

ARITHMETIC GEOMETRY AND DE RHAM THEORY

HANOI, DECEMBER 3<sup>rd</sup> - 6<sup>th</sup>, 2018

PROGRAM  
&  
ABSTRACTS

HANOI 2018



# ARITHMETIC GEOMETRY AND DE RHAM THEORY

HANOI, DECEMBER 3<sup>rd</sup> - 6<sup>th</sup>, 2018

Hélène Esnault has been a long-time supporter of the Vietnamese mathematical community. She has hosted many Vietnamese mathematicians as long-term visitors in her work-groups in Germany, and she frequently visits Hanoi to continue the collaborations. For her contributions to Vietnam she was awarded the honorary doctorate degree of Vietnam Academy of Science and Technology in 2009. This conference takes place on the occasion of her visit to Hanoi.

## HOST INSTITUTION

Institute of Mathematics, Vietnam Academy of Science and Technology

## ORGANIZING COMMITTEE:

- Ta Thi Hoai An (Institute of Mathematics, VAST)
- Doan Trung Cuong (Institute of Mathematics, VAST)
- Phung Ho Hai (Institute of Mathematics, VAST)
- Nguyen Duy Tan (Institute of Mathematics, VAST)
- Ngo Viet Trung (Institute of Mathematics, VAST)

## SPONSORS:

- Institute of Mathematics
- Vietnam Academy of Science and Technology
- International Center Research and Postgraduate Training in Mathematics under the Auspices of UNESCO



# PROGRAM



**Monday, December 3**

**Venue:** Room 302, A5 Building

*Morning session*

08:30 – 09:00	Registration
09:00 – 09:15	<b>Opening ceremony</b>
<b>Chair:</b>	<b>Adrian Langer</b> (University of Warsaw)
09:15 – 10:15	Kang Zuo (Johannes Gutenberg University Mainz) <i>Rank-2 motivic local systems over the projective line with four punctured points</i>
10:15 – 10:30	Tea break
10:30 – 11:30	Nguyen Quoc Thang (Institute of Mathematics - VAST) <i>Rational points of algebraic groups and their relations over arithmetical fields</i>
11:30 – 14:00	<b>Lunch</b>

*Afternoon session*

<b>Chair:</b>	<b>Nguyen Quoc Thang</b> (Institute of Mathematics-VAST)
14:00 – 15:00	Ngo Dac Tuan (CNRS/Université de Caen Normandie) <i>On special values of <math>t</math>-modules</i>
15:00 – 15:20	Tea break
15:20 – 16:20	Dimitri Wyss (Sorbonne University Paris 6) <i><math>p</math>-adic integration and geometric stabilization</i>

**Tuesday, December 4**

**Venue:** Room 302, A5 Building

*Morning session*

<b>Chair:</b>	<b>Kang Zuo</b> (Johannes Gutenberg University Mainz)
09:00 – 10:00	Atsushi Shiho (University of Tokyo) <i>On relative log de Rham-Witt complex</i>
10:00 – 10:20	Tea break
10:20 – 11:20	Dao Van Thinh (National University of Singapore ) <i>Bhargava-Shankar conjecture on the average size of <math>n</math>-Selmer groups of elliptic curves over function fields</i>
11:30 – 14:00	<b>Lunch</b>

*Afternoon session*

<b>Chair:</b>	<b>Ta Thi Hoai An</b> (Institute of Mathematics - VAST)
14:00 – 15:00	Do Duc Thai (Hanoi National University of Education) <i>On integral points off divisors in projective algebraic varieties</i>
15:00 – 15:20	Tea break
15:20 – 16:20	Adrian Langer (University of Warsaw) <i>Higgs bundles and rigid representations of fundamental groups</i>
18:45-21:00	<b>Banquet</b> (Jaspas Restaurant, The 4th Floor of Hanoi Tower, 49 Hai Ba Trung, Hoan Kiem, Hanoi)



**Wednesday, December 5**

Free Discussion and Excursion

**Thursday, December 6**

**Venue:** Room 302, A5 Building

*Morning session*

<b>Chair:</b>	<b>Doan Trung Cuong</b> (Institute of Mathematics - VAST)
09:00 – 10:00	Nguyen Manh Toan (University of Osnabrueck) <i>Orbifold products and motivic hyperkähler resolution conjectures</i>
10:00 – 10:20	Tea break
10:20 – 11:20	Do Viet Cuong (University of Science - Vietnam National University, Hanoi) <i>Metaplectic geometric Satake equivalence and Jacquet-Mao's fundamental lemma</i>
11:30 – 14:00	<b>Lunch</b>

