

Tom Bachmann

Contact Information

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Nationality German

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Research Interests

Motivic homotopy theory, motivic cohomology, algebraic geometry
Algebraic and hermitian K-theory, higher category theory, tt-categories

Employment

- 2023– **Professor**, *JGU*, Mainz, Germany
Reine Mathematik.
- 2022 **Associate Professor**, *UiO*, Oslo, Norway
Algebra and geometry group.
- 2020–22 **Akademischer Rat auf Zeit**, *LMU Munich*, Munich, Germany
Research group of Fabien Morel.
- 2018–20 **C.L.E. Moore Instructor**, *Massachusetts Institute of Technology*, Cambridge, MA, USA
- 2017–18 **Wiss. Mitarbeiter**, *University Duisburg-Essen*, Essen, Germany
Research group of Marc Levine.
- 2016–17 **Wiss. Mitarbeiter**, *LMU Munich*, Munich, Germany
Research group of Fabien Morel.

Education

- 2020–22 **Habilitation**, *LMU Munich*
- 2013–16 **Dr. rer. nat.**, *LMU Munich*
Adviser: Fabien Morel
- 2012–13 **MMath**, *Girton College, Cambridge University*
Adviser: Ian Grojnowski
- 2009–12 **BA Hons Mathematics**, *Girton College, Cambridge University*

Grants

- Oct 2022 *Norwegian Research Council* Project 334444 “Advances in Unstable Motivic Homotopy Theory”
- Dec 2020 *Deutsche Forschungsgemeinschaft* Award BA 7141/1-1 “Motivische Algebraische Topologie” (joint with Fabien Morel, Anand Sawant and Amit Hogadi)
- May 2019 *National Science Foundation* Award DMS-1906072 “Classical methods in motivic homotopy theory”

Awards

- Mar 2023 *Best Paper Award*, awarded at the International Congress of Basic Science in Beijing, for joint work with Kong–Wang–Xu.
- Apr 2018 *Caratheodory-Preis*, awarded by the Department of Mathematics at LMU Munich for the best doctoral thesis

Organization

- 2025 *Conference Motive in Darmstadt*, University of Darmstadt. Co-organizer.
- Mar 2024 *Conference Motives in Mainz*, JGU Mainz. Co-organizer.
- Mar 2024 *Winter school on unstable motivic homotopy theory*, JGU Mainz. Main organizer.
- Aug 2022 *Motivic Geometry Conference*, University of Oslo. Co-organizer.

Publications

- Tom Bachmann. η -periodic motivic stable homotopy theory over Dedekind domains. *accepted for publication in Journal of Topology*, 2022. arXiv:2006.02086.
- Tom Bachmann. Motivic stable homotopy theory is strictly commutative at the characteristic. *accepted for publication in AiM*, 2022. arXiv:2111.02320.
- Tom Bachmann. The very effective covers of KO and KGL over Dedekind schemes. *accepted for publication in JEMS*, 2022. arXiv:2201.02786.
- Tom Bachmann, Adeel A. Khan, Charanya Ravi, and Vladimir Sosnilo. Categorical Milnor squares and K-theory of algebraic stacks. *accepted for publication in Selecta Mathematica*, 2022. arXiv:2011.04355.
- Tom Bachmann and Paul Arne Østvær. Topological models for stable motivic invariants of regular number rings. *Forum of Mathematics, Sigma*, 10, 2022. arXiv:2102.01618.
- Tom Bachmann. Cancellation theorem for motivic spaces with finite flat transfers. *Doc. Math.*, 26:1121–1144, 2021. arXiv:2006.14934.
- Tom Bachmann. Motivic Tambara Functors. *Mathematische Zeitschrift*, 297:1825–1852, 2021. arXiv:1807.02981.
- Tom Bachmann. Rigidity in étale motivic stable homotopy theory. *Algebraic & Geometric Topology*, 21(1):173–209, 2021. arXiv:1810.08028.
- Tom Bachmann. The zeroth \mathbb{P}^1 -stable homotopy sheaf of a motivic space. *Journal of the Institute of Mathematics of Jussieu*, 2021. arXiv:2003.12021.
- Tom Bachmann and Elden Elmanto. Voevodsky’s slice conjectures via Hilbert schemes. *Algebraic Geometry*, 8(5):626–636, 2021. arXiv:1912.01595.
- Tom Bachmann, Elden Elmanto, Marc Hoyois, Adeel A. Khan, Vladimir Sosnilo, and Maria Yakerson. On the infinite loop spaces of algebraic cobordism and the motivic sphere. *Épjournal de Géométrie Algébrique*, 5, 2021. arXiv:1911.02262.

