

Curriculum Vitae

GRETA C. PANOVA

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Education/Employment

- 2018 – **Associate Professor**, University of Southern California, Mathematics.
2018 Fall **Visiting Scholar**, Simons Institute for the Theory of Computing (part-time, unpaid). Program “Lower bounds in computational complexity”.
2017 – 2018 **Von Neumann Fellow**, Institute for Advanced Studies, Princeton, NJ.
2014 – 2018 **Assistant Professor** (promoted to **Associate Professor** with tenure) University of Pennsylvania, Mathematics.
2017 Winter **Visiting Associate Professor**, Institute Henry Poincare, Paris, France. Program “Combinatorics and Interactions”
2011 – 2014 **Simons Postdoctoral Fellow/Assistant Adjunct Professor**, University of California Los Angeles
2012 Spring **Post-doctoral fellow**, MSRI, University of California Berkeley. Program “Random Spatial Processes”.
2006 – 2011 **Ph.D in Mathematics**, Harvard University,
Advisor: Richard Stanley (MIT)
Doctoral Thesis: *Combinatorial applications of symmetric function theory to certain classes of permutations and truncated tableaux*
2005 – 2006 **M.A. in Mathematics**, University of California, Berkeley
2001 – 2005 **B.S. in Mathematics**, Massachusetts Institute of Technology
2001 – 2005 **B.S. in Electrical Science and Engineering**, Massachusetts Institute of Technology

Research interests

Algebraic and enumerative combinatorics with applications and relation to computational complexity theory, probability and statistical mechanics; molecular biology.

Honors and Awards

- 2018 – 2021 **National Science Foundation** Award DMS-1800423.
2017 – 2018 **von Neumann Fellowship**, IAS, Princeton.
2015 – 2018 **National Science Foundation** Award DMS-1500834.
2015 **AWM** travel grant award for Joint EMS-PMS meeting (June, Portugal) and FPSAC’15 (July, Korea).
2015 – 2020 **Simons Collaboration Grant** award (declined due to NSF support).
2011 – 2014 **Simons Postdoctoral Fellowship** (UCLA, Simons Foundation)
2011 **Best Student Paper Award** (23rd Formal Power Series and Algebraic Combinatorics conference, Iceland)
2011 **European Post-Doctoral Institute** fellowship, awarded by IHÉS (Paris, France). (declined)

- 2006 – 2011 **Putnam Fellowship** (Harvard Department of Mathematics)
 2006 – 2009 **James Mills Peirce Fellowship** (Harvard University),
 (awarded to the top three admitted graduate students in a program)
 2005 – 2006 **Katz Fellowship** of the College of Letters and Science (University of
 California, Berkeley)
 2005 **Phi Beta Kappa** member (awarded by the MIT chapter)
 2001 **Third Prize** at the William Lowell Putnam Mathematics Competition, rank
 19.
 1999–2001 **One gold and two silver medals** at the International Mathematics
 Olympiads (in USA, South Korea, Romania)

Publications and Preprints

Submitted

1. *On geometric complexity theory: Multiplicity obstructions are stronger than occurrence obstructions* (with J. Dörfler, C. Ikenmeyer), [arXiv:1901.04576](https://arxiv.org/abs/1901.04576).
2. *Counting partitions inside a rectangle* (with S. Melczer, R. Pemantle), submitted (2018), [arXiv:1805.08375](https://arxiv.org/abs/1805.08375).

