

Helge Ruddat

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Mathematics inspired by mirror symmetry

Employment

- since 2023 **Professor**, *Univ. Stavanger, Norway*, since Mar 2023
- 2022-2023 **Associate professor**, *Univ. Stavanger, Norway*, Nov 2022-Mar 2023
- 2018-2022 **Acting professor**, *Univ. Hamburg*, Sep 2018-Mar 2022
Substituting the chair for Complex Analytic Geometry
- 2015-2022 **Emmy-Noether junior research group leader**, *JGU Mainz*, Jun 2015-Oct 2022
- 2016 **Member**, *Institute for Advanced Study, Princeton*, Sep-Dec
- 2011-2015 **Postdoc**, *JGU Mainz*
Carl Zeiss stipendiary from Oct 2012-Mar 2015
- 2013 **Postdoc**, *Fields Institute*, Toronto, Jun.-Dec
Fields Postdoctoral Fellow, Calabi–Yau program of Noriko Yui
- 2010-2011 **Postdoc**, *UC Berkeley*
DFG fellow, mentor: Denis Auroux
- 2009-2010 **Consultant**, *KPMG*, Frankfurt
Senior Associate for Financial Risk Management (13 months)

Education

- 2008 **PhD (Mathematics)**, *Univ. Freiburg*, 2008/09/17, magna cum laude
“Log Hodge Groups on a Toric Calabi-Yau Degeneration”, advisor: Bernd Siebert
- 2005 **Diplom (Mathematics)**, *Univ. Freiburg*, 2005/11/15, grade A+
“Partial resolution of toric log Calabi-Yau spaces”, advisor: Bernd Siebert
- 2004 **Postgraduate diploma of science**, *University of Auckland*, 2004/09/23, w. distinction
- 2000-2001 **Community service**, *vocational training facility for mentally challenged youth*,
Timmendorfer Strand (11 months)
- 2000 **A-levels**, *Halepaghen-Schule*, Buxtehude 2000/06/27, grade A+

Organisation of Workshops and Conferences

- 2025 Nordfjordeid School, joint with Martin Gulbrandsen and Jørgen Rennemo
- 2025 Three week program at IMSA in Singularities and Mirror Symmetry, joint with José Seade and Javier Fernández de Bobadilla

- 2024 Oberwolfach Workshop: [Real and Logarithmic Enumerative Geometry](#)
- 2023 [Algebraic Geometry in the Daylight](#), Univ. Stavanger, Organiser
- 2022 [Stavanger Geometri Julemøte](#), Univ. Stavanger, Organiser
- 2021-2022 [Kolloquium für Reine Mathematik](#), Univ. Hamburg, Organiser
- 2019 Oberwolfach Workshop: [Logarithmic Enumerative Geometry and Mirror Symmetry](#)
- 2018 [Spring School: Enumerative Invariants from Differential Graded Lie Algebras and Categories](#), Montegufoni Castle, Italy
- 2015-2022 [Emmy Noether Kolloquium](#), JGU Mainz, Organiser
- 2016 [Spring School on Irregular Hodge Structures and Stability Conditions](#), JGU Mainz
- 2013 [Concentrated Graduate Course on Enumerative Geometry and Physics](#), Fields Institute Toronto, Canada
- 2012 Workshop on *Hodge theoretic aspects of mirror symmetry*, JGU Mainz

