

# Curriculum Vitae

## ADAM CLAY

Office Address: University of Manitoba  
Department of Mathematics  
473 Machray Hall  
Winnipeg, R3T 2N2  
Manitoba, Canada  
Email Address: `Adam.Clay@umanitoba.ca`  
Homepage: `server.math.umanitoba.ca/~claya`  
Citizenship: Canadian  
Date of CV: September 12, 2022

### Education

2010 Ph.D. University of British Columbia, Mathematics (advisor: Dale Rolfsen)  
2005 M.Sc. University of British Columbia, Mathematics (advisor: Dale Rolfsen)  
2003 B.Sc. University of King's College, Halifax, Canada, Mathematics

### Employment

2018 – Associate Professor, University of Manitoba  
2013 – 2018 Assistant Professor, University of Manitoba  
2012 – 2013 CIRGET postdoctoral fellow, Université du Québec à Montréal (advisor: Steve Boyer)  
2010 – 2012 NSERC postdoctoral fellow, Université du Québec à Montréal (advisor: Steve Boyer)

### Administrative positions

2020 – Associate Head (Grad Studies), Department of Mathematics, University of Manitoba

### Research interests

Group theory, algebraic properties of left- and circularly orderable groups, actions of groups on  $S^1$  and  $\mathbb{R}$ , 3-manifolds, knot theory, left orderability of fundamental groups of 3-manifolds, Dehn surgery and foliations.

### Publications

#### Books

1. *Ordered groups and Topology*, (with Dale Rolfsen) Graduate Studies in Mathematics 176 (2016), American Mathematical Society, Providence RI, USA.

#### Articles in progress

2. *Cofinal elements and fractional Dehn twist coefficients*, (with Tyrone Ghaswala), in preparation.
3. *Order-detection of slopes on the boundaries of knot manifolds*, (with Steve Boyer), 26 pages. Submitted.
4. *The number of locally invariant orderings of a group*, (with Ian Thompson and Idrissa Ba), 13 pages. Submitted.
5. *Circular orderability of 3-manifold groups*, (with Idrissa Ba), 33 pages. Submitted.

6. *Graph manifolds that admit arbitrarily many Anosov flows*, (with Tali Pinsky), 20 pages. Submitted.

Peer-reviewed journal articles

7. *A theorem of Mumford and Ramanujam for universal algebras*, (with R. Padmanabhan), 14 pages. To appear in *Algebra Universalis*.
8. *Borel structures on the space of left-orderings*, (with Filippo Calderoni), *Bulletin of the London Mathematical Society* 54 (2022), 83–94.
9. *The space of circular orderings and semiconjugacy*, (with Idrissa Ba), *Journal of Algebra*, 586 (2021), 582–606.
10. *Circular ordering direct products and the obstruction to left-orderability*, (with Tyrone Ghaswala), *Pacific Journal of Mathematics*, 312 (2021), no. 2, 401–419.
11. *Promoting circular-orderability to left-orderability*, (with Jason Bell and Ty Ghaswala), *Annales de L’Institut Fourier*, 71 (2021), no. 1, 175–201.
12. *Generalizations of the Burns-Hale theorem*, *Communications in Algebra*, 48 (2020) no. 11, 4846–4858.
13. *Dense orderings in the space of left-orderings of a group*, (with Tessa Reimer) *Canadian Mathematical Bulletin*, 63 (2020), no. 2, 393–404.
14. *Free products of circularly ordered groups with amalgamated subgroup*, (with Ty Ghaswala) *J. Lond. Math. Soc.*, 100 (2019), no. 3, 775–803.
15. *On the number of circular orders on a group*, (with Kathryn Mann and Cristobal Rivas) *J. Algebra* 504 (2018), 336–363.
16. *Automorphisms acting on the left-orderings of a bi-orderable group*, (with Sina Zabanfahm) *New York J. Math.* 23 (2017), 67–83.
17. *Foliations, orders, representations, L-spaces and graph manifolds*, (with Steve Boyer) *Adv. Math.* 310 (2017), 159–234.
18. *Testing bi-orderability of knot groups*, (with Colin Desmarais and Patrick Naylor) *Canadian Mathematical Bulletin*, 59 (2016), no. 3, 472–482.
19. *Graph manifolds, left-orderability and amalgamation*, (with Tye Lidman and Liam Watson) *Algebr. Geom. Topol.* 13 (2013), no. 4, 2347–2368.
20. *Left-orderability and exceptional Dehn surgery on two-bridge knots*, (with Masakazu Teragaito) *Geometry and topology down under*, 225–233, *Contemp. Math.*, 597, Amer. Math. Soc., Providence, RI, 2013.
21. *Left-orderings and quotients of the braid groups*, *J. Knot Theory Ramifications* 21 (2012), no. 14, 125–130, 9 pp.
22. *Ordered groups, eigenvalues, knots, surgery and L-spaces*, (with Dale Rolfsen) *Math. Proc. Cambridge Philos. Soc.* 152 (2012), no. 1, 115–129.
23. *Left-orderable fundamental groups and Dehn surgery*, (with Liam Watson) *Int. Math. Res. Not. IMRN* 2013, no. 12, 2862–2890.
24. *Free lattice-ordered groups and the space of left-orderings*, *Monatsh. Math.* 167 (2012), no. 3–4, 417–430.
25. *On cabled knots, Dehn surgery, and left-orderable fundamental groups*, (with Liam Watson) *Math. Res. Lett.* 18 (2011), no. 6, 1085–1095.

