Martha E. Precup

Curriculum Vitae

Washington University in St. Louis
Department of Mathematics and Statistics
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Academic Employment

Washington University in St. Louis, Associate Professor — 2024–present
Washington University in St. Louis, Assistant Professor — 2018–present
Northwestern University, Postdoctoral Lecturer — 2015–2018
Baylor University, Postdoctoral Associate — 2013–2015

Education

University of Notre Dame, Notre Dame, IN
    Ph.D. Mathematics — May 2013
    Advisor: Samuel Evens

Hope College, Holland, MI
    B.A. Mathematics, Minor: Economics — May 2008

Professional Interests

Applications of Lie theory to algebraic geometry and the related combinatorics.

Grant Support

PI, National Science Foundation CAREER Grant 2237057 — 2023-2028
    CAREER: Hessenberg varieties, symmetric functions, and combinatorial representation theory

PI, National Science Foundation Grant 1954001 — 2020-2025
    Applications of Lie Theory: Combinatorial algebraic geometry and symmetric functions

PI, National Science Foundation Conference Grant 2245927 — March 2023
    Conference: 2023 Graduate Student Combinatorics Conference

Publications

Peer-Reviewed Journal Articles

18. *Which Schubert varieties are Hessenberg varieties?*, Laura Escobar, Martha Precup, and John Shareshian, Transformation Groups (2023).

17. *Perverse sheaves, nilpotent Hessenberg varieties, and the modular law*, Martha Precup and Eric Sommers, Pure and Applied Mathematics Quarterly[*] (accepted for publication).

16. *Torus fixed point sets of Hessenberg Schubert varieties in regular semisimple Hessenberg varieties*, Megumi Harada and Martha Precup, Osaka Journal of Mathematics 60 (2023), no. 3, 637-652.

15. *A new approach to the generalized Springer correspondence*, William Graham, Martha Precup, and Amber Russell, Transactions of the American Mathematical Society 376 (2023), no. 6, 3891-3918.

14. *Upper-triangular linear relations on multiplicities and the Stanley–Stembridge conjecture,* Megumi Harada and Martha Precup, The Electronic Journal of Combinatorics 29 (2022), no. 3, Paper No. 3.16, 35 pp.

13. *Toward permutation bases in the equivariant cohomology rings of regular semisimple Hessenberg varieties,* Megumi Harada, Martha Precup, and Julianna Tymoczko, La Matematica 1 (2022), no. 1, 263-316.

12. *Hessenberg varieties associated to ad-nilpotent ideals*, Caleb Ji and Martha Precup, Communications in Algebra 50 (2022), no. 4, 1728–1749.

11. *Hessenberg varieties of parabolic type*, Martha Precup and Julianna Tymoczko, Geometriae Dedicata 214 (2021), 519-542.

10. *An equivariant basis for the cohomology of Springer fibers*, Martha Precup and Edward Richmond, Transactions of the American Mathematical Society Series B[†] 8 (2021), 481-509.

9. *A filtration on the cohomology rings of regular nilpotent Hessenberg varieties*, Megumi Harada, Tatsuya Horiguchi, Satoshi Murai, Martha Precup, and Julianna Tymoczko, Mathematische Zeitschrift 298 (2021), no. 3-4, 1345-1382.

8. *The cohomology of abelian Hessenberg varieties and the Stanley–Stembridge conjecture*, Megumi Harada and Martha Precup, Algebraic Combinatorics 2 (2019), no. 6, 1059-1108.

7. *The singular locus of semisimple Hessenberg varieties*, Erik Insko and Martha Precup, Journal of Algebra 521 (2019), 65-96.

6. *Springer fibers and Schubert points*, Martha Precup and Julianna Tymoczko, European Journal of Combinatorics 76 (2019), 10-26.

5. *The Betti numbers of regular Hessenberg varieties are palindromic*, Martha Precup, Transformation Groups 23 (2018), no. 2, 491-499.

4. *The connectedness of Hessenberg varieties*, Martha Precup, Journal of Algebra 437 (2015) 34-43.

3. *Affine pavings of Hessenberg varieties for semisimple groups*, Martha Precup, Selecta Mathematica (New Series) 19 (2013), no. 4, 903-922.

