Spring School on non-archimedean geometry and eigenvarieties

Heidelberg, March 6 - 17, 2023

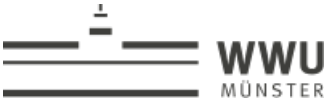
Organizers Eugen Hellmann, Judith Ludwig, Sujatha Ramdorai, Otmar Venjakob

Photo on the frontpage by Dr. Denis Vogel
Editing by Jakob Burgi and Max Witzelsperger

Contents

Acknowledgements

It is a pleasure to thank Birgit Schmoetten-Jonas and Sabine Eulentrop for their help in organizing this spring school.
We gratefully acknowledge the financial and logistical support by the Collaborative Research Center “Geometry and Arithmetic of Uniformized Structures”, the Pacific Institute for the Mathematical Sciences, the “MAThematics Center Heidelberg” (MATCH), as well as the Universities of Münster and Heidelberg.



1 Program

All lectures and talks take place in the "Hörsaal" of the Mathematikon (Address: Im Neuenheimer Feld 205).

Coffee breaks take place in the seminar room SR A+B close to the Hörsaal. The seminar room SR C will be open throughout the spring school as working space.

1.1 Week 1 (March 06 - 10)

	Mo	Tue	Wed	Thu	Fr
8:00	Registration				
9:30	Bergdall 1/4	Bergdall 3/4	Johansson 2/4	Heuer 2/4	Johansson 4/4
		coffee break			
11:00	Bergdall 2/4	Hübner 2/4	Bergdall 4/4	Hübner 4/4	Zhang
	lunch break		Problem session Coherent sheaves	lunch break	
14:00	Hübner 1/4	Hübner 3/4	conference	Johansson 3/4	Birkbeck
	coffee break		hike	coffee break	
15:30	Heuer 1/4	Johansson 1/4		Heuer 3/4	Mann
17:00	Problem session Huber pairs	Problem session Adic spaces		Problem session Perfectoid spaces	

All talks are 60 minutes long. Coffee breaks are at 10:30 and 15:00 in SR A+B, additionally coffee will be served during lunch break. The colored slots refer to the mini courses, while grey slots indicate problem sessions, other slots are research talks. The problem session on Wednesday starts at 12:15, a more detailed description is given in Section 3.4.

1.2 Week 2 (March 13 - 17)

	Mo	Tue	Wed	Thu	Fr
8:00	Registration				
9:30	Ludwig 1/4	Ludwig 3/4	Ludwig 4/4	Hellmann 3/4	Hellmann 4/4
		coffee	break		
11:00	Ludwig 2/4	Newton 2/4	Iovita 3/4	Newton 4/4	Johansson
		lunch	break		
14:00	Newton 1/4	Iovita 2/4	Hellmann 2/4	Iovita 4/4	Bellovin
		coffee	break		
15:30	Iovita 1/4	Hellmann 1/4	Newton 3/4	Pilloni	Rodrigues Jacinto
17:00				Heuer 4/4	
19:00		Conference Dinner			

All talks are 60 minutes long, with coffee breaks at 10:30 and 15:00, additionally coffee will be served during lunch break. Colored slots again refer to the mini courses, all other talks are research talks.

2 Abstracts

2.1 Mini Courses

John Bergdall: Huber rings and valuation spectra

These lectures will focus on valuation theory for topological rings. The discussion will be organized around the class of Huber rings that underlie the theory of adic spaces. We will discuss their definition, basic properties, and ring-theoretic constructions such as the subset of topologically nilpotent elements. We will further outline the theory of continuous valuations and valuations with supports on topological rings. And, depending on goals set by other lectures, we will explain technical material on spectral spaces, topology, specialization, dimension theory, and so on. Throughout, we will gather as many examples as possible and hopefully build intuition.