26. *Exotic left orderings of the free groups from the Dehornoy ordering*, Bull. Aust. Math. Soc. 84 (2011), no. 1, 103–110.
27. *Isolated points in the space of left orderings of a group*, Groups Geom. Dyn. 4 (2010), no. 3, 517–532.
28. *A new characterization of Conrad’s property for group orderings, with applications*, (with Andrés Navas and Cristóbal Rivas, my contribution is the appendix) Algebr. Geom. Topol. 9 (2009) 2079–2100.
29. *Corrigendum to “On ordering free groups” [J. Symbolic Comput. 40 (2005) 1285–1290]*, (with Lawrence H. Smith) J. Symbolic Comput. 44 (2009), no. 10, 1529–1532.
30. *Densely ordered braid subgroups*, (with Dale Rolfsen) J. Knot Theory Ramifications 16 (2007), no. 7, 869–877.

#### Non-peer-reviewed work

31. *Left-orderability of 3-manifold fundamental groups*, CMS Notes 48 (2016) no. 2, 14–15.
32. *Orderable groups and bundles*, (with Mathieu Anel) (2012) 13 pages. [arXiv:1208.5844](https://arxiv.org/abs/1208.5844)
33. *Slope detection, foliations in graph manifolds, and L-spaces*, (with Steve Boyer) (2015), 30 pages. [arXiv:1510.02378](https://arxiv.org/abs/1510.02378).

#### Lectures and presentations

##### Conferences

- 2020 Oct. El Paso, USA (AMS special session in topology): The L-space conjecture, left-orderability and circular orderability of fundamental groups.
- 2019 Dec. Toronto, Canada (CMS special session in topology): Creating actions on the line from actions on the circle
- 2018 Dec. Vancouver, Canada (CMS special session in topology): Circular orderings and amalgamation
- 2017 Aug. Quito, Ecuador (XXII Coloquio Latinoamericano de Álgebra): Automorphisms acting on the space of orderings
- July Montreal, Canada (Mathematical Congress of the Americas): The number of circular orderings of a group
- 2016 Apr. Fargo, USA (AMS sectional meeting): Orderability and Dehn fillings of knot complements
- 2015 July Vancouver, Canada (PIMS Symposium on the Geometry and Topology of Manifolds): Foliations of graph manifolds
- Apr. Victoria, Canada (The 54<sup>th</sup> Cascade Topology Seminar): Foliations, left-orderability and L-spaces
- 2014 Sept. Santiago, Chile (Orderable Groups): Ordered groups and topology (minicourse, three lectures)
- Aug. Dublin, Ireland (The 10<sup>th</sup> William Rowan Hamilton Geometry and Topology Workshop): Graph manifolds, left-orderability and L-spaces
- June Winnipeg, Canada (CMS special session on low-dimensional topology and geometric group theory): Bi-orderability of fundamental groups of 3-manifolds
- 2013 Dec. Ottawa, Canada (CMS special session on geometric group theory and low-dimensional topology): The Burns-Hale theorem and its generalizations
- 2012 Dec. Montreal, Canada (CMS special session on geometrical group theory): Graph manifolds, orderability, L-spaces and foliations

