



VIASM
VIETNAM INSTITUTE FOR
ADVANCED STUDY IN MATHEMATICS



IRL
FVMA

International Research Laboratory
FRANCE - VIETNAM
in MATHEMATICS & ITS APPLICATIONS



SUMMER SCHOOL ON GALOIS REPRESENTATIONS AND RECIPROCITY



July 01-12, 2024



VIASM, Hanoi, Vietnam



This is the booklet for the Summer School on Galois Representations and Reciprocity 2024.

Further information can be found at:

<https://viasm.edu.vn/en/hdkh/Galois2024>

Contents

About	2
VIASM Summer School 2024 on Galois Representations and Reciprocity	2
Scientific Committee	3
Organising Committee	3
Summer School Lecturers	3
Advanced Talk Speakers	3
Sponsors	4
Timetable	5
Monday, July 1	5
Tuesday, July 2	5
Wednesday, July 3	6
Thursday, July 4	6
Friday, July 5	6
Sunday, July 7 (Advanced Talks)	7
Tuesday, July 9	8
Wednesday, July 10	8
Thursday, July 11	9
Friday, July 12	9
Summer School Lectures	10
Talk Abstracts	11
Sunday, July 7 (Advanced Talks)	11
Useful Information	13
How to get to VIASM?	13
Booklet Template	13

About

VIASM Summer School 2024 on Galois Representations and Reciprocity

The Summer School is organised by the Vietnam Institute for Advanced Study in Mathematics (VIASM), in partnership with the Clay Mathematics Institute (CMI).

The goal of the Summer School is to introduce graduate students, advanced undergraduate students, young researchers, and interested mathematicians in Vietnam, Southeast Asia, and other countries in Asia, to the circle of ideas surrounding the Langlands reciprocity conjecture, including an introduction to automorphy lifting theorems, Galois representations and arithmetic aspects of the theory of modular forms.

The Summer School consists of mini-courses by five Lecturers, intertwined with four advanced talks by leading experts in the Langlands program. The lectures are accompanied by problem sessions. The Summer School was preceded by a pre-school (May 5 - May 26) aimed at helping the students with background materials to get the most out of the main school.

The Summer School (July 1 - July 12) is a component of a concentration period in number theory. It will be followed by the VIASM Annual Meeting 2024 (July 13), and then the Pan Asia Number Theory Conference 2024 (July 15 - July 19) held at VIASM.

Scientific Committee

Lê Hùng Việt Bảo (Northwestern University, USA)

Ngô Bảo Châu (Vietnam Institute for Advanced Study in Mathematics, Vietnam and University of Chicago, USA)

Ngô Đắc Tuấn (CNRS - Université de Caen Normandie, France)

Organising Committee

Lê Hùng Việt Bảo (Northwestern University, USA)

Lê Minh Hà (Vietnam Institute for Advanced Study in Mathematics, Vietnam)

Ngô Bảo Châu (Vietnam Institute for Advanced Study in Mathematics, Vietnam and University of Chicago, USA)

Ngô Đắc Tuấn (CNRS - Université de Caen Normandie, France)

Summer School Lecturers

Patrick Allen (McGill University, Canada)

Ariane Mézard (Institut de Mathématiques de Jussieu and Ecole Normale Supérieure de Paris, France)

Kieu Hieu Nguyen (Institut de Mathématiques de Marseille, France)

David Savitt (Johns Hopkins University, USA)

Richard Taylor (Stanford University, USA)

Advanced Talk Speakers

Tony Feng (University of California, Berkeley, USA)

David Hansen (National University of Singapore, Singapore)

Teruhisa Koshikawa (Research Institute for Mathematical Sciences, Kyoto University, Japan)

Sug Woo Shin (University of California, Berkeley, USA)

Sponsors

The VIASM Summer School 2024 on Galois Representations and Reciprocity is organised by the Vietnam Institute for Advanced Study in Mathematics (VIASM), in partnership with the Clay Mathematics Institute (CMI). The Organisers gratefully acknowledge the support of:

- Vietnam Institute for Advanced Study in Mathematics (VIASM),
- Vietnam National Program for the Development of Mathematics 2021-2030 (NPDM),
- Clay Mathematics Institute (CMI),
- International Research Laboratory France-Vietnam in Mathematics and its Applications (IRL FVMA),
- Number Theory Foundation (NTF),
- Alabaster.

