

Nima Rasekh

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Professional Positions

- Oct 2024–
Now **Postdoctoral Fellow**, *Universität Greifswald*, Greifswald
- Jul 2024–
Now **Quantum Formalism Fellow**, *Zaiku Group Ltd*, Remote
- Sep 2022–
Sep 2024 **Postdoctoral Fellow**, *Max-Planck-Institut für Mathematik*, Bonn
- Jun 2022 **Academic Visitor**, *Centre de Recerca Matemàtica*, Barcelona
- Feb 2020 **Academic Visitor**, *Institut des Hautes Études Scientifiques*, Bures-sur-Yvette
- Sep 2019–
Aug 2022 **Postdoctoral Fellow**, *École Polytechnique Fédérale de Lausanne*, Lausanne
- Mar 2019 **Academic Visitor**, *Czech Academy of Sciences*, Prague
- Sep 2018–
Aug 2019 **Postdoctoral Fellow**, *Max-Planck-Institut für Mathematik*, Bonn

Education

- 2013–2018 **Ph.D. in Mathematics**, *University of Illinois at Urbana-Champaign*
Adviser: Dr. Charles Rezk
- 2012–2013 **M.S. in Mathematics**, *University of Western Ontario*
- 2008–2012 **B.S. in Mathematics**, *Shiraz University*

Publications

Published

- Published **A homotopy coherent nerve for (∞, n) -categories**, joint with Lyne Moser & Martina Rovelli, arXiv:2208.02745, DOI:10.1016/j.jpaa.2024.107620
Journal of Pure and Applied Algebra
- Published **A Model for the Higher Categories of Higher Categories**, arXiv:1805.03816
Theory and Applications of Categories
- Published **Univalent Double Categories**, joint with Niels van der Weide, Benedikt Ahrens & Paige North, arXiv:2310.09220, DOI:10.1145/3636501.3636955
Certified Programs and Proofs 2024
- Published **Yoneda Lemma for Simplicial Spaces**, arXiv: 1711.03160, DOI:10.1007/s10485-023-09734-z
Applied Categorical Structures

- Published **Cartesian Fibrations of Complete Segal Spaces**, arXiv:2102.05190, DOI:10.21136/HS.2023.03
Higher Structures
- Published **Constructing Coproducts in Locally Cartesian Closed ∞ -Categories**, *joint with Jonas Frey*, arXiv:2108.11304, DOI:10.4310/HHA.2023.v25.n1.a4
Homology, Homotopy and Applications
- Published **Thom spectra, higher THH and tensors in ∞ -categories**, *joint with Bruno Stonek & Gabriel Valenzuela*, arXiv:1911.04345, DOI:10.2140/agt.2022.22.1841
Algebraic & Geometric Topology
- Published **Cartesian Fibrations and Representability**, arXiv:1711.03670, DOI:10.4310/HHA.2022.v24.n2.a7
Homology, Homotopy and Applications
- Published **Quasi-Categories vs. Segal Spaces: Cartesian Edition**, arXiv:2102.05192, DOI:10.1007/s40062-021-00288-2
Journal of Homotopy and Related Structures
- Published **Filter Quotients and Non-Presentable $(\infty, 1)$ -Toposes**, arXiv:2001.10088, DOI:10.1016/j.jpaa.2021.106770
Journal of Pure and Applied Algebra
- Published **Every Elementary Higher Topos has a Natural Number Object**, arXiv:1809.01734
Theory and Applications of Categories
- Published **The cotangent complex and Thom spectra**, *joint with Bruno Stonek*, arXiv:2005.01382, DOI:10.1007/s12188-020-00226-8
Abhandlungen aus dem Mathematischen Seminar der Universität Hamburg
- Submitted
- Submitted **(∞, n) -Limits II: Comparison across models**, *joint with Lyne Moser & Martina Rovelli*, arXiv:2408.04742
- Submitted **Insights From Univalent Foundations: A Case Study Using Double Categories**, *joint with Niels van der Weide, Benedikt Ahrens & Paige North*, arXiv:2402.05265
- Submitted **(∞, n) -Limits I: Definition and first consistency results**, *joint with Lyne Moser & Martina Rovelli*, arXiv:2312.2312.11101
- Submitted **An (∞, n) -categorical straightening-unstraightening construction**, *joint with Lyne Moser & Martina Rovelli*, arXiv:2307.07259
- Submitted **Cosmological Unstraightening**
- Submitted **Twisted Arrow Construction for Segal Spaces**, *joint with Chirantan Mukherjee*, arXiv:2203.01788
- Submitted **Shadows are Bicategorical Traces**, *joint with Kathryn Hess*, arXiv:2109.02144
- Submitted **Yoneda Lemma for \mathcal{D} -Simplicial Spaces**, arXiv:2108.06168
- Submitted **Univalence in Higher Category Theory**, arXiv:2103.12762
- Submitted **An Elementary Approach to Truncations**, arXiv:1812.10527
- Submitted **A Theory of Elementary Higher Toposes**, arXiv:1805.03805
- Preprint
- Preprint **Complete Segal Objects**, arXiv:1805.03561
- Preprint **Yoneda Lemma for Elementary Higher Toposes**, arXiv:1809.01736

