

# CURRICULUM VITAE

McMaster University  
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## EMPLOYMENT

- 2026 – 2029 **University of Nebraska, Lincoln** NSF RTG Postdoctoral Fellow  
RESEARCH GROUP: Commutative Algebra RTG group
- 2025 – 2026 **McMaster University** Britton Postdoctoral Fellow  
RESEARCH GROUP: Combinatorial Algebraic Geometry
- 2025 Spring **Fields Institute for Research in Mathematical Sciences** Postdoctoral Fellow  
THEMATIC PROGRAM: Commutative Algebra and Applications
- 2024 Fall **Max Planck Institute for Mathematics in the Sciences** Postdoctoral Fellow  
RESEARCH GROUP: Nonlinear Algebra

## EDUCATION

- 2024 Ph.D. **University of Minnesota, Twin Cities** ADVISOR: Christine Berkesch  
THESIS: Diagonalization, Direct Summands, and Resolutions of the Diagonal
- 2017 B.A. **University of California, Berkeley** (with Honors) ADVISOR: David Eisenbud  
THESIS: Local Computations in Macaulay2
- 2016 **Math in Moscow** (semester abroad at the Independent University of Moscow)

## AWARDS

- 2023 – 2024 Doctoral Dissertation Fellowship, University of Minnesota
- 2020 Honorable Mention, Graduate Research Fellowships Program, NSF
- 2018 – 2020 John Ordway Fellowship, School of Mathematics, University of Minnesota

## GRANTS

- 2025 NSF DMS-2508868 for Macaulay2 Workshop at UW-Madison
- 2023 NSF DMS-2302476 for M2Week at the University of Minnesota
- 2022 NSF DMS-2206872 for GradMoCCA at the University of Minnesota
- 2018 DRP Network Seed Grant

## PUBLICATIONS

- 2026 10. “Characterizing multigraded regularity and virtual resolutions on products of projective spaces”  
J. Bruce, and L. Cranton Heller. *Advances in Mathematics* **500** (2026) 111049. [arXiv:2110.10705](#)
- 2025 9. “Computing Direct Sum Decompositions”  
D. Mallory. *Journal of Symbolic Computation* **133** (2026) 102486. [arXiv:2412.19799](#)
- 2024 8. “A short resolution of diagonal for smooth projective toric varieties of Picard rank 2”  
M.K. Brown. *Algebra & Number Theory* **18** (2024) 10. [arXiv:2208.00562](#)
- 2020 7. “The virtual resolutions package for Macaulay2”  
A. Almousa, J. Bruce, and M.C. Loper. *J. of Software for Algebra & Geometry* **10** (2020), 51–60. [arXiv:1905.07022](#)
- 2017 6. “What is the optimal way to prepare a Bell state using measurement and feedback?”  
L. Martin and K.B. Whaley. *Quantum Sci. & Technol.* **2** (2017) 4. [arXiv:1704.00332](#)

## PREPRINTS

- 2025 6. “Seshadri regions and the asymptotic shape of multigraded regularity”  
J. Bruce, and L. Cranton Heller, A. Seceleanu. [arXiv:2512.05289](#)
- 2025 5. “Computing global Ext for complexes”  
M. Brown, S. Dey, G. Li. Submitted. [arXiv:2509.25103](#)
- 2025 4. “Connection Matrices in Macaulay2”  
P. Görlach, J. Koeﬂer, A.-L. Sattelberger, H. Schroeder, N. Weiss, F. Zaffalon. Submitted. [arXiv:2504.01362](#)
- 2025 3. “Splitting of vector bundles on toric varieties”  
Submitted. [arXiv:2412.19793](#)
- 2022 2. “Bounds on multigraded regularity”  
J. Bruce, and L. Cranton Heller. Submitted. [arXiv:2208.11115](#)

