

Darij Grinberg

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Field of research

algebraic combinatorics / Hopf algebras / Young tableaux / combinatorial representation theory / noncommutative algebra / invariant theory

Education and affiliations

- 2019–** [Assistant Professor](#) at [Drexel University](#).
- 2020** [Postdoctoral Fellow](#) at [Institut Mittag-Leffler](#).
- 2019, 2020** [Leibniz Fellow](#) at [Mathematisches Forschungsinstitut Oberwolfach](#).
- 2016–2019** [Dunham Jackson Assistant Professor](#) at [University of Minnesota](#), working with Victor Reiner.
- 2016, June 3** Ph.D. in Mathematics at [Massachusetts Institute of Technology](#), advised by Alexander Postnikov. ([Thesis](#)¹.)
- 2011–2016** Graduate student at [Massachusetts Institute of Technology](#).
- 2011, July 1** Diploma (rough equivalent to M.S.) in Mathematics at the [Ludwig-Maximilians-Universität München](#) (Munich), with a minor in Computer Science. ([Thesis](#); comprehensive grade “very good”.)
- 2006–2011** Undergraduate at the [Ludwig-Maximilians-Universität München](#) (Munich).

Publications and preprints (peer-reviewed marked with #)

- 2020** *The Elser nuclei sum revisited*, [arXiv:2009.11527](#), draft.

¹Thesis committee: Alexander Postnikov, Pavel Etingof, Ira Gessel.

All material in this thesis also appears in the preprints and papers listed below.

- 2020 *Three variations on the linear independence of grouplikes in a coalgebra*, joint with Gérard Duchamp, Vincel Hoang Ngoc Minh, arXiv:2009.10970.
- 2020 *The Pelletier–Ressayre hidden symmetry for Littlewood–Richardson coefficients*, arXiv:2008.06128, submitted.
- 2020 *Petrie symmetric functions*, arXiv:2004.11194, submitted.
- 2020 *The Bhargava greedoid as a Gaussian elimination greedoid*, arXiv:2001.05535.
- # 2020 *Chaos and ergodicity are decidable for linear cellular automata over $(\mathbb{Z}/m\mathbb{Z})^n$* , joint with Alberto Dennunzio, Enrico Formenti, Luciano Margara, *Information Sciences* **539** (2020), pp. 136–144. (A fragment of this paper that includes my contribution.)
- # 2020 *Dynamical Behavior of Additive Cellular Automata over Finite Abelian Groups*, joint with Alberto Dennunzio, Enrico Formenti, Luciano Margara, to appear in *Theoretical Computer Science*.
- 2020 *Proof of three conjectures on determinants related to quadratic residues*, joint with Zhi-Wei Sun, Lilu Zhao, arXiv:2007.06453, submitted.
- 2019 *A greedoid and a matroid inspired by Bhargava’s p -orderings*, joint with Fedor Petrov, arXiv:1909.01965, submitted.
- 2019 *Commutators, matrices and an identity of Copeland*, arXiv:1908.09179.
- 2019 *Integrality of matrices, finiteness of matrix semigroups, and dynamics of linear cellular automata*, joint with Alberto Dennunzio, Enrico Formenti, Luciano Margara, arXiv:1907.08565.
- 2019 *A double Sylvester determinant*, arXiv:1901.11109, submitted.
- # 2019 *Multiline queues with spectral parameters*, joint with Erik Aas and Travis Scrimshaw, arXiv:1810.08157, *Communications in Mathematical Physics*, **374** (3), 1743–1786.
- # 2019 *The n body matrix and its determinant*, joint with Peter J. Olver, arXiv:1802.02900, *SIAM Journal on Applied Algebra and Geometry*, **3**(1), 2019, pp. 67–86.
- # 2018 *Shuffle-compatible permutation statistics II: the exterior peak set*, arXiv:1806.04114, *Electronic Journal of Combinatorics* **25** (2018), Paper #P4.17.
- 2017 *Noncommutative Abel-like identities*.
- # 2017 *On binomial coefficients modulo squares of primes*, arXiv:1712.02095, *Integers* **19** (2019), A14.

