

DANIEL ORR

Mathematics (MC 0123), McBryde, RM 460, Virginia Tech
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Employment

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Associate Professor (2021–)

Assistant Professor (2014–2021)

Patricia Ann Caldwell Post-Doctoral Fellow (2013–2014)

Visiting Positions

MAX PLANCK INSTITUTE FOR MATHEMATICS, BONN, GERMANY

Visiting Scientist (2022–2023)

Education

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

Ph.D. in Mathematics (May 2013)

Nonsymmetric Difference Whittaker Functions and Double Affine Hecke Algebras

Advisor: Ivan Cherednik

DAVIDSON COLLEGE

B.S. in Mathematics, *magna cum laude* (2008)

Studies at JULIUS-MAXIMILIANS-UNIVERSITÄT WÜRZBURG, GERMANY (2006–2007)

Research Interests

Representation theory, algebraic combinatorics, Macdonald polynomials

Funding

- 4-VA Collaborative Research Grant, Complementary Award, “Randomness by algebraic structures” (co-PI with PI Leonid Petrov, UVA, 2022-2024)
- Simons Foundation, Collaboration Grants for Mathematicians, “Combinatorics and geometry via quantum algebra representations” (2019-2024)
- NSF DMS-1600653 “Combinatorics of Koornwinder polynomials and stable double affine Hecke algebras” (co-PI with Mark Shimozono, 2016-2019)

Publications

- Daniel Orr and Mark Shimozono. Difference operators for wreath Macdonald polynomials. *Proceedings of Symposia in Pure Mathematics*, to appear (2023).
- Takafumi Kouno, Satoshi Naito, and Daniel Orr. Identities of inverse Chevalley type for graded characters of level-zero Demazure submodules over quantum affine algebras of type C . *Algebras and Representation Theory*, to appear (2023).
- Daniel Orr. Equivariant K -theory of the semi-infinite flag manifold as a nil-DAHA module. *Selecta Mathematica* (N.S.) 29 (2023), no. 3, Paper No. 45, 26 pp.
- Daniel Orr, Mark Shimozono, and Joshua Jeishing Wen. Wreath Macdonald operators (extended abstract). *FPSAC Proceedings*, to appear (2023).
- Cristian Lenart, Satoshi Naito, Daniel Orr, and Daisuke Sagaki. Inverse K -Chevalley formulas for semi-infinite flag manifolds, II: arbitrary weights in ADE type. *Advances in Mathematics* 423 (2023), Paper No. 109037.
- Daniel Orr and Mark Shimozono. Quiver Hall-Littlewood functions and Kostka-Shoji polynomials. *Pacific Journal of Mathematics* 319-2 (2022), 397–437.
- Daniel Orr and Mark Shimozono. On cyclic quiver parabolic Kostka-Shoji polynomials. *Journal of Combinatorial Theory Series A* 190 (2022), Paper No. 105634, 27 pp.
- Takafumi Kouno, Satoshi Naito, Daniel Orr, and Daisuke Sagaki. Inverse K -Chevalley formulas for semi-infinite flag manifolds, I: minuscule weights in ADE type. *Forum of Mathematics, Sigma* 9 (2021), Paper No. e51, 25 pp.
- Satoshi Naito, Daniel Orr, and Daisuke Sagaki. Pieri-Chevalley formula for anti-dominant weights in the equivariant K -theory of semi-infinite flag manifolds. *Advances in Mathematics* 387 (2021), Paper No. 107828, 59 pp.
- Dinakar Muthiah and Daniel Orr. On the double-affine Bruhat order: the $\varepsilon = 1$ conjecture and classification of covers in ADE type. *Algebraic Combinatorics* 2 (2019), no. 2, 197–216.
- Evgeny Feigin, Ievgen Makedonskyi, and Daniel Orr. Generalized Weyl modules and nonsymmetric q -Whittaker functions. *Advances in Mathematics* 330 (2018), 997–1033.
- Dinakar Muthiah and Daniel Orr. Walk algebras, distinguished subexpressions, and point counting in Kac-Moody flag varieties. *Representations of Lie algebras, quantum groups and related topics*, 187–203, Contemporary Math., 713, Amer. Math. Soc., Providence, RI, 2018.
- Daniel Orr and Mark Shimozono. Specializations of nonsymmetric Macdonald-Koornwinder polynomials. *Journal of Algebraic Combinatorics* 47 (2018), no. 1, 91–127.
- Daniel Orr and Leonid Petrov. Stochastic higher spin six vertex model and q -TASEPs. *Advances in Mathematics* 317 (2018), 473–525.

- Ivan Cherednik and Daniel Orr. Nonsymmetric difference Whittaker functions. *Mathematische Zeitschrift* 279 (2015), no. 3-4, 879–938.
- Ivan Cherednik and Daniel Orr. One-dimensional nil-DAHA and Whittaker functions II. *Transformation Groups* 18 (2013), no. 1, 23–59.
- Ivan Cherednik and Daniel Orr. One-dimensional nil-DAHA and Whittaker functions I. *Transformation Groups* 17 (2012), no. 4, 953–987.

