DAVID AYALA

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Education.

Stanford University. Ph.D. Mathematics (2009).
Dissertation title: *Geometric cobordism categories*
Advisor: Ralph L. Cohen

University of Utah. M.S. Mathematics (2004).

University of Utah. B.S Physics (2004).

University of Utah. B.S Mathematics (2002).

Employment.

Montana State University. Associate Professor of Mathematics (2020–present).

Mathematical Sciences Research Institute. Research Professor (2020).

Montana State University. Assistant Professor of Mathematics (2014–2020).

University of California, Berkeley. Mathematical Sciences Research Institute, Postdoctoral Fellow (2014).

University of Southern California. NSF Postdoctoral Fellow (2013–2014).

Harvard University. NSF Postdoctoral Fellow (2009, 2011–2013).

University of Copenhagen. ERC Postdoctoral Fellow (2009–2010).

Grants.

Career Grant: Factorization Homology and Quantum Topology, $400,000. National Science Foundation, division of

mathematical sciences. Award 1945639 (2019–present).

Workshops: Homotopy Harnessing Higher Structures, $30,000. National Science Foundation, division of mathematical sciences. Award 1833295 (2018).

Factorization Homology, Deformation Theory, and Duality, $213,878. National Science Foundation, division of mathematical sciences: topology. Award 1812055 (2018–2021).

Faculty Excellence Grant, teaching buy-out. Montana State University (2015, 2016, 2017).

Factorization Homology and the Cobordism Hypothesis, $253,547. National Science Foundation, division of mathematical sciences: topology. Award 1507704 (2015–2018).

Scanning Methods in Algebraic Topology, $135,000. National Science Foundation, division of mathematical sciences: postdoctoral fellowship. Award 0902639 (2009–2013).

Awards.

Excellence in Mentorship at the Graduate Level Award, issued by the the College of Letters and Science at Montana State University (2024).

Meritorious Research and Creativity Award, issued by the the College of Letters and Science at Montana State University (2019).

Stannard Teaching Award, for upper-division instruction and mentorship in the Mathematical Sciences department at Montana State University (2018).

ARCS. Achievement Rewards for College Scientists: graduate student fellowship (2007–2008).

VIGRE. National Science Foundation, division of mathematical sciences: graduate fellowship (2003–2004).

Research articles.

Published or accepted (refereed).

(1) **Stratified non-commutative stacks**. Joint with Aaron Mazel-Gee and Nick Rozenblyum. To appear in Memoirs of the AMS. arXiv:1910.14602

(2) **Natural symmetries of secondary Hochschild homology**. Joint with John Francis and Adam Howard. To appear in Algebraic and Geometric Topology.
arXiv:2111.08798

(3) **Flagged higher categories**. Joint with John Francis. Topology and quantum theory in interaction, 137–173, Contemporary Mathematics, 718, Amer. Math. Soc., Providence, RI, 2018.

(4) **Fibrations of ∞-categories**. Joint with John Francis. Ayala, David; Francis, John High. Struct. 4 (2020), no. 1, 168–265.

(5) **Factorization homology I: higher categories**. Joint with John Francis and Nick Rozenblyum. Advances in Mathematics 333 (2018), 1042–1177.

(6) **A stratified homotopy hypothesis**. Joint with John Francis and Nick Rozenblyum. J. Eur. Math. Soc. (JEMS) 21 (2019), no. 4, 1071–1178.

(7) **Poincaré/Koszul duality**. Joint with John Francis. Comm. Math. Phys. 365 (2019), no. 3, 847–933.

(8) **Zero-pointed manifolds**. Joint with John Francis. Journal of the Institute of Mathematics of Jussieu 20(2021), no.3, 785–858.

(9) **Factorization homology of stratified spaces**. Joint with John Francis and Hiro Lee Tanaka. Selecta Mathematica (N.S.) 23 (2017), no. 1, 293–362.

(10) **Local structures on stratified spaces**. Joint with John Francis and Hiro Lee Tanaka. Advances in Mathematics 307 (2017), 903-1028.