Accepted

3. *Bounds on the largest Kronecker and induced multiplicities of finite groups* (with I. Pak, D. Yeliussizov), *Comm. Algebra* (accepted 2018), [arXiv:1804.04683](https://arxiv.org/abs/1804.04683).
4. *On the largest Kronecker and Littlewood–Richardson coefficients* (with I. Pak, D. Yeliussizov), *J. Comb. Theory Ser. A* (accepted 2018), [arXiv:1804.04693](https://arxiv.org/abs/1804.04693).
5. *No occurrence obstructions in geometric complexity theory* (with P. Bürgisser, C. Ikenmeyer), *J. Amer. Math. Soc.*, <https://doi.org/10.1090/jams/908> (2018).
 Proceedings 57th Annual IEEE Symposium on Foundations of Computer Science (FOCS), 386–395, 2016.
6. *Hook formulas for skew shapes III. Multivariate and product formulas* (with A. Morales, I. Pak), *Alg. Comb.*, accepted (2018), [arXiv:1707.00931](https://arxiv.org/abs/1707.00931).
 Extend abstract: *Proc. of FPSAC 2018, Discrete Math. Theor. Comput. Sci. Proc.*
7. *LLT polynomials, chromatic quasisymmetric functions and graphs with cycles* (with P. Alexandersson), *Discrete Math.*, **341**(12) (2018), pp. 3453–3482.
8. *Asymptotics of principal evaluations of Schubert polynomials for layered permutations* (with A. Morales, I. Pak), *Proc. Amer. Math. Soc.*, <https://doi.org/10.1090/proc/14369> (2018).
9. *Coordination of Repair of Complex DNA Lesions.* (R. Aleksandrov, A. Dothchev, D. Krastev, A. Vladimirova, G. Georgiev, G. Panova, Y. Babucov, G. Danovski, T. Dyankova, A. Atemin, M. Nedelcheva-Veleva, M. Sarov, F. Buchholz, A. Hyman, S. Grill, S. Stoynov), *Mol. Cell* **69**(6) (2018), <https://doi.org/10.1016/j.molcel.2018.02.016>.
10. *A minimaj-preserving crystal on ordered multiset partitions* (with G. Benkart, L. Colmenarejo, P. E. Harris, R. Orellana, A. Schilling, M. Yip). *Adv. Appl. Math.* **98** (2018), pp 96–115.
 Extend abstract: *Proc. of FPSAC 2018, Discrete Math. Theor. Comput. Sci. Proc.*

11. *External powers of tensor products as representations of general linear groups* (with P. Śniady), Alg. Comb. **1**(2018), no. 1, pp 81–94.
12. *Geometric complexity theory and matrix powering* (with F. Gesmundo, C. Ikenmeyer) Diff. Geom. and Its Applications **55**(2017), pp 106–127.
13. *Asymptotics of the number of Standard Young Tableaux of skew shape* (with A. Morales, I.Pak), Europ. J. Comb. **70**(2018), pp. 26–49.
14. *Hook formulas for skew shapes II: combinatorial proofs and enumerative applications*(with A. Morales, I. Pak), SIAM J. Discrete Math. **31** (2017), no. 3, pp.1953–1989.
15. *Rectangular Kronecker coefficients and plethysms in geometric complexity theory* (with C. Ikenmeyer), Adv. Math. **319** (2017), pp. 40–66.
Proceedings 57th Annual IEEE Symposium on Foundations of Computer Science (FOCS), 395–405, 2016.
16. *Hook formulas for skew shapes I: q -analogues and bijections* (with A. Morales, I. Pak), J. Combin. Theory Ser. A, **154** (2018), pp. 350–405.
Extend abstract: Proc. of FPSAC 2016, *Discrete Math. Theor. Comput. Sci. Proc.*
17. *Lozenge tilings with free boundaries* (2014), Lett. Math. Phys., (2015), **105**(11), pp. 1551–1586.
Extended abstract: Proc. of FPSAC 2015, *Discrete Math. Theor. Comput. Sci. Proc.*
18. *Bounds on the Kronecker and q -binomial coefficients* (with I. Pak),J. Combin. Theory Ser. A, **147**, (2017), pp. 1–17.
19. *On the complexity of computing Kronecker coefficients* (with I.Pak), Comput. Complexity, **26**(2017), no. 1, pp.1–36.
20. *Pfaffian formulas for spanning tree probabilities* (with D.B.Wilson), Combin. Probab. Comput. **26** (2017), no. 1, 118–137.
21. *Strict unimodality of q -binomial coefficients* (with I.Pak), C. R. Math. Acad. Sci. Paris **351**(2013), no. 11-12, pp.415–418.
22. *The Thermodynamic Patterns of Eukaryotic Genes Suggest a Mechanism for Intron–Exon Recognition* (M. Nedelcheva-Veleva , M. Sarov , I. Yanakiev , E. Mihailovska , M. Ivanov , G. Panova, S. Stoynov[PI]), Nature Communications **4** (2013), doi:10.1038/ncomms3101
23. *Unimodality via Kronecker products* (with I.Pak), J. Algebraic Combin. **40**(2014), no. 4, pp.1103–1120.
24. *Kronecker products, characters, partitions, and the tensor square conjectures* (with I.Pak, E.Vallejo), Advances in Mathematics, **288**(2016), pp. 702–731.
Extended abstract in DMTCS Proceedings, FPSAC 2014.
25. *Asymptotics of symmetric polynomials with applications to statistical mechanics and representation theory*(with V.Gorin), Ann. Probab. (2015), **43**(6), pp. 3052 – 3132.
Extended abstract in DMTCS Proceedings of FPSAC 2013.
26. *Schur times Schubert via the Fomin-Kirillov algebra* (with K.Meszaros, A.Postnikov), Electron. J. Combin. **21**(2014), no. 1, Paper 1.39, 22 pp.
27. *Dyck tilings, linear extensions, inversions and descents*(with J.S.Kim, K.Meszaros, D.B.Wilson), J. Combin. Theory Ser. A (2014), **122**:9–27.
Extended abstract in DMTCS Proceedings of FPSAC 2012.

