

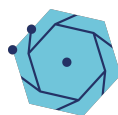
# Modular in Bielefeld

Bielefeld University

June 23 – 26, 2025



UNIVERSITÄT  
BIELEFELD



TRR  
358

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# About

## Modular in Bielefeld

The aim of the conference is to bring together researchers working in various mathematical areas where modular forms play a key role.

## Format

The conference will take four days. Early career reseachers (PhD students and early postdocs) will have the chance to present their results to experts during multiple poster sessions.

## Organizing committee

- Alfes, Claudia (Bielefeld University)
- Botero, Anna (Bielefeld University)
- Burmester, Annika (Nagoya University)
- Gehrmann, Lennart (Bielefeld University)
- Kiefer, Paul (University of Antwerp)

# Timetable

## Monday

9:30–10:30	<b>Alice Pozzi</b> Non-holomorphic Eisenstein series and obstructed modularity liftings
10:30–11:00	<b>Coffee</b>
11:00–12:00	<b>Jan Vonk</b> $p$ -Adic aspects of Maass forms
12:00–14:00	<b>Lunch</b>
14:00–15:00	<b>Ignacio Barros</b> Extremal divisors on moduli spaces of K3 surfaces
15:00–15:30	<b>Coffee</b>
15:30–16:30	<b>Brandon Williams</b> Hermitian modular forms and orthogonal modular forms

## Tuesday

9:30–10:30	<b>Riccardo Zuffetti</b> Smooth decompositions of Kudla-Millson theta functions
10:30–11:00	<b>Coffee</b>
11:00–12:00	<b>Eugenia Rosu</b> A higher degree Weierstrass function
12:00–14:00	<b>Lunch</b>
14:00–15:00	<b>Martí Roset Julià</b> Rigid cocycles for $SL(n)$ and their values at special points
15:00–15:30	<b>Coffee</b>
14:00–15:00	<b>Xenia Dimitrakopolou</b> $p$ -adic L-functions for $U(n) \times U(n+1)$
19:00	<b>Conference Dinner</b>

## Wednesday

9:30–10:30	<b>Jan-Willem van Ittersum</b> Mock Eisenstein series associated to partition ranks
10:30–11:00	<b>Coffee</b>
11:00–12:00	<b>Karin Ikeda</b> The distinct partition function via probability
12:00–14:00	<b>Lunch</b>
14:00	<b>Walk to the Bauernhausmuseum</b>

## Thursday

9:30–10:30	<b>Gabriele Bogo</b> Curves in Hilbert modular varieties
10:30–11:00	<b>Coffee</b>
11:00–12:00	<b>Robert Wilms</b> A purely algebraic intersection theory
12:00–14:00	<b>Lunch</b>
15:30–16:30	<b>Isabella Negrini</b> RM periods and Petersson pairings for rigid cocycles
15:00–15:30	<b>Coffee</b>
15:30–16:30	<b>Hanneke Wiersema</b> Crystalline liftability of irregular weights and partial weight one modularity

# List of Abstracts – Talks

## Monday

### Non-holomorphic Eisenstein series and obstructed modularity liftings

*Alice Pozzi*

University of Bristol

Since the celebrated proof of Fermat's Last Theorem, the Taylor-Wiles method has seen many generalisations—yet many aspects fail to adapt at Eisenstein primes. In this talk, we focus on the setting of weight 2 modular forms of squarefree level. We explain how a missing “degree” Hecke eigensystem, related to the absence of a holomorphic Eisenstein series of level 1, creates an obstruction to a naive formulation of modularity lifting in this setting. We formulate an “obstructed” conjecture and prove it in some cases. This is joint work in preparation with Amie Bray, Cathy Hsu, Óscar Rivero, Nike Vatsal and Carl Wang-Erickson.

### $p$ -Adic aspects of Maass forms

*Jan Vonk*

Leiden University

Following a suggestion of Blasius and Calegari, we explore some analogies between Maass wave forms and ( $p$ -adic) overconvergent eigenforms, focussing on their zero loci. This is joint work with Paolo Bordinon.

### Extremal divisors on moduli spaces of K3 surfaces

*Ignacio Barros*

University of Antwerp

We establish numerical criteria for when a Noether–Lefschetz divisor on a moduli space of quasi-polarized K3 surfaces  $F_{2d}$ , or more generally on an orthogonal modular variety, generates an extremal ray in the cone of pseudoeffective divisors. In particular, for all  $d$ , we exhibit many extremal rays of the cone of pseudo-effective divisors of both  $F_{2d}$  and any normal projective  $\mathbb{Q}$ -factorial compactification over its Baily–Borel model. This is based on joint work with L. Flapan and R. Zuffetti.

## Hermitian modular forms and orthogonal modular forms

***Brandon Williams***

University of Heidelberg

I will describe a conjectural correspondence between Hermitian modular forms of degree two and automorphic forms for the compact group  $SO(6)$  and some applications. This is joint work with Tomoyoshi Ibukiyama.

