

# Nils Matthes

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## Research interests

*Modular forms and their periods, multiple zeta values and elliptic analogues, elliptic motives, string amplitudes.*

## University education and employment

- 10/2018 – **Postdoctoral Research Assistant in Mathematics**, *University of Oxford*, Principal Investigator: Prof. Francis Brown.
- 10/2017 – **Postdoctoral Fellow of the Japan Society for the Promotion of Science (JSPS)**, *Kyushu University, Fukuoka*, Academic Host: Prof. Masanobu Kaneko.
- 09/2018
- 04/2017 – **Research associate**, *Max-Planck-Institut für Mathematik, Bonn*.
- 09/2017
- 10/2013 – **PhD student**, *Department of Mathematics, University of Hamburg*, Supervisor: Prof. Ulf Kühn, Thesis topic: **Elliptic multiple zeta values**, Date of defense: 21/12/16.
- 03/2017
- 10/2011 – **M.Sc. Mathematics**, *Department of Mathematics, University of Hamburg*, Grade – 1,0, *with distinction*.
- 09/2013
- 10/2008 – **B.Sc. Mathematics**, *Department of Mathematics, University of Hamburg*.
- 09/2011

## Research stays (two weeks or more)

- 04/2019 **Modular forms, periods and scattering amplitudes**: Institute for Theoretical Sciences, ETH, Zurich.
- 01/2018 **Periods in algebraic geometry, number theory, and physics**, Hausdorff Institute for Mathematics, Bonn.
- 10/2014 **Research Trimester on Multiple Zeta Values, Multiple Polylogarithms, and Quantum Field Theory**, ICMAT, Madrid.

## Grants

- 2017 **Grant-in-aid for JSPS postdoctoral fellows**, *Total value:  $\sim \text{¥ } 2,200,000$  ( $\sim \text{€ } 18,000$ ).*

## Publications

### Journal articles

1. **An algebraic characterization of the Kronecker function**, *Res. Math. Sci.* 6 (2019), no. 3, 6:24. 11. [arXiv:1806.04948](#)
2. **On Ecalle's and Brown's polar solutions to the double shuffle equations modulo products** (w. K. Tasaka), *Kyushu J. Math.* Vol. 73 (2019), issue 2, 337–356. [arXiv:1805.09500](#)
3. **On the algebraic structure of iterated integrals of quasimodular forms**, *Algebra Number Theory* 11(9):2113–2130, 2017. [arXiv:1708.04561](#)
4. **Twisted elliptic multiple zeta values and non-planar one-loop open-string amplitudes** (w. J. Broedel, G. Richter, O. Schlotterer), *J. Phys. A.* 51(28):285–401, 2018. [arXiv:1704.03449](#)
5. **Elliptic multiple zeta values and the elliptic double shuffle relations** (w. P. Lochak, L. Schneps), *Int. Math. Res. Not. IMRN* 2021, no. 1, 695–753. [arXiv:1703.09410](#)
6. **The meta-abelian elliptic KZB associator and periods of Eisenstein series**, *Selecta Math. (N.S.)*, 24 (2018), no.4, 3217–3239. [arXiv:1608.00740](#)
7. **Elliptic double zeta values**, *J. Number Theory*, 171:227–251, 2017. [arXiv:1509.08760](#)
8. **Relations between elliptic multiple zeta values and a special derivation algebra** (w. J. Broedel, O. Schlotterer), *J. Phys. A.* 49(15):155–203, 2016. [arXiv:1507.02254](#)
9. **Elliptic multiple zeta values and one-loop superstring amplitudes** (w. J. Broedel, C.R. Mafra, O. Schlotterer), *J. High Energ. Phys.* (7), 2015. [arXiv:1412.5535](#)

### Preprints

1. **Iterated primitives of meromorphic quasimodular forms for  $SL_2(\mathbb{Z})$** . [arXiv:2101.11491](#)

### Conference proceedings

1. **Towards algebraic iterated integrals for elliptic curves via the universal vectorial extension** (w. T.J. Fonseca), *RIMS Kokyuroku*, no. 2160 (2020), 114–125. [arXiv:2009.10433](#)
2. **Overview on elliptic multiple zeta values**, to appear in “Periods in quantum field theory and arithmetic”, Springer Proceedings in Mathematics and Statistics. Eds H. Gangl, K. Ebrahimi-Fard and J. Burgos Gil. *Available upon request*.
3. **Decomposition of elliptic multiple zeta values and iterated Eisenstein integrals**, *RIMS Kokyuroku*, 2015:170–183, 2017. [arXiv:1703.09597](#)

