Brandon Williams

CONTACT INFORMATION

University of Heidelberg
Institute of Mathematics
Im Neuenheimer Feld 205
69120 Heidelberg

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RESEARCH INTERESTS

Modular forms and their generalizations, including vector-valued modular forms, Jacobi forms, mock modular forms and automorphic forms on more general groups.

EDUCATION

University of California, Berkeley, CA

Ph.D., Mathematics **2013-2018**

- Dissertation title: *Computing modular forms for the Weil representation*
- Adviser: Prof. Richard Borcherds
- Area of Study: Automorphic forms

University of Heidelberg, Germany

M.Sc., Mathematics **2011-2013**

- Thesis title: *On elliptic curves with complex multiplication, L-functions, and p-adic interpolation*
- Adviser: Prof. Dr. Otmar Venjakob

B.Sc., Mathematics **2009-2011**

- Thesis title: *GARCH(1,1)-models*
- Adviser: Prof. Dr. Rainer Dahlhaus

EMPLOYMENT

University of Heidelberg, Germany

Postdoctoral researcher **2024-Present**

- Postdoc mentor: Prof. Dr. Georg Oberdieck

RWTH Aachen, Germany

Postdoctoral researcher **2020-2024**

- Postdoc mentor: Prof. Dr. Aloys Krieg

Technische Universität Darmstadt, Germany

Postdoctoral researcher **2018-2020**

- Postdoc mentor: Prof. Dr. Jan Bruinier

AWARDS

- 2018 Ken Ribet – Lisa Goldberg Award in Algebra (department dissertation award)
- Lehmer Fellowship in Number Theory, Spring 2018.

PUBLICATIONS

[1] Williams, B. *Poincaré square series for the Weil representation*. Ramanujan J. 47 (2018), no. 3, 605–650.

[2] Williams, B. *Vector-valued Hirzebruch–Zagier series and class number sums*. Res. Math. Sci. 5 (2018), no. 2, Paper No. 25, 13 pp.

[3] Williams, B. *Rankin–Cohen brackets and Serre derivatives as Poincaré series*. Res. Number Theory 4 (2018), no. 4, Art. 37, 13 pp.

[4] Williams, B. *Vector-valued Eisenstein series of small weight*, Int. J. Number Theory 15 (2019), no. 2, 265–287.

[5] Williams, B. *Poincaré square series of small weight*. Ramanujan J. 48 (2019), no. 3, 585–612.

[6] Williams, B. *Overpartition $M2$-rank differences, class number relations, and vector-valued mock Eisenstein series*. Acta Arith. 189 (2019), no. 4, 347–365.

[7] Pribitkin, W. and Williams, B. *Short proof of Rademacher's formula for partitions*. Res. Number Theory 5 (2019), no. 2, Art. 17, 6 pp.

[8] Williams, B. *Remarks on the theta decomposition of vector-valued Jacobi forms*, J. Number Theory 197 (2019), 250–267.

[9] Schwagenscheidt, M. and Williams, B. *Twisted component sums of vector-valued modular forms*, Abh. Math. Sem. Univ. Hamburg 89 (2019), no. 2, 151–168.

[10] Williams, B. *A construction of antisymmetric modular forms for Weil representations*, Math. Zeitschrift 296 (2020) 391–408.

[11] Williams, B. *Graded rings of paramodular forms of level 5 and 7*, J. Number Theory 209 (2020) 483–515.

[12] Williams, B. *The rings of Hilbert modular forms for Q(sqrt29) and Q(sqrt37)*, J. Algebra 559 (2020) 679–711.

[13] Wang, H. and Williams, B. *On some free algebras of orthogonal modular forms*, Adv. Math. 373 (2020), Article 107332.

[14] Williams, B. *Higher pullbacks of modular forms on orthogonal groups*, Forum Math. 33 (2021), 631–652.

[15] Wang, H. and Williams, B. *Borcherds products of half-integral weight*, J. Number Theory 238 (2022), 944–950.

[16] Williams, B. *Two graded rings of Hermitian modular forms*, Abh. Math. Sem. Univ. Hamburg 91 (2021) 257–285.

[17] Wang, H. and Williams, B. *Graded rings of Hermitian modular forms with singularities*, Manuscripta Math. 170 (2023) 283–311.

[18] Wang, H. and Williams, B. *Siegel modular forms of degree two and level five*, Ramanujan J. 60 (2023) 597–613.

[19] Hauffe-Waschbüsch, A. and Krieg, A. and Williams, B. *On Hermitian Eisenstein series of degree 2*, Funct. Approx. 68(1) (2023), 127–141.

[20] Wang, H. and Williams, B. *Projective spaces as orthogonal modular varieties*, Transform. Groups, in press.

[21] Wang, H. and Williams, B. *Simple lattices and free algebras of modular forms*, Adv. Math. 413 (2023), Article 108835.

[22] Schwagenscheidt, M. and Williams, B. *Binary theta functions and Borcherds products*, J. Number Theory 249 (2023) 441–461.

[23] Wang, H. and Williams, B. *On weak Jacobi forms of rank two*, J. Algebra 634 (2023) 722–754.

[24] Wang, H. and Williams, B. *Modular forms with poles on hyperplane arrangements*, Algebraic Geom., in press.

[25] Wang, H. and Williams, B. *Automorphic products that are singular modulo primes*, Res. Number Theory, in press.