Peer-Reviewed Conference Proceedings

2. *Hessenberg varieties and the Stanley–Stembridge conjecture*, Martha Precup, Oberwolfach Reports 46 (2019), 28-30.

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[*]Special issue in honor of George Lusztig.

[†]Open access version of Transactions of the American Mathematical Society

1. *The cohomology of abelian Hessenberg varieties and the Stanley–Stembridge conjecture*,
   Megumi Harada and Martha Precup, in Proceedings of the 30th International Conference on
   Formal Power Series and Algebraic Combinatorics, Séminaire Lotharingien de
   Combinatoire 80B (2018), Art. 49, 12 pp.

Work in Progress

Books

4. *Handbook of Combinatorial Algebraic Geometry: Subvarieties of the Flag Variety*
   Co-editors: Erik Insko, Martha Precup, and Edward Richmond
   CRC Press, estimated publication Spring 2025

Preprints submitted for Publication

3. *Geometric and combinatorial properties of extended Springer fibers*, William Graham,
   Martha Precup, and Amber Russell; submitted, arXiv:2309.13764
2. *K-orbit closures and Hessenberg varieties*, Mahir Can, Martha Precup, John Shareshian,
   and Özlem Uğurlu; submitted, arXiv:2309.05770
1. *Hessenberg varieties of codimension one in the flag variety*, Laura Escobar, Martha
   Precup, and John Shareshian; submitted, arXiv:2208.06299

Professional Talks

Invited Conference Presentations

AMS[‡] Spring Central Sectional Meeting, Special Session on Geometric Methods   April 2024
    in Representation Theory

Conference on Enumerative and Algebraic Combinatorics,   February 2024
    University of Florida

AMS Fall Eastern Sectional Meeting, Special Session on Some Tantalizing   October 2022
    Conjectures in Discrete Mathematics

AMS Fall Eastern Sectional Meeting, Special Session on Geometric Aspects   October 2022
    of Algebraic Combinatorics

ISM Discovery School: Geometry and Combinatorics of Hessenberg Varieties   June 2022
    Series of eight lectures on Hessenberg varieties, Institut des sciences mathématiques,
      University of Quebec in Montreal

AMS Spring Central Sectional Meeting, Special Session on Combinatorics   March 2022
    and Representations of Noncommutative Algebras

Oberwolfach Mini-Workshop: Degeneration Techniques in   October 2019
    Representation Theory, Oberwolfach Research Institute for Mathematics

AMS Fall Central Sectional Meeting, Special Session on Lie   September 2019
    Representation Theory

AMS Spring Southeastern Sectional Meeting, Special Session on Geometric   March 2019
    and Combinatorial Aspects of Representation Theory

[‡]American Mathematical Society

Hessenberg Varieties in Combinatorics, Geometry and Representation Theory Workshop at Banff International Research Station	October 2018
AMS Fall Central Sectional Meeting, Special Session on Combinatorics in Algebra and Algebraic Geometry	October 2018
International Conference on Formal Power Series and Algebraic Combinatorics Dartmouth College	July 2018
Combinatorial Algebra meets Algebraic Combinatorics McMaster University	January 2018
Joint Mathematics Meetings, Special Session on Combinatorics and Geometry	January 2018
AMS Spring Eastern Sectional Meeting, Special Session on Cohomologies and Combinatorics	May 2017
Algebra, Combinatorics and Geometry Day (ALGECOM) University of Illinois Urbana-Champaign	April 2017
Joint Mathematics Meetings, Special Session on Representations and Related Geometry in Lie Theory	January 2017
AMS Spring Western Sectional Meeting, Special Session on Algebraic Combinatorics	April 2016
AMS Spring Western Sectional Meeting, Special Session on Combinatorial and Computational Commutative Algebra and Algebraic Geometry	April 2016
AMS Spring Southeastern Sectional Meeting, Special Session on Lie Theory, Representation Theory, and Geometry	March 2016
Focused Research Group on Hodge Theory, Moduli and Representation Theory: Workshop 5, Texas A&M University	January 2016
AMS Fall Eastern Sectional Meeting, Special Session on Algebraic Geometry and Combinatorics	November 2015
Workshop on Recent Developments in the Geometry and Combinatorics of Hessenberg Varieties, The Fields Institute	July 2015
AMS Southeastern Sectional Meeting, Special Session on Geometric and Combinatorial Methods in Lie Theory	March 2014