- Preprint **An Introduction to Complete Segal Spaces**, arXiv:1805.03131
- Preprint **RGB image-based data analysis via discrete Morse theory and persistent homology**, with C. Du, C. Szul, A. Manawa, R. Guzman, R. Davidson, arXiv:1801.09530

Awards and Certificates

- Spring 2018 **Campus Award for Excellence in Undergraduate Teaching**, *University of Illinois*, 2000\$
- Spring 2018 **LAS Award for Excellence in Undergraduate Teaching by a Graduate Teaching Assistant**, *College of Liberal Arts and Sciences*, 2000\$
- Fall 2016 **Departmental TA Instructional Award**, *Department of Mathematics*, 500\$
- Spring 2016 **Teaching Scholar Certificate**, *Center for Innovation in Teaching and Learning*, University of Illinois
- Spring 2016 **Graduate Teaching Certificate**, *Center for Innovation in Teaching and Learning*, University of Illinois
- Spring 2016 **Foundations of Teaching Certificate**, *Center for Innovation in Teaching and Learning*, University of Illinois
- 2013–2017 On List of Teachers Ranked as Excellent (x6) and listed as Outstanding (x1)

Fellowships and Research Funds

- Summer 2019 **Research Funds to organize the Summer School on Higher Topos Theory and Univalent Foundations**, 5000£, joint with Nicola Gambino and Karol Szumilo, University of Leeds
- Summer 2018 **Departmental Research Assistantship**, 2270.5\$, University of Illinois
- Spring 2018 **Hogan Fellowship**, 9966.56\$, University of Illinois
- Summer 2017 **Departmental Research Assistantship**, 9136.01\$, University of Illinois
- Spring 2017 **R.H. Schark & B.G. Trjitzinsky Fellowship**, 4885.19\$, University of Illinois
- Summer 2015 **Departmental Research Assistantship**, 4342.72\$, University of Illinois
- Summer 2013 **Research Experience for Graduate Students Summer**, Advisor: Charles Rezk, Computational Aspects of Topological Modular Forms, 2000\$

Talks and Presentations

Invited Talks

- August 2024 **Homotopical Algebra and Higher Structures**, *Formalizing Higher Categories*, Mathematisches Forschungsinstitut Oberwolfach
- July 2024 **Forschungsseminar Algebra / Geometrie / Topologie**, *The Power of Computers: Formalizing (Higher) Mathematics*, Universität Greifswald
- April 2024 **Conference on (∞, n) -Categories and Their Applications**, *(∞, n) -Limits II: Fibrational Approach and Properties*, Universiteit Utrecht
- Feb 2024 **Topology Seminar**, *A Univalence Maxim for Category Theory*, University of Minnesota
- Feb 2024 **Research Seminar on Quantum Topology and Categorification**, *Double Categorical Methods in Higher Mathematics*, Universität Hamburg
- Jan 2024 **Certified Programs and Proofs 2024**, *Univalent Double Categories*, London

