

Adam Topaz

Curriculum Vitae

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Personal Information

Full Name: Adam Topaz. **Email:** topaz@ualberta.ca.

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Research Expertise: Algebraic and arithmetic geometry; Galois theory; anabelian geometry; algebraic cycles; valuation theory; model theory of fields; formal mathematics.

Academic Positions

- **University of Alberta.** Edmonton, Alberta, Canada.
Associate Professor (2024–present).
Assistant Professor (2018–2024).
- **University of Oxford.** Oxford, United Kingdom.
Postdoctoral Research Assistant (2016–2018).
- **Mathematical Sciences Research Institute.** Berkeley, California, USA.
MSRI Postdoctoral Fellow (Spring 2014).
Part of the MSRI semester on Model Theory, Arithmetic Geometry and Number Theory.
- **University of California, Berkeley.** Berkeley, California, USA.
National Science Foundation Postdoctoral Fellow (2013–2016).

Education

- **University of Pennsylvania.** Philadelphia, Pennsylvania, USA.
PhD in mathematics, Awarded May 2013. Thesis title: *Commuting-liftable subgroups of Galois groups*. Advisor: Florian Pop.
- **Davidson College.** Davidson, North Carolina, USA.
BS in mathematics, Awarded May 2008. *Magna cum laude* with high honours.

Awards and Honours

- National Science Foundation Mathematical Sciences Postdoctoral Fellowship, 2013–2016.
- Carlitz-Zippin Prize for outstanding PhD Thesis, University of Pennsylvania, May 2013.
- Benjamin Franklin Fellowship, University of Pennsylvania, 2008–2013.
- High honours in pure mathematics, Davidson College, 2008.
- Membership in Phi Beta Kappa, Davidson College, 2008.
- Barry M. Goldwater scholarship, Davidson College, 2007–2008.
- William G. McGavock Mathematics Award, Davidson College, 2008.

Grants and Fellowships

- NSERC Discovery Grant; 2019–2026; 144,000 CAD.
- NSERC Discovery Grant Launch Supplement, 2019–2025; 12,500 CAD.
- University of Alberta Startup Grant; 2018–2023; 75,000 CAD.
- NSF mathematical sciences postdoctoral research fellowship; 2013–2016. 150,000 USD.

Publications and Manuscripts

Manuscripts

1. D. Asgeirsson, R. Brasca, N. Kuhn, F. A. E. Nuccio and A. Topaz. *Categorical Foundations of Formalized Condensed Mathematics*, 2024. Available as: [arXiv](#)
2. A. Topaz, *Algebraic dependence and Milnor K-theory*, 2023. Available as: [PDF](#)
3. A. Topaz, *Alternating pairs with coefficients*, 2023. Available as: [PDF](#)
4. F. Pop and A. Topaz, *A linear variant of GT*, 2021. Available as: [arXiv](#)
5. A. Topaz, *Recovering function fields from their integral ℓ -adic cohomology with the Galois action*, 2019. Available as: [arXiv](#)

Accepted and Published Papers

1. J. Commelin and A. Topaz, *Abstraction boundaries and spec driven development in pure mathematics*, to appear in Bull. Amer. Math. Soc. (2023).
2. A. Topaz, *A Torelli-like theorem for higher-dimensional function fields*, to appear in JEMS (2022).

3. J. Bell, R. Moosa and A. Topaz, *Invariant Hypersurfaces*, J. Inst. Math. Jussieu 21 (2022), no. 2, 713–739.
4. P. Guillot, J. Mináč and A. Topaz, Appendix by O. Wittenberg, *Four-fold Massey products in Galois cohomology*, Compositio Mathematica (2018) 154 (9), 1921–1959.
5. A. Topaz, *The Galois action on geometric lattices and the mod- ℓ I/OM*, Invent. Math. (2018) 213 (2), 371–459
6. A. Topaz, *Abelian-by-Central Galois Groups I: A Formal Description*, Trans. Amer. Math. Soc. (2017) 368, pg. 2721–2745.
7. A. Topaz, *Commuting-Liftable Subgroups of Galois Groups II*, J. reine angew. Math. (2017) 730, pg. 65–133
8. A. Topaz, *Reconstructing Function Fields from Rational Quotients of Mod- ℓ Galois Groups*, Math. Annalen (2016) 366 (1), Pg. 337–385.
9. A. Topaz, *Abelian-by-Central Galois Groups II: Definability of Inertia / Decomposition Groups*, Israel J. Math. (2016) 215 (2), Pg. 713–748.
10. A. Topaz, *On the nature of base fields*, Appendix in “On The Minimized Decomposition Theory of Valuations” by F. Pop, Bull. Math. Soc. Sci. Math. Roumanie. Tome 58(106) No. 3.
11. J. Mináč, J. Swallow and A. Topaz, *Galois Module Structure of \mathbb{Z}/ℓ^n -th Classes of Fields*, Bull. London Math. Soc. (2014) 46 (1), Pg. 143–154