28. *Tableaux and plane partitions of truncated shapes*(2010), Adv. in Appl. Math., **49**, Issues 3–5, (2012), pp.196–217.
Extended abstract in DMTCS Proceedings of FPSAC 2011 (*Best student paper award*).
29. *Invertible matrices with restricted patterns and q -analogues of permutations* (with J.Lewis, R.Liu, A.Morales, S.Sam, Y.Zhang) (2010), J. Comb. 2 (2011), no. 3, pp.355–395. Extended abstract in DMTSC Proceedings of FPSAC 2011.
30. *Separable permutations and Greene’s theorem* (with A.Crites, G.Warrington)(2010), Ars Combin. **128**(2016), pp.103–116.
31. *Factorization of banded permutations*, Proc. Amer. Math. Soc. **140** (2012), pp.3805–3812.
32. *Bijjective enumeration of permutations starting with a longest increasing subsequence*, 22nd International Conference on Formal Power Series and Algebraic Combinatorics Proceedings, Discrete Math. Theor. Comp. Sci. Proc. (2010), pp. 973–982.
33. *Polynomiality of some hook-length statistics* (formerly *Proof of a conjecture of Okada*)(2008), Ramanujan J. (2012) **27**, pp.349–356.

Popular mathematics:

34. *Why is $\pi < 2\phi$?* (with A. Morales, I. Pak), Amer. Math. Monthly (2018), <https://doi.org/10.1080/00029890.2018.1496757>.

Preprints/In preparation:

35. *Hook formulas for skew shapes IV. Increasing tableaux and factorial Groethendieck polynomials* (with A. Morales, I. Pak) (2016), preprint.

Talks and presentations**Plenary talks**

- 2018 Feb *Algebraic and Enumerative Combinatorics* conference, Okayama, Japan.
2017 Jul *Formal Power Series and Algebraic Combinatorics*, London, UK.
2017 May *Midwest Combinatorics Conference*, Minneapolis, MN.
2016 Feb *Triangle Lectures in Combinatorics*, Greensboro, NC.

Invited conference and seminar talks

- 2019 May *Enumerative Combinatorics minisymposium at the 7th Canadian Discrete and Algorithmic Mathematics Conference*, Vancouver, Canada.
2019 May *Mathematical aspects of Quantum Information Theory* workshop, Lorentz Center, Leiden, Netherlands.
2019 Mar *Asymptotic Algebraic Combinatorics* workshop, BIRS, Banff, Canada.
2019 Jan *Representation theory connections to (q, t) -Combinatorics* workshop, BIRS, Banff, Canada.
2018 Dec *Algebraic Methods* workshop (in “Lower bounds in computational complexity”), Simons Institute, Berkeley, CA.
2018 Jun *Exactly Solvable Quantum Chains* workshop, IIP-UFRN, Natal, Brazil.
2018 May *Enumerative Combinatorics* workshop, Mathematisches Forschungsinstitut Oberwolfach, Germany.
2018 Mar *Cornell Combinatorics Seminar*, Ithaca, NY.
2018 Mar *Mathematics Colloquium*, University of California Berkeley.