Katharina Hübner: Adic Spaces

Starting with a Huber pair (A, A^+) we construct its adic spectrum $X = \mathrm{Spa}(A, A^+)$. This is a certain space of continuous valuations equipped with presheafs of rings $\mathcal{O}_X$ and $\mathcal{O}_X^+$. We discuss the relevant cases when these presheaves are actually sheaves, allowing to glue adic spectra together to obtain adic spaces. In order to understand the underlying topological space of the adic spectrum of (A, A^+), we study specialization relations of points in $\mathrm{Spa}(A, A^+)$. We then take a look at analytic adic spaces. They correspond to Tate Huber pairs and are the type of adic spaces we are interested in.

Christian Johansson: Coherent sheaves on adic spaces and examples

These lectures will mostly focus on adic spaces with certain finiteness conditions, most importantly rigid spaces. We will discuss some aspects of sheaf theory and cohomology on adic spaces, and some obstructions to setting a theory of coherent/quasicoherent sheaves on general adic spaces. We will then set up the theory of coherent sheaves for rigid analytic varieties and discuss the analogues of Cartan's Theorem A and B as well as finiteness of cohomology for proper rigid spaces. The latter will necessitate a discussion of various properties of morphisms of rigid spaces, such as smoothness, étaleness and properness amongst others. Finally, we will discuss some examples of particular importance in the historic development of the theory, such as Tate's uniformization of elliptic curves with multiplicative reduction and the Drinfeld-Cerednik uniformization of Shimura curves.

Ben Heuer: Perfectoid spaces

In this course, we first define perfectoid algebras, which are certain kinds of topological rings over the p-adic integers. We discuss some basic properties, most importantly the "tilting equivalence" which gives an equivalence between perfectoid algebras in characteristic 0 and those in characteristic p.

Building on the previous lectures, we then discuss perfectoid spaces, which are adic spaces built out of adic spectra of perfectoid algebras. A basic and important result about perfectoid spaces is the almost acyclicity theorem, for which we will sketch a proof.

Finally, we discuss examples of how perfectoid spaces arise in nature, and how we can use them to study rigid spaces. For this we introduce several locally perfectoid topologies on a rigid space, namely the pro-étale and the v-topology. We then use these to discuss applications to p-adic Hodge theory.

Judith Ludwig: Spectral theory and the eigenvariety machine

In this course we explain the eigenvariety machine. This is an abstract gadget that eats spaces of p-adic automorphic forms and returns adic spaces that parametrize systems of Hecke eigenvalues of these forms. In order to build the machine, we need some results from p-adic functional analysis, which we will develop first. We will learn about compact operators on p-adic Banach spaces and understand how to geometrically handle their spectral theory. We will then study the eigenvariety machine and some of its basic properties.

James Newton: Construction of eigenvarieties

This mini-course will explain the construction of eigenvarieties in various different contexts, including the prototypical example of the Coleman-Mazur eigencurve. We will also discuss some of the common geometric properties of eigenvarieties.

Adrian Iovita: De Rham cohomology and modular forms

Plan of the course: We will focus on three main themes. We will explain the main ideas and constructions first for modular curves and than for Siegel modular varieties.

1) p-adic variation of de Rham classes on modular curves

Fix a prime $p > 2$. If $(H, \mathrm{Fil}, \nabla)$ is a triple consisting of: the relative de Rham cohomology sheaf, H, of the universal generalized elliptic curve over a modular curve X, its Hodge filtration and Gauss-Manin connection, the goal of this section is to construct sheaves of Banach modules on certain strict neighborhoods of the ordinary locus in X (seen as an adic space over $\mathrm{Spa}(\mathbb{Q}_p, \mathbb{Z}_p)$, which interpolates p-adically the family of sheaves with filtrations and connections $(\mathrm{Sym}^n(H), \mathrm{Fil}_n, \nabla_n)_{n\in\mathbb{N}}$. The neighborhoods of the ordinary locus in X are constructed first as neighborhoods of ∞ in $\mathbb{P}^1$, are pulled back by the Hodge-Tate period map to the perfectoid modular curve of infinite p-level and descended to X by Galois theory. This allows for a good understanding of the dynamic of the U_p-operator on the sections of our sheaves.