## Tuesday

### Smooth decompositions of Kudla-Millson theta functions

**Riccardo Zuffetti**

TU Darmstadt

The Kudla-Millson theta functions are Siegel modular forms with values in spaces of closed differential forms on some orthogonal Shimura variety. Although they are non-holomorphic modular forms, they become holomorphic after passing to cohomology. In joint work with Bruinier (2024), we showed that the Lefschetz decomposition of the cohomology classes of these theta functions yields a modular decomposition into Eisenstein, Klingen, and cuspidal components. In this talk, I will first review this result, and then present recent progress toward a smooth analogue of this decomposition, considering the theta functions purely as differential forms.

This is an ongoing project with Bruinier.

### A higher degree Weierstrass function

**Eugenia Rosu**

Leiden University

The Weierstrass  $\wp$ -function plays a great role in the classical theory of complex elliptic curves. A related function, the Weierstrass  $\zeta$ -function, is used by Guerzhoy to construct preimages under the  $\xi$ -operator of newforms of weight 2, corresponding to elliptic curves. In this talk, I will discuss a generalization of the Weierstrass  $\zeta$ -function and an application to harmonic Maass forms. More precisely, I will describe a construction of a preimage of the  $\xi$ -operator of a newform of weight  $k$  for  $k > 2$ . This is based on joint work with C. Alfes-Neumann, J. Funke and M. Mertens.

### Rigid cocycles for $SL(n)$ and their values at special points

**Martí Roset Julià**

McGill University

The theory of complex multiplication implies that the values of modular functions at CM points belong to abelian extensions of imaginary quadratic fields. In this talk, we propose a first step toward a conjectural extension of this phenomenon to the setting of totally real fields. Generalizing the work of Darmon, Pozzi, and Vonk, we construct rigid cocycles for  $SL(n)$ , which play the role of modular functions, and define their values at points associated with totally real fields. The construction of these cocycles originates from a topological source: the Eisenstein class of a torus bundle. This is ongoing joint work with Peter Xu.



## **$p$ -adic L-functions for $U(n) \times U(n+1)$**

***Xenia Dimitrakopolou***

Aix-Marseille Université

In this talk, I will explain how  $p$ -adically interpolating the branching law for the spherical pair  $(U(n) \times U(n+1), U(n))$  allows us to construct a  $p$ -adic L-function attached to Coleman families of cohomological representations of  $U(n) \times U(n+1)$ . Using the recent proof of the unitary Gan–Gross–Prasad conjecture, I will demonstrate that this  $p$ -adic L-function interpolates the square root of the central critical L-value, including anticyclotomic variation.

## Wednesday

### Mock Eisenstein series associated to partition ranks

*Jan-Willem van Ittersum*

University of Cologne

We introduce a new class of mock Eisenstein series, describe their modular properties, and write the partition rank generating function in terms of so-called partition traces of these. Moreover, we obtain a holomorphic anomaly equation for their completions.

### The distinct partition function via probability

*Karin Ikeda*

Kyushu University

The partition function counts the number of ways to express a natural number as a sum of positive integers. Hardy and Ramanujan proved its asymptotic formula using the circle method, and Duarte later gave an alternative proof based on probability theory.

In this talk, we introduce Duarte's method and, based on it, present proof of asymptotic formulas for various partition functions using probability theory. This is a joint work with Ram Murty (Queen's University).

## Thursday

### Curves in Hilbert modular varieties

***Gabriele Bogo***

Bielefeld University

I will motivate the study of modular forms on certain non-arithmetic Fuchsian groups. In particular, I will discuss their expansions at the cusps and their properties modulo  $p$ . This is partially joint work with Yingkun Li.

### A purely algebraic intersection theory

***Robert Wilms***

Université de Caen

In this work-in-progress talk I will present a new intersection theory for norms on rings using purely algebraic means. While the main goal of the theory is to provide a generalization and unification of geometric and arithmetic intersection theory, I will also discuss applications in the theory of modular forms.

### RM periods and Petersson pairings for rigid cocycles

***Isabella Negrini***

University of Toronto

Rigid cocycles, introduced by Darmon and Vonk in 2017, offer a promising framework to extend complex multiplication theory to real quadratic fields, suggesting a theory of “real multiplication.” They exhibit striking parallels with modular forms and are central to the emerging  $p$ -adic Kudla program.

In this talk, I will present joint work in progress with Hassan and Vatsal, in which we define RM periods for rigid cocycles and show how these periods naturally give rise to pairings on rigid cocycles — analogous to the classical Petersson inner product on modular forms.

# Crystalline liftability of irregular weights and partial weight one modularity

**Hanneke Wiersema**

University of Cambridge

Let  $p$  be an odd prime. Let  $K/\mathbb{Q}_p$  be a finite unramified extension. Let  $\rho : G_K \rightarrow \mathrm{GL}_2(\overline{\mathbb{F}}_p)$  be a continuous representation. We prove that  $\rho$  has a crystalline lift of small irregular weight if and only if it has multiple crystalline lifts of certain specified regular weights. The inspiration for this result comes from recent work of Diamond and Sasaki on geometric Serre weight conjectures. We also discuss applications to partial weight one modularity.