Tom Bachmann and Marc Hoyois. Norms in Motivic Homotopy Theory. *Astérisque*, 425, 2021. arXiv:1711.03061.

Tom Bachmann, Hana Jia Kong, Guozhen Wang, and Zhouli Xu. The Chow t-structure on motivic spectra. *Accepted for publication in Annals of Mathematics*, 2021. arXiv:2012.02687.

Tom Bachmann and Kirsten Wickelgren. \mathbb{A}^1 -Euler classes: six functors formalisms, dualities, integrality and linear subspaces of complete intersections. *Journal of the Institute of Mathematics of Jussieu*, 2021. arXiv:2002.01848.

Tom Bachmann and Maria Yakerson. Towards conservativity of \mathbb{G}_m -stabilization. *Geometry & Topology*, 24(4):1969–2034, 2020. arXiv:1811.01541.

Tom Bachmann. Affine Grassmannians in \mathbb{A}^1 -homotopy theory. *Selecta Mathematica*, 25(2):25, Mar 2019. arXiv:1801.08471.

Tom Bachmann and Alexander Vishik. Motivic equivalence of affine quadrics. *Mathematische Annalen*, 371(1):741–751, Jun 2018. arXiv:1707.08087.

Tom Bachmann. Motivic and real étale stable homotopy theory. *Compositio Mathematica*, 154(5):883–917, 2018. arXiv:1608.08855.

Tom Bachmann. On the conservativity of the functor assigning to a motivic spectrum its motive. *Duke Math. J.*, 167(8):1525–1571, 06 2018. arXiv:1506.07375.

Tom Bachmann. Some remarks on units in Grothendieck–Witt rings. *Journal of Algebra*, 499:229 – 271, 2018. arXiv:1707.08087.

Tom Bachmann. The generalized slices of Hermitian K-theory. *Journal of Topology*, 10(4):1124–1144, 2017. arXiv:1610.01346.

Tom Bachmann. On the Invertibility of Motives of Affine Quadrics. *Documenta Math.*, 22:363–395, 2017. arXiv:1506.07377.

Preprints

Aravind Asok, Tom Bachmann, and Michael J. Hopkins. On the Whitehead theorem for nilpotent motivic spaces. arXiv:2210.05933, 2022.

Tom Bachmann. Motivic spectral Mackey functors. arXiv:2205.13926, 2022.

Tom Bachmann, Elden Elmanto, and Jeremiah Heller. Normed motivic spectra and power operations. arXiv:2210.07150, 2022.

Tom Bachmann, Elden Elmanto, and Jeremiah Heller. Splitting results for normed motivic spectra. arXiv:2210.07137, 2022.

Tom Bachmann, Elden Elmanto, and Jeremiah Heller. Motivic colimits and extended powers. arXiv:2104.01057, 2021.

Tom Bachmann and Marc Hoyois. Remarks on étale motivic stable homotopy theory. arXiv:2104.06002, 2021.

Tom Bachmann and Kirsten Wickelgren. On quadratically enriched excess and residual intersections. arXiv:2112.05960, 2021.

Tom Bachmann, Elden Elmanto, and Paul Arne Østvær. On étale motivic spectra and Voevodsky's convergence conjecture. arXiv:2003.04006, 2020.

Tom Bachmann and Michael J. Hopkins. η -periodic motivic stable homotopy theory over fields. arXiv:2005.06778, 2020.

Tom Bachmann and Jeremy Hahn. Nilpotence in normed MGL-modules. arXiv:1906.01306, 2019.