- June Regina, Canada (CMS special session on geometry and topology): Foliations of graph manifolds and left-orderability
- Feb. Banff, Canada (BIRS workshop “Ordered groups and topology”): Left-orderability and foliations
- 2010 Apr. Banff, Canada (Cascade topology seminar): Group orderings and knots
- 2009 Jan. Washington DC, USA (AMS special session on orderings and logic): Limit points in the space of left orderings of a group
- 2008 May Montreal, Canada (Colloque Panquébécois des Étudiants): Cofinal elements in orderable groups
- 2007 June Vancouver, Canada (Pure Math Graduate Student Conference): Densely ordered braid subgroups
- May Banff, Canada (BIRS workshop): Normal subgroups of the braid groups and the Dehornoy order

### Seminars

- 2021 Oct. Oklahoma State University (Topology Seminar): Circular orderings, 3-manifolds and covering spaces.
- 2020 Oct. The University of British Columbia (Topology Seminar): Cohomological conditions for left-orderability.
- June Group actions seminar (Online): Towards a cohomological characterization of left-orderability
- Apr. University of Texas at Dallas (Geometry, Topology, Dynamical Systems seminar): Cancelled due to COVID-19
- 2019 Nov. University of Chicago at Illinois (Logic seminar): The structure of the space of left-orderings
- Oct. University of Manitoba (Learning seminar in geometry and topology): Groups of homeomorphisms of low-dimensional manifolds
- May Technion (Geometry and topology seminar): Promoting group actions on the circle to actions on the real line
- May University of British Columbia (Algebra and topology seminar): When does a group that acts on the circle also act on the line?
- 2018 Dec. Université du Québec à Montréal (CIRGET working group): Introduction to circular orderings
- Nov. University of Texas at Austin (Geometry and topology seminar): Circular orderings, amalgamation and 3-manifolds
- 2017 Nov. University of Manitoba (Learning seminar in geometry and topology): Free subgroups of groups of homeomorphisms
- Sept. University of Manitoba (Learning seminar in geometry and topology): The Ping-Pong Lemma
- Aug. Dalhousie University (Colloquium): An introduction to circular orderings and left orderings of groups
- Mar. The University of British Columbia (Topology seminar): The spaces of left and circular orderings of a group
- 2016 July Dalhousie University (Colloquium): Smooth Foliations of 3-Manifolds
- 2015 Nov. University of Manitoba (Learning seminar in geometry and topology): Introduction to the space of left-orderings (2 talks)
- Sept. University of Manitoba (Learning seminar in geometry and topology): Introduction to group growth

