

Michael Groechenig

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Career

Assistant professor, University of Toronto, since July 2018

Marie Skłodowska-Curie fellow in Esnault's group at Freie Universität Berlin, 2016-2018

Chapman fellow at Imperial College London, 2013-2016

Grants/fellowships

NSERC Discovery Grant “*Arithmetic and topology of moduli spaces*” (120000CAD), 2019-2024

Marie Skłodowska-Curie individual fellowship “*Higher Epsilon-factors for Higher Local Fields*”, 2016-2018 (EU grant amounting to a total of 159,460 Euro)

EPSRC studentship for the project “Topology of the Hitchin map and arithmetics of the character variety” (covering university fees, living expenses, as well as books and travel), 2009 - 2013

Education

DPhil, University of Oxford, supervised by Tamás Hausel (2009 - 2013), doctoral exchange student at EPF Lausanne (2012 - 2013)

BSc Mathematics, ETH Zürich (2006 - 2009), *passed with distinction*

Written Work

Preprints and work in progress are listed below.

Publications

- (1) Geometric stabilisation via p-adic integration, with Dimitri Wyss and Paul Ziegler
accepted in JAMS (2020)

- (2) Mirror symmetry for moduli spaces of Higgs bundles via p-adic integration, with Dimitri Wyss and Paul Ziegler
Inventiones (2020)
- (3) Cohomologically rigid local systems and integrality, with H el ene Esnault
Selecta Mathematica (2018)
- (4) The A_∞ -structure of the index map, with Oliver Br aunling and Jesse Wolfson
Annals of K-theory 3 (2018), no. 4 (2018), 581-614.
- (5) On the normally ordered tensor product for Tate objects, duality, and applications, with Oliver Br aunling, Aron Heleodoro, and Jesse Wolfson
Theory and Applications of Categories 33 (2018), no. 1, 296-349
- (6) Adelic Descent Theory
Compositio Mathematica (2017), 153(8), 1706-1746
- (7) Relative Tate objects and boundary maps in the K-theory of coherent sheaves, with Oliver Braunling and Jesse Wolfson
Homology Homotopy Appl. 19 (2017), no. 1, 341-369
- (8) Geometric and analytic structures on the higher ad eles, with Oliver Braunling and Jesse Wolfson
Res. Math. Sci. 3 (2016), no. 22 (special volume in honour of F. Bogomolov)
- (9) Operator ideals in Tate objects, with Oliver Braunling and Jesse Wolfson
Math. Res. Lett. 23 (2016), no. 6, 1565-1631
- (10) The Index Map in Algebraic K-theory, with Oliver Braunling and Jesse Wolfson
Selecta Mathematica 24 (2018), no. 2, 1039-1091
- (11) Tate Objects in Exact Categories, with Oliver Braunling and Jesse Wolfson and an appendix by Jan  stov icek and Jan Trlifaj
Mosc. Math. J. 16 (2016), no. 3, 433-504
- (12) Moduli Problems in Abelian Categories and the Reconstruction Theorem, with John Calabrese
Algebr. Geom. 2 (2015), no. 1, 1-18.
- (13) Appendix to Cluster algebras of infinite rank by Grabowski–Gratz
J. Lond. Math. Soc. (2) 89 (2014), no. 2, 337-363
- (14) Hilbert schemes as moduli of Higgs bundles and local systems
Int. Math. Res. Not. IMRN 2014, no. 23, 6523-6575
- (15) Moduli stacks of maps for supermanifolds, joint with Tim Adamo
Adv. Theor. Math. Phys. 17 (2013), no. 6, 1303-1342
- (16) Moduli of flat connections in positive characteristic
Math. Res. Lett. 23 (2016), no. 4, 989-1047

Preprints

- (17) Hypertoric Hitchin systems and Kirchoff polynomials, with Michael McBreen
arXiv:2001.11084
- (18) De Rham epsilon factors for flat connections on higher local fields
arXiv:1807.07888
- (19) Higher de Rham epsilon factors
arXiv:1807.03190
- (20) Rigid connections, F -isocrystals and integrality, with H el ene Esnault
arXiv:1707.00752
- (21) A Generalized Contou-Carr ere Symbol and its Reciprocity Laws in Higher Dimensions, with Oliver Braunling and Jesse Wolfson
arXiv:1410.3451

In preparation

Refined motivic integration, with Oliver Br aunling, Jesse Wolfson, and Inna Zakharevich

Not intended for publication

Ad elic methods in geometry, lecture notes for a mini-course held at the University of Chicago in Spring 2016, with Oliver Braunling

Complex manifolds, lecture notes for a course held at Imperial College in spring 2016