Professional Service

- 2013-2024 PhD referee for Edvard Aksnes (Oslo), Evgeny Goncharov (Cambridge), Luca Battistella (IC London), Hung Ming Tsoi, Tim Gräfnitz (Hamburg), Simon Felten (Mainz)
- 2024 Co-organizer for the program welcoming the 2024 Abel Prize winner in Stavanger
- 2024 Committee member for the restructuring of the master in math and physics at UiS
- 2023-2024 Team leader of the geometry and analysis group's national evaluation of mathematical science research ([EVALMIT](#))
- 2023 External master thesis examiner for Sasha Hannisdal (Oslo)
- 2022-2023 Recruiting outreach for math and physics master program at University Stavanger
- 2018-2022 Coordinator for the course content planning of the math. faculty at Univ. Hamburg
- 2018-2022 Committee member for the selection of stipendiaries for Deutschlandstipendium
- 2017-2018 Committee member to hire a W3 professor in Algebraic Geometry, JGU Mainz
- 2011- Referee for
Adv. Math., Algebraic Geometry, BzAuG, Central Eur.J.Math., Complex Manifolds, Compositio, Crelle, Duke Math. J., EJM, Exper. Math., Forum Math. Pi, Geom. & Topol., IJM, IMRN, Inventiones Math., JAG, JAMS, JEMS, JDG, JLMS, J. Symplectic Geom., Manuscripta Math., Math. Annalen, Nagoya Math. J., Nucl. Phys. B, PLMS, PJM, SIGMA
- 2017- MathSciNet reviewer
- 2009-2013 Mentor for stipendiaries of the German National Academic Foundation in Frankfurt

Outreach

- 2023 Presentations for professional school teachers on the visualization software "Surfer"
- 2023 Panel discussion and presentation "Differences and similarities between mathematics and physics", Uni Stavanger, Sep 5, 2023

- 2023 Newspaper article "[Ny matematikk som virker både her og der](#)", appeared in print in Stavanger Aftenblad on May 22, 2023
- 2023 Public Interview at the announcement of the Abel prize winner in 2023, University Library of Stavanger, Mar 22, 2023
- 2016 Calabi-Yau Degenerations and Related Geometries, presentation of my Emmy Noether research to a general science audience, presented on July 16, 2015 at the Emmy Noether annual meeting in Potsdam

Grant acquisition

- 2023 DFG Sachbeihilfe "Hilbertschemata logarithmischer Punkte", joint with C.Liedtke, 181k€
- 2015-2022 Emmy Noether grant: "Degeneration of Calabi-Yau manifolds and related geometries", 940k€+overhead
- 2016-2019 Carl Zeiss-foundation grant for Felten's PhD position: "Differentiell graduierte Lie-Algebren in der logarithmischen Geometrie", 36k€
- 2014 JGU Mainz preparatory grant third party funding application, 7k€
- 2014-2016 ANR- and DFG-Grant: "Mirror symmetry and irregular singularities coming from Physics", contributor
- 2013 DFG research scholarship: "Hodge Theory of Log Singular Loci", 28k€
- 2012-2015 Carl Zeiss fellowship: "Conifold Transitions via Toric Degenerations", 160k€
- 2010-2011 DFG research fellowship: "Toric Degenerations and Calabi-Yau orbifolds", 35k€
- 2006 National Academic Science Foundation PhD scholarship, 30k€

Industry work experience

- 2009-2010 Consulting of 6 major banks in restructuring and valuation of toxic assets during the subprime crisis

Honors

- Sep 2023 Plenary Lecturer at IberoSing Congress 2023
- Okt 2022 Invited Speaker Memorial Conference Bumsig Kim
- Jan 2018 Team Award of JGU Mainz
- Sep-Dec 2016 Invited Member at the Institute for Advanced Study in Princeton Sep-Dec 2016 for the homological mirror symmetry program
- May 2015 Invitation for an interview for the START prize, Austria (among top 15 of 82 proposal applications), declined by me since incompatible with Emmy Noether fellowship
- Feb 2015 Emmy Noether fellowship (like ERC starting grant, 15% success rate)

Recent Invited Talks

- Jun 2024 *TBD*, Toric and Tropical Techniques in Symplectic Field Theory, Mittag-Leffler Institute, Jun 24-28, Stockholm
- Jan 2024 *Degenerations and Periods*, Mørketidens Mattemøte, Jan 19, Tromsø