INVITED SEMINARS AND COLLOQUIA

Mathematics Seminar, Montana State University	January 2024
Algebra Seminar, University of Georgia	April 2023
Discrete Math Seminar, Michigan State University	March 2023
Colloquium, Saint Louis University	February 2023
Algebraic Geometry and Commutative Algebra Seminar, University of Notre Dame	November 2022
Rocky Mountain Algebraic Combinatorics Seminar, Colorado State University	November 2022
Representation Theory Seminar, University of Bonn	November 2021
Combinatorics Seminar, University of California Berkeley	September 2021
Geometry, Physics, and Representation Theory Seminar, Northeastern University	February 2021

Algebra Seminar, Virginia Tech	January 2021
Algebraic Geometry Seminar, University of California, Davis	January 2021
Number Theory & Algebraic Geometry Seminar, Boston College	November 2020
Representation Theory Seminar, University of Massachusetts Amherst	October 2020
Seminar on Combinatorics and Discrete Math, LaCIM University of Quebec in Montreal	February 2020
Colloquium, Tulane University	January 2020
Combinatorics Seminar, University of Washington	June 2019
Combinatorics Seminar, University of Michigan	March 2019
Geometry, Combinatorics, and Integrable Systems Seminar, The Ohio State University	March 2018
Colloquium, Washington University in St. Louis	December 2017
Seminar Lectures on Hessenberg Varieties (Four Talks), Osaka City University Advanced Mathematical Institute	July 2017
Algebraic Geometry and Commutative Algebra Seminar, University of Notre Dame	April 2017
Lie Groups and Representation Theory Seminar, University of Maryland	March 2017
Colloquium, Washington University in St. Louis	October 2016
Algebraic Geometry Seminar, Washington University in St. Louis	October 2016
Algebra and Combinatorics Seminar, DePaul University	May 2016
Graduate Student Seminar, Northwestern University	January 2016
Geometry and Topology Seminar, McMaster University	November 2015
Representation Theory Seminar, Oklahoma State University	April 2015
Algebra Seminar, University of Georgia	April 2015
Algebraic Geometry Seminar, Texas A&M University	March 2015
Representation Theory Seminar, University of Massachusetts Amherst	November 2014
Mathematics Colloquium, Sam Houston State University	October 2014
Algebraic Geometry Seminar, Texas A&M University	February 2014
Algebra Seminar, University of North Texas	October 2013
Algebraic Geometry Seminar, The University of British Columbia	April 2013
Mathematics Colloquium, Baylor University	February 2013
Algebra Seminar, University of Wisconsin Milwaukee	November 2012

INVITED EXPOSITORY TALKS

Lecture sponsored by Association for Women in Mathematics (WUSTL)	December 2020
Northwestern University Math Society	November 2017
Northwestern University Math Society	October 2016
Mathematics Colloquium, Butler University	February 2016
Mathematics Colloquium, Florida Gulf Coast University	October 2015

Honors and Awards

Departmental Award for Excellence in Teaching, Northwestern University	2017
Outstanding Graduate Student Teacher Award for Excellence in Teaching	2012
Kaneb Center for Teaching and Learning, University of Notre Dame	
Richard V. Andree Award	2010
Best publication appearing in the Pi Mu Epsilon Journal in 2010.	
Albert E. Lampen Award in Mathematics, Hope College	2008
Awarded annually in recognition of outstanding achievement in mathematics.	

