nanjun Yang (Beijing Institute of Mathematical Sciences and Applications)**

Title: Witt group of nondyadic curves
Abstract: Witt group of real algebraic curves has been studied since Knebusch in 1970s. But few results are known if the base field is non-Archimedean except the hyperelliptic case by works of Parimala, Arason et al.. In this talk, we compute the Witt group of smooth proper curves over nondyadic local fields with $char \neq 2$ by reduction, with a general study of the existence of Theta characteristics.

**Zhiyu Tian (Peking University)**

Title: Weak Approximation and integral Tate/Hodge conjecture
Abstract: It is well known that Tate conjecture and Hodge conjecture fail for integral coefficients. However, for some special type of varieties, we still expect that they hold true for one-cycles (surprisingly, because of the validity of these conjectures with rational coefficients). In this talk I plan to explain some arithmetic reasons of why we hope to prove such statements, and some special cases of these conjectures where we can prove them using arithmetic argument.

**Weizhe Zheng (Chinese Academy of Sciences)**

Title: Hodge-Riemann polynomials and log-concave sequences
Abstract: Hodge-Riemann relations provide a rich source of log-concave sequences. In this talk I will present recent extensions of Hodge-Riemann relations to ample vector bundles and applications to the log-concavity of derivative sequences of Schur polynomials and their products. I will discuss properties of Hodge-Riemann polynomials, which are partially symmetric polynomials that produce cohomology classes satisfying Hodge-Riemann relations when evaluated at Chern roots of ample vector bundles. In the case of line bundles in bidegree (1,1), these are precisely the nonzero dually Lorentzian polynomials. This talk is partially based on joint work with Qing Lu.

**Hourong Qin ( Nanjing University)**

Title: A connection between the Milnor K group and the Shafarevich-Tate group
Abstract: We develop a new Shimura lift for weight 3/2 modular forms in the study of congruent numbers, allowing us to derive a new criterion for them

and, furthermore, to establish a close connection between Milnor K-groups and Shafarevich-Tate groups.

**Adeel Khan (Academia Sinica)**

Title: Coherent duality via K-theory
Abstract: If X is a smooth scheme, the coherent dualizing complex of X can be described as the graded determinant of the cotangent sheaf. In forthcoming joint work with Andy Jiang we generalize this to the case of algebraic stacks (or even derived algebraic stacks that are only quasi-smooth). A key idea is to express both sides of the formula in terms of the Thomason-Trobaugh algebraic K-theory space.

**Jin Cao (University of Science and Technology Beijing)**

Title: Hasse-Witt matrices for Calabi-Yau threefolds
Abstract: In this talk, we will review the different ways for the computation of the Hasse-Witt invariant for elliptic curves. Then we will discuss the some related problems in the case of Calabi-Yau threefolds.

**Yigeng Zhao (Westlake University)**

Title: On Swan classes for constructible étale sheaves
Abstract: For constructible étale sheaves on varieties over fields of positive characteristic, the Swan class extends the Swan conductor to a 0-cycle, serving as an invariant that measures ramification. Using different approaches, Kato-Saito and Saito have constructed two versions of the Swan class. In this talk, we introduce a new cohomological Swan class and investigate Saito's conjecture on its uniqueness. This is a joint work with Enlin Yang.

**Guoping Tang (University of Chinese Academy of Sciences)**

Title: Mahler measure, integral $K_2$ and Beilinson's conjecture of curves over number fields
Abstract: We will talk about several Mahler measure identities involving families of two-variable polynomials defining curves of arbitrary genus, by means of their integral $K_2$. As an application, we can obtain some relations between the Mahler measure of non-tempered polynomials defining elliptic curves of conductor 14, 15, 24, 48, 54 and corresponding L-values. We construct $g$ independent (integral) elements in the kernel of the tame symbol on several families of curves with genus $g = 1, 2, 4, 7$. Furthermore, we prove

that there exist non-torsion divisors $P - Q$ with $P, Q$ in the divisorial support of these $K_2$ elements when $g = 1, 2$, which is potentially different from previous constructions in literature.

**Thomas Hudson (Daegu Gyeongbuk Institute of Science and Technology)**

Title: (Non-Borel) Equivariant cohomology and applications to enumerative geometry
Abstract: In spite of all its merits, Borel $G$-equivariant cohomology does not allow for a theory of Chern classes which is able to tell apart bundles which are given different $G$-actions . The equivariant ordinary cohomology of Costenoble-Waner, which is an extension of Bredon $RO(G)$-graded cohomology, was introduced precisely to overcome this and other related limitations.

In this talk I will display some of the features of this cohomology theory in the case $G = \mathbb{Z}/2\mathbb{Z}$ by describing the cohomology rings of both finite and infinite projective spaces and of quadrics. As an application I will show how the knowledge of these cohomology rings can be used to refine some classical results in enumerative geometry like, for instance, Bezout's theorem and the count of the lines on a smooth cubic surface.

**Jean Fasel* (Université Grenoble Alpes)**

TBA

**Grigory Andreychev (Morningside Center of Mathematics)**

Title: Stacky Approach to Galois Representations
Abstract: In ongoing joint work with Maximilian Hauck and Tasos Moulinos, we investigate the étale realization functor from prismatic F-gauges to Galois representations of $Q_p$ with coefficients in $Z_p$; in the course of this study, we construct an analytic stack in the sense of Clausen–Scholze whose category of quasi-coherent sheaves, or to be more precisely, its category of perfect complexes, is equivalent to the bounded derived category of finitely generated Galois representations.

**Jens Hornbostel (University of Wuppertal)**

Title: Real topological Hochschild homology of perfectoid rings
Abstract: We recall the definition of classical THH and its real refinement THR for rings and schemes with involution. Then we discuss some general results as well as some recent computations, in particular about perfectoid

rings. The latter refines results of Bhatt-Morrow-Scholze on THH. Along the way, we establish a real refinement of the Hochschild-Kostant-Rosenberg theorem. This is joint work with Doosung Park. Time permitting, we sketch how Park uses these results to define real syntomic cohomology, and how all this is related to the recent preprints of Lucy Yang and of Angelini-Knoll, Kong and Quigley.

## Contact Persons:

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## Accommodation:

(1) Hotel Name: SYSU hotel & Conference Center

(2) Address: North gate of Sun Yat-sen University, Binjiang Dong Road, Haizhu District, Guangzhou

(3) Tel: +86-20-89222888

(4) Website: http://www.syskaifeng.com

## Transportation:

By TAXI between Baiyun Airport and SYSU hotel & Conference Center (approx. RMB 170).

## A map of Sun Yat-sen University:

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