- Dec 2023 *Global Smoothings of Toroidal Crossing Varieties*, Algebraic Geometry Seminar, Dec 6, Frankfurt
- Dec 2023 *Theta functions for the projective plane relative a smooth cubic*, Algebraic Geometry Seminar, Dec 5, Darmstadt
- Nov 2023 *Homological Mirror Symmetry*, IberoSing Congress, 6 plenary lectures, Nov 6-10, Granada
- Sep 2023 *How to make log structures*, Workshop on Deformation Theory II, Sep 11-15, ICTP Triest
- Jul 2023 *Quantum theta functions*, 29th Nordic Congress of Mathematicians, Jul 3-7, Aalborg, Denmark
- Nov 2023 *Clusters, twistors and stability conditions*, GLEN workshop - Derived Categories, Hodge theory and Singularities, Jun 28-30
- May 2023 *Tropical Geometry beyond Toric Varieties*, Oberwolfach Workshop "Tropical Methods in Geometry"
- Sep 2022 *The proper Landau-Ginzburg potential is the open mirror map*, Bumsig Kim memorial conference, Sep 19-23, Kias, Seoul
- Sep 2022 ~~TBD, Workshop on Periods in Mirror Symmetry at ICMS, Edinburgh~~ baby born
- Sep 2022 ~~TBD, "BPS states, mirror symmetry and ex. WKB II", Sep 5-9, Sheffield~~ baby born
- Jun 2022 *Tropical Quantum Field Theory, Mirror Polyvector Fields and Multiplicities of Tropical Curves*, ICTS Program "Combinatorial Algebraic Geometry: Tropical and Real", Tata Institute of Fundamental Research, Jun 27-Jul 8, Bengaluru, India
- Jun 2022 *Oberwolfach Research Fellow*, Jun 5-11, Oberwolfach
- May 2022 *The proper Landau-Ginzburg potential is the open mirror map*, Workshop: Curves and K3 surfaces, Bonn, Mai 9-13
- Apr 2022 *Torus fibrations and period integrals*, Essen
- Mar 2022 *Global Smoothings of Toroidal Crossing Varieties*, Séminaire d'algèbre, topologie et géométrie Année, Mar 24, Nice
- Mar 2022 *Periods and Degenerations*, seminar, Mar 06, Nottingham
- Jan 2022 *Periods and Degenerations*, seminar, Jan 21, Stavanger
- Jan 2022 *Smoothing Toroidal Crossing Fano Varieties*, geometry seminar, Jan 14, Liverpool
- Dec 2021 *The proper Landau-Ginzburg potential is the open mirror map*, conference "Online Workshop on Mirror symmetry and Related Topics", Dec 15, Kyoto
- Dec 2021 *Fano manifolds from smoothing toroidal crossing varieties*, Zoom Algebraic Geometry Seminar, Dec 9, Edinburgh
- Dec 2021 *Muster in Geometrie und mathematischer Physik*, Dec 7, UBW Munich
- Nov 2021 *Global Smoothings of Toroidal Crossing Varieties*, CIRM conference "Faces of Singularities", Nov 22-26, Luminy
- Oct 2021 *Periods and Degenerations*, Oct 14, Cardiff
- Sep 2021 *Smoothing Toroidal Crossing Fano Threefolds*, Sep 1, MCCME Moscow
- May 2021 *Polytopes, Periods, Degenerations*, May 26, Nottingham

