Arithmetic and Cohomology of Algebraic Varieties

September 18-22, 2023

Hanoi, Vietnam

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This is the booklet for the conference Arithmetic and Cohomology of Algebraic Varieties 2023.
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About

Arithmetic and Cohomology of Algebraic Varieties 2023

This is a conference in arithmetic geometry devoted to the cohomological study of algebraic varieties, broadly interpreted.

The conference is from September 18 to September 22, 2023 and is hosted by the Institute of Mathematics, Vietnam Academy of Science and Technology.

Organizing committee

Kęstutis Česnavičius Đoàn Trung Cường Ngô Trung Hiếu

Institute of Mathematics - Vietnam Academy of Science and Technology

The Institute of Mathematics is a research institute of the Vietnam Academy of Science and Technology, abbreviation IM VAST. Since its establishment in 1969, its main task is to carry out basic research in the mathematical sciences. It also has a postgraduate program and publishes the mathematics journals Acta Mathematica Vietnamica and Vietnam Journal of Mathematics.

Timetable

Monday, September 18

8:30–9:10	**Registration**	
9:10–9:15	**Welcome remarks**	
9:15–10:15	**Hélène Esnault** Freie Universität Berlin	*Rigid local systems and their integrality/crystallinity properties, an overview*
10:15–10:45	**Coffee**	
10:45–11:45	**Anna Cadoret** Sorbonne Université	*On the toric part of the degeneration locus of p-adic local systems arising from geometry*
11:45–14:00	**Lunch**	
14:00–15:00	**Phùng Hồ Hải** Institute of Mathematics - Vietnam Academy of Science and Technology	*Local fundamental group of pinched curves and cocommutative Hopf algebras*
15:00–15:30	**Coffee**	
15:30–16:30	**Takeshi Saito** University of Tokyo	*On the Hasse–Arf theorem*

Tuesday, September 19

9:15–10:15	**Bogdan Zavyalov** Institute for Advanced Study, Princeton	*Poincaré Duality in abstract 6-functor formalism*
10:15–10:45	**Coffee**	
10:45–11:45	**Wiesława Niziol** Sorbonne Université	*Duality in p-adic pro-etale cohomology of analytic spaces*
11:45–14:00	**Lunch**	
14:00–15:00	**Hiroki Kato** Max Planck Institute for Mathematics, Bonn	*Remarks on integral properties of the filtered F-isocrystal associated to an integral crystalline local system*
15:00–15:30	**Coffee**	
15:30–16:30	**Ofer Gabber** Institut des Hautes Études Scientifiques	*On some flat Ext sheaves*

Wednesday, September 20

9:15–10:15	**Pierre Colmez** Sorbonne Université	*On Emerton's factorisation of completed cohomology*
10:15–10:45	**Coffee**	
10:45–11:45	**Ngô Đắc Tuấn** Université de Caen Normandie	*Special zeta values, regulators, and motives*
11:45–14:00	**Lunch**	
14:00–15:00	**Hồ Phú Quốc** Hong Kong University of Science and Technology	*Traces and Drinfel'd centers of finite Hecke categories*
15:00–15:30	**Coffee**	
15:30–16:30	**Alexis Bouthier** Sorbonne Université	*Affine Character sheaves*
19:00–21:00	**Banquet**	

Thursday, September 21

9:15–10:15	**Sug Woo Shin** University of California, Berkeley	*Vanishing theorems for cohomology of locally symmetric spaces*
10:15–10:45	**Coffee**	
10:45–11:45	**Alex Youcis** University of Tokyo	*Prismatic realization functors on Shimura varieties of abelian type*
11:45–14:00	**Lunch**	
14:00–15:00	**Teruhisa Koshikawa** Research Institute for Mathematical Sciences, Kyoto	*Some computations in categorical local Langlands*
15:00–15:30	**Coffee**	
15:30–16:30	**Naoki Imai** University of Tokyo	*Geometric Satake equivalence for p-adic covering groups*

Friday, September 22

9:15–10:15	**Jinhyun Park** Korea Advanced Institute of Science and Technology	*Milnor K-theory and big de Rham-Witt forms revisited via algebraic cycles*
10:15–10:45	**Coffee**	
10:45–11:45	**Luc Illusie** Université Paris-Saclay	*New developments in de Rham cohomology in mixed characteristic, after Bhatt-Lurie, Drinfeld, and Petrov*
11:45–13:00	**Lunch**	

Talk Abstracts

Monday, September 18

Rigid local systems and their integrality/crystallinity properties, an overview

Hélène Esnault

Freie Universität Berlin

We'll give a not too technical overview lecture on the properties of local systems which have been proved in the last five years, jointly with Michael Groechenig and recently with Johan de Jong, on rigid local systems: integrality, crystallinity. If time permits, we shall also mention, in a simplified case, a purely local (over the Witt vectors) and topological proof of some of the crystallinity properties (joint with Michael Groechenig).