(11) **Factorization homology of topological manifolds**. Joint with John Francis. Journal of Topology 8 (2015), no. 4, 1045–1084.

(12) **Configuration spaces and Θ_n**. Joint with Richard Hepworth. Proceedings in the American Mathematical Society 142 (2014),

no. 7, 2243–2254.

(13) **Counting bitangents with stable maps**. Joint with Renzo Cavalieri. Expositiones Mathematicae 24 (2006), no. 4, 307–335.

Preprints. Available on the ArXiv.

(1) **Symmetries of the cyclic nerve**. Joint with Aaron Mazel-Gee and Nick Rozenblyum. 79 page preprint.

(2) **Additivity of factorization algebras**. Joint with Eric Berry. 53 page preprint.

(3) **Symmetries of a rigid braided category**. Joint with John Francis. 20 page preprint.

(4) **Derived Mackey functors and C_{p^n}-equivariant cohomology**. Joint with Aaron Mazel-Gee and Nick Rozenblyum. 84 page preprint.

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(5) **Traces for factorization homology in dimension 1**. Joint with John Francis. 30 page preprint.

(6) **The geometry of cyclotomic trace**. Joint with Aaron Mazel-Gee and Nick Rozenblyum. 48 page preprint.

(7) **A naive approach to equivariant and cyclotomic spectra**. Joint with Aaron Mazel-Gee and Nick Rozenblyum. 84 page preprint.

(8) **Factorization homology of enriched $(\infty, 1)$-categories**. Joint with John Francis, Aaron Mazel-Gee, and Nick Rozenblyum. 46 page preprint.

(9) **The cobordism hypothesis**. Joint with John Francis. 36 page preprint.

Book chapters (invited, refereed).

(1) **A factorization homology primer**. Joint with John Francis. CRC Press/Chapman Hall Handb. Math. Ser. CRC Press, Boca Raton, FL, 2020, 39–101. ISBN: 978-0-815-36970-7

Other publications (not refereed).

(1) **In hope of climate-aware conferencing**. Joint with Lukas Bantner, Andre Henriques, Theo Johnson-Freyd, and Aaron Mazel-Gee. London Mathematical Society Newsletter 480 (2019), 32–33.

Editorial Work.

Topology and quantum theory in interaction. Jointly edited with Daniel Freed and Ryan Grady. Contemporary Mathematics of the American Mathematical Society, 718 (2018).

Advisory Boards.

Banff International Research Station (BIRS). Scientific advisory board; Equity, Diversity and Inclusion advisory board (2023–present).

Supervised Theses.

(1) Benjamin Moldstad, PhD thesis *Actions of the circle group on presentable stable ∞-categories* (229 pages), Montana State University, 2024.
`https://math.montana.edu/dayala/documents/MoldstadThesis.pdf`

(2) Adam Howard, PhD thesis *Immersions of surfaces* (143 pages), Montana State University, 2021.
`https://scholarworks.montana.edu/items/2b8d564c-0110-4414-ba31-2f5056e06e36`

(3) Eric Berry, PhD thesis *Additivity of factorization algebras & the cohomology of real Grassmannians* (175 pages), Montana State University, 2021.
`https://scholarworks.montana.edu/items/af090b2d-18f3-487d-8c6a-6ea015500ba8`

(4) Mark Poston & Scotty Tilton, BS project *The cohomology of real Grassmannians via Schubert stratifications* (35 pages), Montana State University, 2019.
arXiv:2011.07695

(5) Daniel Perry, PhD thesis *Homotopy groups of contact 3-manifolds* (325 pages), Montana State University, 2019.
`https://scholarworks.montana.edu/items/dd6e8baa-15aa-495c-9b28-a3dda672f09f`

(6) Anna Cepek, PhD thesis *On configuration categories* (121 pages), Montana State University, 2019.

https://scholarworks.montana.edu/items/2db58f24-8b6b-4ddb-9122-097825f244e0

(7) (Aaron Mazel-Gee, *informal advisor* on PhD thesis *Goerss–Hopkins obstruction theory via model ∞-categories*, University of California at Berkeley, 2016.)
https://etale.site/writing/GHOsT-thesis.pdf
arXiv: 1510.02402, 1510.03525, 1510.03961

(8) Emanuele Dotto, MS project *A relative h-principle via cobordism-like categories* (26 pages), University of Copenhagen, 2010. Contemporary Mathematics, 617, 133–155, Amer. Math. Soc., 2014.