- Nov 2023 **Oberseminar Logik**, *Formalizing (Double) Categories*, Bonn Universität
- Nov 2023 **Dutch Categories And Types Seminar**, *Univalent Double Categories*, Radboud University Nijmegen
- Sept 2023 **Interactions of Proof Assistants and Mathematics**, *Formalizing Categories*, Universität Regensburg
- July 2023 **Topologie Seminar**, *Limits in $(\infty, 2)$ -Categories*, Universität Regensburg
- July 2023 **Category Theory 2023**, *Limits in (∞, n) -Categories*, Université catholique de Louvain
- June 2023 **Seminar on Geometric Methods in Mathematics**, *Formalizing (Double-)Categories*, Technische Universität Dresden
- Mai 2023 **Beyond finite sets - Homotopy Theory and Combinatorics**, *∞ -Categories and Finite Sets*, University of Copenhagen
- Apr 2023 **Working Group 6 Type Theory Meeting**, *Category Theory of Universes*, Technische Universität Wien
- Apr 2023 **Workshop on Homotopy Type Theory/Univalent Foundations 2023**, *Higher Topoi as Internal Higher Categories*, Technische Universität Wien
- Feb 2023 **Sémantique Seminar**, *Category Theory of Universes*, IRIF
- Feb 2023 **EPFL Topology Seminar**, *What is a topological structure?*, EPFL
- Dec 2022 **Oberseminar Topologie**, *Hochschild Homology via homotopy-coherent Shadows*, WWU Münster
- Oct 2022 **Topology & Geometry Seminar**, *Higher Algebra in non-classical Mathematics*, Norges teknisk-naturvitenskapelige universitet
- Oct 2022 **eCHT Networking Event**, *Homotopy Invariant Mathematical Foundations*
- Oct 2022 **Algebraic Topology, in memory of Hans-Joachim Baues**, *Contributed talk: Algebraic topology in non-classical mathematics*, Max Planck Institute for Mathematics
- May 2022 **PSSL 106**, *Stone Spaces and Integer Objects*, Masaryk University
- Jan 2022 **HoTTTEST Event for Junior Researchers 2022**, *Constructing Coproducts in locally Cartesian closed ∞ -Categories*
- Dec 2021 **Topology Seminar**, *THH and Shadows of Bicategories*, University of Warsaw
- Nov 2021 **Topology Seminar**, *THH and Shadows of Bicategories*, Bilkent University
- Nov 2021 **Topology Seminar**, *Filter Quotient ∞ -Categories*, Universität Regensburg
- Oct 2021 **Geometry and Topology Seminar**, *THH and Shadows of Bicategories*, Binghamton University
- Oct 2021 **Topology Seminar**, *Shadows are bicategorical Traces*, University of Kentucky
- Oct 2021 **Warwick Algebraic Topology Seminar**, *Shadows are bicategorical Traces*, University of Warwick
- Aug 2021 **Category Theory 2021**, *Fibrations of (∞, n) -Categories*, Università di Genova
- Jun 2021 **Toposes online**, *Every Elementary Higher Topos has a Natural Number Object*
- Jun 2021 **8th European Congress of Mathematics**, *Towards Non-Presentable Models of Homotopy Type Theory*
- Apr 2021 **Homotopy Type Theory Seminar**, *Every Elementary Higher Topos has a Natural Number Object*, Carnegie Mellon University
- Feb 2021 **OCHoTop Zoom Seminar**, *Non-Standard Truncations*

