

# Timo Richarz

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## Research Interests

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

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## 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

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## 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

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## Funding

- 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*.

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## 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.

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## Graduate students

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

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## 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 “ $\infty$ -categories” at Darmstadt.

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## 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.

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## Preprints

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.

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## Proceedings

*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).

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## 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.

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## 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.

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## 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.

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## 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.

### Assistancy

- 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*.

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## Other Publications

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

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## Further Activities

- Languages German (Native), English (Fluent), French (Basic), Latinum  
 Referee Forum Pi, ASENS, Selecta, Compositio, JIMJ, JEP, JAG, RT, ANT, Forum Sigma, IMRN

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## 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: December 15, 2021