(9) Casper Guldberg, MS project *Quasi-categories* (29 pages), University of Copenhagen, 2010.
geotop.math.ku.dk/research/past_ag_theses_and_projects/ms-projects/Casper_Guldberg-MS_Project-Quasi_Categories.pdf/

Graduate Committees.

PhD (as chair).

Past.

(1) Benjamin Moldstad, 2024;
(2) Adam Howard, 2021;
(3) Eric Berry, 2021;
(4) Anna Cepek, 2019;
(5) Daniel Perry, 2019.

Present. Alexandra Ballow; Zachary Jandrasi; Joshua Colahan.

PhD (as committee member).

Past. Christopher McKay, 2023; Eric Fink, 2020; Hannah Bergren, 2016; Joseph Manlove, 2015.

Present. Grace Stroh; Kyle Fitch; Christopher Boehlert; Thomas Carlson; Changson Choi; Fredrick Fox; Christopher Boehlert; Samuel Wirges; Michael Yakubu.

MS.

Past. James Powell (chair), 2023; Zoya Batool (chair), 2023; Samuel McCrosson (chair), 2023; Grant Bushman, 2022; Matthew Raymond, 2019; Quinn Anderson, 2019; Adam Howard, 2018; Holt Bodish (chair), 2018; Micah Thorpe-Kramp, 2018; Stephen Gormley, 2018; Dustin Roose, 2018; Kai Jensen, 2018; Tyler Reckner, 2017; Derek Conder, 2016.

Present. Garrett Figueroa, MS (chair); Hadley Wells, MS (chair); Sarah Dale, MS (chair).

Teaching.

- Advanced Linear Algebra, MSU, Fall 2024.
- Topology, MSU, Fall 2024.
- Methods of Proof, MSU, Spring 2023.
- Algebraic Topology, MSU, Spring 2023.
- Topology, MSU, Fall 2022.
- Calculus on Manifolds, MSU, Fall 2021.
- Introduction to Topology, MSU, Fall 2021.
- Algebraic Topology, MSU, Spring 2021.
- Introduction to Linear Algebra, MSU, Spring 2021.
- Advanced Linear Algebra, MSU, Fall 2020.
- Calculus on Manifolds, MSU, Fall 2019.
- Introduction to Topology, MSU, Fall 2019.
- Geometric and Algebraic Topology, MSU, Spring 2019.
- Topology, MSU, Fall 2018.
- Advanced Linear Algebra, MSU, Fall 2018.
- Introduction to Abstract Algebra, MSU, Spring 2018.
- Calculus on Manifolds, MSU, Fall 2017.
- Advanced Linear Algebra, MSU, Fall 2017.
- Abstract Algebra, MSU, Spring 2017.
- Introduction to Linear Algebra (course supervisor), MSU, Spring 2017.
- Advanced Linear Algebra, MSU, Fall 2016.
- Introduction to Linear Algebra, MSU, Fall 2016.
- Riemannian Geometry, MSU, Spring 2016.
- Abstract Algebra, MSU, Spring 2016.
- Topology, MSU, Fall 2015.
- Geometric and Algebraic Topology, MSU, Spring 2015.
- Topology. Fall 2014.
- Honors Vector Calculus, MSU, Fall 2014.
- Integral Calculus, Harvard University, Spring 2011.
- Integral Calculus, Harvard University, Fall 2010.
- Morse Theory, University of Copenhagen, Spring 2010.
- Topology, University of Copenhagen, Fall 2009.

University service.

2023/24: Graduate curriculum reform committee, Graduate program committee, Topology comprehensive exam.

2022/23: Graduate curriculum reform committee, Graduate program committee, Hiring committee, DEI task-force member, Colloquium committee, Topology comprehensive exam.

2021/22: Graduate program committee, DEI task-force member, Colloquium committee, Retention-Promotion-Tenure committee, Topology comprehensive exam.

