

Michael Groechenig

Date of Birth: July 2, 1988
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Interests

Arithmetic and algebraic geometry:

Higgs bundles and Hitchin systems

Algebraic K -theory, adèles, and n -local fields

p -adic and motivic integration

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*

Career

Chapman fellow at Imperial College London, 2013-2016

Marie Skłodowska-Curie fellow in the group of Hélène Esnault at Freie Universität Berlin, 2016-2018

Grants/fellowships

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

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 Vicky Hoskins, April 2017

Postdoc representative, Imperial College, 2015-2016

Referee for *Compositio*, *Journal of Differential Geometry and Math. Res. Lett.*

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

Written Work

Preprints and work in progress are listed below.

Publications

- (1) Adelic Descent Theory
Compositio Mathematica (2017), 153(8), 1706-1746
- (2) 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
- (3) Geometric and analytic structures on the higher adèles, with Oliver Braunling and Jesse Wolfson
Res. Math. Sci. 3 (2016), no. 22 (special volume in honour of F. Bogomolov)
- (4) Operator ideals in Tate objects, with Oliver Braunling and Jesse Wolfson
Math. Res. Lett. 23 (2016), no. 6, 1565-1631
- (5) The Index Map in Algebraic K-theory, with Oliver Braunling and Jesse Wolfson
to appear in *Selecta Mathematica*
- (6) Tate Objects in Exact Categories, with Oliver Braunling and Jesse Wolfson and an appendix by Jan Šťovíček and Jan Trlifaj
Mosc. Math. J. 16 (2016), no. 3, 433-504
- (7) Moduli Problems in Abelian Categories and the Reconstruction Theorem, with John Calabrese
Algebr. Geom. 2 (2015), no. 1, 1-18.
- (8) Appendix to Cluster algebras of infinite rank by Grabowski–Gratz
J. Lond. Math. Soc. (2) 89 (2014), no. 2, 337-363
- (9) Hilbert schemes as moduli of Higgs bundles and local systems
Int. Math. Res. Not. IMRN 2014, no. 23, 6523-6575
- (10) Moduli stacks of maps for supermanifolds, joint with Tim Adamo
Adv. Theor. Math. Phys. 17 (2013), no. 6, 1303-1342
- (11) Moduli of flat connections in positive characteristic
Math. Res. Lett. 23 (2016), no. 4, 989-1047

Preprints

- (12) On the normally ordered tensor product for Tate objects, duality, and applications, with Oliver Bräunling, Aron Heleodoro, and Jesse Wolfson

arXiv:1709.07962

- (13) Mirror symmetry for moduli spaces of Higgs bundles via p -adic integration, with Dimitri Wyss and Paul Ziegler

arXiv:1707.06417

- (14) Rigid connections, F -isocrystals and integrality, with H el ene Esnault

arXiv:1707.00752

- (15) A Generalized Contou-Carr ere Symbol and its Reciprocity Laws in Higher Dimensions, with Oliver Braunling and Jesse Wolfson

arXiv:1410.3451

In preparation

De Rham epsilon factors for n -local fields

Geometric endoscopy via p -adic integration, with Dimitri Wyss and Paul Ziegler

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 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)

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

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

Ad elic 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

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

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 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

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

co-supervision of a PhD thesis by Yun Hao, Berlin 2017 - ongoing

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

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

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