## INVITED TALKS (selected)

### Conferences

|      |      |  |  |
|------|------|--|--|
| 2026 | Jan. | Joint Math Meetings                        | Washington, D.C.                         |
| 2025 | Sep. | Route 81 Mathematics Conference            | Queen's University, Canada               |
| 2024 | July | Effective Methods in Algebraic Geometry    | MPI MiS, Leipzig, Germany                |
|      | May  | Spring Western AMS Sectional Meeting       | San Francisco State University           |
|      | Jan. | Joint Math Meetings                        | San Francisco, California                |
| 2023 | Oct. | Fall Central AMS Sectional Meeting         | Creighton University, Omaha              |
|      | Jul. | SIAM Applied Algebraic Geometry Conference | TU Eindhoven, the Netherlands            |
|      | Jul. | Géométrie Algébrique en Liberté (GAeL)     | University of Warwick, UK                |
|      | Apr. | CA+ Conference                             | University of Minnesota, Twin Cities     |
|      | Mar. | Spring Southeastern AMS Sectional Meeting  | Georgia Institute of Technology, Atlanta |
| 2022 | Oct. | Fall Western AMS Sectional Meeting         | University of Utah, Salt Lake City       |
|      | Sep. | Fall Central AMS Sectional Meeting         | University of Texas, El Paso             |
|      | May  | Macaulay2 Conference                       | Cleveland State University               |
| 2021 | Apr. | Spring Central AMS Sectional Meeting       | University of Cincinnati (virtual)       |
| 2019 | Aug. | SIAM Applied Algebraic Geometry Conference | Universität Bern, Switzerland            |
| 2018 | Jan. | Joint Mathematics Meetings                 | San Diego, California                    |

### Seminars

|      |      |  |  |
|------|------|--|--|
| 2025 | Oct. | Algebra Seminar                                    | Syracuse University                            |
|      | Oct. | Algebra and Algebraic Geometry Seminar             | McMaster University                            |
|      | Jun. | Commutative Algebra and Applications Seminar       | Fields Institute                               |
| 2024 | Dec. | Discrete Geometry Seminar                          | Technische Universität Berlin                  |
|      | Dec. | Algebra Seminar                                    | Universität Osnabrück                          |
|      | Dec. | BIREP Seminar                                      | Universität Bielefeld                          |
|      | Nov. | EDGE Geometry Seminar                              | University of Edinburgh, Hodge Institute       |
|      | Oct. | Algebra Seminar                                    | Friedrich-Schiller-Universität Jena            |
|      | May  | Algebra Seminar                                    | University of Oregon, Eugene                   |
|      | Apr. | Commutative Algebra and Algebraic Geometry Seminar | University of California, Berkeley             |
|      | Mar. | Commutative Algebra Seminar                        | University of Michigan, Ann Arbor              |
|      | Feb. | Algebra Seminar                                    | Georgia Tech, Atlanta                          |
|      | Feb. | Combinatorics Seminar                              | Washington University in St. Louis             |
| 2023 | Nov. | Algebraic Geometry and Commutative Algebra Seminar | University of Notre Dame                       |
|      | Apr. | Commutative Algebra Seminar                        | University of Nebraska - Lincoln               |
|      | Feb. | Algebra and Combinatorics Seminar                  | Texas A&M University                           |
|      | Jan. | Commutative Algebra Seminar                        | University of Illinois, Chicago                |
| 2022 | Oct. | Algebraic Geometry Seminar                         | University of Utah                             |
|      | Oct. | Number Theory and Algebra Seminar                  | Arizona State University                       |
| 2021 | Oct. | Algebra Seminar                                    | Georgia Tech, Atlanta                          |
|      | Oct. | Algebra Seminar                                    | Auburn University                              |
|      | Feb. | Grad/Postdoc Seminar (virtual)                     | ICERM Combinatorial Algebraic Geometry Program |

### Posters

|      |      |  |                                     |
|------|------|--|-------------------------------------|
| 2024 | Oct. | Group actions, combinatorics, and Fano varieties conference    | Universität Innsbruck, Austria      |
|      | Sep. | Syzygies and Hilbert Schemes Conference                        | Jagiellonian University, Poland     |
|      | Jan. | SLMath Connections Workshop: Commutative Algebra               | SLMath, Berkeley                    |
| 2023 | Nov. | Western Algebraic Geometry Symposium                           | Washington University in St. Louis  |
|      | May  | MSRI/SLMath Summer School in Commutative Algebra               | University of Notre Dame            |
| 2022 | Nov. | Western Algebraic Geometry Symposium                           | University of California, Riverside |
|      | Jun. | Pan-American School in Commutative Algebra                     | CIMAT, Mexico                       |
| 2017 | Aug. | SIAM Applied Algebraic Geometry Conference                     | Georgia Tech, Atlanta               |
| 2015 | Feb. | Southwest Quantum Information and Technology Workshop (SQuInT) | UC Berkeley                         |

