

Timo Richarz

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Research Interests

arithmetic algebraic geometry, Langlands program, moduli spaces of bundles, geometric representation theory

Positions

- 2019–25 **Professor (W1)**, *Technische Universität Darmstadt*, Germany.
- 2018–19 **Postdoc**, *Sorbonne Université*, Paris, France.
Research group of Laurent Fargues
- 2016–18 **Wiss. Mitarbeiter**, *University of Duisburg-Essen*, Germany.
Research group of Jochen Heinloth
- 2014–16 **Fellow for Teach First Deutschland**, *Dreikönigsgymnasium*, Köln, Germany.
Teaching mathematics and philosophy
- 2014 **Wiss. Mitarbeiter**, *Bonn University*, Germany.
Research group of Michael Rapoport

Studies

- 2010–14 **PhD Studies Mathematics**, *Bonn University*, Germany.
Advisor: Michael Rapoport, defended 30.01.2014 (summa cum laude)
Title: *Affine Grassmannians and Geometric Satake Equivalences*
- 2006–10 **Diploma in Mathematics**, *Bonn University*, Germany.
Advisor: Michael Rapoport, defended 21.07.2010

Funding

- 2021 Grant, *PI in ERC StG MotLang*.
- 2021 Grant, *PI in Collaborative Research Center 326 - Geometry and Arithmetic of Uniformized Structures*.
- 2021 Grant, *Partner in ERC CoG RedLang of Simon Riche*.
- 2018 Scholarship, *Deutsche Forschungsgemeinschaft*, Forschungsstipendium.
- 2010–13 Scholarship, *Max-Planck Gesellschaft*, Promotionsstipendium.
- 2008–10 Scholarship, *Studienstiftung des Deutschen Volkes*.

Research Visits

- Mar 2019 **University of Maryland**, Invitation by *T. J. Haines*, College Park MD, USA.
- Jun 2018 **École normale supérieure de Lyon**, *Groupes algébriques et géométrisation du programme de Langlands*, Lyon, France.
- Mar 2018 **University of Maryland**, Invitation by *T. J. Haines*, College Park MD, USA.
- Aug–Sep 2016 **Max-Planck Institut für Mathematik**, *Gastaufenthalt*, Bonn, Germany.
- Jul 2013 **Mathematical Sciences Research Institute**, *Fellow visitor of Peter Scholze*, Berkeley CA, USA.
- Feb–Mar 2012 **Fields Institute**, *Thematic Program on Galois Representations*, Toronto, Canada.

Sep–Dec 2010 **Harvard University**, *Fellow visitor of Michael Rapoport*, Cambridge MA, USA.
Jan–Mar 2010 **Institut Henri Poincaré**, *Galois trimester*, Paris, France.

Graduate students

Mar 2022 – Rızacan Çiloğlu.
Oct 2021 – Thibaud van den Hove.
Oct 2021 – Yassine El-Kaoui, jointly supervised with Vincent Pilloni.
Apr 2019 – Patrick Bieker.

Organization of scientific meetings

2022 Co-organizer (with U. Görtz, T. Wedhorn) of the conference “Arithmetic Algebraic Geometry” at Darmstadt.
2022 Co-organizer (with K. Hübner, H. Krieger) of the conference “Women in Arithmetic Geometry” at Heidelberg.
2022 Co-organizer (with A. Mayeux, S. Riche) of a workshop on geometric Satake at Clermont-Ferrand.
2021 Co-organizer (with O. Venjakob, M. Ulirsch) of the “Ruth Moufang Lectures” held online.
2019 Co-organizer (with T. Wedhorn) of the workshop “ ∞ -categories” at Darmstadt.