- 2018 Feb **Algebraic and Enumerative Combinatorics in Okayama** conference, Okayama, Japan.
- 2018 Jan **Special Colloquium**, University of Southern California, Los Angeles, CA.
- 2018 Jan **Special Colloquium**, University of Washington, Seattle, WA.
- 2018 Jan **Special Colloquium**, Institute for Science and Technology, Vienna, Austria.
- 2017 Dec **Geometric R-Matrices in Combinatorics and Probability** workshop, MATRIX Institute, University of Melbourne, Australia.
- 2017 Dec **Members Seminar**, Institute for Advanced Study, Princeton, NJ.
- 2017 Nov **Computer Science and Discrete Math Seminar**, Institute for Advanced Study, Princeton, NJ.
- 2017 Nov **Discrete Mathematics Seminar**, Princeton University, Princeton, NJ.
- 2017 Nov **Discrete Mathematics Seminar**, Rutgers University, New Brunswick, NJ.
- 2017 Nov **Algebra–Number Theory seminar**, University of Maryland, College Park, MD.
- 2017 Oct **Enumerative Combinatorics Workshop**, Erwin Schrödinger Institute, Vienna, Austria.
- 2017 Sep **Integrability across mathematics and physics**, Berkeley, CA.
- 2017 May **Algebraic Combinatorics** workshop, BIRS, Banff, Canada.
- 2017 Apr **Combinatorics Seminar**, KTH Royal Institute of Technology, Stockholm, Sweden.
- 2017 Mar **Seminaire Lotharingien de Combinatoire**, Ottrott/Strasbourg, France.
- 2017 Feb **Asymptotic Representation Theory** workshop, Institute Henri Poincaré, Paris, France.
- 2017 Jan **Mathematics Colloquium**, Rice University, Houston, TX.
- 2017 Jan **UCLA Combinatorics Seminar**, University of California Los Angeles, CA.
- 2017 Jan **UCSD Mathematics Colloquium**, University of California San Diego, La Jolla, CA.
- 2017 Jan **Large Random Structures in Two Dimensions** workshop, Institute Henri Poincaré, Paris, France.
- 2016 Nov **MIT Combinatorics Seminar**, Cambridge, MA.
- 2016 Oct **Foundations of Computer Science (FOCS)** conference, New Brunswick, NJ.
- 2016 Sep **AMS Fall Eastern Sectional Meeting**, Bowdoin College, Brunswick, ME.
- 2016 Sep **Kronecker Coefficients Conference 2016**, City University London, United Kingdom.
- 2016 Jul **Formal Power Series and Algebraic Combinatorics** conference, Vancouver, Canada.
- 2016 Jun **University of Pennsylvania CAGE seminar**, Philadelphia, PA.
- 2016 Mar **Six-vertex model, dimers, shapes and all that** workshop, Simons Center for Geometry and Physics, Stony Brook, NY.
- 2016 Mar **UCLA Combinatorics Seminar**, Los Angeles, CA.
- 2015 Nov **Texas A&M University Probability / Algebra and Combinatorics Seminar**, College Station, TX.
- 2015 Nov **AMS Fall Eastern Sectional Meeting, Special Session on Probability, Combinatorics and Statistical Mechanics**, Rutgers University, New Brunswick, NJ.
- 2015 Nov **Haverford Mathematics Colloquium**, Haverford, PA.
- 2015 Oct **University of Rochester Probability Seminar**, Rochester, NY.
- 2015 Oct **Temple University Mathematics Colloquium**, Philadelphia, PA.
- 2015 July **Formal Power Series and Algebraic Combinatorics**, Daejeon, Korea.