- Nov 2020 **Florida State University Homotopy Theory Seminar**, *Thom spectra, higher THH and Tensors in ∞ -Categories*
- Nov 2020 **Homotopy Type Theory Electronic Seminar**, *Filter Products and Elementary Models of Homotopy Type Theory*
- July 2020 **Workshop on Homotopy Type Theory/Univalent Foundations 2020**, *A Step towards Non-Presentable Models of Homotopy Type Theory*
- Mar 2020 **Topics in Category Theory**, *An Elementary Approach to Localizations*, University of Edinburgh
- Feb 2020 **Topology Seminar**, *An Elementary Approach to Truncation*, Université Paris XIII
- Feb 2020 **Groupe de Travail: Catégories Supérieures, Polygraphes et Homotopie**, *Fibrations for Segal spaces*, Institut de Recherche en Informatique Fondamentale
- Feb 2020 **Topology Seminar**, *Truncations Revisited*, Université de Paris
- Jan 2020 **SU Topology Seminar**, *Thom spectra, higher THH and Tensors in ∞ -Categories*, Stockholms Universitet
- Jan 2020 **SU Logic Seminar**, *An Example of an Elementary Higher Topos that is not a Grothendieck Higher Topos*, Stockholms Universitet
- Dec 2019 **Bochum Topology Seminar**, *Thom spectra, higher THH and Tensors in ∞ -Categories*, Bochum Universität
- Jul 2019 **Category Theory 2019**, *A Theory of Elementary $(\infty,1)$ -Toposes*, University of Edinburgh
- Jun 2019 **Summer School on Higher Topos Theory and Univalent Foundations**, *Elementary Higher Toposes*, University of Leeds
- Jun 2019 **Early Career Topology Researchers Conference**, *An Axiomatic Approach to Algebraic Topology*, Sheffield University
- Mar 2019 **CAS Topology Seminar**, *An Axiomatic Approach to Algebraic Topology*, Czech Academy of Sciences
- Feb 2019 **EPFL Topology Seminar**, *An Axiomatic Approach to Algebraic Topology*, EPFL
- Feb 2019 **Homotopy Type Theory Electronic Seminar**, *Algebraic Topology in an Elementary Higher Topos*
- Jan 2019 **Higher Geometric Structures along the Lower Rhine XII**, *An Axiomatic Approach to Algebraic Topology*, Radboud University Nijmegen
- Oct 2018 **Oberseminar Topologie**, *Fundamental Group and Natural Number Objects*, Bonn University
- Mar 2018 **AMS Sectional Meeting (Special Session in Homotopy Theory)**, *A Theory of Elementary Higher Toposes*, Ohio State University
- Feb 2018 **Ohio Topology Seminar**, *A Theory of Elementary Higher Toposes*, Ohio State University
- Jan 2018 **Rochester Topology Seminar**, *A Theory of Elementary Higher Toposes*, University of Rochester
- Jan 2018 **Joint Mathematical Meetings 2018**, *Analyzing RGB Images using Topology*, San Diego
- Nov 2017 **ND Topology Seminar**, *A Theory of Elementary Higher Toposes*, Notre Dame University

- Nov 2017 **Algebraic Topology Seminar**, *A Theory of Elementary Higher Toposes*, University of Chicago
- Nov 2017 **UIC Algebraic K-Theory Seminar**, *A Theory of Elementary Higher Toposes*, University of Illinois Chicago
- Nov 2017 **Graduate Student Colloquium**, *Higher categories: What's up with that?*, University of Illinois at Urbana Champaign
- Oct 2017 **JHU Topology Seminar**, *A Theory of Elementary Higher Toposes*, Johns Hopkins University
- Oct 2017 **Northwestern Topology Seminar**, *A Theory of Elementary Higher Toposes*, Northwestern University
- Oct 2017 **Graduate Student Homotopy Seminar**, *Why Higher Categories come into Topological Field Theories*, University of Illinois at Urbana Champaign
- Sept 2017 **UVA Topology Seminar**, *A Theory of Elementary Higher Toposes*, University of Virginia
- Sept 2017 **Purdue Topology Seminar**, *A Theory of Elementary Higher Toposes*, Purdue University

Selected List of Talks

- June 2018 **Talbot Workshop 2018**, *Other approaches to model-independent ∞ -category theory*, Government Camp, OR
- July 2017 **Homotopy Theory: Tools and Applications**, *Representable Cartesian Fibrations*, University of Illinois at Urbana Champaign
- April 2017 **Topology Seminar**, *Representable Cartesian Fibrations*, University of Illinois at Urbana Champaign
- April 2017 **AMS Sectional Meeting (Special Session in Homotopy Theory)**, *Composition Fibrations*, Indiana University
- May 2016 **Workshop on Homotopy Type Theory and Univalent Foundations**, *Complete Segal Objects and Univalent Maps*, Fields Institute, Toronto
- April 2016 **Graduate Student Geometry Topology Conference 2016**, *A new Approach to the Straightening Construction*, Indiana University
- Feb 2016 **Graduate Student Geometry Topology Seminar**, *Yoneda Lemma and the Fundamental Group*, University of Illinois at Urbana Champaign
- Nov, 2014 **Graduate Student Homotopy Seminar**, *Complete Segal Objects*, University of Illinois at Urbana Champaign
- Oct, 2014 **Graduate Student Geometry Topology Seminar**, *Topos Theory: Sketches of an Elephant*, University of Illinois at Urbana Champaign
- Apr, 2013 **Talbot Workshop 2013**, *The Chromatic Spectral Sequence*, South Lake Tahoe, CA