Refereed Publications (published/accepted)

with Thomas J. Haines, *Normality and Cohen-Macaulayness of Parahoric Local Models*, arXiv:1903.10585, accepted in **Journal of the European Mathematical Society**.

with Jakob Scholbach, *Tate motives on Witt vector affine flag varieties*, **Selecta Mathematica** 27 (2021), 1-34.

with Jakob Scholbach, *The motivic Satake equivalence*, **Mathematische Annalen** 380 (2021), 1595-1653.

with Thomas J. Haines, *The Test Function Conjecture for Parahoric Local Models*, **Journal of the American Mathematical Society** 34 (2021), 135-218.

with Thomas J. Haines, *Smoothness of Schubert varieties in twisted affine Grassmannians*, **Duke Math. Journal** 169 (2020), 3223-3260.

with Thomas J. Haines, *The Test Function Conjecture for Local Models of Weil-restricted groups*, **Compositio Mathematica**, 156 (2020), 1348-1404.

with Jakob Scholbach, *The intersection motive of the moduli stack of shtukas*, **Forum Mathematics, Sigma** 8 (2020), 1-99.

Spaces with \mathbb{G}_m -action, hyperbolic localization and nearby cycles, **J. Algebraic Geom.** 28 (2019), 251-289.

On the Iwahori-Weyl Group, **Bulletin de la SMF** 144 (2016), 117- 124.

Affine Grassmannians and Geometric Satake Equivalences, **Int. Math. Res. Not.** 12 (2016), 3717-3767.

with Xinwen Zhu, Appendix to Xinwen Zhu: *The Geometrical Satake Correspondence for Ramified Groups*, **Annales scientifiques de l'ENS** 48 (2015), 409-451.

A new approach to the Geometric Satake Equivalence, **Documenta Mathematica** 19 (2014), 209-246.

Schubert Varieties in Twisted Affine Flag Varieties and Local Models, **Journal of Algebra** 375 (2013), 121-147.

Preprints

with Johannes Anschütz, Ian Gleason, João N. P. Lourenço, *On the p -adic theory of local models*, arxiv.org/abs/2201.01234, 53 pages.

with Tamir Hemo, Jakob Scholbach, *Constructible sheaves and a categorical Künneth formula*, arxiv.org/abs/2012.02853, 43 pages.

with Thomas J. Haines, João N. P. Lourenço, *On the normality of Schubert varieties: Remaining cases of positive characteristic*, arXiv:1806.11001, 46 pages.

with Arnaud Mayeux, Matthieu Romgany, *Néron blowups and low-degree cohomological applications*, arXiv:2001.03597, 22 pages.

Proceedings

Categorical Künneth formula for Weil sheaves, Automorphic Forms, Geometry and Arithmetic, Oberwolfach Reports (2021).

Non-normality of Schubert varieties, Algebraic Groups, Oberwolfach Reports (2021).

Cohen-Macaulayness of local models, Arithmetic Geometry, Oberwolfach Reports (2020).

The test function conjecture for parahoric local models, Arithmetic of Shimura varieties, Oberwolfach Reports (2019).

The stack Bun and Hecke stacks, Arbeitsgemeinschaft: Higher Gross-Zagier Formulas, Oberwolfach Reports (2017).

Affine Grassmannians and Geometric Satake Equivalences, Langlands correspondence and constructive Galois theory, Oberwolfach Reports (2014).

Invited Lectures

Feb 2020 *t.b.a.*, 10h, Peking University, China, (cancelled due to Covid).

Sep 2019 *Basic geometry of affine Grassmannians*, 6h, Research School on Buildings and affine Grassmannians, CIRM, Luminy.

Oct 2018 *The geometric Satake isomorphism*, 3h, London Number Theory Study group, Imperial College, London.

Conference Talks

Jul 2022 *t.b.a.*, AMS-SMF-EMS joint meeting, Grenoble.

Sep 2021 *Motivic Satake equivalence*, Motives and Representation Theory, Münster.

Sep 2021 *Constructible sheaves on schemes*, Six Functor Formalism and Motivic Homotopy Theory, Milano.

Aug 2021 *Categorical Künneth formula for Weil sheaves*, Automorphic Forms, Geometry and Arithmetic, Oberwolfach.

Apr 2021 *Non-normality of Schubert varieties*, Algebraic Groups, Oberwolfach.

Mar 2021 *t.b.a.*, IMU-DMV Meeting, Hebrew University, Israel.
cancelled due to Covid

Jul 2020 *Cohen-Macaulayness of local models*, Arithmetic Geometry, Oberwolfach.

Oct 2019 *Singularities in the reduction modulo p of Shimura varieties*, Modularity and Moduli spaces, Oaxaca, Mexico.