On the toric part of the degeneration locus of p-adic local systems arising from geometry

Anna Cadoret

Sorbonne Université

For a smooth variety over a number field and a p-adic local system arising from geometry on it, classical conjectures on algebraic cycles predict that the degeneration locus ("stratified by the algebraic monodromy group") of the p-adic local system should fit with the Hodge locus ("stratified by the Mumford-Tate group") of the associated variation of Hodge structures; in particular they should have similar properties in terms of sparcity. I will discuss results in this direction for the toric part of it. This is a joint work with Jakob Stix.

Local fundamental group of pinched curves and cocommutative Hopf algebras

Phùng Hồ Hải

Institute of Mathematics - Vietnam Academy of Science and Technology

In this talk we report on our recent progress on the computation of the local fundamental group (after Nori) of pinched projective lines. The result is presented in terms of a class of cocommutative Hopf algebras.

On the Hasse–Arf theorem

Takeshi Saito

University of Tokyo

The classical Hasse–Arf theorem affirms the integrality of the conductor of an abelian character. Kato refined this in 1980's by introducing a filtration on the dual group of the abelianized absolute Galois group by using the cup-product with valued in the Brauer group and proved a variant of the HA theorem in some cases where the extension of the residue field is inseparable. We reformulate the HA theorem as equivalent conditions for an inequality on the conductor to be an equality. We also discuss a generalization of Kato's theory of Swan conductors.

Tuesday, September 19

Poincaré Duality in abstract 6-functor formalism

Bogdan Zavyalov

Institute for Advanced Study, Princeton

In this talk, I will discuss Poincaré Duality in the context of an abstract 6-functor formalism. Somewhat surprisingly, a 6-functor formalism satisfies an appropriate form of Poincaré Duality under a minimal set of extra assumptions. Furthermore, these assumptions are essentially independent of the "coefficient" categories $\mathrm{D}(X)$. This makes it easy to verify these assumptions in practice. In particular, this allows us to reprove previously established Poincaré Duality results in a uniform and almost formal way.

Duality in p-adic pro-etale cohomology of analytic spaces

Wiesława Niziol

Sorbonne Université

I will discuss duality theorems in p-adic pro-etale cohomology of analytic spaces. This is based on a joint work with Pierre Colmez and Sally Gilles.

Remarks on integral properties of the filtered F-isocrystal associated to an integral crystalline local system

Hiroki Kato

Max Planck Institute for Mathematics, Bonn

I will discuss how to apply the recent development on the theory of prisms and prismatic cohomology initiated by Bhatt and Scholze to obtain integral properties of the functor D_{crys} that associates a filtered F-isocrystal to each crystalline local system. Joint work with Naoki Imai and Alex Youcis.

On some flat Ext sheaves

Ofer Gabber

Institut des Hautes Études Scientifiques

We study properties of Ext groups $\mathrm{Ext}^i(G_a, G_m)$ in mixed characteristic extending results of Rosengarten in characteristic p. In particular we show that the flat $\mathcal{E}xt^1$ sheaf is the direct image of its restriction to characteristic 0.

Wednesday, September 20

On Emerton's factorisation of completed cohomology

Pierre Colmez

Sorbonne Université

I will explain a new proof of Emerton's factorisation of the completed cohomology of the tower of modular curves. This is joint work with Shanwen Wang.

Special zeta values, regulators, and motives

Ngô Đắc Tuấn

Université de Caen Normandie

Special zeta values play a central role in modern number theory. First, we recall results and conjectures concerning these values of number fields with their link to regulators and motives: the analytic class number formula, the Borel theorem, and some conjectures of Zagier. Then we switch to the function field setting, explain some analogous conjectures of Taelman, and report our recent work on these conjectures. This talk is based on a joint work with B. Angles and F. Tavares Ribeiro.

Traces and Drinfel'd centers of finite Hecke categories

Hồ Phú Quốc

Hong Kong University of Science and Technology

Playing an important role in both representation theory and the theory of categorified link invariants, finite Hecke categories come in many different flavors, from geometric, via the finite Hecke stack, to combinatorial, via Soergel bimodules. In this talk, I will explain how to study the traces and Drinfeld centers of all the different flavors uniformly and geometrically, relating them to different flavors of the category of unipotent character sheaves. This is joint work with Penghui Li.

Affine Character sheaves

Alexis Bouthier

Sorbonne Université

The goal is to study the affine Springer fibration, which is a true infinite-dimensional object and explain how one can build a theory parallel to the classical Springer theory. We then apply these results in order to construct some character sheaves on the loop group that geometrize, in the unipotent case, characters of p-adic representations.