Tom Bachmann and Jean Fasel. On the effectivity of spectra representing motivic cohomology theories. 2017. arXiv:1710.00594.

Conference Talks

- Aug 2023 *A C_2 -equivariant generalization of Gabber's presentation lemma*, SPP 1786 Abschlussstagung, University of Duisburg-Essen, Essen, Germany.
- Jul 2023 *Unstable real étale motivic homotopy theory*, International Workshop on Algebraic Topology, Peking University, Beijing, China
- Jul 2023 *cdh-local motivic cohomology for singular schemes*, Homotopy theory, K-theory, and trace methods, Nijmegen, Netherlands
- Jun 2023 *Biconnectivity for motivic spaces*, A Panorama of Homotopy Theory, University of Oxford, Oxford, UK
- Aug 2022 *Rational (unstable) motivic homotopy theory*, Nordic Topology Meeting, University of Trondheim, Trondheim, Norway
- Jun 2022 *Progress in unstable motivic homotopy theory*, Harnessing motivic invariants, University of Duisburg-Essen, Essen, Germany.
- Jun 2022 *The slices of KGL over arbitrary bases*, Workshop on Algebraic K-theory, motivic cohomology and motivic homotopy theory, Isaac Newton Institute for Mathematical Sciences, Cambridge, UK
- May 2022 *Motivic stable homotopy theory is \mathbb{Z} -linear at the characteristic*, Workshop on algebraic K-theory, Mathematisches Forschungsinstitut Oberwolfach, Oberwolfach, Germany.
- Jul 2020 *Pullbacks for the Rost-Schmid complex*, Summer School "Motivic, Equivariant and Non-commutative Homotopy Theory", IHES, Paris, France (online)
- Oct 2019 *Motivic spectral Mackey functors*, SPP 1786 Jahrestagung, University of Duisburg-Essen, Essen, Germany.
- Sep 2019 *Some remarks on Euler numbers in motivic homotopy theory*, Conference on Emerging Research in Algebraic Groups, Motives, and K-Theory, Euler International Mathematical Institute, St. Petersburg, Russia
- Aug 2019 *Nilpotence in normed MGL-modules*, Workshop on Homotopy Theory, Mathematisches Forschungsinstitut Oberwolfach, Oberwolfach, Germany.
- Feb 2019 *Rigidity in p -complete étale motivic stable homotopy theory*, International Workshop on motives in Tokyo, Graduate School of Mathematics, University of Tokyo, Japan

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- Sep 2018 *From Strictly Homotopy Invariant Sheaves to Effective Homotopy Modules*, Conference on Motives and their applications, Euler International Mathematical Institute, St. Petersburg, Russia
- Aug 2018 *Motivic Tambara Functors*, Workshop on Equivariant and motivic homotopy theory, Isaac Newton Institute for Mathematical Sciences, Cambridge, UK
- Jun 2018 *Generalized Cycle Complexes*, Motivic homotopy groups of spheres III, Freie Universität Berlin, Berlin, Germany
- Jun 2018 *Affine Grassmannians in Motivic Homotopy Theory*, International Workshop on Algebraic Topology, Southern University of Science and Technology, Shenzhen, China
- Feb 2018 *Rational Contractibility as an Effectivity Criterion*, Conference on K-theory, \mathbb{A}^1 -Homotopy and Quadratic Forms, University of Warwick, Coventry, UK
- Nov 2017 *Normed Motivic Spectra*, 28th NRW Topology Meeting, University of Bielefeld, Bielefeld, Germany
- Jul 2017 *Multiplicative Transfer in Motivic Homotopy Theory*, Motives: arithmetic, algebraic geometry and topology under the white-blue sky, LMU Munich, Munich, Germany
- May 2017 *The Generalized Slices of Hermitian K-Theory*, Workshop on K-theory and related fields, HIM, Bonn, Germany
- Aug 2016 *On the invertibility of motives of affine quadrics*, The international conference in K-Theory WSU 2016, Western Sydney University, Sydney, Australia.
- Jun 2016 *The Invertibility of Quadrics in Motivic Homotopy Theory*, Second Workshop on Motivic homotopy groups of spheres, University of Duisburg-Essen, Essen, Germany.
- Feb 2016 *The Hurewicz and Conservativity Theorems for $\mathbf{SH}(k) \rightarrow \mathbf{DM}(k)$* , Workshop on Algebraic Cobordism and Projective Homogeneous Varieties, Mathematisches Forschungsinstitut Oberwolfach, Oberwolfach, Germany.