# Useful Information

## Directions, Location and Lecture Hall

The conference will take place in the main building of the university. The talks will be in room V2-210/216, while the coffee breaks and posters will be in room V3-201.

From Bielefeld Hauptbahnhof, one can take the subway line 4 (Lohmannshof). Get off at the stop "Universität."

## Walk to the Bauernhausmuseum

On Wednesday afternoon, we will walk together to the Bauernhausmuseum at 2 pm. It takes approximately 45 minutes. There, we'll enjoy some coffee and cake together!

## Conference Dinner

The conference dinner takes place at Numa on Tuesday at 7 pm.

## Food & Beverage

There is a number of restaurants and bars to choose from.

- Brauhaus and Hofbräu: Typical german beergarden.
- Capvin: An italian restaurant that offers good pizza.
- Bernstein: A restaurant with a nice view over the city.
- 3ck and Plan B: Burger, wraps etc. You can also get cocktails here.
- Peppers: Mexican-American kitchen and cocktails.
- S'j Ramen: You can get ramen here.
- Moccaklatsch: Vegan and vegetarian kitchen.

# List of Participants

Surname, First name	Affiliation
Alfes, Claudia	Bielefeld University
Atale, Omprakash	Pune University
Barros, Ignacio	University of Antwerp
Bieker, Patrick	Bielefeld University
Bogo, Gabriele	Bielefeld University
Bordignon, Paolo	Leiden University
Botero, Ana	Bielefeld University
Bovdi, Victor	United Arab Emirates University
Bronger, Jonas	Bielefeld University
Burmester, Annika	Nagoya University
Caralps, Carlos	Universität Duisburg-Essen
Daas, Michael	Max Planck Institute for Mathematics, Bonn
Das, Shamik	Indian Institute of Technology, Kanpur
de Preter, Ruben	University of Antwerp
De Vries, Sjoerd	Stockholm University
Dimitrakopoulou, Xenia	Aix-Marseille Université
Dombrowsky, Charlotte	Universiteit Leiden
Eibrink, Marco	Bielefeld University
Funck, Daniel	Universität Tübingen
Gehrmann, Lennart	Bielefeld University
Ghoshal, Suparno	Ruhr University Bochum
Groutides, Alexandros	University of Warwick
Guntermann, Anna	Bielefeld University
Gupta, Sarthak	University of Debrecen
Gupta, Sanyam	University of Lille
Hassan, Hazem	McGill University
Ikeda, Karin	Kyushu University
Jaffar , Eshan	Chennai Mathematical Institute
Jha, Somnath	IIT Kanpur
Johannesson, Björn	University College Dublin
Kala, Divyanshu	Indian Institute of Technology, Delhi
Kalker, Felix	Leiden University
Kettani , Ghizlane	Paris University
Kiefer, Paul	University of Antwerp
Liu, Humphrey	Hamburg University
Maksoud, Alexandre	Paderborn University
Mauth, Lukas	University of Cologne
Mazzanti, Carlo	Bielefeld University
Mehta, Pawan Singh	Indian Institute of Technology, Delhi
Mishra, Rajat	Indian Institute of Technology, Gandhinagar
Moussa, Ouannas	Engineer
Negrini, Isabella	University of Toronto

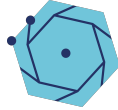
Ni Chobhthaigh, Miriam	Ulm University
Nikolakopoulos, Dimitrios	University of Tennessee, Knoxville
Pandit, Sudip	King's College London
Perea, Sinuhe	King's College London / Max Planck Institute
Pozzi, Alice	University of Bristol
Ray, Anish	Université Paris-Saclay
Rehmatullah, Aqil	Yanbu industrial college Royal Commission
Roset Julià, Martí	McGill University
Rosu, Eugenia	Leiden University
Sabri, Khadidja	University of Oran
Saha, Ekata	IIT Delhi
Saha, Biswajyoti	Indian Institute of Technology, Delhi
Saikia, Neelam	Indian Institute of Technology, Bhubaneswar
Sebbar, Abdellah	University of Ottawa
Singhal, Chirag	University of Illinois, Chicago
Strathausen, Rebekka	Bielefeld University
Swati, Swati	University of South Carolina
Tomos, Parry	Bilkent University
van Ittersum, Jan-Willem	University of Cologne
Varadhan, Murugan	Vellore Institute of Technology India
Vial, Charles	Bielefeld University
Vital, Eduardo	Universität Bielefeld
Vonk, Jan	Leiden University
Wiersema, Hanneke	University of Cambridge
Williams, Brandon	University of Heidelberg
Wilms, Robert	Université Caen
Xu, Peter	UCLA
Zhang, Pengcheng	Max Planck Institute for Mathematics
Zuffetti, Riccardo	TU Darmstadt

# Sponsors

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