Research Fellowships

Fellowship, Summer Research for Women in Math	June 2019
Mathematical Sciences Research Institute (MSRI), Berkeley, California, USA	
Award dates: 6/1/2019–6/30/2019	
Fields Research Fellowship	August 2018
The Fields Institute for Research in Mathematical Sciences, Toronto, Canada	
Award dates: 8/1/2018–8/31/2018	

Teaching and Advising

PhD Advising

Nathan Lesnevich	2020-2024
Cristina Sabando Alvarez	2022-present
Xijing (Carole) Zhuang	2024-present

Undergraduate Research

Faculty Director, Freiwald Summer Course	2024
Research program for first and second year undergraduate students in	
mathematics funded by NSF CAREER Grant.	
Undergraduate Research Project (Freiwald Scholars Program)	2020
Ruofan (Michael) Zeng, *Combinatorial invariants of regular Hessenberg varieties*	
Undergraduate Research Project	2018-19
Caleb Ji, *Hessenberg varieties associated to nilpotent ideals*	

Teaching at Washington University in St. Louis

Lie Algebras and Representation Theory (Math 537)	Fall 2024
Calculus III (Math 233)	Spring 2024
Modern Algebra (Math 430)	Spring 2019, 2022
Foundations for Higher Mathematics (Math 310)	Spring 2022
Calculus II (Math 132)	Spring 2021
Algebraic Groups (Math 537)	Fall 2020
Foundations for Higher Mathematics with Writing (Math 310W)	Spring 2020

Algebra 2 (Math 5032)	Spring 2020
Algebra 1 (Math 5031)	Fall 2019
Introduction to Analysis (Math 4111)	Fall 2018

SERVICE

DEPARTMENTAL SERVICE

Co-organizer, Combinatorics Seminar	Fall 2018-present
Chair of the Putnam Committee	Fall 2019, Fall 2020
Co-organizer, Combinatorics Reading Seminar for Grad Students	2019-2020
Member of the Applied and Computational Mathematics Search Committee	Fall 2019
Member of the Putnam Committee	Fall 2018

UNIVERSITY SERVICE

Washington University in St. Louis, Level 1 Mentor — 2023
Center for the Improvement of Mentored Experiences in Research

Member of the Instructional Planning Task Force — Summer/Fall 2020
University committee to provide recommendations and support instructional excellence in the fluid teaching and learning environment of AY20-21.

CONFERENCE AND WORKSHOP ORGANIZATION

Faculty Advisor for the Graduate Student Combinatorics Conference, WUSTL — Fall 2021-23
Mentored student preparation of funded conference grant proposal NSF DMS 2245927

Interactions between Hessenberg Varieties, Chromatic Functions, and — October 2022
LLT Polynomials, Banff International Research Station Workshop 22w5143
(with Per Alexandersson, Laura Colmenarejo, and Julianna Tymoczko)

AMS Fall Southeastern Sectional Meeting, University of Florida — November 2019
Special Session on Combinatorial Lie Theory (with Erik Insko and Edward Richmond)

Algebra, Geometry and Combinatorics Day XVIII, WUSTL — September 2019
Regional conference (with Laura Escobar and John Shareshian)

Graduate Research Opportunities for Women (GROW), Northwestern University — October 2017
Conference for women-identified students interested in graduate studies in mathematics.

AMS Fall Central Sectional Meeting, University of North Texas — September 2017
Special Session on Algebraic Combinatorics of Flag Varieties (with Edward Richmond)

Joint Mathematics Meetings, Special Session on Combinatorial and — January 2017
cohomological invariants of flag manifolds and related varieties (with Rebecca Goldin)

OUTREACH

Faculty Organizer, Sonia Kovalevsky Math Day at WUSTL	April 2024
Faculty Advisor, Association for Women in Mathematics, WUSTL	Fall 2018-present

WUSTL Math Circle Speaker   Spring 2022, Spring 2024
Faculty Speaker, High School Summer Launch, WUSTL   July 2022
Guest, *Tulane AWM Coffee & Discussion Series*   January 2020
   Tulane University (Association for Women in Mathematics event)
Moderator, *Panel: Academic Careers in Mathematics*   October 2017
   Graduate Research Opportunities for Women (GROW), Northwestern University
Northwestern Women in Mathematics, co-organizer   Winter 2015- Fall 2017
Panelist, *Panel: Nuts and bolts of getting into graduate school*   October 2016
   Graduate Research Opportunities for Women (GROW), Northwestern University

OTHER COLLEGIATE SERVICE

National Science Foundation Panelist, Division of Mathematical Sciences   Fall 2020
External Examiner of PhD Thesis for Lauren Dedieu, McMaster University   July 2016