Teaching Experience

Projects Supervised at Max-Planck-Institut für Mathematik

- Fall 2023 - **M.Sc. Thesis**, *Theofanis Chatzidiamantis Christoforidis*, Bonn University
- Spring 2024 **Thesis Topic**: Formalizing Higher Categories
- Spring 2023 **B.Sc. Thesis**, *Deborah Stein*, Bonn University
- Project Topic**: Classical Topology in Higher Topos Theory

Fall 2022 - **M.Sc. Thesis**, Qi Zhu, Bonn University
Spring 2023 **Thesis Title**: Fractured Structure on Condensed Anima

Courses taught at École Polytechnique Fédérale de Lausanne

Spring 2022 **Homotopical Algebra**, Teaching Assistant

Fall 2020 **Homotopical Algebra**, Teaching Assistant & Lecturer

Designed and graded weekly exercises, ran online exercise sessions (via Zoom) and online question forum (via Slack). Also designed and taught last chapter with combination of pre-recorded and Zoom lectures.

Spring 2020 **Higher Categories: Theory and Practice**, Primary Instructor

Designed a new course with the goal of giving students an insight into the inner workings and applications of higher category theory. Lecture notes available online.

Fall 2019 **Advanced Linear Algebra**, Teaching Assistant

Projects Supervised at École Polytechnique Fédérale de Lausanne

Spring 2022 **M.Sc. Project**, Sami Mir, EPFL

Project Title: Functor Quasi-Category

Spring 2022 **M.Sc. Thesis**, Virgile Constantin, EPFL

Thesis Title: Categorical Models of Homotopy Type Theory

Fall 2021 **M.Sc. Project**, Donghan Wang, EPFL

Project Title: Sheaves, Spectra, and Quasi-categories: A Definition of the ∞ -Category of Differential Cohomology Theories

Spring 2021 **B.Sc. Project**, Gabin Kolly, EPFL

Project Title: Filter Quotient Model Categories

Spring & Fall 2021 **M.Sc. Thesis**, Chirantan Mukherjee, University of Trento

Thesis Title: Complete Segal Spaces as a Model of Higher Categories

Fall 2020 **M.Sc. Thesis**, Djian Post, EPFL

Thesis Title: A Simplicial Model for Homotopy Type Theory

Spring 2020 **M.Sc. Thesis**, Emma Chollet, Université de Neuchâtel

Thesis Title: An Introduction to Simplicial Sets and Model Categories

Courses taught at University of Illinois at Urbana-Champaign

Summer 2018 **Illinois Scholars Program Summer Bridge Experience**, Teaching Assistant & Instructor

A three week summer program for incoming under-represented and first generation students with the goal of preparing students for the first semester. Designed and implemented individual lesson plans for students with the goal of preparing them for the appropriate course in the calculus sequence.

Fall 2017 **Calculus 2**, Merit section discussion leader

These classes are highly-interactive discussion sections in which students are engaged in groupwork via challenging problem sets. Participating students are selected from underrepresented groups, as well as from small high schools.

Fall 2016 **Calculus 3**, Merit section discussion leader

Summer 2016 **Calculus**, Primary Instructor

Designed the syllabus and all of the course material, held classes in an active learning format to enhance teaching and used quizzes for immediate feedback. Also designed, held and graded exams.