2) Given a p-adic weight k, let us denote by $(W_k, \mathrm{Fil}_k, \nabla_k)$ the result of the construction at 1) above. The Kodaira-Spencer isomorphism allows us to see the connection, i.e. the family

$$(\nabla_{k+2(n-1)} \circ \ldots \circ \nabla_{k+2} \circ \nabla_k : W_k \to W_{k+2n})_{n\in\mathbb{N}}.$$

This are interesting applications of this construction to a) triple product p-adic L-functions, for finite slope (versus ordinary) families of modular forms and b) Katz-type p-adic L-functions for cases when p is non-split in the CM field.

3) Let k be a family weight. If $(W_K, \mathrm{Fil}_k, \nabla_k)$ is the Banach sheaf with filtration and connection constructed at 1) above, we'd like to compute the finite slope part of

$$H^1_{\mathrm{dR}}(Z, W_k^*),$$

where W_k^* is the de Rham complex $\nabla_k : W_k \to W_k \otimes \Omega^1_Z$, and Z is the neighborhood of the ordinary locus in X where W_k exists. We found that the best way to do this is to use Lie-algebra methods à la BGG and find a simpler complex, quasi-isomorphic to the (uncompleted) de Rham complex, which can be described in terms of overconvergent modular forms, and which computes the finite slope part of the de Rham cohomology. This has applications to de Rham Eichler-Shimura morphisms.

4) We will explain the ideas at 1) and 3) above for Siegel threefolds (i.e. for Shimura varieties for GSp_4).

Eugen Hellmann: Eigenvarieties via locally analytic representation theory

In this course we will discuss a representation-theoretic approach to eigenvarieties using completed cohomology of locally symmetric spaces (e.g. the tower of modular curves) and Emertons locally analytic Jacquet-module. We will start by introducing the representation theoretic background, the theory of so-called locally analytic representations developed by Schneider-Teitelbaum. After that we will describe locally analytic parabolic induction (as well as a close relative of this construction) and Emertons Jacquet-module. Applying the constructions to representations obtained from the completed cohomology of modular curves we can reconstruct the eigencurve (and, if we replace the modular curves by more general Shimura varieties: more general eigenvarieties) as the support of a coherent sheaf on the (rigid analytic generic fiber of the) deformation space of Galois representations. The global sections of this coherent sheaf are identified with the dual of the Jacquet module of the completed cohomology and have an interpretation in terms of overconvergent p-adic automorphic forms. We will finish the lecture course by relating the above construction to the p-adic local Langlands program. In particular we will sketch the relation of the coherent sheaf (whose support is identified with the eigenvariety) with coherent sheaves on stacks of Galois representations that show up in categorical approaches to a (p-adic) local Langlands correspondence.

Mingjia Zhang: Perfectoid modular curve

p-Adic Shimura varieties with infinite level at p are important examples of perfectoid spaces. We discuss the example of the modular curve, the Hodge-Tate period map on it and its geometry revealed by the Hodge-Tate map. If time permits, we will review briefly some applications.

Lucas Mann: Condensed quasicoherent sheaves on adic spaces

Condensed mathematics is a recent theory by Clausen-Scholze which solves several major problems of topological algebra by redefining the notion of a topological space. We will explain the basic ideas of condensed mathematics and use them to define a category of quasicoherent sheaves on adic spaces, which seemed previously impossible. This has some immediate consequences to the theory of vector bundles (or more general coherent sheaves) on adic spaces.

Vincent Pilloni: Higher Hida theory for Hilbert modular forms

We describe the ordinary part of the coherent cohomology of Hilbert modular varieties. Along the way we establish a geometric Jacquet-Langlands correspondence. Joint with G. Boxer.

Chris Birkbeck: Overconvergent Hilbert modular forms via perfectoid methods

Following a construction of Chojecki-Hansen-Johansson, we show how to use Scholze's infinite level modular varieties and the Hodge-Tate period map to define overconvergent elliptic and Hilbert modular forms in a way analogous to the standard construction of modular forms. As an application we show that this is one way of constructing overconvergent Eichler-Shimura maps in these settings. This is joint work with Ben Heuer and Chris Williams.