Jul 2019 *The motivic Satake equivalence*, L-Functions and Geometric Representation Theory, Island of Nisyros, Greece.

Jul 2019 *Cohen-Macaulayness of parahoric local models*, Shimura varieties, representation theory and related topics, Hokkaido University, Japan.

Jun 2019 *Cohen-Macaulayness of parahoric local models*, Arithmetic Geometry in Carthage, Tunisian Academy Beit al-Hikma, Tunisia.

Jan 2019 *The test function conjecture for parahoric local models*, Arithmetic of Shimura Varieties, Oberwolfach.

- Oct 2018 *Smoothness of Schubert varieties in twisted affine Grassmannians*, Conference on the occasion of Michael Rapoport's 70th birthday, Bonn University.
- Jun 2018 *The test function conjecture for parahoric local models*, Groupes algébriques et géométrisation du programme de Langlands, ENS Lyon.
- Mar 2018 *Spaces with \mathbb{G}_m -actions and applications*, DMV Tagung, University of Paderborn.
- Apr 2017 *The stack Bun and Hecke stacks*, Higher Gross-Zagier formulas, Oberwolfach.
- Feb 2014 *Ramified geometric Satake isomorphisms*, Langlands correspondence and constructive Galois theory, Oberwolfach.

Seminar Talks

- Dec 2021 *Motive und das Langlands-Programm*, Universität Mainz.
- Jul 2021 *Reduktion von Shimura-Varietäten*, Universität Wuppertal.
- Jul 2021 *Motive und das Langlands-Programm*, LMU Munich.
- May 2021 *A categorical Künneth formula for Weil sheaves*, RAMpAGE seminar.
- Apr 2021 *The motivic Satake equivalence*, Harvard number theory seminar.
- Dec 2020 *Reduktion von Shimura-Varietäten*, Leibniz Universität Hannover.
- Sep 2020 *Reduktion von Shimura-Varietäten*, LMU Munich.
- Jul 2020 *Reduktion von Shimura-Varietäten*, University of Mainz.
- Jun 2020 *Motivische Methoden im Langlandsprogramm*, University of Duisburg-Essen.
- Jun 2020 *The motivic Satake equivalence*, Séminaire TN, Lyon.
- May 2020 *The motivic Satake equivalence*, HUJI-BGU AGNT seminar, Israel.
- May 2020 *Néron blowups and integral models of shtuka spaces*, POINTS seminar, Beijing, China.
- Jan 2020 *The motivic Satake equivalence*, Séminaires de Géométrie Arithmétique et Motivique, Université Paris 13.
- Dec 2019 *Geometry in the reduction modulo p of Shimura varieties*, Max-Planck-Institut, Bonn.
- Dec 2019 *The motivic Satake equivalence*, SAGA, Département de Mathématiques d'Orsay.
- Nov 2019 *Smoothness of Schubert varieties in affine Grassmannians*, Seminar, École Polytechnique Fédérale de Lausanne.
- Nov 2019 *The motivic Satake equivalence*, Forschungsseminar Arithmetische Geometrie, Technische Universität München.
- Jul 2019 *Geometry in the reduction modulo p of Shimura varieties*, Workshop of the GRK 2240, Bergische Universität Wuppertal.
- May 2019 *The intersection motive of the moduli stack of shtukas*, Séminaire Autour des cycles algébriques, IMJ, Paris.
- Mar 2019 *Smoothness of Schubert varieties in affine Grassmannians*, Algebra and Number Theory Seminar, Louisiana State University.
- Mar 2019 *The intersection motive of the moduli stack of shtukas*, Algebra and Number Theory Seminar, University of Maryland.
- Dec 2018 *Smoothness of Schubert varieties in affine Grassmannians*, Séminaire, Université Clermont Auvergne.
- Nov 2018 *The test function conjecture for parahoric local models*, Séminaire de théorie des nombres, Université de Caen.
- Oct 2018 *Motivic Satake Equivalence*, Seminar, Universität Heidelberg.
- May 2018 *The geometric Satake isomorphism over non-algebraically closed fields*, Séminaire Quantique, Université de Strasbourg.
- Sep 2017 *The test function conjecture for parahoric local models*, Séminaire d'arithmétique à Lyon, ENS Lyon.