### PhD thesis

**Elliptic multiple zeta values**, Universität Hamburg, 2016. [Link](#)

## Other

**Multiple zeta values and modular forms**, Research Case Study, 2019. [Link](#)

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## Selected Talks

### Conferences and Workshops

- 09/2019 **Motivic periods and motivic elliptic multiple zeta values**, *Elliptics '19*, Albert–Einstein–Institute, Potsdam-Golm.
- 06/2019 **Some remarks on modular graph forms**, *Supergravity Divergences and Modular Graph Forms*, Uppsala University.
- 05/2019 **Motivic elliptic multiple zeta values**, *Masterclass: Elliptic motives*, Stockholm University.
- 04/2019 **Motivic elliptic multiple zeta values**, *Workshop: Modular forms, periods and scattering amplitudes*, ETH-ITS Zurich.
- 09/2018 **Configuration spaces of Riemann surfaces and open string amplitudes**, *Elliptic integrals in mathematics and physics*, ETH-ITS, Ascona.
- 02/2018 **On Ecalle's and Brown's construction of rational solutions to double shuffle equations**, *The 11th Young Mathematicians Conference on Multiple Zeta Functions*. Ehime University, Matsuyama.
- 01/2018 **Elliptic analogues of multiple zeta values**, *Workshop: Periods and regulators*. HIM, Bonn.
- 08/2017 **Twisted elliptic multiple zeta values**, *Motives for periods*. Free University of Berlin.
- 03/2017 **Elliptic multiple zeta values and periods**, *Hot Topics: Galois theory of periods and applications*. MSRI, Berkeley.
- 03/2017 **Elliptic multiple zeta values and the elliptic depth filtration**, *Fonctions zêta Franco–Japonaises*. University Lille 1.
- 02/2017 **Elliptic and modular analogues of multiple zeta values**, *10th Kansai–Kyushu multiple zeta workshop*. Kindai University, Osaka.
- 08/2016 **The algebraic structure of elliptic multiple zeta values**, *GRT, MZVs and associators II*. Les Diablerets.
- 09/2014 **Elliptic analogues of multiple zeta values**, *Numbers and Physics 2014*. ICMAT, Madrid.

### Seminar invitations

- 09/2019 **Introduction to motivic periods**, *Séminaire Quantique*, University of Strasbourg.
- 03/2019 **Single-valued integration and superstring amplitudes**, *HET seminar*, NBI(A) Copenhagen.
- 02/2019 **Elliptic analogues of cyclotomic multiple zeta values**, *Number Theory Lunch Seminar*, MPIM Bonn.
- 02/2019 **An algebraic characterization of the Kronecker function**, *Seminar on Algebra, Geometry and Physics*, MPIM Bonn.

- 07/2018 **An algebraic characterization of the Kronecker function**, *Mathematics Seminar*, Tokyo Denki University.
- 03/2018 **The meta-abelian elliptic KZB associator and periods of Eisenstein series**, *Machikaneyama Galois seminar*. Osaka University.
- 02/2017 **Elliptic double zeta values**, *Seminar on analytic number theory*. Nagoya University.
- 04/2016 **Elliptic multiple zeta values**, *Séminaire de géométrie algébrique*. University of Montpellier II.
- 10/2015 **Elliptic double zeta values**, *Number theory seminar*. Carl von Ossietzky University, Oldenburg.
- 04/2015 **Elliptic analogues of multiple zeta values**, *Seminar on local structures in quantum field theory*. Humboldt University, Berlin.

### Events co-organised

- July 2019: **Arithmetic and Geometric Aspects of Modular Forms**, All Souls College, University of Oxford (joint w. Francis Brown & Erik Panzer).

### Professional service

- Referee for: Forum Math. Pi, Algebra Number Theory, Selecta Math. (N.S.), Commun. Number Theory Phys., Manuscripta Math., Abh. Math. Sem. Univ. Hamburg, J. Number Theory
- Reviewer for: MathSciNet, zbMATH

### Supervision experience

#### Theses (as co-supervisor)

- 2020 **Michael Lalla** (University of Hamburg), Master's thesis: *Hopf algebras of multiple zeta values and their applications in Brown's theorem*. First supervisor: Prof. Ulf Kühn
- 2015 **Rebecca Meinert** (University of Hamburg), Bachelor's thesis: *Multiple zeta values and moulds*. First supervisor: Prof. Ulf Kühn

#### Graduate student projects

- 2020 **Sebastjan Cizel** (University of Oxford), *The Riemann–Hilbert correspondence (after Deligne)*.
- 2020 **Thibault Décoppet** (University of Oxford), *Tannakian categories in differential Galois theory*.

### Teaching

- Trinity Term 2020 **Graduate Course: *Differential Galois Theory*** *University of Oxford*
- Trinity Term 2019 **Graduate Course: *Multiple Zeta Values*** *University of Oxford*

February 2019	<b>Minicourse: <i>Around integrals of modular forms for <math>SL_2(\mathbb{Z})</math></i></b>	ETH Zurich
Winter 2015/2016	<b>Lecture: <i>Preparation course for mathematical master programs</i></b>	University of Hamburg

## Teaching assistance

Hilary 2020	<b><i>Algebraic Curves</i></b>	University of Oxford
Hilary 2020	<b><i>Algebraic Number Theory</i></b>	–
Michaelmas 2019	<b><i>Galois Theory</i></b>	–
Winter 2016/2017	<b><i>Mathematics for physicists I</i></b>	University of Hamburg
Summer 2016	<b><i>Algebraic and geometric structures</i></b>	–
–	<b><i>Algebra II</i></b>	–
2015/2016	<b><i>Algebra I &amp; II</i></b>	–
Winter 2014/2015	<b><i>Linear algebra I</i></b>	–
Summer 2014	<b><i>TA: Analysis II</i></b>	–
2013/2014	<b><i>Analysis I &amp; II</i></b>	–
Winter 2012/2013	<b><i>Linear algebra I</i></b>	–
Summer 2012	<b><i>Linear algebra II</i></b>	–
–	<b><i>TA for Complex analysis I &amp; Analysis II</i></b>	–
Winter 2011/2012	<b><i>Complex analysis I</i></b>	–
–	<b><i>Lie algebras</i></b>	–
Summer 2011	<b><i>Functional analysis</i></b>	–
Winter 2010/2011	<b><i>Linear algebra I</i></b>	–
Summer 2010	<b><i>Analysis II</i></b>	–
2009/2010	<b><i>Analysis I &amp; II</i></b>	–

## Languages

German	<b>Native</b>
English	<b>Fluent</b>
French	<b>Good</b>
Japanese	<b>Beginner</b>