2020/21: Graduate program committee, Math seminar organizer, Colloquium committee, Algebra comprehensive exam.

2019/20: Math seminar organizer, Hiring committee, Colloquium committee.

2018/19: Math seminar organizer, Hiring committee, Colloquium committee.

2017/18: Awards committee, Algebra comprehensive exam, Topology comprehensive exam.

2016/17: Algebra comprehensive exam, Topology comprehensive exam.

2015/16: Topology comprehensive exam.

2014/15: Hiring committee, Topology comprehensive exam.

2009/10: Seminar organizer.

Program organization.

(1) **Symplectic Paradise**, principle organizer, 35 participants, international scope. Montana State University (2023). Residential week-long workshop.

(2) **Higher category theory and categorification**, principle organizer, 55 participants, international scope. Instituto de Mathematicas, Universidad Nacional Autonoma de Mexico (2022). Residential month-long program.

(3) **Higher category theory and categorification**, principle organizer, 85 participants, international scope. Mathematical Sciences Research Institute (2020). Residential semester-long program.

(4) **Higher category theory: introductory workshop**, principle organizer, 180 participants, international scope. Mathematical Sciences Research Institute (2020). Week-long workshop.

(5) **Homotopy harnessing higher structures: manifolds**, scientific organizer, 120 participants, international scope. Isaac Newton Institute (2018). Week-long conference.

(6) **Higher algebra and mathematical physics**, principle organizer, 130 participants, international scope. Perimeter Institute (2018). Week-long double-conference.

(7) **NSF-CBMS: geometric and topological methods in quantum field theory**, principle organizer, 55 participants, international scope. Montana State University (2017). Week-long conference.

(8) **Factorizable structures in topology and algebraic geometry**, principle organizer, 45 participants, international scope. Banff International Research Station (2015). Week-long workshop.

(9) **West coast algebraic topology summer school: topological quantum field theory**, scientific organizer, 45 participants, international scope. University of British Columbia (2014). Week-long summer school.

(10) **West coast algebraic topology summer school: homotopy theory, manifolds, and topological field theories**, scientific organizer, 45 participants, international scope. University of Oregon (2010). Week-long summer school.

Reviewer / panelist.

Journal referee. Annals of Mathematics; Inventions Mathematicae; Journal of the American Mathematical Society; Geometry and Topology; Algebraic and Geometric Topology; Journal of Topology; Advances in Mathematics; Proceedings of the American Mathematical Society; Transactions of the American Mathematical Society; Mathematics Annalen; London Mathematical Society; Israel Journal of Mathematics; Mathematische Zeitschrift; Higher Structures; Homology, Homotopy, and Application; Royal Society of Edinburgh: Proceedings A.

NSF panelist. Topology grants.

Invited conference presentations (selected).

Global categorical symmetries. Derived Skein modules. Switzerland (2023).

Stratifications in algebra and topology. Homotopy theory with applications to arithmetic and geometry. Fields Institute (2022).

Traces via factorization homology. Getzler's Birthday conference. Northwestern (2022).

Factorization homology for tangles. Homotopical methods in geometry and physics; 6-part lecture series. Northwestern (2022).

The 1-dimensional tangle hypothesis. Tensor categories and topological quantum field theories. MSRI (2020).
Video: https://www.msri.org/workshops/917/schedules/28198

Factorization homology. Higher structures in holomorphic and topological field theory. IHES (2019).
Video: https://www.imclips.net/video/UENa1-ZehG4.html

Geometry of the cyclotomic trace. NRW Topology Meeting. University of Muenster (2018).

Geometry of the cyclotomic trace. Conference on Trace Methods. Northwestern University (2018).

Factorization homology. Conference on Factorization Homology; 8-part lecture series. Haifa University (2018).

Adjoints and orthogonal groups. Workshop on Higher Operads. BIRS, Oaxaca (2018).
Video: www.birs.ca/events/2018/5-day-workshops/18w5147/videos/watch/201805091000-Ayala.html

Geometry of the cyclotomic trace. AMS special session, Portland State University (2018).
Factorization homology and the cobordism hypothesis. Workshop on Factorization Algebras and Configuration Spaces; 2-part lecture series. University of Nice (2018).