- Feb 2017 *Spaces with \mathbb{G}_m -actions and applications*, Seminar des Sonderforschungsbereichs “Higher Invariants”, University of Regensburg.
- Jan 2017 *Spaces with \mathbb{G}_m -actions and applications*, Mittagsseminar zur Arithmetik, University of Münster.
- May 2014 *The geometric Satake isomorphism*, Oberseminar zur Arithmetischen Geometrie, University of Bayreuth.
- Nov 2012 *On the geometric Satake isomorphism*, Arbeitsgemeinschaft Arithmetische Geometrie, University of Paderborn.
- Nov 2012 *On the geometric Satake isomorphism*, Forschungsseminar Arithmetische Geometrie, University of Duisburg-Essen.
- Nov 2012 *Schubert varieties in twisted affine flag varieties*, Oberseminar Darstellungstheorie, Bergische Universität Wuppertal.
- Mar 2012 *On the geometric Satake isomorphism*, Thematic Program on Galois Representations, Fields Institute Toronto.

Teaching Experience

Lecture Courses

- WS 21 *Algebraic Geometry II*, TU Darmstadt, joint with Yingkun Li.
- SS 21 *Einführung in die Algebra*, TU Darmstadt.
- WS 20/21 *Introduction to the Langlands program*, TU Darmstadt.
- SS 20 *Galois cohomology*, TU Darmstadt.
- WS 19/20 *Algebraic Geometry II*, TU Darmstadt, joint with Torsten Wedhorn.
- SS 19 *Weil Conjectures*, TU Darmstadt.
- SS 19 *Algebraic Geometry I*, TU Darmstadt.
- WS 18/19 *Pro-étale cohomology*, TU Darmstadt, joint with Torsten Wedhorn.
- WS 17/18 *Didaktik der Linearen Algebra und Analytischen Geometrie*, University of Duisburg-Essen.
- SS 17 *Figuren und Abbildungen im Geometrieunterricht*, University of Duisburg-Essen.
- WS 16/17 *Didaktik der Linearen Algebra und Analytischen Geometrie*, University of Duisburg-Essen.

Seminars

- WS 20/21 *Condensed Mathematics*, TU Darmstadt/Universität Frankfurt, joint with Torsten Wedhorn.
- SS 20 *Homological Algebra and Sheaves*, TU Darmstadt/Universität Frankfurt, joint with Torsten Wedhorn.
- WS 18/19 *Prismatic cohomology*, Institut de Mathématiques de Jussieu, joint with Ariane Mezard.
- WS 17/18 *The Fargues-Fontaine curve*, University of Duisburg-Essen.
- WS 17/18 *Seminar on Stacks*, University of Duisburg-Essen, joint with Jochen Heinloth.
- WS 16–WS17 *Forschungsseminar Arithmetische Geometrie*, University of Duisburg-Essen, WS16 joint with Michael Wong.
- SS 11 *The unramified Drinfeld-Langlands Correspondence*, University of Bonn.

Assistency

- WS 13/14 Michael Rapoport, *Algebra II*, University of Bonn.
- SS 13 Michael Rapoport, *Algebra I*, University of Bonn.
- WS 12/13 Michael Rapoport, *Einführung in die Algebra*, University of Bonn.

Tutorials

Prepared and held tutorials for students.

- SS 07–WS 10 Courses in *Topology, Algebra, Complex Geometry, Linear Algebra and Analysis*.

Other Publications

Ulf Grebe, Timo Richarz, *Brennpunkt Rechenschwäche*, Mathematik lehren 201 (2017), Themenheft Inklusion.

Further Activities

Languages German (Native), English (Fluent), French (Basic), Latinum

Referee Forum Pi, ASENS, Selecta, Compositio, JIMJ, JEP, JAG, RT, ANT, Forum Sigma, IMRN

Career break

After my doctorat, 04/2014 - 07/2016, I worked full time for the non-governmental organization “Teach First Deutschland” that focusses on schools in socially troubled areas within Germany. (Similar programs include Teach for America, Teach First UK, Le Choix de l'école.) I taught mathematics, German language skills for young refugees, and built cooperations with external partners in career orientation and for supporting children with learning difficulties.

Update: March 4, 2022