Christian Johansson: The $\mathrm{SL}(2)$-eigenvariety at endoscopic points

An interesting question in the theory of eigenvarieties is to recognize classical modular forms among p-adic overconvergent ones. For example, for $\mathrm{GL}(2)$ it is known that an overconvergent eigenform whose Hecke eigenvalues agree with those of a classical eigenform is in fact classical itself. However, J. Ludwig showed by a non-constructive method that this need not be the case for $\mathrm{SL}(2)$. In this talk I will explain a way to understand and quantify this phenomenon using ideas from the geometrization of Langlands correspondences. Along the way we also obtain results on the local geometry at endoscopic points. This is joint work with Judith Ludwig.

Rebecca Bellovin: Families of Galois representations over the (extended) eigencurve

I will discuss families of Galois representations which can be constructed over the extended eigencurve. I will discuss the p-adic properties of such Galois representations, and give some applications to the structure of the extended eigencurve over the boundary of weight space.

Joaquín Rodrigues Jacinto: Solid locally analytic representations

I will explain a joint and ongoing project with Juan Esteban Rodríguez Camargo, where we develop new foundations for the theory of locally analytic representations of a p-adic Lie group through the use of condensed mathematics. As an application of this new formalism, I will explain some comparison results between different cohomology theories for solid representations.

3 General Information

3.1 Lecture Hall

The talks will take place in the **lecture hall (Hörsaal)** of the Mathematikon building, located at the address **Im Neuenheimer Feld 205**.

Note that there are three similar buildings next to each other that are all called Mathematikon. The Spring School takes place in the southernmost one of them, directly across the tram station "Bunsengymnasium" and a Shell gas station.

When entering from the (southern) main entrance, you will find the lecture hall on the ground floor at the end of the left hand wing of the building. Around halfway through the corridor leading up to the lecture hall, you find the break room (SR A+B) on the right, where the registration desk is located.

3.2 Registration

Upon your arrival it is necessary to sign in at the registration desk in the **seminar room (SR) A+B**.
Registration is **open from 8 am until 9:30 am on Monday**, the 6th of March, and on Monday, March 13 (if you are only coming for the second week). Additionally, registration is **also open during the coffee breaks from 10:30 am until 11 am on all weekdays for the entire duration of the spring school.**

At the desk you can **buy vouchers for lunch at the university cafeteria** (see Section *Restaurants* below), prices:

1) Students (student ID necessary): 5,00 €

2) Other guests: 8,00 €

Moreover, you can register for the conference dinner there. **All payments have to be made in cash (€)**.

You also receive your name tag and a water bottle there. Note that you cannot buy any beverages at the cafeteria since the vouchers are only intended for one plate of food at the buffet, so it is recommended to take your water bottle with you instead.

You can refill the bottle at the restroom, since the faucets/water-tabs in the Mathematikon yield drinking water (in fact everywhere in Germany). Additionally, there is a water fountain on the ground floor of the cafeteria building.

3.3 WiFi

Eduroam is available on the campus of Heidelberg University. Alternatively, you can use the UNI-WEBACCESS WiFi via a temporary account that is included in your personal file.

3.4 Problem Sessions

There will be four problem sessions in the first week, one for each of the mini courses. We will be discussing the content of the associated mini course, discuss relevant exercises and try to answer questions. The sessions are lead by:

Mo: Problem session on Huber pairs with Håvard Damm-Johnsen and Milan Malčić

Tue: Problem session on adic spaces with Max Witzelsperger

Wed: Problem session on coherent sheaves on adic spaces with Rustam Steingart

Thu: Problem session on perfectoid spaces with Jakob Burgi and Mingjia Zhang

3.5 Conference Hike

On Wednesday, the 8th of March, there will be a conrefence hike, taking about 2 hours. We will start at 14:15, in front of the Mathematikon main entrance (INF 205).

3.6 Conference Dinner

On Tuesday, march 14 there will be a conference dinner, starting at 7 pm at the "Bootshaus" restaurant. The address is *Schurmanstr. 2, 69115 Heidelberg*.

3.7 Restaurants

Out of a large variety of restaurants in Heidelberg the following is meant to be a subjective and by no means complete collection of nice places to check out, or to have lunch close to the venue.