Factorization homology. Conference on Floer Homology and Homotopy Theory. University of California at Los Angeles (2017).

Factorization homology and TQFT. Topology Festival. Cornell University (2017).

Deeply non-affine algebraic sigma-models are state sum field theories. QFT on Manifolds with Boundary and BV. Perimeter Institute (2017).

Higher adjoints and the orthogonal group. Wasatch Topology Conference. University of Utah (2016).

Factorization homology. Workshop on Factorization Homology; 3-part lecture series. University of Texas at Austin (2016).

Factorization homology. Summer school on factorization homology; 12-part lecture series. Instituto Nacional de Mathematica Pura e Apliceda (IMPA) (2016).
Video: https://m.youtube.com/watch?v=JL57PFiqptM

Factorization homology. Summer school: Homotopy theory, manifolds, and topological field theories; 6-part lecture series. Hausdorff Institute of Mathematics (2015).
Video: https://m.youtube.com/watch?v=T1dhHwNmDXI

Factorization homology. Topology conference. Oberwolfach (2015).

Poincaré/Koszul duality. Reimagining the Foundations of Algebraic Topology. MSRI / University of California at Berkeley (2014).

Poincare/Koszul duality. Goodwillie's birthday conference. Dubrovnik (2014).

Higher categories are sheaves on manifolds. Workshop: higher categories; 3-part lecture series. University of Trondheim (2013).

Labeled configuration spaces. Graduate Student Topology Conference. University of Notre Dame (2013).

Higher categories as sheaves on manifolds. Conference on Topological Quantum Field Theories. University of Notre Dame (2012).
Video: https://m.youtube.com/watch?v=8nm2ByS5NnY

Factorization homology. Cohen, Carlsson, Madsen Birthday conference, Stanford University (2012).

Cobordism categories with singularities. The first Copenhagen topology conference. University of Copenhagen (2010).

Cobordism categories. Conference on Topological Field Theories. Northwestern University (2009).

Invited seminar presentations (selected).

Derived Skein modules. Geometry Seminar. UT Austin (2023).

Symmetries of a rigid braided category. Johns Hopkins Topology Seminar. Johns Hopkins (2022).

Orthogonal groups and category theory. Australian Topology Seminar. Australia (2021).

Adjoints and the orthogonal group. Topology Seminar. CalTech (2021).

Picard groups and equivariant cohomology via stratifications. Topology Seminar. Warwick University (2020).

Factorization homology. Factorization homology seminar: 5-part lecture series. Mathematical Sciences Research Institute (2020).

Adjoints and the orthogonal group. Edinburgh Topology Seminar. University of Edinburgh (2018).

Adjoints and the orthogonal group. Isaac Newton Institute. Cambridge University (2018).

Adjoints and the orthogonal group. Topology Seminar. University of Oxford (2018).

Contact geometry. Mathematics Colloquium. Reed College (2017).

Bruhat stratified orthogonal group acts on higher categories. Topology Seminar. Massachusetts Institute of Technology (2017).

Factorization homology. Langlands seminar: 3-part lecture series. University of Chicago (2016).

Poincaré/Koszul duality. Topology Seminar. Stanford University (2014).

Poincaré/Koszul duality. Topology Seminar. Max Planck Institute for Mathematics (2013).

Poincaré/Koszul duality. Topology Seminar. University of Oxford (2013).

Factorization homology and link invariants. Math Colloquium. University of Melbourne (2013).

Higher categories are sheaves on manifolds. Topology Seminar. Stanford University (2012).

Factorization homology and singular manifolds. Topology Seminar. Johns Hopkins University (2012).

Configuration spaces and higher categories. Topology Seminar. Northwestern University (2011).

Configuration spaces and higher categories. Topology Seminar. University of Chicago (2011).

Combinatorial model for configuration spaces. Topology Seminar. Massachusetts Institute of Technology (2010).

Cobordism categories with singularities. Topology Seminar. Massachusetts Institute of Technology (2009).