- Mar. University of British Columbia (Graduate class on orderable groups): Foliations and left-orderings of Seifert fibred manifolds (2 talks)
- 2014 Oct. University of Manitoba (Learning seminar in geometry and topology): Dehn surgery and fundamental groups of manifolds (2 talks)
- Mar. University of Manitoba (Colloquium): Knot groups and orderability
- Feb. University of Manitoba (Learning seminar in geometry and topology): Introduction to braids and knot theory (3 talks)
- 2013 May Dalhousie University (Colloquium): Ordered groups and 3-manifolds
- Mar. Université du Québec à Montréal (CIRGET geometry and topology seminar): Orderability and knots
- Feb. University of Manitoba (Colloquium): Ordered groups and 3-manifolds
- 2012 Oct. McMaster University (Geometry and topology seminar): Left-orderability, foliations, L-spaces and graph manifolds
- 2011 July University of British Columbia (Algebra and topology seminar): Left-orderability and Dehn surgery
- 2010 Nov. Université du Québec à Montréal (CIRGET geometry and topology seminar): Orderability and knots
- 2009 Nov. University of Tokyo (Topology seminar): An introduction to orderable groups
- Jan. Dalhousie University (Graduate student seminar): An introduction to orderable groups
- 2008 Nov. Universidad de Santiago de Chile (Dynamical systems seminar): Isolated points in the space of left orderings of a group
- Feb. University of British Columbia (Algebra and topology): The space of left orders of the braid groups
- 2007 Nov. Laboratoire de Mathématiques Nicolas Oresme (Special seminar): The space of orderings and the braids
- Nov. University of British Columbia (Algebra and topology seminar): Normal subgroups of the braid groups and the Dehornoy order

### Organizing conferences, meetings and activities

- 2023 Co-organizer, CRM conference on orderable groups, April 24–May 5, Montreal, Canada.
- 2021 Co-organizer, CMS session in group theory and low dimensional topology, December 3–6 Vancouver, Canada.
- Co-organizer, CMS session in low dimensional topology, June 5–8 Ottawa, Canada.
- Co-chair of organizing committee, Nexus 2021: Bridging Academia and Industry, May 19–21, Winnipeg, Canada.
- 2019 Co-organizer, 63<sup>rd</sup> Cascade Topology seminar, September 14–15 Winnipeg, Manitoba.
- Co-organizer, Ordered Groups and Rigidity in Dynamics and Topology (BIRS/CMO event 19w5044), June 16–21 Oaxaca, Mexico.
- 2017 Co-organizer, CMS session in low dimensional topology and geometric group theory, December 8–11 Waterloo, Canada.
- 2016 Co-organizer, CMS session in low dimensional topology and geometric group theory, December 3–5 Niagara Falls, Canada.
- 2015 Co-organizer, CMS session in low dimensional topology and geometric group theory, December 6–9 Montreal, Canada.
- 2014 Co-organizer, CMS session in low dimensional topology and geometric group theory, June 6–9 Winnipeg, Canada.

- 2013 Co-organizer, CMS session in geometric group theory and low dimensional topology, December 6–9 Ottawa, Canada.
- Co-organizer, Low dimensional topology, knots and orderable groups, July 1–5 Luminy, Marseille.

### Referee and review activities

#### Journals refereed (many multiple times)

Canadian Mathematical Bulletin  
 Canadian Journal of Mathematics  
 Topology and its Applications  
 Algebra Universalis  
 Order – A Journal on the Theory of Ordered Sets and its Applications  
 Proceedings of Winterbraids  
 Compositio Mathematica  
 Journal of Knot theory and its Ramifications  
 Communications in Analysis and Geometry  
 Journal of Algebra  
 Algebraic & Geometric Topology  
 Communications in Algebra  
 Proceedings of the American Mathematical Society  
 Journal of the London Mathematical Society  
 Proceedings of the London Mathematical Society

#### Granting agencies refereed

Fonds de recherche du Québec - Nature et technologies (FRQNT)  
 Natural Sciences and Engineering Research Council (NSERC)

#### Miscellaneous review activities

External reviewer for promotion and tenure applications outside the University of Manitoba.  
 External reviewer for named chair applications outside the University of Manitoba.