Other publications

1. A. Topaz, *A linear variant of GT (joint with F. Pop)*. In Oberwolfach Reports: Homotopic and Geometry Galois Theory (2021).
2. A. Topaz, *On the (generic) cohomology of function fields*. In Oberwolfach Reports: Field Arithmetic (2018).
3. A. Topaz, *On Milnor K-groups of Function Fields*. In Oberwolfach Reports: Valuation Theory and its Applications (2014).
4. A. Topaz, *Detecting valuations using small Galois groups*. In Valuation Theory in Interaction (Proceedings of the 2nd international Conference on Valuation Theory).
5. A. Topaz, *Pro- ℓ Galois groups and valuations*. In Oberwolfach Reports: Arithmetic of Fields (2013).
6. A. Topaz, *Commuting-liftable subgroups of Galois groups*. PhD thesis at the University of Pennsylvania (2013).
7. A. Topaz, *Almost-commuting-liftable subgroups of Galois groups*. ArXiv Manuscript (2012). Will not be submitted for publication.

Contributions to Formalized Mathematics

- Together with Johan Commelin, we led the *liquid tensor experiment* using the Lean3 interactive proof assistants and its mathematics library `mathlib`. This project was **completed in July 2022**. A full list of my contributions to the repository containing the formalization can be found [here](#).
- I have made significant contributions to Lean’s open source formalized mathematics library `mathlib`, which can be found on [github](#). My contributions to `mathlib` span various areas of algebra, algebraic geometry and category theory. A full list of my contributions to `mathlib` can be found [here](#). A full list of my contributions to `mathlib4` (the main mathematics library for Lean4) can be found [here](#).
- I have formalized several results from the theory of rigid elements, as well as the main theorem on alternating pairs, which has various applications in my research on anabelian geometry. The code is available at this [github repository](#).
- Other formalization projects (all available on [github](#)): [Adjunctions in universal algebra](#), joint work with C. MacDonald; [Combinatorial geometries in Lean](#), joint work with C. MacDonald.

Supervision

This section describes my HQP supervision since starting my position at the University of Alberta in Summer 2018.

Postdocs: Sylvain Gaulhiac (Supervisor, 2021–2022); Abhishek Shukla (Cosupervisor, 2020–2021).

PhD Students: Qi Ge (Supervisor 2023–present).

MSc Students: Jack McKoen (Supervisor 2023–present); Rindra Razafy (Supervisor, 2023–present); Qi Ge (Supervisor 2020–2023).

Undergraduates: Math 499 Honours projects: Qi Ge (2020), Coleton Kotch (2023). Completed NSERC USRAs: Qi Ge (2019), Aaron Trongsard (2020), Andrew Riesen (2020), Colter MacDonald (2020), Jack McKoen (2022), Michael Blyth (2022). Current NSERC USRAs: Coleton Kotch (2023), Isaac Hernando (2023).

Teaching

This section summarizes the courses I taught at the University of Alberta thus far. In total, I taught ten courses since starting my position in Summer 2018. Among those, six were undergraduate courses and four were crosslisted undergraduate/graduate courses. I also organized three reading courses and three unofficial learning seminars during that time.

- **Undergraduate Courses:** Math 324 Elementary Number Theory (three times); Math 328 Group Theory (three times); Math 225 Linear Algebra II (two times).
- **Graduate Courses:** Math 428/582 Rings and Modules (three times); Math 412/512 Algebraic Number Theory (one time); Math 681 Topics in Algebra (one time).

- **Reading Courses and Reading Seminars:** I taught reading courses on the following topics: Local class field theory; general valuation theory; étale fundamental groups. I (co)organized (unofficial) reading seminars on the following topics: Massey products in Galois cohomology; prismatic cohomology; condensed mathematics.