- 2015 June **AMS-EMS-SPM joint meeting**, Special Session on Algebraic Combinatorics and Representation Theory, Porto, Portugal.
- 2015 May **Lattice Models: Exact Results and Combinatorics** workshop, Galileo Galilei Institute for Theoretical Physics, Florence, Italy.
- 2015 Apr **Limit Shapes** workshop, ICERM, Providence, RI.
- 2015 Mar **University of Virginia Algebra Seminar**, UVA, Charlottesville, VA.
- 2015 Feb **Columbia/Courant Probability Seminar**, Random Tilings, New York, NY.
- 2015 Feb **Princeton Combinatorics Seminar**, Princeton University, NJ.
- 2015 Jan **Joint AMS/MAA meeting**, Special Session on Probability and Applications, San Antonio, TX.
- 2014 Nov **Symbolic and Computational Methods for Tensors and Representation Theory**, Simons Institute, Berkeley, CA.
- 2014 Nov **IMA workshop on Geometric and Enumerative Combinatorics**, Minneapolis, MN.
- 2014 Nov **AIM workshop**, Palo Alto, CA.
- 2014 Oct **AMS Meeting**, Special Session on Combinatorial Representation Theory, Halifax, Canada.
- 2014 Sep **Geometric Complexity Theory workshop**, Simons Institute, Berkeley, CA.
- 2014 Jun **Formal Power Series and Algebraic Combinatorics**, Chicago, IL.
- 2014 Jun **Stanley 70th birthday conference**, Cambridge, MA.
- 2014 Jun **SIAM Discrete Mathematics** conference, Minneapolis, MN.
- 2014 Jan **UC Davis Mathematics Colloquium**, Davis, CA.
- 2014 Jan **Caltech Mathematics Colloquium**, Pasadena, CA.
- 2014 Jan **Institute of Science and Technology (IST Austria) Seminar**, Austria.
- 2014 Jan **ETH Zurich Special Lecture**, Zurich, Switzerland.
- 2013 Dec **Washington University Mathematics Colloquium**, St. Louis, MO.
- 2013 Dec **University of Pennsylvania Mathematics Colloquium**, Philadelphia, PA.
- 2013 Nov **Georgia Tech Mathematics Colloquium**, Atlanta, GA.
- 2013 Nov **Vanderbilt Mathematics Colloquium**, Nashville, TN.
- 2013 Oct **UC Berkeley Combinatorics Seminar**, Berkeley, CA.
- 2013 Oct **UCSD Combinatorics Seminar**, San Diego, CA.
- 2013 Sep **University of Washington Combinatorics Seminar**, Seattle, WA.
- 2013 Aug **Mathematics Congress of the Americas**, Guanajuato, Mexico.
- 2013 Jun **Formal Power Series and Algebraic Combinatorics**, Paris, France.
- 2013 Feb **Random tilings workshop**, SCGP, Stony Brook, NY.
- 2013 Jan **UCLA Probability Seminar**, Los Angeles, CA.
- 2012 Aug **UCLA Combinatorics Seminar**, Los Angeles, CA.
- 2012 Aug **Formal Power Series and Algebraic Combinatorics**, Nagoya, Japan.
- 2012 Jul **Workshop on Convex Polytopes**, RIMS, Kyoto, Japan.
- 2012 Mar **MSRI Postdoc seminar**, Berkeley, CA.
- 2012 Mar **UC Berkeley Combinatorics Seminar**, Berkeley, CA.
- 2012 Feb **MSRI/Evans Lecture**, Berkeley, CA.
- 2011 Dec **UCLA Combinatorics seminar**, Los Angeles, CA.
- 2011 Jun **Formal Power Series and Algebraic Combinatorics**, Reykjavic, Iceland.
- 2011 May **Microsoft Research, Theory Group** Redmond, WA.
- 2011 Apr **AMS Spring Eastern Sectional Meeting**, Worcester, MA.
- 2010 Nov **MIT Combinatorics Seminar**.
- 2010 Aug **Permutation Patterns Conference**, Dartmouth, NH.

2010 Aug *Formal Power Series and Algebraic Combinatorics Conference, San Francisco, CA.*

2010 Jan *Joint Mathematics Meeting of the AMS, San Francisco, CA.*

Teaching activities

Advising:

Shiyong Dong: M.A. Mathematics 2016, University of Pennsylvania.

Logan Crew: Ph.D. candidate (exp. 2020), University of Pennsylvania, co-advised with Jim Haglund.

Awards:

Good teaching award, Spring 2016, University of Pennsylvania Mathematics Department.

Good teaching award, Spring 2017, University of Pennsylvania Mathematics Department.