### Academic honours and grants

- 2020 – 2025 NSERC Discovery grant (\$135000 over 5 years)  
 2023 CRM-Simons Scholar in Residence (April-May)  
 2019 PI for PIMS conference grant (\$4500)  
 2018 – 2019 University of Manitoba URGP (\$7500)  
 2014 – 2015 University of Manitoba URGP (\$6000)  
 2014 – 2019 NSERC Discovery grant (\$95000 over 5 years)  
 2013 – 2016 University of Manitoba startup grant (\$45000)  
 2013 Co-PI for NSF conference grant 1305741 (\$32000 USD)  
 — PI for PIMS conference grant (\$4000)  
 2010 – 2012 NSERC postdoctoral fellowship, Université du Québec à Montréal  
 2008 University graduate fellowship, University of British Columbia  
 2005 – 2007 NSERC PGS-D, University of British Columbia  
 2003 – 2005 NSERC PGS-M, University of British Columbia

**Awards**

2021	University of Manitoba Merit Award in Service (\$3000)
2017	Faculty of Science Award for Innovation in Teaching (\$1000)
2008	University of British Columbia graduate teaching award (departmental)
2003	King's Medal

**Teaching activities**

2022	Fall	Introduction to Topology (Math 3390 at the University of Manitoba)
2022	Winter	Orderable groups and topology (Reading course at the University of Manitoba)
2021	Fall	Introduction to Topology (Math 3390 at the University of Manitoba)
		Homology and Cohomology (Reading course at the University of Manitoba)
2021	Summer	Bass-Serre Theory (Reading course at the University of Manitoba)
2021	Winter	Advanced Galois Theory (Reading course at the University of Manitoba)
2020	Fall	Introduction to Topology (Math 3390 at the University of Manitoba)
2020	Winter	Introduction to Encryption (SCI 2000 at the University of Manitoba)
2019	Fall	Introduction to Analysis (MATH 2080 at the University of Manitoba)
2018	Winter	Algebra 3 (MATH 3322 at the University of Manitoba)
2017	Fall	Introduction to Analysis (MATH 2080 at the University of Manitoba)
		Differential Calculus (Math 1500 at the University of Manitoba)
2017	Winter	Analysis 3 (MATH 3472 at the University of Manitoba)
		Differential Calculus course coordinator (Math 1500 at the University of Manitoba)
2016	Fall	Topics in Geometric group theory
		Honours Differential Calculus (Math 1230 at the University of Manitoba)
2016	Winter	Algebra 1 (MATH 2020 at the University of Manitoba)
		Differential Calculus (Math 1500 at the University of Manitoba)
2015	Fall	Introduction to Topology (Math 3390 at the University of Manitoba)
2015	Winter	Engineering Analysis 1 (Math 2132 at the University of Manitoba)
		Advanced Calculus (Math 3760 at the University of Manitoba)
2014	Fall	Advanced Calculus (Math 3760 at the University of Manitoba)
2014	Winter	Topology I (Math 3240 at the University of Manitoba)
		Differential Calculus (Math 1500 at the University of Manitoba)
2012	Fall	Enriched Linear Algebra and Geometry (Math 134 at McGill)
2011	Fall	Linear Algebra and Geometry (Math 133 at McGill)
2010	Fall	Linear Algebra and Geometry (Math 133 at McGill)
2009–2010		Organizer of nine calculus workshops (Math 110 at UBC)
2005–2008		Ordinary differential equations (Math 265 at UBC)
2005	Winter	Integral calculus (Math 103 at UBC)

**Postdoctoral**

Idrissa Ba (2019–2022)  
 Ty Ghaswala (2017–2019)  
 Juliana Theodoro de Lima (2015–2016, co-supervisor with Steve Boyer)

**PhD**

Junyu Lu (2021–present)  
 Tommy Cai (2020–present)

## MSc

Dana Kapoostinsky (Sept 2022 (expected))

Vindya Lakshani (2021–2022)

Withdrew from program due to travel restrictions.

Irshad Ayoob (2017–2020)

Thesis: Ordered groups and a theorem of Farrell.

Adriana Ciupeanu (2016–2019)

Thesis: Left-orderable groups and amenability.