Algebraic stacks, lecture notes for a course held at Imperial College in autumn 2014 (including contributions by students)

Talks

Invited conference talks and mini-courses

p -adic integration for Hitchin systems and the fundamental lemma, *Texas Algebraic Geometry Symposium*, Austin (February 2019)

p -adic integration for Hitchin systems and the fundamental lemma, *CMS Winter meeting*, Vancouver (November 2019)

A higher-dimensional generalisation of the epsilon connection, *p -adic cohomology and arithmetic geometry 2018*, Sendai (November 2018)

p -adic integration for the Hitchin system, *Mathematical Congress of the Americas*, Montr eal (July 2017)

p -adic integration for the Hitchin system, mini-course (4 talks) at Northwestern University, Chicago (April 2017)

Adèles and the geometry of schemes, mini-course (3 talks), Nottingham (October/November 2016)

Contou-Carrère symbol, workshop *Homotopical approaches to categories and geometry*, Freiburg (June 2016)

Adèlic methods in geometry, mini-course at the University of Chicago, April 2016, with Oliver Braunling

Adèles and the geometry of schemes, Workshop *arithmetic aspects of moduli spaces*, Lausanne (February 2016)

Higgs bundles and crepant resolutions, *COW/Categorically Cardiff*, Cardiff (October 2013)

Moduli of local systems and Geometric Langlands in positive characteristic, Workshop on *vector bundles in positive characteristic*, Nice (June 2013)

Invited seminar talks

p-adic integration for Hitchin systems and the fundamental lemma, University of Chicago (April 2020), *online, due to pandemic*

p-adic integration and hypertoric Hitchin systems, MIT (November 2019)

p-adic integration for Hitchin systems and the fundamental lemma, MIT (November 2019)

p-adic integration for Hitchin systems and the fundamental lemma, UMass Amherst (November 2019)

p-adic integration for Hitchin systems and the fundamental lemma, Colloquium, Rutgers-Newark (April 2019)

p-adic integration for Hitchin systems and the fundamental lemma, Colloquium, Western University (March 2019)

A higher-dimensional generalisation of the epsilon connection, UIUC (November 2018)

A higher-dimensional generalisation of the epsilon connection, Purdue University (November 2018)

Higgs bundles and p-adic integration, Columbia University (September 2018)

Higgs bundles and p-adic integration, University of Edinburgh (May 2018)

Rigid local systems, Universität zu Regensburg (November 2017)

Rigid local systems, Universität Zürich (October 2017)

Tate objects and algebraic K-theory, UIC (April 2017)

Refined motivic integration, University of Northwestern (April 2017)

Mirror symmetry for Higgs bundles via arithmetic geometry, CIRGET seminar at UQAM, Montréal April 2017

Adèles and the geometry of schemes, MPI Bonn (November 2016)

Adèles and the geometry of schemes, Geometry Seminar, Université de Strasbourg (March 2016)

Adèles and the geometry of schemes, Geometry Seminar, EPF Lausanne (September 2015)

Infinite-dimensional vector bundles and reciprocity, Université Toulouse III Paul Sabatier (June 2015)

Infinite-dimensional vector bundles and reciprocity, University of Edinburgh (March 2015)

The algebraic K-theory of Tate objects, Algebraic Topology Seminar, Bonn (January 2015)

Reciprocity laws for higher-dimensional varieties, Algebraic Geometry and Number Theory Seminar, Rice University, Houston (October 2014)

Delooping and Reciprocity, Algebraic and Symplectic Geometry Seminar, University of Oxford (November 2013)

Determinantal line bundles and reciprocity laws, Imperial College London (April 2013)

Higgs bundles and crepant resolutions, Freie Universität Berlin (January 2013)

Moduli of local systems and Geometric Langlands in positive characteristic, Universität Duisburg-Essen (June 2012)

Flat connections in positive characteristic: Moduli and Langlands correspondence, Leibniz Universität Hannover (December 2011)

Talks given in student seminars

An introduction to stacks, University of Toronto (February 2019)

Mini-course for graduate students on ∞ -categories in algebraic geometry (4 hours), FU Berlin (June 2017)

p -adic integration, Paris (March 2015)

p -adic integration, London (January 2015)

Loop groups, Imperial College London (February 2014)