Timetable

Monday, July 1

8:30–9:10	Registration	
9:10–9:30	Welcome remarks	
9:30–10:30	Ariane Mézard Institut de Mathématiques de Jussieu and ENS Paris, France	<i>Arithmetic of elliptic curves</i>
10:30–11:00	Teatime	
11:00–12:00	Patrick Allen McGill University, Canada	<i>Galois representations 1</i>
12:00–14:00	Lunch	
14:00–15:00	Richard Taylor Stanford University, USA	<i>Langlands conjectures 1</i>
15:00–15:20	Teatime	
15:20–16:20	<i>Problem session</i>	

Tuesday, July 2

9:30–10:30	Patrick Allen McGill University, Canada	<i>Galois representations 2</i>
10:30–11:00	Teatime	
11:00–12:00	Richard Taylor Stanford University, USA	<i>Langlands conjectures 2</i>
12:00–14:00	Lunch	
14:00–15:00	Patrick Allen McGill University, Canada	<i>Galois representations 3</i>
15:00–15:20	Teatime	
15:20–16:20	<i>Problem session</i>	

Wednesday, July 3

9:30–10:30	Patrick Allen McGill University, Canada	<i>Deformation rings 1</i>
10:30–11:00	Teatime	
11:00–12:00	Kieu Hieu Nguyen Institut de Mathématiques de Marseille, France	<i>Automorphic forms 1</i>
12:00–14:00	Lunch	
14:00–15:00	Richard Taylor Stanford University, USA	<i>Langlands conjectures 3</i>
15:00–15:20	Teatime	
15:20–16:20	<i>Problem session</i>	

Thursday, July 4

9:30–10:30	Patrick Allen McGill University, Canada	<i>Deformation rings 2</i>
10:30–11:00	Teatime	
11:00–12:00	Ariane Mézard Institut de Mathématiques de Jussieu and ENS Paris, France	<i>p-adic Hodge theory 1</i>
12:00–14:00	Lunch	
14:00–15:00	Kieu Hieu Nguyen Institut de Mathématiques de Marseille, France	<i>Automorphic forms 2</i>
15:00–15:20	Teatime	
15:20–16:20	<i>Problem session</i>	

Friday, July 5

9:30–10:30	Patrick Allen McGill University, Canada	<i>Deformation rings 3</i>
10:30–11:00	Teatime	
11:00–12:00	David Savitt Johns Hopkins University, USA	<i>Automorphy lifting 1</i>
12:00–14:00	Lunch	

Sunday, July 7 (Advanced Talks)

8:45–9:00	Welcome remarks	
9:00–10:00	Tony Feng University of California, Berkeley, USA	<i>Modular functoriality in the Local Langlands correspondence</i>
10:00–10:30	Teatime	
10:30–11:30	Sug Woo Shin University of California, Berkeley, USA	<i>Langlands reciprocity for reductive groups</i>
11:30–13:30	Lunch	
13:30–14:30	David Hansen National University of Singapore, Singapore	<i>The categorical local Langlands program</i>
14:30–15:00	Teatime	
15:00–16:00	Teruhisa Koshikawa Research Institute for Mathematical Sciences, Kyoto University, Japan	<i>Spectral side of the categorical local Langlands</i>

Tuesday, July 9

9:30–10:30	Kieu Hieu Nguyen Institut de Mathématiques de Marseille, France	<i>Automorphic forms 3</i>
10:30–11:00	Teatime	
11:00–12:00	David Savitt Johns Hopkins University, USA	<i>Automorphy lifting 2</i>
12:00–14:00	Lunch	
14:00–15:00	Ariane Mézard Institut de Mathématiques de Jussieu and ENS Paris, France	<i>p-adic Hodge theory 2</i>
15:00–15:20	Teatime	
15:20–16:20	<i>Problem session</i>	

Wednesday, July 10

9:30–10:30	David Savitt Johns Hopkins University, USA	<i>Automorphy lifting 3</i>
10:30–11:00	Teatime	
11:00–12:00	Ariane Mézard Institut de Mathématiques de Jussieu and ENS Paris, France	<i>p-adic Hodge theory 3</i>
12:00–14:00	Lunch	
14:00–15:00	Kieu Hieu Nguyen Institut de Mathématiques de Marseille, France	<i>Modular Galois representations 1</i>
15:00–15:20	Teatime	
15:20–16:20	<i>Problem session</i>	

Thursday, July 11

9:30–10:30	David Savitt Johns Hopkins University, USA	<i>Automorphy lifting 4</i>
10:30–11:00	Teatime	
11:00–12:00	Kieu Hieu Nguyen Institut de Mathématiques de Marseille, France	<i>Modular Galois representations 2</i>
12:00–14:00	Lunch	
14:00–15:00	Richard Taylor Stanford University, USA	<i>Potential modularity 1</i>
15:00–15:20	Teatime	
15:20–16:20	<i>Problem session</i>	