- May 2021 *Periods and Degenerations*, May 14, Sheffield
- Feb 2021 *Integration and Degeneration*, Feb 4, Univ. Amsterdam
- Oct 2020 *Periodenintegrale und Torusfaserungen*, Oct 14, LMU Munich
- Sep 2020 *Advances in smoothing normal crossing varieties*, two talks at online 3CinG Workshop 2020, 'Algebraic and tropical geometry', Sep 16-18
- Sep 2020 *Toroidal crossing spaces, log structures and smoothings*, Imperial College London seminar, online, Sep 3
- Mar 2020 *Smoothings and Periods*, Mar 12, Univ. of Bristol
- Mar 2020 *Topological Mirror Symmetry*, Mar 5, Kansas State University
- Feb 2020 *Finite order period integrals in normal crossing K3 degenerations*, Feb 19, Lisbon
- Jan 2020 *Smoothing normal crossing varieties*, Jan 28, seminar in Sheffield UK
- Dec 2019 *Introduction to Strominger-Yau-Zaslow torus fibrations*, Dec 9 and *Recent progress on SYZ torus fibrations via the Gross-Siebert program* on Dec 16 at MATRIX program "Tropical Geometry and Mirror Symmetry", Creswick, Victoria, Australia
- Sep 2019 *Smoothing toroidal crossing varieties*, lecture series, Workshop on Mirror Symmetry and Fano Manifolds II, Chicheley UK
- Sep 2019 *Smoothing toroidal crossing varieties*, conference on "Homological Mirror Symmetry and Self Organized Criticalities", inaugural event for the Institute of the Mathematical Sciences of the Americas, Univ. Miami
- May 2019 *Periods and Degenerations*, HU Berlin
- Apr 2019 *From algebraic curves to tropical curves to Lagrangian submanifolds*, MFO workshop "Tropical Geometry: new directions", Oberwolfach
- Mar 2019 *From tropical 1-cycles to period integrals and analyticity of smoothings*, AMS Spring Central and Western Joint Sectional Meeting, Section "Special Session on SYZ Mirror Symmetry and Enumerative Geometry", University of Hawaii at Manoa, Honolulu
- Mar 2019 *From algebraic curves to tropical curves to Lagrangian submanifolds*, colloquium, Kansas State University, Manhattan KS
- Mar 2019 *Period integrals from wall structures*, M-seminar, Kansas State University, Manhattan KS
- Mar 2019 *Introduction to toric degenerations and their smoothings*, graduate minicourse, Kansas State University, Manhattan KS
- Feb 2019 *A Tropical TQFT that computes multiplicities of tropical curves*, Geometry seminar, UT Austin
- Feb 2019 *Smoothing toroidal crossing varieties*, geometry seminar, Cambridge
- Jan 2019 *Smoothing toroidal crossing varieties*, Research Seminar, Univ. Hannover
- Oct 2018 *From algebraic curves to tropical curves to Lagrangian submanifolds*, Pure Math colloquium, Univ. Hamburg
- Oct 2018 *Smoothing toroidal crossing varieties*, conference "Recent developments in Higgs theory", HSE Moscow
- Oct 2018 *Smoothing toroidal crossing varieties*, seminar, Seattle

Publications

Google Scholar citations are given in square brackets [532 in total], top 5 articles marked by *.

Peer reviewed journal publications

1. *Tropical quantum field theory, mirror polyvector fields, and multiplicities of tropical curves*, IMRN 4, **2023**, 3249–3304. [free access link](#). (with Travis Mandel) [21 cit.]
2. *The degeneration formula for stable log maps*, Manuscripta Math. 170(1-2), **2023**, 63–107. [o.a. link](#). (with Bumsig Kim, Hyenho Lho) [34 cit.]
3. *A homology theory for tropical cycles on integral affine manifolds and a perfect pairing*, Geom. Topol. 25(6), **2021**, 3079–3132, [open access link](#). [21 cit.]
4. *Smoothing toroidal crossing spaces*, Forum Math. Pi 9:e7, **2021**, 1–36, [open access link](#). (with S. Felten, M. Filip) *[30 cit.]
5. *Tailoring a pair of pants*, Adv. Math. 381, **2021**, 107622, 1–26. (with I. Zharkov) [12 cit.]
6. *Period integrals from wall structures via tropical cycles, canonical coordinates in mirror symmetry and analyticity of toric degenerations*, Publ. Math. IHÉS 132, **2020**, 1–82. (with B. Siebert) *[68 cit.]
7. *Tropically constructed Lagrangians in mirror quintic threefolds*, Forum Math. Sigma 8:e58, **2020**, 1–55, [open access link](#). (with Cheuk Yu Mak) [23 cit.]
8. *Descendent Log Gromov-Witten Invariants for Toric Varieties and Tropical Curves*, Trans. Amer. Math. Soc. 373(2), **2020**, 1109–1152. (with T. Mandel) *[57 cit.]
9. *Local Gromov-Witten Invariants are Log Invariants*, Adv. Math. 350, **2019**, Pages 860-876. (with Michel van Garrel, Tom Graber) *[48 cit.]
10. *Perverse Curves and Mirror Symmetry*, J. Algebraic Geom. 26, **2017**, 17–42. [9 cit.]
11. *Towards Mirror Symmetry for Varieties of General Type*, Adv. Math. 308, **2017**, 208–275. (with M. Gross, L. Katzarkov) *[66 cit.]
12. *Skeleta of Affine Hypersurfaces*, Geom. Topol. 18(3), **2014**, 1343–1395. (with N. Sibilla, D. Treumann, E. Zaslow) [30 cit.]