Seminar Talks

- Apr 12, 2023 *Cohomology of motivic Eilenberg–MacLane spaces*, Oberseminar Topologie, Universität Münster, Münster, Germany
- Nov 17, 2022 *Cohomology of motivic Eilenberg–MacLane spaces*, Electronic Computational Homotopy Theory Seminar
- Oct 28, 2022 *Real étale motivic homotopy theory revisited*, Geometry & Topology seminar, NMSU, NM, USA (online)
- Aug 21, 2022 *Cohomology of motivic Eilenberg–MacLane spaces*, Oberseminar Motivische Algebraische Topologie, LMU Munich, Munich, Germany
- Sep 9, 2021 *Euler classes of residual intersections*, Algebra seminar, University of Milan, Milan, Italy
- Mar 30, 2021 *Cellular motivic invariants of $\mathbb{Z}[1/2]$* , Electronic Algebraic K-Theory Seminar (online)
- Jan 26, 2021 *Cellular motivic invariants of $\mathbb{Z}[1/2]$* , UCSD topology seminar, UC San Diego, CA, USA (online)

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- Jan 21, 2021 *η -periodic motivic stable homotopy theory*, Seminar on A1-topology, motives and K-theory, Euler International Mathematical Institute, St. Petersburg, Russia (online)
- Nov 9, 2020 *η -periodic cohomology theories for algebraic varieties*, Geometry & Topology Seminar, Duke University, Durham, NC, USA (online)
- Oct 22, 2020 *The η -periodic motivic image of j spectrum over fields*, Electronic Computational Homotopy Theory Seminar
- Oct 8, 2020 *η -periodic motivic stable homotopy theory*, Motivic geometry seminar series, Centre for advanced study, Oslo, Norway (online)
- Apr 21, 2020 *Stabilization in classical, equivariant and motivic homotopy theory*, SFB-Seminar, University of Regensburg, Regensburg, Germany (online)
- Feb 25, 2020 *η -periodic motivic stable homotopy theory*, Warwick algebraic topology seminar, University of Warwick, Coventry, UK
- Jan 13, 2020 *η -periodic motivic stable homotopy theory*, Oberseminar Topologie, WWU Münster, Münster, Germany
- Oct 14, 2019 *Euler numbers for motivic extraordinary cohomology theories*, Geometry & Topology Seminar, Duke University, Durham, NC, USA
- Sep 16, 2019 *η -periodic motivic stable homotopy theory*, Topology Seminar, Massachusetts Institute of Topology, Cambridge, MA, USA
- Jun 19, 2019 *Inverting spherical Bott elements*, UiO Topology Seminar 2019, University of Oslo, Oslo, Norway
- Feb 20, 2019 *Affine Grassmannians in motivic homotopy theory*, Pick My Brain Seminar, Northeastern University, Boston, MA, USA
- Jan 17, 2019 *p -complete étale motivic stable homotopy theory*, Oberseminar Motivische Algebraische Topologie, LMU Munich, Munich, Germany
- Jan 3, 2019 *Motivic Tambara Functors*, Algebra/Topology Seminar, University of Copenhagen, Copenhagen, Denmark
- Dec 7, 2018 *Power operations in normed motivic spectra*, Topology Seminar, University of Minnesota, Minneapolis, MN, USA
- Nov 29, 2018 *Power operations in normed motivic spectra*, Electronic Computational Homotopy Theory Seminar
- Nov 20, 2018 *Power operations in normed motivic spectra*, Topology Seminar, University of Chicago, Chicago, IL, USA
- Nov 12, 2018 *Affine Grassmannians in motivic homotopy theory*, Geometry and Topology Seminar, Georgia Institute of Technology, Atlanta, GA, USA
- Nov 5, 2018 *Rigidity in étale motivic stable homotopy theory*, Algebra Seminar, University of Southern California, Los Angeles, CA, USA
- Oct 2, 2018 *Affine Grassmannians in Motivic Homotopy Theory*, Algebraic Geometry Seminar, Harvard/MIT, Cambridge, MA, USA
- Sep 24, 2018 *Power Operations in Normed Motivic Spectra*, Topology Seminar, Massachusetts Institute of Topology, Cambridge, MA, USA