Friday, July 12

9:30–10:30	David Savitt Johns Hopkins University, USA	<i>Automorphy lifting 5</i>
10:30–11:00	Teatime	
11:00–12:00	Ariane Mézard Institut de Mathématiques de Jussieu and ENS Paris, France	<i>p-adic Hodge theory 4</i>
12:00–14:00	Lunch	
14:00–15:00	Richard Taylor Stanford University, USA	<i>Potential modularity 2</i>
15:00–15:20	Teatime	
15:20–16:20	<i>Problem session</i>	

Summer School Lectures

The Summer School Lectures comprise the following modules:

- Arithmetic of elliptic curves (1 lecture),
- Galois representations (3 lectures),
- Langlands conjectures (3 lectures),
- Automorphic forms (3 lectures),
- Deformation rings (3 lectures),
- p -adic Hodge theory (4 lectures),
- Automorphy lifting (5 lectures),
- Modular Galois representations (2 lectures),
- Potential modularity (2 lectures).

A main reference for the Summer School Lectures is the Arizona Winter School 2013 lecture notes on Modularity Lifting Theorems of Toby Gee, available at:

https://www.ma.imperial.ac.uk/~tsg/Index_files/ArizonaWinterSchool2013.pdf

For p -adic Hodge theory, a main reference is the CMI Summer School 2009 lecture notes on p -adic Hodge theory of Olivier Brinon and Brian Conrad, available at:

<https://math.stanford.edu/~conrad/papers/notes.pdf>

Sunday, July 7 (Advanced Talks)

Modular functoriality in the Local Langlands correspondence

Tony Feng

University of California, Berkeley, USA

I will discuss a proof, under technical assumptions, of conjectures of Treumann and Venkatesh concerning functoriality in the Local Langlands correspondence between reductive groups in the defining characteristic of a prime order automorphism.

The categorical local Langlands program

David Hansen

National University of Singapore, Singapore

I will recall the categorical local Langlands conjecture of Fargues-Scholze, and outline a proof strategy for many groups, in particular for GL_n .

Spectral side of the categorical local Langlands

Teruhisa Koshikawa

Research Institute for Mathematical Sciences, Kyoto University, Japan

The spectral side of the categorical local Langlands conjecture is roughly the derived categories of coherent sheaves on the moduli of L-parameters. In a joint project with Bertoloni Meli, we aim to study the structure of such categories, with connections to eigensheaves in a generalized sense and Adams-Barbasch-Vogan packets. I will give an introduction to these ideas.

Langlands reciprocity for reductive groups

Sug Woo Shin

University of California, Berkeley, USA

In this talk I will discuss some known results on a version of the global Langlands reciprocity conjecture from automorphic representations of a reductive group G to Galois representations valued in the C -group of G , as formulated by Buzzard-Gee (based on works by Langlands, Clozel, Fontaine-Mazur, and others). The discussion may include the role of Shimura varieties as well as some facts in group theory and representation theory.

Useful Information

The **VIASM Summer School 2024** (July 1 - July 12) includes an interlude **Number Theory on Boat Workshop** (July 6 - July 8) which will be held at Ha Long Bay, Quang Ninh Province, Vietnam. **Advanced Talks** will take place on July 7.

The Summer School will be followed by the **VIASM Annual Meeting 2024** (July 13), and then the **Pan Asia Number Theory Conference 2024 (PANT2024)** (July 15 - July 19) held at VIASM.

Lectures and **Talks**, except only for the workshop in Ha Long Bay, will be held at the **Laurent Schwartz Lecture Hall** of the **Vietnam Institute for Advanced Study in Mathematics (VIASM)**.

Teatime will be at the hallway outside of the Lecture Hall. **Wi-Fi** will be available; the detailed information of Wi-Fi access will be provided during the Summer School.

How to get to VIASM?

The address of the Vietnam Institute for Advanced Study in Mathematics (VIASM) is:

157 Chùa Láng Street, Láng Thượng Ward, Đống Đa District, Hà Nội, Việt Nam.

In English: 157 Chua Lang Street, Lang Thuong Ward, Dong Da District, Hanoi, Vietnam.

Booklet Template

This template originates from `LaTeXTemplates.com` and is based on the original version at:
https://github.com/maximelucas/AMCOS_booklet