Preprints

- Evgeny Feigin, Anton Khoroshkin, Ievgen Makedonskyi, and Daniel Orr. Peter-Weyl theorem for Iwahori groups and highest weight categories (2023). arXiv:2307.02124
- Evgeny Feigin, Ievgen Makedonskyi, and Daniel Orr. Nonsymmetric q -Cauchy identity and representations of the Iwahori algebra (2023). arXiv:2303.00241
- Daniel Orr, Mark Shimozono, and Joshua Jeishing Wen. Wreath Macdonald operators (2022). arXiv:2211.03851
- Daniel Orr and Mark Shimozono. Wreath Macdonald polynomials, a survey (2022). arXiv:2308.12166

Graduate Advising

Ph.D. advisees at Virginia Tech

- Richard Shaplin (2020–present)
- Benjamin Goodberry, *Partially Symmetric Macdonald Polynomials* (2022)
 - Employment: Salisbury University (tenure-track, 2023–) Wake Forest University (2022–2023)
- Amanda Welch, *Double Affine Bruhat Order* (2019)
 - Publication: *Electron. J. Combin.* 29 (2022), no. 4, Paper No. 4.7–.
 - Employment: Eastern Illinois University (tenure-track, 2021–), College of the Holy Cross (2019–2021)

M.S. advisees at Virginia Tech

- Aidan Quinlan, *Miki Images of Quantum Toroidal Algebra Generators* (2020)
- Richard Shaplin, *Spherical Elements in the Affine Yokonuma-Hecke Algebra* (2020)
- Benjamin Goodberry, *Multiparameter BC_n -Kostka-Foulkes Polynomials* (2018)

- Mark Hertz, *Difference Raising Operators for Kirillov-Reshetikhin Characters and Parabolic Jing Operators* (2017)

Professional Service

Organizer

Randomness and Lie-theoretic structures
4-VA Conference, UVA (March 2024)

Special Session on Macdonald Theory and Beyond
AMS Eastern Sectional Meeting, Tufts (March 2022)

Special Session on Macdonald Polynomials and Related Structures
AMS Southeastern Sectional Meeting, Vanderbilt (April 2018)

Algebra Seminar, Virginia Tech (2015–2020)

Reviewer

Mathematical Reviews (MathSciNet)
zbMATH Open (formerly Zentralblatt der Mathematik)

Referee

Advances in Mathematics
Algebraic Combinatorics
Communications in Algebra
Contemporary Mathematics
Duke Mathematical Journal
Formal Power Series and Algebraic Combinatorics (FPSAC)
Forum of Mathematics, Pi
International Mathematics Research Notices (IMRN)
Inventiones Mathematicae
Journal für die reine und angewandte Mathematik (Crelle's Journal)
Journal of Combinatorial Algebra
Journal of Combinatorial Theory, Series A
Michigan Mathematical Journal
NSF DMS Algebra & Number Theory
Proceedings of the American Mathematical Society
Representation Theory
Simons Foundation
Symmetry, Integrability, Geometry: Methods and Applications (SIGMA)
Transformation Groups

Talks

“Peter-Weyl theorem for Iwahori groups”

AMS Eastern Sectional Meeting, SUNY Buffalo (September 2023)

“Inverse Chevalley formulas for semi-infinite flag manifolds”

University of Cologne (June 2023)

Representation Theory Oberseminar, Bonn (April 2023)

“From quantum toroidal algebras to wreath Macdonald operators”

University of Amsterdam (May 2023)

Algebraic Geometry and Representation Theory Oberseminar, Paderborn (April 2023)

Oberseminar, MPIM Bonn (March 2023)

ABCD Seminar, Bochum (February 2023)

Representation Theory Seminar, RWTH Aachen (December 2022)

“ K -theory of semi-infinite flag manifolds”

Schubert Seminar, Rutgers/Virginia Tech (May 2022)

“Difference operators for wreath Macdonald polynomials”

Seminar on Lie Algebras and Applications, HSE/Skoltech (November 2021)

AMS Southeastern Sectional Meeting, South Alabama (November 2021)

Southeastern Lie Theory Workshop, Charleston (October 2021)

Algebra Seminar, Virginia Tech (September 2021)

“Equivariant K -theory of the semi-infinite flag manifold as a nil-DAHA module”

AMS Eastern Sectional Meeting, Virtual (March 2021)

Southeastern Lie Theory Workshop, Charleston (May 2020) – CANCELED

Geometric Methods in Representation Theory, UNC-CH (April 2020) – CANCELED

AMS Eastern Sectional Meeting, Tufts (March 2020) – CANCELED

“On cyclic quiver parabolic Kostka-Shoji polynomials”

AMS Southeastern Sectional Meeting, Gainesville (November 2019)

“Semi-infinite flag manifolds via nonsymmetric Macdonald polynomials”

Colloquium, USNA (October 2019)

Colloquium, Virginia Tech (September 2019)

“Semi-infinite flag manifolds and the nonsymmetric q -Toda system”

AMS Eastern Sectional Meeting, Hartford (April 2019)