## TEACHING and MENTORING EXPERIENCE

### Department of Mathematics & Statistics, McMaster University

2026 Winter MATH 1MM3: instructor of record for Applied Calculus (class of 340 students).

2025 Fall MATH 3GR3: instructor of record for Abstract Algebra (class of 35 students).

2026 Summer REU: co-mentored M. Cotter towards formalizing Macaulay's theorem in Lean4.

### School of Mathematics, University of Minnesota, Twin Cities

2023 Spring MATH 1272: instructor of record for Calculus II (class of 100 students).

2022 Fall MATH 8253: graded homework for Algebraic Geometry (2nd year graduate course).

2022 Spring MATH 1272: instructor of record for Calculus II (class of 90 students).

2019 – 2021 MATH 2243: TA for Linear Algebra & Differential Equations (six sections total).

2018 Fall MATH 1271: TA for Calculus I (two sections total).

2020 Summer REU: mentored P. Cranford, A. Peng, and V. Srinivasan towards [arXiv:2106.12667](https://arxiv.org/abs/2106.12667).

2019 & 2022 DRP: mentored five undergraduate students in weekly reading projects.

### Department of Mathematics, UC Berkeley

2015 Spring Math113: graded homework for Abstract Algebra.

2014 Fall Math116: graded homework and assisted the instructor for Mathematical Cryptography.

### Math Center, Irvine Valley College

2013 – 2014 Tutored lower-div courses including linear algebra, differential equations, and discrete math.

### Mathobotix, Irvine, CA

2012 – 2014 Developed curriculum for computer science-based problem-solving using Python.

## CONFERENCE AND WORKSHOP ORGANIZATION

2025 Dec. **CA+AG Session at the Canadian Math Society Meeting** Toronto, Canada

2025 Jul. **Macaulay2 Workshop** Madison, Wisconsin

2024 Nov. **Macaulay2 in the Sciences Workshop** Leipzig, Germany

2023 Jun. **Macaulay2 Workshop & Mini-school** Minneapolis, Minnesota

2022 May **Graduate Meeting on Combinatorial Commutative Algebra**

Weekend graduate event with 12 speakers bringing 70 students and postdocs to Minneapolis.

## MATHEMATICAL SERVICE

2018 – 2023 **Directed Reading Program**, University of Minnesota, Co-founder and co-organizer  
Matched over 250 undergraduate and graduate students in guided mathematics reading projects.

2019 – 2022 **Student Commutative Algebra Meeting**, University of Minnesota, Co-organizer  
Held a weekly meetup of friendly neighborhood commutative algebra students.

2021 Apr. **Graduate Student Combinatorics Conference**, Session Chair  
Chaired the session on Combinatorial Algebraic Geometry.

2017 – 2018 **Pauline Sperry Undergraduate Lecture Series**, UC Berkeley, Organizer  
Inaugurated an annual lecture aimed at providing a role model for marginalized students in math.

### Referee Work:

Journal of Pure and Applied Algebra, Journal of Software for Algebra and Geometry

## BROADER OUTREACH

2019 – 2023 **Vincent Hall Thespians, University of Minnesota**, Performer  
Helped with first-time teaching assistant orientation through situational comedy.

2023 Jan. **Minnesota Project in Mathematics**, Counselor  
Helped with workshops and mentored two undergraduate projects during the week-long program.

2019 – 2020 **AMS Graduate Student Blog**, Staff Writer  
Wrote about finding community through mathematical art and history.

2018 Jul. **Girls Who Code @ Cloudflare**, Workshop Leader  
Instilled an appreciation for mathematics in high school girls using elliptic cryptography puzzles.

2016 – 2017 **Mathematics Undergraduate Student Association**, UC Berkeley, President  
Helped build an inclusive and diverse community among undergraduate math students at Berkeley.

2015 & 2018 **Berkeley Splash**, Activity Leader  
Led interactive activities about cryptography and elliptic curves for high school students.

2014 & 2015 **Berkeley mini Math Tournament**, Grader and Lecturer  
Instilled an appreciation for knot theory in advanced elementary and middle school students.