SUBMITTED PREPRINTS

[26] Wang, H. and Williams, B. *Free algebras of modular forms on ball quotients*, 2021, arXiv:2105.14892

[27] Wang, H. and Williams, B. *The fake monster algebra and singular Borcherds products*, 2022, arXiv:2207.14518

[28] Wang, H. and Williams, B. *Mathieu moonshine and Borcherds products*, 2022, arXiv:2208.00574

[29] Wang, H. and Williams, B. *On the non-existence of singular Borcherds products*, 2023, arXiv:2301.13367

[30] Sun, K. and Wang, H. and Williams, B. *Hyperbolization of affine Lie algebras*, 2023, arXiv:2312.03234

[31] Barros, I. and Beri, P. and Flapan, L. and Williams, B. *Cones of Noether–Lefschetz divisors and moduli spaces of hyperkähler manifolds*, 2024, arXiv:2407.07622

CONFERENCES AND SEMINARS

- *Poincaré square series for the Weil representation* in *Trends in modular forms*, Daejeon, South Korea, December 19-22, 2017.
- *Computing obstruction spaces for Borcherds products* in ABKLS seminar, Aachen, Germany, February 14, 2018.
- *Vector-valued Hirzebruch-Zagier series and class number sums* in Emory University Algebra and Number Theory Seminar, April 17, 2018.
- *Class number sums* in Universität Köln Oberseminar Zahlentheorie und Modulformen, June 12, 2018.
- *Hilbert modular forms and Borcherds products* in Chalmers University of Technology, Algebraic Geometry and Number Theory Seminar, November 21, 2018.
- *Hilbert modular forms and Borcherds products* in Darmstadt Algebra Group Winter Seminar, February 22, 2019.
- *Hilbert modular forms and Borcherds products* in Dartmouth College Number Theory Seminar, May 23, 2019.
- *Higher pullbacks of modular forms on orthogonal groups* in Darmstadt Algebra Seminar, February 18, 2020.
- *Higher pullbacks of modular forms on orthogonal groups* in *Integrable systems and automorphic forms*, Sochi, Russia, February 23-27, 2020.
- *Free algebras of orthogonal modular forms* in Darmstadt Algebra Group Winter Seminar, March 13, 2020.

- *Simple lattices and free algebras of modular forms*, RWTH Aachen, January 18, 2021. (Online)
- *Simple lattices and free algebras of modular forms*, Brown University, March 1, 2021. (Online)
- *Borcherds products and a ring of Hermitian modular forms*, University of Oregon, May 3, 2021. (Online)
- *Weak Jacobi forms of rank two*, 34th Automorphic Forms Workshop, March 19, 2022. (Online)
- *Free algebras of modular forms on complex ball quotients* in Universität Bielefeld Oberseminar Gruppen und Geometrie, April 27, 2022.
- *Free algebras of modular forms on complex ball quotients* in International Seminar on Automorphic Forms, May 3, 2022. (Online)
- *Additive theta lifts that are Borcherds products* in ENTR Workshop, Darmstadt, Germany, October 27, 2022.
- *Modular products that are singular modulo primes*, KTH Royal Institute of Technology, Stockholm, June, 7, 2023.
- *Computation of vector-valued modular forms* (Lightning talk) in *LuCaNT*, ICERM, Providence, RI, July 13, 2023.
- *Computing Fourier coefficients of paramodular eigenforms*, ETH Zürich, October 20, 2023.
- *Modular forms with poles on hyperplane arrangements*, Research on Automorphic Forms, RIMS, Kyoto, Japan, January 24, 2024.
- *Modular forms that are singular modulo primes*, Seminar, Osaka University, Osaka, Japan, February 2, 2024.
- *Modular forms with poles on hyperplane arrangements*, Algebraic Geometry seminar, Sapienza University, Rome, Italy, February 28, 2024.
- *Hermitian modular forms and orthogonal modular forms*, Automorphic Forms in Budapest 2024, Budapest, Hungary, August 30, 2024.

TEACHING EXPERIENCE

RWTH Aachen, Germany

Teaching assistant **2020-present**

- Complex analysis II
- Analytic number theory
- Smart Study Start - Mathematics (Introductory mathematics course)

Technische Universität Darmstadt, Germany

Teaching assistant **2019-2020**

- Analysis II (English)
- Linear Algebra I (English)

University of California, Berkeley, CA

Instructor (GSI) **Summers 2014-2016**

- Math 16B (Analytic geometry and calculus)
- Math 54 (Linear algebra and differential equations)
- Math 110 (Linear algebra)

Teaching assistant (GSI) **2013-2017**

- Math 16A (Analytic geometry and calculus)
- Math 53 (Multivariable calculus)
- Math 54 (Linear algebra and differential equations)
- Math 55 (Discrete mathematics)
- Math H54 (Honors linear algebra and differential equations)
- Math 110 (Linear algebra)
- Math 185 (Introduction to complex analysis)
- Math 250A (Groups, rings, and fields)

Grader **Spring 2014**

- Math H185 (Honors introduction to complex analysis)

Ruprecht-Karls-Universität Heidelberg, Germany

Teaching assistant (Tutor) **2011-2013**

- Linear algebra
- Algebra 1 (field and Galois theory)
- Elementary number theory

OTHER EXPERIENCE

Ruprecht-Karls-Universität Heidelberg, Germany

- **Data mining practicum** (Summer 2012) Analyzed clusters in graphs of OSM geographic data using a variant of the PageRank algorithm.

Heidelberg Collaboratory for Image Processing, Heidelberg, Germany

- **Computer vision practicum** (Summer 2011) Used histograms of oriented gradients and related image descriptors to analyze illuminated manuscripts.

SOFTWARE

Programming languages:
- I am proficient with Python.
- I have some experience programming in C++ and Julia.

Mathematical software:
- Mathematica, MATLAB, SageMath

Other:
- TEX (LATEX, BIBTEX),
- Microsoft Office, LibreOffice, Google Docs

LANGUAGES

English, German (fluent)
Dutch, French, Russian (intermediate)