Serhii Dovhyi (2014–2017)

Thesis: Non-left-orderable surgeries of twisted torus knots.

Ali Khardani (2013–2014, joint supervision with Steve Boyer at UQAM)

Thesis: Groupes ordonnés et les variétés de dimension 3.

## Undergraduate students mentored

- 2022 Indep. Eliza Haraldson *Left-orderability and countable Borel equivalence relations*
- 2022 USRA Dana Kapoostinsky *Left-orderability and homeomorphisms of the disk*
- 2021 USRA Waweru Kariuki *Bass-Serre theory and circular orderings*
- 2021 USRA Tjay Staruch *Left-orderability and fundamental groups of cyclic branched covers of knots*
- 2021 USRA Dana Kapoostinsky *Obstructing circular orderability*
- 2019 USRA Robert Harris *Circular orderability and obstructing left-orderability*
- 2019 USRA Mitchell Heron *Left-orderability and Dehn filling*
- 2019 USRA Mary-Elaine Herrera *Left-orderings and branched cyclic covers of knots*
- 2019 USRA Ian Thompson *Locally invariant orderings and amenability*
- 2018 USRA Jeremy Friesen *Groups and topological dynamics*
- 2018 USRA Robert Harris *Density of representations of the free group*
- 2018 USRA Tessa Reimer *Isolated points in spaces of orderings*
- 2018 Hons. Jeremy Friesen (honours project) *Topological groups in physics*
- 2017 USRA Tessa Reimer *Algebraic properties of ordered groups*
- 2016 USRA Sina Zabanfahm *Spaces of left-orderings of braid groups*
- 2015 USRA Patrick Naylor *Diffuse groups and locally invariant orderings*
- 2015 USRA Colin Desmarais *A brute force approach to knot group bi-orderability*
- 2014 USRA Patrick Naylor *Bi-orderability of two bridge knot groups*
- 2014 USRA Colin Desmarais *Testing bi-orderability of knot groups*

## Seminars organized or co-organized

- 2017–2019 Learning seminar in geometry and topology (at University of Manitoba, co-organizer)
- 2014–2016 Learning seminar in geometry and topology (at University of Manitoba, co-organizer)
- 2013 Co-organizer, CIRGET-LaCIM seminar (at UQÀM)
- 2011 Working group in low dimensional topology (at UQÀM)

## Committee work

## Professional committees



Canadian Mathematical Society finance committee (member 2016–2021, chair 2022–present)  
Co-chair of NSERC Mathematics and Statistics Evaluation Group (2019–present)  
Canadian Mathematical Society board of directors (2019–present)

#### Administrative committees

University of Manitoba Tri-Agency bridge funding committee (2022–present)  
University of Manitoba Senate (2022–present)  
Research committee (U of M departmental committee) (2021–present)  
Faculty of Science Nucleus Tenure Committee (U of M faculty committee) (2020–present)  
Hiring (for Faculty of Science administrative position) (2022)  
Hiring (U of M departmental committee) (2021)  
Data Science M.Sc. program committee (U of M faculty committee) (2020–2022)  
Graduate studies (U of M departmental committee) (2018–2020)  
Promotion and tenure (U of M departmental committee) (2018)  
Hiring (U of M departmental committee) (2017)  
Promotion (U of M departmental committee) (2016)  
Executive (U of M departmental committee) (2016–2019)  
Scholarships and awards (U of M departmental committee) (2016–2019)  
Hiring (U of M departmental committee) (2015)  
Research advisory team science (U of M faculty committee) (2014–2017)  
Hiring (U of M departmental committee) (2014)  
Strategic planning (U of M departmental committee) (2013–2016)  
Various comprehensive examination committees (14 committees over 2013–2022)  
Chair of various external examination committees (8 committees between 2013–2022)

#### Examination and advisory committees

Dinamo Djounvouna (PhD internal examiner)  
Md Ismail Hossain (MSc internal examiner, 2018)  
Juliana Theodoro de Lima (PhD external examiner, 2014)