Thursday, September 21

Vanishing theorems for cohomology of locally symmetric spaces

Sug Woo Shin

University of California, Berkeley

We have multiple approaches to vanishing theorems for the cohomology of Shimura varieties, via either algebraic geometry or automorphic forms. Such theorems have been of interest with either complex or torsion coefficients. Recently, results have been obtained under various genericity hypotheses by Caraiani-Scholze, Koshikawa, Hamann-Lee et al. I will report on an ongoing project with Koshikawa to understand the non-generic case. The more general case of locally symmetric spaces may also be discussed.

Prismatic realization functors on Shimura varieties of abelian type

Alex Youcis

University of Tokyo

Shimura varieties are certain classes of schemes which play a central role in the study of the Langlands conjecture. While far from known in general, it is expected that Shimura varieties are moduli spaces of certain motives with extra structure. In this talk I discuss joint work with Imai and Kato, which constructs prismatic objects on the integral canonical models of Shimura varieties of abelian type at hyperspecial level. These may be thought of as the prismatic realization of such a hypothetical universal motive. We then discuss several arithmetic applications of such a prismatic realization functor, including a prismatic characterization of such integral canonical models. (joint with Naoki Imai and Hiroki Kato)

Some computations in categorical local Langlands

Teruhisa Koshikawa

Research Institute for Mathematical Sciences, Kyoto

Several people have proposed categorical versions of local Langlands. These are closely related to the cohomology of global and local Shimura varieties. In his proposal, Hellmann made some explicit computations for general linear groups on the spectral side. I will explain some more computations and their meanings on the geometric side.

Geometric Satake equivalence for p-adic covering groups

Naoki Imai

University of Tokyo

Recently Fargues-Scholze constructed local Langlands correspondences for p-adic local fields. One key input in the construction is geometric Satake equivalence for p-adic reductive groups. In this talk, we discuss a generalization of this equivalence to covering groups. This is a joint work in progress with Tony Feng, Ildar Gaisin, Teruhisa Koshikawa and Yifei Zhao.

Friday, September 22

Milnor K-theory and big de Rham-Witt forms revisited via algebraic cycles

Jinhyun Park

Korea Advanced Institute of Science and Technology

For certain nice regular rings over a field, it is known that the Milnor K-theory and the restricted de Rham-Witt forms admit descriptions as groups of algebraic cycles, more precisely by higher Chow groups of Bloch and additive higher Chow groups of Bloch-Esnault, in the Milnor range.

In this talk, I would like to sketch my recent results as well as a work in progress that (try to) extend some of the above known results in a few directions, using rather unconventional notion of algebraic cycles over the formal power series rings.

New developments in de Rham cohomology in mixed characteristic, after Bhatt-Lurie, Drinfeld, and Petrov

Luc Illusie

Université Paris-Saclay

Bhatt-Scholze's prismatic cohomology and Bhatt-Lurie-Drinfeld's prismatic stacks have led to the discovery of mysterious structures on de Rham cohomology in mixed characteristic. These, in turn, enabled Petrov to solve a 1987 question on the Hodge to de Rham spectral sequence of proper, smooth varieties over a field of positive characteristic. I will describe these new structures and sketch the key ideas in Petrov's work.

List of Participants

Tạ Thị Hoài An	Institute of Mathematics - VAST
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Tong Zhou	University of California, Berkeley
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Useful Information

Talks will be held at **Hoàng Tụy Conference Hall**. It is situated on the second floor of Building A6. It has direct access from Building A5 where the main entrance of IM VAST is located.

Wi-Fi will be available. The detailed information of Wi-Fi access will be provided during the conference.

Coffee breaks will be offered at the hallway outside of the Conference Hall.

Lunches will be at the Soulmate Restaurant just opposite of the IM VAST. The address is

Tràng An Complex, 1 Phùng Chí Kiên, Cầu Giấy, Hà Nội

(in plain English: Trang An Complex, 1 Phung Chi Kien Street, Cau Giay District, Hanoi)

The Common Room on the second floor of Building A5 is a place where participants can have coffee, relax and chat after lunches, and socialize with other participants and/or researchers at IM VAST.

Banquet will be held on Wednesday evening; the address of the restaurant is:

Jaspas Restaurant, 4th floor, Hanoi Towers

49 Hai Ba Trung Road, Hoan Kiem District, Hanoi.

How to get to IM VAST?

The address of the Institute of Mathematics - Vietnam Academy of Science and Technology (IM VAST) is:

18 Hoàng Quốc Việt, Cầu Giấy, Hà Nội

(in plain English: 18 Hoang Quoc Viet Road, Cau Giay District, Hanoi)

The participants who stay at Hòa Bình Hotel can take the conference bus to commute between the hotel and IM VAST.

Sponsors

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