Courses:

2018 Fall Combinatorial analysis (USC, Math 532). Graduate course.

2016 Fall Combinatorial analysis (UPenn, Math 580). Graduate course.

2016 Fall Putnam Problem Solving seminar (UPenn).

2016 Spring Differential Equations and Linear Algebra (UPenn, Math 240).

2015 Fall Combinatorial analysis (UPenn, Math 580). Graduate course.

2015 Fall Putnam Problem Solving seminar (UPenn).

2015 Spring Combinatorial analysis and graph theory II: Algebraic Combinatorics (UPenn, Math 581). Graduate topics course.

2014 Fall Combinatorial analysis and graph theory (UPenn, Math 580). Graduate course.

2014 Spring Topics in Combinatorics: Algebraic Combinatorics (UCLA, Math 285N). Graduate topics course.

2013 Fall Probability (UCLA, Math 170A).

2013 Winter Optimization (UCLA, Math 164)

2011 Fall Combinatorics (UCLA, Math 180)

2011 Spring Linear Algebra and Differential Equations (Harvard, Math 21b), TF.

2010 Spring Algebraic Combinatorics– Symmetric functions (Harvard, Math 99r), Lecturer.

2009 Spring Linear Algebra and Differential Equations (Harvard, Math 21b), Lecturer.

2008 Fall Topics in Combinatorial Representation Theory (Harvard, Math 277), CA.

2008 Spring Differential Equations for the Life Sciences (Harvard, Math 19a), TF.

2004, 2005 Project Laboratory in Mathematics (MIT, 18.821), TA.

Professional Activities

Journals refereed for:

Advances in Mathematics, Computational Complexity, Journal of Combinatorial Theory Series A, The Electronic Journal of Combinatorics, Journal of Algebraic Combinatorics, European Journal of Combinatorics, Random Structures and Algorithms, Discrete Mathematics, SIAM Journal of Computing.

Workshop co-organizer:

- Asymptotic Algebraic Combinatorics, March 2019, Banff International Research Station, Banff, Canada.

- Combinatorics and Complexity of Kronecker coefficients, *November 2014, American Institute of Mathematics, Palo Alto, CA.*

Visiting Scholarships (member):

- *(invited to) Algebraic and Enumerative Combinatorics Program, Institute Mittag-Leffler, Sweden, January 13 – April 30, 2020.*
- *Algorithmic and Enumerative combinatorics Program, Erwin Schrödinger Institute, Vienna, Austria, October 16–27, 2017.*
- *New approaches to non-equilibrium and random systems: KPZ integrability, universality, applications and experiments Program, Kavli Institute for Theoretical Physics, Santa Barbara, CA, March 6-11 2016.*
- *Statistical mechanics Program, Galileo Galilei Institute for Theoretical Physics, Florence, Italy. May 11– Jul 3, 2015.*

Participant at:

- *Encuentro Colombiano de Combinatoria 2016 (Colombian summer school in combinatorics), June 2016, Medellin, Colombia.*
- *St. Petersburg Summer-school on Probability and Statistical Physics (SPSPSP), St. Petersburg, Russia, June 2012.*

Scientific committee member:

- *Formal Power Series and Algebraic Combinatorics conference 2016.*
- *Mid-Atlantic Algebraic Geometry and Combinatorics conference (2015, 2016, 2017).*

Chair (and coach) of the Prize committee (UPenn Math), running the Putnam Problem Solving seminar, team selection/training and exam administration. (in Putnam 2015 UPenn team ranked 34 out of 540 institutions; in 2016 UPenn ranked 24 with one honorable mention and 6 students in top 500)

Panelist:

“Towards a new Theoretical Biology” *workshop, April 2018, University of Pennsylvania.*

“Publish, don’t perish” *panel on writing research papers at the MAAGC 2017.*

“Surviving the on-campus interview” *panel at the Joint AMS/MAA meeting, San Antonio, TX, 2015.*

Colloquium co-organizer of UPenn Mathematics Colloquium, 2014–2015.

Seminar co-organizer of UCLA Combinatorics Seminar, 2013–2014; CAGE and Combinatorics and Probability seminars at UPenn, 2014–2017.

Consultant at Microsoft Research, Redmond, WA, Aug–Sept 2013 and May 2011.