Spring 2016 **Calculus 2**, Merit section discussion leader

Fall 2015 **Calculus 1**, Merit section discussion leader

- Spring 2015 **Calculus 2**, Merit section discussion leader
- Fall 2014 **Calculus 1**, Mathematica based discussion leader
These classes are interactive discussion sections in which students apply scientific softwares (Mathematica) to visualize and master intricate mathematical subjects.
- Spring 2014 **Calculus for Business 1**, Active learning discussion Session Leader
- Fall 2013 **Calculus**, Discussion Session Leader
- [Courses taught at University of Western Ontario](#)
- Summer 2013 **Advanced Calculus**, Teaching Assistant
- Spring 2013 **Methods of Calculus**, Teaching Assistant
- Fall 2012 **Introductory Calculus**, Teaching Assistant

Academic Service and Professional Development

- Fall 2022 **Organizer**, Online workshop on $(\infty, 2)$ -Categories, MPIM
- Fall 2022 **External Expert**, Master Thesis Committee, EPFL
- Fall 2019 - **Organizer**, EPFL Topology Seminar, EPFL
- Spring 2022
- Since 2017 **Reviewer**, zbMath, Mathematical Reviews
Referee, *Applied Categorical Structure*, *Algebraic & Geometric Topology*, *Journal of Pure and Applied Algebra*, *Theory and Applications of Categories*, *Honam Mathematical Journal*
- June 2019 **Organizer**, Summer School on Higher Topos Theory and Univalent Foundations, University of Leeds
- Fall 2017, **President**, AMS Graduate Student Chapter
- Spring 2018
- Fall 2017 **Organizer**, Graduate Student Homotopy Seminar
I organized a student seminar where each student had the opportunity to present their current research.
- Fall 2017 **Committee Chair, TA Teaching Awards Committee**, Dept. of Mathematics
This committee selects exemplary graduate students as recipients of various departmental teaching awards. I assembled the remainder of the committee, solicited applications, read and evaluated teaching statements and portfolios, observed/interviewed applicants, scheduled and oversaw meetings, mediated between the committee members, and reported our decisions to the department chair.
- Summer 2017 **Merit Program Advising**, Dept. of Mathematics
- 2018 *Held brief advising appointments with incoming freshmen interested in Merit program, and authorized students for registration to Merit sections.*
- Spring 2017 - **Member of the Senate Committee on Academic Freedom and Tenure**,
 Spring 2018 University of Illinois at Urbana Champaign
Discussing matters of freedom of speech and academic freedom and giving the university recommendations on which actions to take.
- Spring 2017 **Organizer**, Higher Category Theory Reading Seminar
- Fall 2016 - **Merit Program TA Mentor**, Dept. of Mathematics
- Spring 2018 *I guided several students through their first experience with the merit program and helped them adjust to the new environment.*

- Fall 2016 **TA Mentor**, Dept. of Mathematics
I guided several first time TAs throughout their first semester by providing first day of class instructions, observing their teaching in class, discussing feedback forms and giving mental support.
- Aug 2016 **Workshop Organizer**, Graduate Academy for College Teaching
I ran a one hour session for first time TAs introducing basics of active learning and group work methods.
- Aug 2016 **Co-organizer and Developer of the TA Training Program**, Mathematics Ph.D. Orientation Program
I assisted in developing and organizing two sessions for both incoming and current teaching assistants. I organized one session focusing on international TAs and one concerned with international diversity in the classroom.
- Fall & Spring 2016 **Project Manager**, Discrete Morse Theory, Vector Fields, and Materials Science, Illinois Geometry Lab
I managed a team of 4 undergraduate students applying discrete Morse theory to the analysis of qualitative features of gray scale images, where we did this by modifying a given code. My main duty was to manage the team, assign responsibilities, and organize meetings and future plans.
- Spring 2016 **Organizer**, Spectral Sequence Seminar
I organized a student seminar focused on spectral sequences with an effort to include students' research into the syllabus.
- Fall 2015 **Organizer**, Graduate Student Homotopy Seminar
- May 2015 **Orals Competition Judge**, Illinois Council of Teachers of Mathematics State Math Finals
As a judge, I evaluated high school students as they presented solutions to various questions, and I assisted in final selection of the awardees.
- March 2015 **Co-organizer**, Graduate Student Geometry Topology Seminar 2015
I was part of the conference organization team and as part of that team I chose conference speakers, determined conference schedule, designed conference schedule sheet and helped with the technical aspects.

Memberships

- 2023 - Now **Association for Computing Machinery, (ACM)**
- 2013 - 2018 **American Mathematical Society, (AMS)**