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- May 3, 2018 *Loop Groups in \mathbb{A}^1 -Algebraic Topology*, Oberseminar Motivische Algebraische Topologie, LMU Munich, Munich, Germany
- Mar 2, 2018 *Motivic and Real Étale Stable Homotopy Theory*, Journées réelles du CHL, Université de Rennes 2, Rennes, France
- Aug 1, 2017 *Motivic Normed Spectra*, SFB-Seminar, University of Regensburg, Regensburg, Germany
- Jul 27, 2017 *Highly Commutative Objects in Motivic Homotopy Theory*, Kepler-Kolloquium, University of Regensburg, Regensburg, Germany
- Jul 11, 2017 *Real Realisation in Motivic Stable Homotopy Theory*, University of Münster, Münster, Germany
- May 11, 2017 *Units in Grothendieck-Witt rings and dreams of multiplicative motivic infinite loop space theory*, Research Seminar Arithmetic Geometry 2017, University Duisburg-Essen, Essen, Germany
- Nov 22, 2016 *The Generalized Slices of Hermitian K-Theory*, UiO Topology Seminar 2016, University of Oslo, Oslo, Norway
- Nov 2, 2016 *Real Realisation in Motivic Homotopy Theory*, Oberseminar Topologie, University of Wuppertal, Wuppertal, Germany
- Oct 25, 2016 *Geometric Fixed Point Functors for Motives*, SFB-Seminar, University of Regensburg, Regensburg, Germany
- Jun 7, 2016 *$\mathrm{SH}(k)_2^-$ and the Real Étale Topology*, Topology Seminar, University of Osnabrück, Osnabrück, Germany.

Teaching Experience

Professor, JGU Mainz

SS 2023 Algebraische Topologie 1

SS 2023 Seminar Kategorientheorie

Associate Professor, University of Oslo

SS 2022 Commutative Algebra

Lehrassistent, LMU Munich

WS 2021/2 Algebraic Number Theory

WS 2021/2 Presheaves with transfers (responsible for complete course)

SS 2021 Algebraic Geometry 2

SS 2021 Galois Cohomology (responsible for complete course)

WS 2020/1 Algebraic Geometry 1

SS 2020 Mathematik II für Physiker / Linear Algebra Lehramt (joint with Serj Aristarhov)

SS 2020 Algebra II (joint with Maksim Zhykovich)

Instructor, Massachusetts Institute of Technology

Fall 2019 Seminar in Topology (18.904)

Spring 2019 Algebraic Topology II (18.906)

Recitation Instructor, Massachusetts Institute of Technology

Tom Bachmann

Fall 2018 Multivariable Calculus (18.02)

Dozent, *University Duisburg-Essen*

SS 2018 Algebraic Topology 2 (joint with Daniel Harrer and Fangzhou Jin)

WS 2017 Algebraic Topology 1 (joint with Daniel Harrer)

SS 2017 Algebraic Geometry 4 (joint with Daniel Harrer and Marc Levine)

Lehrassistent, *LMU Munich*

WS 2013 Analysis für Informatiker und Statistiker (joint with Sebastian Gottwald)

Supervision of students

2022– Co-adviser of PhD student Nikolai Opdan at University of Oslo

2020– Co-adviser of PhD student Ola Sande at University of Oslo

2019 Advising for four MIT undergraduate students (regarding classes to choose, graduate schools to apply to, etc.).

Expository works

2021 Online mini course and accompanying notes “Algebraic K -theory from the viewpoint of motivic homotopy theory” at Peking University

2019 With Elden Elmanto: “Notes on motivic infinite loop space theory” accompanying a series of talks at the Harvard Thursday seminar

Updated: Aug 28, 2023