*Afternoon session*

<b>Chair:</b>	<b>Ngo Viet Trung</b> (Institute of Mathematics - VAST)
14:00 – 15:00	Tomoyuki Abe (Kavli Institute for the Physics and Mathematics of the Universe) <i>TBA</i>
15:00 – 15:20	Tea break
15:20 – 16:20	Marco d'Addezio (Free University of Berlin) <i>Finiteness of perfect torsion points of an abelian variety</i>

# ABSTRACTS



## **Finiteness of perfect torsion points of an abelian variety**

Marco D'Addezio

Free University of Berlin

I will report on a joint work with Emiliano Ambrosi. Let  $k$  be a field that is finitely generated over the algebraic closure of a finite field. As a consequence of the theorem of Lang-Néron, for every abelian variety over  $k$  which does not contain any isotrivial abelian variety, the group of  $k$ -rational torsion points is finite. We show that if  $k^{perf}$  is a perfect closure of  $k$ , the group of  $k^{perf}$ -rational torsion points is finite as well. This gives a positive answer to a question asked by Hélène Esnault in 2011. To prove the theorem we translate the problem to a certain question on morphisms of  $F$ -isocrystals.

## **Metaplectic geometric Satake equivalence and Jacquet-Mao's fundamental lemma**

Do Viet Cuong

University of Science - Vietnam National University, Hanoi

Jacquet conjectured that automorphic representations of  $GL_r$  distinguished by an orthogonal subgroup can be classified by automorphic representations of its metaplectic cover. Jacquet and Mao have suggested a program to prove this conjecture by establishing a comparison between two relative traces formulas: one on the group  $GL_r$  and the other one on its metaplectic cover. One of the steps of this program is precisely a fundamental lemma.

In this talk, firstly, I report on the proof of this fundamental lemma for unit elements. Then, I explain how to prove the general one using metaplectic geometric Satake equivalence.

# Higgs bundles and rigid representations of fundamental groups

Adrian Langer

University of Warsaw

The first part of the talk will be devoted to the study of Chern classes of Higgs bundles. The second part will be devoted to applications of Higgs bundles in the study of rigid representations of fundamental groups of algebraic varieties (this part is joint with Carlos Simpson).

# On relative log de Rham-Witt complex

Atsushi Shiho

University of Tokyo

The notion of relative log de Rham-Witt complex, which is the log version of relative de Rham-Witt complex of Langer-Zink, is defined by Matsuue. In this talk, we give the comparison theorem between relative log de Rham-Witt cohomology and relative log crystalline cohomology for log smooth saturated morphism of fs log schemes satisfying certain condition on which  $p$  is nilpotent. Our result generalizes most of the previously known results by Illusie, Hyodo-Kato, Langer-Zink and Matsuue.

This is a joint work with Kazuki Hirayama.

## On integral points off divisors in projective algebraic varieties

Do Duc Thai

Hanoi National University of Education

The purpose of this talk is to present the following in Diophantine Geometry.

1. The first is to show the dimension of the set of integral points off divisors in subgeneral position in a projective algebraic variety  $V \subset \mathbb{P}_k^m$ , where  $k$  is a number field. As its consequences, the results of Ru-Wong, Noguchi-Winkelmann, Levin are recovered.
2. The second is to show the complete hyperbolicity in the sense of Kobayashi of the complement of divisors in subgeneral position in a projective algebraic variety  $V \subset \mathbb{P}_{\mathbb{C}}^m$ .
3. Let  $k$  be a number field and  $S$  a finite set of valuations of  $k$  containing the archimedean valuations. The third is to determine when there exists a Zariski-dense set  $R$  of  $S$ -integral points on the complement of a union of divisors in projective space  $\mathbb{P}_k^m$ , defined over  $k$ , where  $k$  is a number field and  $S$  is a finite set of valuations of  $k$  containing the archimedean valuations..

## Rational points of algebraic groups and their relations over arithmetical fields

Nguyen Quoc Thang

Institute of Mathematics, VAST

We investigate some relations between rational points of algebraic groups defined over local and global fields and extend some well-known exact sequences connecting arithmetic, cohomological and geometric invariant of reductive groups.