## WORKSHOPS and SUMMER SCHOOLS (selected)

- 2023 Sep. **Syzygies and mirror symmetry**, American Institute of Mathematics, Pasadena, California  
Topics: resolutions of the diagonal for toric varieties, homological mirror symmetry
- Jul. **Géométrie Algébrique en Liberté**, University of Warwick, UK  
Topics: Mori Dream Spaces and quiver GIT, klt singularities, the geometry of curves
- Jun. **MRC Derived Categories, Arithmetic and Geometry**, AMS  
Topics: Frobenius pushforwards and  $F$ -thickness of the blowup  $\mathrm{Bl}_5\mathbf{P}^2$
- May **MSRI/SLMath Summer School in Commutative Algebra**, University of Notre Dame  
TA for mini-course on the geometry of nonstandard syzygies by Daniel Erman
- 2022 Dec. **RTG Workshop on Birational Complexity**, SCGP, Stony Brook University  
Topics: rationality, curves in algebraic varieties, the Cremona group, measures of irrationality
- Jun. **Pan-American School in Commutative Algebra**, CIMAT, Mexico  
Topics: positive characteristic methods, toric varieties, DG algebras, modules of differentials
- 2021 Spr. **Combinatorial Algebraic Geometry**, ICERM  
Topics: Schubert varieties, toric varieties, tropical varieties, cluster algebras and varieties
- 2018 May **RTG Summer School in Commutative Algebra**, University of Utah  
Topics: limits in positive characteristic, symbolic powers, differential operators, and syzygies.
- Mar. **Geometry of Redistricting Workshop**, University of San Francisco  
Topics: gerrymandering, voting rights, discrete geometry and graph theory

## OPEN SOURCE DEVELOPMENT

Since 2017 **Macaulay2 Internals**

I have contributed to various internal components of Macaulay2, including the engine, interpreter, core mathematical routines, and documentation. I have also contributed to the following packages:

- Since 2023 **DirectSummands**: for decomposing modules and coherent sheaves, with D. Mallory.
- Since 2023 **Varieties**: for computations involving projective varieties, including complexes of coherent sheaves and their morphisms, with D. Mallory, R. Ramkumar, G. Smith, K. VandeBogert.
- Since 2020 **NormalToricVarieties**: added support for pullbacks of coherent sheaves over toric maps, and computations on the Cox ring of toric varieties whose class group has torsion.
- Since 2021 **Truncations**: added support for truncations of modules with respect to arbitrary cones, for instance on simplicial toric varieties where the nef and effective cones differ.
- Since 2020 **Saturation**: improved and added to core routines for computing annihilators, saturations, and quotients of ideals and modules, with J. Chen and M. Stillman.
- Since 2019 **FGLM**: for computing Gröbner bases of zero-dimensional ideals, with D. Peifer.
- Since 2018 **VirtualResolutions**: see paper above, with A. Almousa, J. Bruce, and M. Loper.
- Since 2017 **LocalRings**: for symbolic computations over local rings, with M. Stillman.

## OTHER WORK & RESEARCH EXPERIENCE

- 2018 Summer **Cloudflare, Inc.** Cryptography Engineering Intern  
Launched products involving Tor, Keyless SSL, and distributed randomness generation.
- 2017 Winter **Proton Research, Inc.** Cryptography Research and Development Intern  
Launched support for elliptic curve cryptography in OpenPGP.js.
- 2017 Summer **Institute for Quantum Computing**, University of Waterloo  
Topics: quantum error correcting codes from algebraic curves under John Watrous.
- 2015 – 2016 **Berkeley Quantum Information and Computation Center**, UC Berkeley  
Topics: control theory & entanglement generation under Leigh Martin and Birgitta Whaley.
- 2014 Summer **SURF @ Institute for Quantum Information and Matter**, Caltech  
Topics: quantum game theory and semi-definite optimization under Thomas Vidick.
- 2013 Summer **SURF @ Jet Propulsion Laboratory**, NASA  
Topics: secure multiparty computation and secret sharing systems under Ed Chow.

## REFERENCES

|  |                                   |                                       |   |
|--|-----------------------------------|---------------------------------------|---|
| Christine Berkesch<br>cberkes@umn.edu<br>Advisor | David Eisenbud<br>de@berkeley.edu | Michael Stillman<br>mes15@cornell.edu | Craig Westerland<br>cweste1@umn.edu<br>Teaching |
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