To start with, here are the major options to have lunch inside the campus:

Name	Address	Cuisine
Zentralmensa	INF 304	Cafeteria with buffet (vouchers)
Café Botanik	INF 304	Snacks, Salad and Pizza (cash only)
Görtz	Berliner Str. 43	Bakery and café
BräuStadel	Berliner Str. 41	Traditional German cuisine
Bellini	INF 371	Standard italian cuisine
Neuenheim Döner	Furtwänglerstr. 13	Best Döner in town, cheap & fast

University cafeteria "Zentralmensa": With one voucher (bought at the registration desk) you can **fill one plate at the buffet** ("Ausgabe B") each day. The buffet is **reached via the stairs (marked with the letter B or color red)** that come up right after entering through the front entrance of the cafeteria building.
Note that the **vouchers can only be used for the buffet**, and you can only use them for **exactly one plate per lunch**.
Please recall that payment for the conference dinner and canteen vouchers at the registration desk is only possible in cash (€).

In the vicinity of the old town, we can recommend the following restaurants:

Name	Address	Description
La Bruschetta	Plöck 56	Both foodstore and tiny restaurant, right from Naples
Soban	Zwingerstr. 21	Small and cosy korean restaurant
Konomi	Plöck 75	Japanese cafe serving a few excellent dishes, open during daytime only
Bay Jok	Bergheimer Str. 137	More expensive but great Thai cuisine, nice vegan dishes
Zum Roten Ochsen	Hauptstr. 217	German cuisine, rather expensive
Raja Rani	Friedrichstr. 15	Cheap and great Indian dishes, lots of vegan options
Schwarzer Peter	Römerstr. 34	A great and affordable place to hang out an evening

There are also the following nice restaurants in Handschuhsheim (northern part of the town, on the way to Dossenheim):

Name	Address	Description
La Locanda 26	Steubenstr. 26	Small and solid italian restaurant, great food for its price
Restaurant zum Ritter	Friedensstr. 27	Freshly made Venetian dishes.
Gilbert's Goldener Adler	Handschuhsheimer Landstraße 96	Another old original, German cuisine

3.8 Nightlife

As a student city Heidelberg has some decent bars and offers possibilities for late night activities. The hot spot is the Untere Straße which is stuffed with iconic bars and pubs, but you will also find plenty of oppotunities for a drink at the Hauptstraße, which is just one block up the road. Generally, the old town is the place to be. Both the castle viewpoint and the famous Philosophenweg are just a stone's throw away. During weekends, trams to Dossenheim leave every hour throughout the night from Bismarkplatz (see also the Getting Around Section). **Remember to take cash with you** when going out, as payment by card might not be available in your favourite bar.

Recall that most bars and pubs in Heidelberg allow to smoke inside, which is heavily made use of.

Name	Address	Description
La Fee	Untere Straße 29	Stylish cocktail bar, but rather expensive
Sonderbar*	Untere Straße 13	Crowded pub serving everything
Destille*	Untere Straße 16	Lots of shots
Max Bar*	Marktplatz 5	Popular student pub
Orange*	Ingrimstr. 26	Small but classy and cheap pub
Drugstore*	Kettengasse 10	Another small student pub
The Dubliner*	Hauptstr. 93	The usual irish pub
Vater Rhein*	Untere Neckar-Str. 20	A traditional german pub
Café Bar Grano	Kornmarkt 9	Calm café/bar serving coffee, wine and food

Here, * denotes smoking bars.