AMS Southeastern Sectional Meeting, Auburn (March 2019)

Representation Theory, Combinatorics, and Geometry, UVA (October 2018)

“Quiver Hall-Littlewood functions and Kostka-Shoji polynomials”

Geometry and Representation Theory..., Bochum, Germany (September 2018)

Colloquium, University of Maryland (April 2017)

Algebra Seminar, Virginia Tech (March 2017)

“Hecke algebras and some of their incarnations”

Algebra Seminar, Virginia Tech (September 2017)

- “Generalized Weyl modules and nonsymmetric q -Whittaker functions”
 Integrability and Representation Theory Seminar, UIUC (October 2017)
 AMS Southeastern Sectional Meeting, NC State (November 2016)
 Algebra Seminar, University of Virginia (October 2016)
 Algebra Seminar, University of Cologne (July 2016)
 AMS Western Sectional Meeting, University of Utah (April 2016)
- “A length function for the double-affine Bruhat order”
 Algebra Seminar, Virginia Tech (September 2016)
- “Specializations of Macdonald polynomials and the PBW filtration”
 Mini-Workshop 1609a, Mathematisches Institut Oberwolfach (March 2016)
- “Creation operators for Macdonald polynomials”
 Algebra Seminar, Virginia Tech (November 2015)
- “Combinatorics of nonsymmetric Macdonald polynomials”
 Geometry, Algebra, and Physics Seminar, University of Alberta (October 2015)
 Southeastern Lie Theory Workshop, NC State (October 2015)
- “Elliptic Hall algebra, spherical DAHA, and symmetric function operators”
 AMS Southeastern Sectional Meeting, UNC Greensboro (November 2014)
 Algebra Seminar, University of Virginia (October 2014)
- “Specializations of nonsymmetric Macdonald polynomials at infinity”
 Geometric Methods in Representation Theory Seminar, UNC-CH (September 2014)
 Combinatorial Representation Theory, CRM, Montreal (April 2014)
 CAGE Seminar, Drexel University (March 2014)
 Whittaker Functions, BIRS (October 2013)
- “The Toda lattice in algebra and geometry”
 Colloquium, Wake Forest University (April 2014)
 Colloquium, Haverford College (March 2014)
- “Macdonald polynomials, positivity, and specializations”
 Colloquium, Virginia Tech (January 2014)
- “Macdonald polynomials and their specializations”
 Algebra Seminar, Virginia Tech (November 2013)
- “The Toda lattice, Dunkl operators, and Macdonald polynomials”
 Colloquium, Virginia Tech (September 2013)
- “Double affine Hecke algebras and difference Whittaker functions”
 Southeastern Lie Theory Workshop, College of Charleston (December 2012)
 Algebra Seminar, Virginia Tech (November 2012)
- “ q -Hermite polynomials, nil-DAHA, and q -Whittaker functions”
 AMS Southeastern Sectional Meeting, Wake Forest University (September 2011)

Invited Conferences and Workshops

The Geometry of Double Affine Hecke Algebras and Coulomb Branches
ICMS, Bayes Centre, Edinburgh (March 2023)

Geometry and Representation Theory at the interface of Lie algebras and quivers
Ruhr-Universität Bochum, Germany (September 2018)

PBW Structures in Representation Theory
Mathematisches Forschungsinstitut Oberwolfach (February–March 2016)

Théorie des Représentations
Université Paris Diderot (January 2015)

Whittaker Functions: Number Theory, Geometry and Physics
Banff International Research Station (October 2013)

Double Affine Hecke Algebras, the Langlands Program, Affine Flag Varieties, ...
Physics-Mathematics Summer Institute, CIRM (June 2011)

Teaching

Courses taught at Virginia Tech

Advanced Calculus (Summer 2022)
Graduate Abstract Algebra (Fall 2019, Spring 2020, Fall 2021, Spring 2022)
Graduate Graph Theory (Fall 2023)
Elementary Complex Analysis (Spring 2021)
Number Theory (Spring 2018, 2020)
Linear Algebra II (Spring 2019)
Graduate Combinatorics (Spring and Fall 2015, Spring 2017)
Introduction to Abstract Algebra (Fall 2014, 2016, 2017, 2018)
Calculus of Several Variables (Fall 2021)
Applied Combinatorics and Graph Theory (Spring 2014, 2016, 2018, Fall 2020)
Introduction to Differential Equations (Fall 2013)
Elementary Linear Algebra (Summer 2013)

Courses taught at UNC-CH

Calculus of Functions of Several Variables (Summer 2013)
Number Theory and its Applications (HHMI Science Seminar, Spring 2013)
Selected Topics in Mathematics (Spring 2012, Spring 2011)
Calculus of Functions of One Variable I, II (2010-2011)
Intuitive Calculus (Fall 2009)

Awards

“Thank a Teacher” Recognition, Virginia Tech	2019, 2021, 2022
MAA Student Chapter Professor of the Year, Virginia Tech	2019
NSF “US Junior Oberwolfach Fellows” Travel Support	2016
Favorite Faculty Award, Virginia Tech (student nominated)	2014