Service Activities

- I gave lecture series for the Western Summer School in Algebra on three different years, in 2018, 2019 and 2020.
- I was a coorganizer, together with D. Favero, of the Western Summer School in Algebra in the summer of 2020.
- Since Fall 2021 I have been the sole member of the communications committee in the Mathematics department at the University of Alberta, where I have helped several colleagues set up their personal webpages and make them visible on the official webpage of the department.
- **Seminar organization:** I coorganized the seminar on number theory and representation theory in Winter 2019 with K. Koziol and M. Patnaik. I organized the number theory seminar in Fall 2019. I coorganized the arithmetic geometry seminar in Fall 2021 with S. Gaulhiac.
- **Refereeing:** I have refereed papers for many respected mathematics journals, including *Compositio Mathematica*; *Algebra and Number Theory*; *Mathematische Annalen*; *Mathematische Nachrichten*; *Advances in Mathematics*; *Journal of Pure and Applied Logic*; *Publications of RIMS*; *Canadian Journal of Math*; *Research in Number Theory*; *Transactions of the AMS*.
- **Open Source Software Maintainer:** Since April 2021, I have been on the maintainer team of the Leanprover community, focusing primarily on maintaining Lean's mathematics libraries `mathlib` and `mathlib4` and their related tools.

Workshop and conference organization

- MFO workshop: Anabelian Geometry and Representations of Fundamental Groups; October 2024; coorganized with A. Cadoret, F. Pop and J. Stix.
- AIM workshop: Formalising algebraic geometry; June 2024; coorganized with K. Buzzard, J. Commelin, J. Riou.
- BIRS-JP workshop: Formalization of cohomology theories; May 2023; coorganized with J. Commelin, H. Macbeth, A. Baanen and M. Ballard.
- BIRS workshop: Derived Categories, Arithmetic, and Reconstruction in Algebraic Geometry; July 2022; coorganized with M. Olsson, L. Flapan and K Honigs.
- BIRS workshop: Nilpotent fundamental groups, June 2017; coorganized with J. Mináč, F. Pop and K. Wickelgren.

Lectures and Presentations

Below is a *selected* list of lectures I have given related to my research, since I started my position at the University of Alberta in Summer 2018.

1. *Milnor K-theory and algebraic dependence*; MFO/RIMS tandem workshop on homotopy theoretic Galois theory; Sept. 2023.
2. *Some idealized results in anabelian geometry*; University of Pennsylvania Galois Seminar; Sept. 2023.
3. *Formalizing Condensed Mathematics*; University of Pennsylvania Colloquium; Sept. 2023.
4. *Lecture series on the formalization of condensed mathematics*; Masterclass on formalization of mathematics; University of Copenhagen; June 2023.
5. *Arithmetic, geometry and Galois theory of geometric function fields*; Workshop on Definability, Decidability and Computability over Arithmetically Significant Fields; June 2023.
6. *Formal Mathematics and AI*; National Academies workshop (AI to assist mathematical reasoning); June 2023.
7. *The Liquid Tensor Experiment*; Workshop on Machine Assisted Proofs; IPAM, Los Angeles, CA, USA; February 2023.
8. *An overview of the liquid tensor experiment*; Seminar talk at Simon Fraser University; 2022.
9. *An overview of the liquid tensor experiment*; Seminar talk at the University of South Carolina (online); 2021.
10. *Hyperplane complements and a variant of GT*; Algebraic geometry seminar, Universidad Nacional de Columbia (online); 2021.
11. *A linear variant of GT*; Oberwolfach Workshop on Homotopic and Geometric Galois Theory (online); 2021.
12. *Baby steps in formalizing results in anabelian geometry*; Lean Together 2021, online workshop; 2021.
13. *Toward anabelian geometry with coefficients*; MSRI workshop DCC-Valuation theory (online); 2020.
14. *Incedence structures in anabelian geometry*; Canadian Western Algebraic Geometry Symposium, University of Saskatchewan; 2020.
15. *Parameterization of divisors using cohomology*; Seminar talk at Simon Fraser University; 2019.
16. *Parameterization of divisorial valuations and applications*; Fields Institute workshop on Recent Applications of Model Theory, Toronto ON; 2019.
17. *Around the cohomology of geometric function fields*; Alberta Number Theory Days at BIRS, Banff, Alberta, Canada; 2019.

18. *Reconstructing Function Fields from their ℓ -adic Cohomology*; Galois Seminar at the University of Pennsylvania; 2019.
19. *Reconstructing Function Fields from their ℓ -adic Cohomology*; CMS Winter Meeting; Vancouver, BC, Canada; 2018.