3.9 Sightseeing

Apart from the beautiful **Altstadt** (old town) with its **Old Brigde**, some famous destinations for sightseeing are **Heidelberg Castle** and the **Thingstätte**, as well as various routes for hiking in the forests and hills surrounding the city.
You could start with the **Philosopher's Path** on the northern side of the Neckar opposite the old town, about halfway up the hillside. Enjoying the phenomenal view on the old town and the castle from there, it might also help to get a sense of orientation. As for more adventurous hikes, you can explore the old trade routs along the Neckar valley, such as the **Neckarsteig**, or walk your way up to the Thingstätte, an old Nazi open air theatre.
The old town is worth a stroll on its own, with its half-timbered houses and old palais. The latter can even be explored from the inside, as a lot of them belong to **Heidelberg University**. Walking up to the castle during night time makes for a nice experience, before having a beer at one of the bars we listed above. In case you want to see the city illuminated, keep in mind that illumination of the castle, the churches and other monuments is switched off after 10 pm for energy saving reasons.
Heidelberg is one of few Unesco Cities of Literature. There are lots of public bookshelves, bookstores and antiquarian bookshops all around, usually also supplied with foreign language books. Notable ones are Antiquariat Hatry with its four floors (antiquarian, Hauptstr. 119) and the tiny artes liberales (bookstore, Kornmarkt 8).
As for a weekend trip, you might consider visiting Mannheim. Going there takes half an hour by train. Mannheim is substantially larger than Heidelberg and has a variety of museums and theatres to check out, as well as a big party scene.

3.10 Contact Information

If you have any questions regarding the Spring School, feel free to contact either of the organizers or our secretaries:

- Birgit Schmoetten-Jonas
  Phone: +49 6221 54 14241
  Email: schmoett@mathi.uni-heidelberg.de

- Sabine Eulentrop
  Phone: +49 6221 54 14238
  Email: eulentrop@mathi.uni-heidelberg.de

4 Participants

Participant		Affiliation
Agarwal	Devang	University of British Columbia
Aryampilly Jayanthan	Abhijit	Universität Bonn
Bakeberg	Jacksyn	Boston University
Bao	Chengyang	University of Chicago
Baracchini	Marco	Università Padova
Bellovin	Rebecca	University of Glasgow
Belvotagi	Poornima	University of California San Diego
Bergdall	John	University of Arkansas
Birkbeck	Chris	University of East Angelian
Böckle	Gebhard	Universität Heidelberg
Brommer-Wierig	Paul	Berlin Mathematical School
Burgi	Jakob	Universität Heidelberg
Caleca	Saverio	University of Bonn
Chiang	Hung	Columbia University
Conti	Andrea	University of Luxembourg
Damm-Johnsen	Håvard	University of Oxford
Das	Bhargab	Harish-Chandra Research Institute
El Maazouz	Yassine	U.C. Berkeley
Feng	Zachary	University of Oxford
Forrás	Ben	Universität Duisburg-Essen
Frenz	Janne	Universität Heidelberg
Fust	Paulina	University Duisburg-Essen
García Cortés	Francisco	Universidad de Sevilla
Gerth	Lucas	Universität Frankfurt
Gezmis	Oguz	Universität Heidelberg
Ghosh	Sohan	Harish Chandra Research Institute
Gräf	Peter	Boston University
He	Zhengqing	Universität Münster
Heger	Lukas	Universität Heidelberg
Hellmann	Eugen	Universität Münster
Heuer	Ben	Universität Frankfurt
Hoff	Manuel	Universität Duisburg-Essen
Hübner	Katharina	Universität Frankfurt
Imai	Naoki	University of Tokyo
Iovita	Adrian	Univ. Concordia/Padua

Jiang	Yuanyang	École Normale Supérieure de Paris
Johansson	Christian	Univ. of Gothenburg
Kansal	Kalyani	Johns Hopkins University
Kesting	Youshua	Universität Bonn
Kobak	Mateusz	Institute of Mathematics Polish Academy of Sciences
Kundu	Arnab	Universite Paris-Saclay
Lee	Yu-Sheng	Columbia University
Lee	Heejong	University of Toronto
Leonhardt	Marius	Universität Heidelberg
Lin	Milton	Johns Hopkins University
Linden	Georg	Bergische Universität Wuppertal
Littler	Annie	Boston University
Ludwig	Judith	Universität Heidelberg
Lutz	Judith	Universität Münster
Malčić	Milan	Universität Heidelberg
Maletto	Simone	University of British Columbia
Mann	Lucas	Universität Bonn
Marannino	Luca	Universität Duisburg-Essen
McDonald	Vaughan	Stanford University
Meinke	Luisa	Universität Münster
Molin	Douglas	University of Gothenburg
Newton	James	University of Oxford
Nguyen	Dac Nhan Tam	University of British Columbia
Nguyen Dang	Khai Hoan	University of Padova
Ortiz	Martin	London School of Geometry and Number Theory
Pennig	Felix	TU Darmstadt
Pilloni	Vincent	Université Paris-Saclay
Popescu	Tudor	Brandeis University
Qian	Lie	Stanford University
Raczka	Feliks	Polish Academy of Sciences
Raha	Manodeep	Mumbai,Tata Institute of Fundamental Research
Ramdorai	Sujatha	University of British Columbia
Rawson	James	University of Warwick
Rodrigues Jacinto	Joaquin	Université Paris Nord
Schneider	Marvin	Universität Heidelberg
Shavali Kohshor	Alireza	Universität Heidelberg