## **Bhargava-Shankar conjecture on the average size of $n$ -Selmer groups of elliptic curves over function fields**

Dao Van Thinh

National University of Singapore

Recently, the problem related to the size of the Selmer group has been investigated vastly by many mathematicians such as *M. Bhargava*, *Poonen*, *B. Gross*, *A. Shankar*... It is essential due to the role of the Selmer group in BSD-conjecture. In the case of elliptic curves over the rational field  $\mathbb{Q}$ , the average size of  $n$ -Selmer groups is expected to be the sum of divisors of  $n$ . This conjecture is confirmed in case  $n < 6$  by Bhargava et. al. Of course, people may ask a similar question in the function fields setting, and this talk is all about it. Precisely, we will see that the average size of  $n$ -Selmer groups ( $n < 6$ ) of elliptic curves over a function field  $F_q(C)$  is bound by an expression that tends to the sum of divisors of  $n$  when  $q$  goes to infinity. Note that the case Quoc Ho did  $n = 2$ , Le H. V. Bao, Ngo Bao Chau (2014), and the claim for  $n = 3$  and  $C$  is the projective line, was done by de Jong (2002).

## **Orbifold products and motivic hyperkähler resolution conjectures**

Nguyen Manh Toan

University of Osnabrueck

In this talk, we will discuss about the so-called orbifold products for motivic cohomology and algebraic K-theory of smooth, separated complex Deligne–Mumford stacks. They are motivic versions of the Chen–Ruan orbifold product which is defined using orbifold Gromov–Witten theory. I will explain how these products relate to each other as well as to the usual products on the motivic cohomology and K-theory ring of hyperkähler resolutions of singularities of coarse moduli spaces of stacks. If time permits, some computations for Hilbert schemes and toric stacks will be given.



## On special values of $t$ -modules

Ngo Dac Tuan

CNRS/Université de Caen Normandie

Special values of  $t$ -motives (or  $t$ -modules) play a central role in function field arithmetic. In this talk, we present recent developments on this topics. We will focus on a conjecture of Taelman on these values and its connection with log-algebraicity. If time permits, we discuss a possible connection with de Rham cohomology of  $t$ -motives. This is a joint work with B. Angles and F. Tavares Ribeiro.

## $p$ -adic integration and geometric stabilization

Dimitri Wyss

Institute of Mathematics, Jussieu

I will explain a new proof of the geometric stabilization theorem for Hitchin fibers, a key ingredients in Ngô's proof of the fundamental lemma. Our approach relies on ideas of Denef-Loeser and Batyrev on  $p$ -adic integration and Langlands duality for generic Hitchin fibers. This is joint work with Michael Groechenig and Paul Ziegler.

# Rank-2 motivic local systems over the projective line with four punctured points

Kang Zuo

Johannes Gutenberg University Mainz

We propose an arithmetic Simpson correspondence for Higgs bundles over arithmetic schemes. It predicts that a rank-2 graded stable Higgs bundle of degree -1 over the projective line with logarithmic singularities at four given punctured points corresponds to a polarized variation of Hodge structure over a algebraic number ring if and only if the zero of the Higgs field is the image of a torsion point on the elliptic curve as double cover of the projective line ramified at those four points. We did construct 26 pieces complete solutions in the case of the integer ring and Higgs fields having zeros of torsion order 1, 2, 3, 4 and 6. This is a joint project with J. Lu, X. Lu, R.R. Sun and J. B. Yan.

# **LIST OF PARTICIPANTS**



**Tomoyuki Abe**, p.11  
Kavli Institute for the Physics and  
Mathematics of the Universe  
tomoyuki.abe@ipmu.jp

**Ta Thi Hoai An**<sup>1</sup>  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
tthan@math.ac.vn

**Tran Nguyen An**  
Thai Nguyen University of Education  
antrannguyen@gmail.com

**Marco D'Addezio**, p.11  
Free University of Berlin  
marco.daddezio@fu-berlin.de

**Dao Phuong Bac**  
University of Science  
Vietnam National University, Hanoi  
dphac.vnu@gmail.com

**Nguyen Luong Thai Binh**  
Sai Gon University  
nltbinh@sgu.edu.vn

**Nguyen Van Chau**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
nvchau@math.ac.vn

**Luong Viet Chuong**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
hoathekiet@gmail.com

**Doan Trung Cuong**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
dtkuong@math.ac.vn

**Do Viet Cuong**, p.11  
University of Science  
Vietnam National University, Hanoi  
334 Nguyen Trai, Thanh Xuan Hanoi  
vcuong.do@hus.edu.vn