The character theory, Eugene (OR), August 2012

Perspectives on spectra, November 2011

Fundamental groups and positive characteristic, Oxford, June 2011

Geometrization of trace formulas, Oxford, 2010

Homotopy theory of C^* -algebras, Oxford, October 2010

Introduction to descent theory, Oxford, March 2010

Research visits

Two week visit of the Simons Centre, Stony Brook, Spring 2019

Two week visit of Northwestern University, Spring 2017

Two week visit of the MFI Oberwolfach (Research in Pairs), Winter 2016

Month-long visit of the University of Chicago, Spring 2016

Ten day visit of the University of Chicago, Autumn 2014

Conferences and Summer Schools attended

Texas Algebraic Geometry Symposium, Austin, February 2019
 CMS Winter meeting, November 2018
p-adic cohomology and arithmetic geometry 2018, Sendai, November 2019
 Homotopy theory summer, Berlin, June 2018
 Motives for periods, Berlin, Autumn 2017
 Mathematical Congress of the Americas, Montréal, Summer 2017
 Representation theory and beyond, Oxford, Autumn 2016
 AMS Summer Institute in Algebraic Geometry, Salt Lake City, Summer 2015
 Geometry of moduli spaces and representation theory, Park City, PCMI Summer Session 2015
 Symmetries and Correspondences, Nottingham and Oxford, Summer 2014
 Towards a proof of the Geometric Langlands Conjectures, Jerusalem, Spring 2014
 Workshop on vector bundles in positive characteristic, Nice, Summer 2013
 Categorical Representation Theory, Eugene (OR), Summer 2012
 Representation Theory and Symplectic Algebraic Geometry, Luminy, Summer 2012
 Higher Categorical Structures and their Interactions with Algebraic Geometry, Algebraic Topology and Algebra, Luminy, Summer 2012
 Characteristic p and p -adic geometry, Mainz, Spring 2012
 Principal G -bundles, Madrid, Summer 2011
 Moduli Spaces and Moduli Stacks, New York, Spring 2011
 Flag Varieties, Luminy, Spring 2011
 Geometric Langlands and Gauge Theory, Barcelona, Spring 2010
 Sheaves in Representation Theory, Isle of Skye, Spring 2010
 The Decomposition Theorem and the Topology of Algebraic Maps, Freiburg, Winter 2010
 Geometric Methods in Representation Theory, Köln, Summer 2009

Teaching

Supervision of student projects

I'm currently supervising three beginning graduate students at the University of Toronto (one of them in co-supervision).

co-supervision of a PhD thesis by Yun Hao, Berlin 2017 - thesis completed and defended in May 2019

I proposed the topic (non-abelian Hodge theory in positive characteristic for abelian varieties) and regularly met the student for discussions.

Bachelor thesis by Joaquim Ribeiro on *p-adic integration*, Berlin 2018

Bachelor thesis by Karl Volkenandt on *Barr–Beck*, Berlin 2018

Master thesis by Sangmin Lee on *geometric representation theory*, London 2015

Master thesis by Adam Schienle on *∞ -categories*, London 2014

Second year project on *a cohomological proof of Sperner’s Lemma*, London 2014 & 2016

MSc semester project by Coralie Spahn on *sheaf cohomology*, Lausanne 2013

University of Toronto

Classical geometries, Fall 2019 and Winter 2019, University of Toronto (Mississauga)

Algebraic geometry: arithmetic techniques, Fall 2018, University of Toronto (St. George)

FU Berlin

Co-organiser of a reading group (*Forschungsseminar*) on the Langlands programme over function fields at FU-Berlin, Spring 2017

I wrote the programme for the seminar and assisted speakers in preparing their talks

Courses taught at Imperial College London

Complex manifolds, Spring Term 2016

Algebraic Stacks, Taught Course Centre, Autumn Term 2014

Manifolds, Autumn Term 2013

Teaching Assistance at EPF Lausanne

Linear Algebra for engineers, Autumn 2013

Teaching Assistance at University of Oxford

Class Teaching Seminar attended

Differentiable Manifolds, Hilary 2012

Lie Algebras, Michaelmas 2010

Analysis at St Hilda’s College, Michaelmas 2010

Galois Theory, Michaelmas 2009

Teaching Assistance at ETH Zürich

Topology, Spring 2009

Analysis I, Fall 2008

Numerical Methods, Spring 2008

Linear Algebra for civil engineers, Fall 2007

Miscellaneous

co-supervised a workshop (2.5 hours) at FU Berlin's Girl's Day (letting 12-year olds discover the joy of mathematics), with Victoria Hoskins, April 2017

Postdoc representative, Imperial College, 2015-2016

Referee for *Compositio*, *Journal of Differential Geometry*, *Math. Res. Lett.*, *Duke*, *Inventiones*, *JEMS*

co-organiser of a reading group (*Forschungsseminar*) at FU-Berlin, Spring 2017

Last updated: April 23, 2020