Sheth	Arshay	University of Warwick
Sim	Jae Hyung	University of Boston
Sprehe	Sören	Universität Bielefeld
Srinivasan	Vijay	MIT
Steingart	Rustam	Universität Heidelberg
Szachniewicz	Michal	University of Oxford
Tang	Longke	Princeton University
Tarrach	Guellem	University of Cambridge
Thatte	Vaidehee	King's College London
Venjakob	Otmar	Universität Heidelberg
Wang	Yitong	Université Paris-Saclay
Wang	Yingying	Universität Duisburg-Essen
Wear	Peter	University of Utah
Witzelsperger	Maximilian	Universität Heidelberg
Xu	Chris	UC San Diego
Yao	Zijian	University of Chicago
Yi	Zecheng	Boston University
Yin	Mulun	University of California, Santa Barbara
Zhang	Mingjia	Universität Bonn
Zhang	Xiaoyu	Universität Duisburg-Essen
Zhao	Zhipu	Trinity College, University of Cambridge
Zou	Konrad	University of Bonn

5 Public transportation

5.1 General information

Apart from the variety of buses and trams you can use to navigate the city, going via bike is also a good option as Heidelberg is a pretty compact city. There is a Nextbike station right at the Heidelberg Hauptbahnhof for example. You will also find electronic scooters all over the town.

5.2 Hotel directions

From the Heidelberg main station (Hauptbahnhof), you can get to your hotel taking the tram line 5 in the direction *Weinheim*. Depending on your hotel, the closest stations to exit at are the following:

- **Hotel Berger:** Station *Kußmaulstr.*
- **Hotel Panorama:** Station *Bismarckplatz*.
- **Hotel Midori:** Station *Dossenheim Süd*.

The stations are also marked on the tram map in the last section.

5.3 Directions for the Mathematikon (spring school venue)

The station closest to the lecture hall is **Bunsengymnasium** (near the shell gas station). From there, the Mathematikon building is directly across the street.

- **Heidelberg Main Station (Hauptbahnhof) ↦ Mathematikon:** Tram line 24 in the direction “Handschuhsheim Nord”, exiting at the station “Bunsengymnasium” (marked in blue).
- **Hotel Panorama ↦ Mathematikon:** At Bismarckplatz, enter the bus line 31 in the direction “Kopfklinik” (or “Kirschnerstraße”), exit at “Bunsengymnasium”.
- **Hotel Berger ↦ Mathematikon:** Either walk (around 10 minutes) or enter bus line 31 at the station “Mönchhofschule” and exit at “Bunsengymnasium”.
- **Hotel Midori ↦ Mathematikon:** At the station Dossenheim Süd, enter the tram 5 in the direction “Heidelberg” and exit at “Hans-Thoma-Platz”. Enter the tram line 24 in the direction “Rohrbach Süd” there, and exit at “Bunsengymnasium”. As during certain times (morning & afternoon), the tram line 24 also serves Dossenheim, you might be able to avoid switching trams as “Hans-Thoma-Platz”.

- **Mathematikon ↦ Old Town (Altstadt):** Bus line 31 (not shown on the map) going from “Bunsengymnasium” in the direction “Altstadt Uniplatz”. Another option is tram line 21, which does not stop at “Bismarkplatz”, but will take you almost there (“Seegarten” or “Altes Hallenbad”).

5.4 Tram map