**Nguyen Tu Cuong**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
ntcuong@math.ac.vn

**Nguyen Tien Dang**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam

**Nguyen Viet Dung**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
vietdung@math.ac.vn

**Vu Thi Duong**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
vuduongk39d@gmail.com

**Hélène Esnault**  
Free University Berlin  
esnault@math.fu-berlin.de

**Le Giang**  
Hanoi National University of Education  
legiang@hnue.edu.vn

**Phung Ho Hai**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
phung@math.ac.vn

---

1. Additional information after participant's name means the page number of the abstract of his/her talk.

**Nguyen Thu Hang**  
Thai Nguyen University of Sciences  
nguyenthuhang0508@gmail.com

**Truong Thi Hien**  
Hong Duc University  
hientruong86@gmail.com

**Le Tuan Hoa**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
lthoa@math.ac.vn

**Do Trong Hoang**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
dthoang@math.ac.vn

**Nguyen Dang Hop**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
ndhop@math.ac.vn

**Pham Lan Huong**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
phamlanhuong.hpu2@gmail.com

**Bruno Klingler**  
Humboldt University  
bruno.klingler@hu-berlin.de

**Do Van Kien**  
Hanoi Pedagogical University 2  
dovankien@hpu2.edu.vn

**Vu The Khoi**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
vtkhoi@math.ac.vn

**Ha Minh Lam**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
hmlam@math.ac.vn

**Adrian Langer**, p. 12  
University of Warsaw  
alan@mimuw.edu.pl

**Tran Giang Nam**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
tgnam@math.ac.vn

**Pham Hong Nam**  
Thai Nguyen University of Sciences  
phamhongnam2106@gmail.com

**Nguyen Viet Phuong**  
Thai Nguyen University of Economics  
and Business  
nvphuongt@gmail.com

**Nguyen Kim Quy**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
quyntk.pomath@gmail.com

**Pham Hung Quy**  
FPT University, Hanoi  
quyph@fe.edu.vn

**Atsushi Shiho**, p.12  
University of Tokyo  
shiho@ms.u-tokyo.ac.jp

**Pham Thanh Tam**  
Hanoi Pedagogical University 2  
tamsp2@gmail.com

**Nguyen Thi Thanh Tam**  
Hung Vuong University  
thanhtamnguyenhv@gmail.com

**Luu Phuong Thao**  
University of education  
Thai Nguyen University  
thaoktsp@gmail.com

**Nguyen Duy Tan**  
Institute of Mathematics  
10307 Hanoi, Vietnam  
duytan@math.ac.vn

**Nguyen Quoc Thang**, p.13  
Institute of Mathematics  
10307 Hanoi, Vietnam  
nqthang@math.ac.vn

**Nguyen Tat Thang**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
ntthang@math.ac.vn

**Do Duc Thai**, p.13  
Hanoi National University of Education  
thaidd@hnue.edu.vn

**Dao Van Thinh** p.14  
National University of Singapore  
daothinh1812@gmail.com

**Le Quy Thuong**  
University of Science  
Vietnam National University, Hanoi  
leqthuong@gmail.com

**Dinh Si Tiep**  
Institute of Mathematics, VAST  
10307 Hanoi, Vietnam  
dstiep@math.ac.vn

**Nguyen Thi Tra**  
Hanoi Pedagogical University 2  
nguyentra.bsu@gmail.com

**Ngo Viet Trung**  
Institute of Mathematics  
10307 Hanoi, Vietnam  
nvtrung@math.ac.vn

**Tran Nam Trung**  
Institute of Mathematics  
10307 Hanoi, Vietnam  
tntrung@math.ac.vn

**Nguyen Manh Toan**, p.14  
University of Osnabrueck  
toan.nguyen@uni-osnabrueck.de

**Ngo Dac Tuan**, p.15  
CNRS/Université de Caen Normandie  
ngodac@unicaen.fr

**Nguyen Bich Van**  
Institute of Mathematics  
10307 Hanoi, Vietnam  
nbvan@math.ac.vn

**Nguyen Chu Gia Vuong**  
Institute of Mathematics  
10307 Hanoi, Vietnam  
necgvuong@math.ac.vn

**Dimitri Wyss**, p.15  
Sorbonne University Paris 6  
dimitri.wyss@imj-prg.fr

**Kang Zuo**, p.16  
Johannes Gutenberg University Mainz  
zuok@uni-mainz.de