- # 2017 *Critical groups for Hopf algebra modules*, joint with Jia Huang, Victor Reiner, arXiv:1704.03778, *Mathematical Proceedings of the Cambridge Philosophical Society* **168** (2020), no 3., 473–503.
- # 2017 *t-unique reductions for Mészáros’s subdivision algebra*, arXiv:1704.00839, *SIGMA* **14** (2018), 078, 34 pages.
- 2016 *From Chio Pivotal Condensation to the Matrix-Tree theorem*, joint with Karthik Karnik, Anya Zhang, arXiv:1606.08193 (report of student research).
- 2016 *A note on non-broken-circuit sets and the chromatic polynomial*, arXiv:1604.03063.
- 2016 *The Bernstein homomorphism via Aguiar-Bergeron-Sottile universality*, arXiv:1604.02969.
- # 2016 *Proof of a conjecture of Bergeron, Ceballos and Labbé*, joint with Alexander Postnikov, arXiv:1603.03138, *New York Journal of Mathematics* **23** (2017), pp. 1581–1610.
- # 2015 *Double posets and the antipode of $QSym$* , arXiv:1509.08355, *Electronic Journal of Combinatorics* **24** (2017), Paper #P2.22.
- # 2015 *Refined dual stable Grothendieck polynomials and generalized Bender-Knuth involutions*, joint with Pavel Galashin and Gaku Liu, arXiv:1509.03803, *Electronic Journal of Combinatorics* **23** (2016), Paper #P3.14.
- 2015 *The signed random-to-top operator on tensor space (draft)*, arXiv:1505.01201.
- # 2014 *Dual immaculate creation operators and a dendriform algebra structure on the quasisymmetric functions*, arXiv:1410.0079, *Canadian Journal of Mathematics* **69** (2017), pp. 21–53.
- 2014 *Hopf Algebras in Combinatorics*, joint with Victor Reiner, arXiv:1409.8356 (extended lecture notes).
- # 2014 *Iterative properties of birational rowmotion*, joint with Tom Roby, arXiv:1402.6178. This has been published as two papers due to its length:
- *Iterative Properties of Birational Rowmotion I: Generalities and Skeletal Posets*, *Electronic Journal of Combinatorics* **23** (2016), Paper #P1.33;
 - *Iterative Properties of Birational Rowmotion II: Rectangles and Triangles*, *Electronic Journal of Combinatorics* **22** (2015), Paper #P3.40.

- # 2013 *Boolean Witt vectors and an integral Edrei-Thoma theorem*, joint with James Borger, arXiv:1311.5031, *Selecta Mathematica*, 22(2), pp. 595–629 (doi:10.1007/s00029-015-0198-6).
- 2011 *Poincaré-Birkhoff-Witt type results for inclusions of Lie algebras*, diploma thesis (link to updated version) under supervision of Andreas Rosenschon and guidance by Damien Calaque and Giovanni Felder. The thesis has not been submitted to a journal but has already been cited twice.
- 2011 *Zeckendorf family identities generalized*, arXiv:1103.4507.
- 2007–2012 Various [problems and solutions](#) submitted to mathematical magazines.
- # 2002–2004 Four publications in *Forum Geometricorum* on elementary geometry: *The Apollonius Circle as a Tucker Circle* (2002), joint with Paul Yiu; *On the Kosnita point and the reflection triangle* (2003); *Orthopoles and the Pappus Theorem* (2004), joint with Atul Dixit; *A Generalization of the Kiepert Hyperbola* (2004), joint with Alexei Myakishev; and problem 11025 proposed in the *American Mathematical Monthly* (joint with Floor van Lamoen).

Conference proceedings (peer-reviewed marked with #)

- # 2020 Darij Grinberg, *The Petrie symmetric functions (extended abstract)*, Séminaire Lotharingien de Combinatoire 84B.61 (2020), 12 pp. (FPSAC 2020).
- # 2020 Darij Grinberg, Fedor Petrov, *The Bhargava greedoid (extended abstract)*, Séminaire Lotharingien de Combinatoire 84B.47 (2020), 12 pp. (FPSAC 2020).
- # 2020 Alberto Dennunzio, Enrico Formenti, Darij Grinberg, Luciano Margara, *From Linear to Additive Cellular Automata*, Leibniz International Proceedings in Informatics (LIPIcs), Volume 168 (ICALP 2020).
- # 2019 Darij Grinberg, *A quotient of the ring of symmetric functions generalizing quantum cohomology (extended abstract)*, Séminaire Lotharingien de Combinatoire 82B.86 (2019), 12 pp. (FPSAC 2019).
- # 2018 Erik Aas, Darij Grinberg, Travis Scrimshaw, *Multiline queues with spectral parameters (extended abstract)*, Séminaire Lotharingien de Combinatoire, 80B.46 (2018), 12 pp. (FPSAC 2018).
- # 2017 Darij Grinberg, *Double Posets and the Antipode of QSym (extended abstract)*, Séminaire Lotharingien de Combinatoire, 78B.33 (2017), 12 pp. (FPSAC 2017).

- # **2014** Darij Grinberg, Tom Roby, *The order of birational rowmotion (extended abstract)*, DMTCS Proceedings vol. AT, 26th International Conference on Formal Power Series and Algebraic Combinatorics (FPSAC 2014), pp. 753–764.