Peer reviewed proceedings publications

1. *Compactifying torus fibrations over integral affine manifolds with singularities*, 2019-20 MATRIX Annals, MATRIX Book Series 4, **2021**, 609–622, <https://www.matrix-inst.org.au/2019-matrix-annals/> (with I. Zharkov) [15 cit.]
2. *Motivic Zeta Functions of the Quartic and its Mirror Dual*, Proc. Symp. Pure Math. 93, String-Math, **2014**, 189–200. (with J. Nicaise, P. Overholser) [2 cit.]
3. *An Introduction to Hodge Structures*, Calabi-Yau Varieties: Arithmetic, Geometry and Physics, Fields Institute Monographs 34, **2015**, 83–130. (with S. Filippini, A. Thompson) [12 cit.]
4. *Enumerative aspects of the Gross-Siebert program*, Calabi-Yau Varieties: Arithmetic, Geometry and Physics, Fields Institute Monographs 34, **2015**, 337–420. (with P. Overholser, M. van Garrel) [13 cit.]

5. *Mirror duality of Landau-Ginzburg models via Discrete Legendre Transforms*, in *Homological Mirror Symmetry and Tropical Geometry*,
Lect. Notes Unione Mat. Ital. 15, **2014**, 377–406. [8 cit.]
6. *Log Hodge groups on a toric Calabi-Yau degeneration*,
Contemp. Math. 527, AMS, Providence, RI, **2010**, 113–164.
PhD thesis [29 cit.]

Preprints

1. *Local uniqueness of approximations and finite determinacy of log morphisms*,
submitted, www.arxiv.org/abs/1812.02195, 20p. [4 cit.]
2. *The proper Landau-Ginzburg potential is the open mirror map*,
positive report at Advances in Math. in January 2024,
www.arxiv.org/abs/2204.12249, 60p. (with Tim Gräfnitz, Eric Zaslow) [9 cit.]
3. *How to make log structures*, 42p.
<https://arxiv.org/abs/2312.13867> (with Alessio Corti) [1 cit.]

In Preparation

1. *Clusters, twistors and stability conditions*, 40p. (with Tom Bridgeland) [0 cit.]
2. *Deformations of Tropical Polarized K3 Surfaces*, 50p. (with Diego Matessi) [0 cit.]
3. *Topological Strominger-Yau-Zaslow fibrations*, (with Ilia Zharkov) [17 cit.]
4. *Lagrangian Strominger-Yau-Zaslow fibrations*, (with C.Y. Mak, D. Matessi, I. Zharkov) [0 cit.]
5. *Enumerative Period Integrals from Wall Structures in Landau-Ginzburg Models*,
(with M. v. Garrel, B. Siebert) [0 cit.]
6. *Quantum theta functions from open mirror symmetry*, (w. T. Gräfnitz, E. Zaslow, B. Zhou) [0 cit.]

Diplom thesis

Partielle Auflösung eines torischen log-Calabi-Yau-Raumes, **2005**,
<http://www.freidok.uni-freiburg.de/volltexte/6162/>,
Diplom thesis [2 cit.]

As Editor

2019 *Logarithmic enumerative geometry and mirror symmetry*,
Oberwolfach Rep. 16, **2019**, no. 2, 1639–1695. (with D. Abramovich, M. v. Garrel)