Teaching

- 2019** lecturer at Drexel University in [Math 201 \(Linear Algebra\)](#).
- 2019** lecturer at Drexel University in [Math 222 \(Enumerative Combinatorics\)](#).
- 2019** lecturer at UMN in [Math 4281 \(Introduction to Modern Algebra\)](#).
- 2018** lecturer at UMN in [Math 5705 \(Enumerative Combinatorics\)](#).
- 2018** lecturer at UMN in [Math 4707 \(Combinatorics\)](#).
- 2017** lecturer at UMN in [Math 4990 and Math 4707 \(two combinatorics classes\)](#).
- 2017** lecturer at UMN in [Math 5707 \(Graph Theory\)](#).
- 2016** lecturer at UMN in [Math 4242 \(Applied Linear Algebra\)](#).
- 2012–2015** mentor in [the MIT’s PRIMES program](#), supervising [two projects](#) (2012, 2013) by William Kuszmaul and [one](#) (2014) by Eric Neyman, as well as a reading course by two new students (2015). In 2015, I was sponsored by a [George Lusztig PRIMES mentorship](#).
- 2015** teaching assistant at MIT in 18.781 (Theory of Numbers) by Ju-Lee Kim.
- 2014** teaching assistant and recitation leader at MIT in 18.06 (Linear Algebra) by Alexander Postnikov.
- 2013** teaching assistant at MIT in 18.310A (Principles of Discrete Applied Mathematics) by Neil Olver, and in 18.S996 (Category Theory for Scientists) by David Spivak.
- 2009** teaching assistant and recitation leader at LMU Munich in a Euclidean geometry class by Rudolf Fritsch.
- 2007** teaching assistant and recitation leader at LMU Munich in an Abstract Algebra I class by Hans-Jürgen Schneider.

Selected talks

- 2020** at [Algebraic and Combinatorial Perspectives in the Mathematical Sciences 2020](#) on the Pelletier–Ressayre symmetry of Littlewood–Richardson coefficients.

- 2020** at Institut Mittag-Leffler and at Rutgers Experimental Mathematics Seminar (more introductory version of the talk) on greedoids from ultrametric spaces and phylogenetic trees.
- 2020** at Institut Mittag-Leffler on the Petrie symmetric functions.
- 2019** at Drexel University and at University of Minnesota (Combinatorics seminar) on generalized quantum cohomology.
- 2018** at University of Connecticut (Algebra seminar) and at Massachusetts Institute of Technology (Combinatorics seminar) on generalized quantum cohomology.
- 2018** at Dartmouth College Hanover on shuffle-compatible permutation statistics.
- 2018** at Leibniz Universität Hannover on multiline queues.
- 2018** at University of Minnesota Student Combinatorics Seminar, Minneapolis on the diamond lemma (expository talk).
- 2018** at University of Washington, Seattle and at University of Illinois Urbana-Champaign (slightly streamlined version of above talk) on shuffle-compatible permutation statistics; also, expository pre-talk for the latter talk.
- 2017** at University of Wisconsin, Madison on critical groups of Hopf algebra modules.
- 2017** at Combinatorial Algebra meets Algebraic Combinatorics, UQAM, Montréal, and at Cornell (slightly extended version of Montréal talk) on function-field analogues of Witt vectors.
- 2016** at AMS Sectional Meeting, University of St. Thomas, Minneapolis on signs of reduced expressions.
- 2016** at the Combinatorics Seminar at Brandeis and at Massachusetts Institute of Technology (thesis defense) on quasisymmetric functions.
- 2015** at University of Minnesota Combinatorics Seminar, Minneapolis and at AMS Sectional Meeting, Chicago on refined dual stable Grothendieck polynomials.
- 2014** at The Applied Algebra Seminar, York University, Toronto on birational rowmotion.
- 2014** at Arbeitsgemeinschaft Diskrete Mathematik, Vienna on birational rowmotion.
- 2013** at University of Connecticut on integer-valued polynomials (expository talk).

Various contributions

- 2018 Organizing committee: [SageDays@ICERM](#), July 2018.
- 2012– [Programming and code review](#) for the [SageMath](#) project.
- 2010– Member of [MathOverflow](#) and [math.stackexchange](#), contributing over 500 answers.
- 2006– Grading/coordination in mathematical contests, including the [International Mathematical Olympiad](#) (2009 and 2011).
- 2005– Mathematical exposition at various levels (mostly undergraduate) on [web-site](#).

Research mentored/advised

- 2014 [Eric Neyman](#), *Cylindric Young Tableaux and their Properties*, arXiv:1410.5039, mentored through the [MIT PRIMES](#) project.
- 2013 [William Kuszmaul](#), *A New Approach to Enumerating Statistics Modulo n* , arXiv:1402.3839, mentored through the [MIT PRIMES](#) project.
- 2012 [William Kuszmaul](#), *Counting Permutations Modulo Pattern-Replacement Equivalences for Three-Letter Patterns*, *Electron. J. Comb.*, Volume 20, Issue 4 (2013), #P10, mentored through the [MIT PRIMES](#) project.

Awards and Honors

- 2015 [George Lusztig](#) PRIMES mentorship for “exceptional mentor service in past years”.
- 2008 first place in the 15th [Vojtěch Jarník Annual International Mathematical Competition](#) (a contest for university students).
- 2006–2011 scholarship from the [Studienstiftung des Deutschen Volkes](#).
- 2006 gold medal in the [International Mathematical Olympiad](#).
- 2004–2005 silver medals in the [International Mathematical Olympiad](#).
- 2003–2006 Bundessieger (national-level award) in the [Bundeswettbewerb Mathematik Deutschland](#) (German national mathematical olympiad).