

# Yi Sun

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CONTACT INFORMATION	Address: Department of Mathematics, Columbia University, New York, NY 10027. Email: <a href="mailto:yisun@math.columbia.edu">yisun@math.columbia.edu</a> Webpage: <a href="http://yisun.io">yisun.io</a>
RESEARCH INTERESTS	Representation theory, integrable systems, and applications to probability theory and random matrices.
EMPLOYMENT	<b>Columbia University</b> New York, NY Simons Fellow (2016–present).
EDUCATION	<b>Massachusetts Institute of Technology</b> Cambridge, MA Ph.D., Mathematics (2011–2016), advised by Pavel Etingof. <b>University of Cambridge</b> Cambridge, UK M.A.St., Mathematics, with distinction (2010–2011). <b>Harvard University</b> Cambridge, MA A.M., Mathematics (2006–2010). A.B., Mathematics, <i>magna cum laude</i> , with secondary field in Economics (2006–2010). Phi Beta Kappa (one of 24 juniors inducted)
GRANTS FELLOWSHIPS AND AWARDS	NSF Grant DMS-1701654, Algebra and Number Theory, 2017–2020. Simons Junior Fellowship, 2016–2019. NSF Mathematical Sciences Postdoctoral Research Fellowship, 2016–2019 (declined). Johnson Prize for best research paper by MIT graduate student in mathematics, 2016. NSF Graduate Research Fellowship, 2012–2015. MIT Praecis Presidential Fellowship, 2011–2012. Churchill Scholarship for study at Cambridge, 2010–2011. William Lowell Putnam Competition, 10 <sup>th</sup> Place, 2009. COMAP Math Contest in Modeling, Outstanding Winner, SIAM Prize, 2008 and 2009. Intel Science Talent Search, 2 <sup>nd</sup> Place, 2006. International Mathematical Olympiad, Silver Medal, 2006. Asian Pacific Mathematics Olympiad, Gold Medal, 2005. International Physics Olympiad, Gold Medal, 2004.
MATHEMATICS RESEARCH	14. <i>Gaussian fluctuations for products of random matrices</i> (with V. Gorin), preprint, 2018. <a href="https://arxiv.org/abs/1812.06532">arXiv:1812.06532</a> 13. <i>Spiked covariances and principal components analysis in high-dimensional random effects models</i> (with Z. Fan and I. Johnstone), preprint, 2018. <a href="https://arxiv.org/abs/1806.09529">arXiv:1806.09529</a> 12. <i>Affine Macdonald conjectures and special values of Felder-Varchenko functions</i> (with E. Rains and A. Varchenko), <i>Selecta Mathematica N. S.</i> <b>24</b> (2018), 1549–1591. <a href="https://arxiv.org/abs/1610.01917">arXiv:1610.01917</a> 11. <i>Laquerre and Jacobi analogues of the Warren process</i> (single author, with an appendix by A. Sarantsev), submitted, 2016. <a href="https://arxiv.org/abs/1610.01635">arXiv:1610.01635</a> 10. <i>Traces of intertwiners for quantum affine algebras and difference equations (after Etingof-Schiffmann-Varchenko)</i> (single author), <i>Transformation Groups</i> <b>23</b> (2018), 1167–1215. <a href="https://arxiv.org/abs/1609.09038">arXiv:1609.09038</a> 9. <i>Matrix models for multilevel Heckman-Opdam and multivariate Bessel measures</i> (single author), submitted, 2016. <a href="https://arxiv.org/abs/1609.09096">arXiv:1609.09096</a> 8. <i>Traces of intertwiners for quantum affine <math>\mathfrak{sl}_2</math> and Felder-Varchenko functions</i> (single author), <i>Communications in Mathematical Physics</i> <b>347</b> (2016), 573–653. <a href="https://arxiv.org/abs/1508.03918">arXiv:1508.03918</a> 7. <i>The polynomial representation of the type <math>A_{n-1}</math> rational Cherednik algebra in characteristic <math>p \mid n</math></i> (with S. Devadas), <i>Communications in Algebra</i> <b>45</b> (2016), 1926–1934.

arXiv:1505.07891

6. *A representation-theoretic proof of the branching rule for Macdonald polynomials* (single author), *Mathematical Research Letters* **23** (2016), 887–927. Extended abstract in FPSAC 2015. arXiv:1412.0714
  5. *A new integral formula for Heckman-Opdam hypergeometric functions* (single author), *Advances in Mathematics* **289** (2016), 1157–1204. arXiv:1406.3772
  4. *Finite dimensional representations of the rational Cherednik algebra for  $G_4$*  (single author), *Journal of Algebra* **323** (2010), 2864–2887. arXiv:0910.5527
- OTHER RESEARCH
3. *From random walks to distances on unweighted graphs* (with T. Hashimoto and T. Jaakkola), NIPS 2015. arXiv:1511.00573
  2. *Metric recovery from directed unweighted graphs* (with T. Hashimoto and T. Jaakkola), NIPS 2014 workshop (Best Student Paper), AISTATS 2015. arXiv:1411.5720
  1. *Axiomatic attribution for multilinear functions* (with M. Sundararajan), ACM Conf. on Electronic Commerce 2011. arXiv:1102.0989
- RESEARCH PRESENTATIONS
39. UCSD: Probability Seminar  
Fluctuations for products of random matrices January 2019
  38. Yale: Geometry, Symmetry, and Physics Seminar  
Affine Macdonald conjectures and special values of Felder-Varchenko functions April 2018
  37. Simons Society of Fellows Retreat  
A probabilistic view on random covariance matrices February 2018
  36. PCMI: Research Program on Random Matrices  
Algebraic structures for multilevel eigenvalue densities July 2017
  35. Rochester: Probability Seminar  
Laguerre and Jacobi analogues of the Warren process April 2017
  34. Perimeter Institute: Mathematical Physics Seminar  
Affine Macdonald conjectures and special values of Felder-Varchenko functions April 2017
  33. Rutgers: Lie Group / Quantum Mathematics Seminar  
Affine Macdonald conjectures and special values of Felder-Varchenko functions April 2017
  32. Columbia-Princeton Probability Day  
Laguerre and Jacobi analogues of the Warren process March 2017
  31. ESI: Workshop on Elliptic Hypergeometric Functions  
Affine Macdonald conjectures and special values of Felder-Varchenko functions March 2017
  30. Columbia: Probability Seminar  
Laguerre and Jacobi analogues of the Warren process November 2016
  29. Columbia: Mathematical Physics Seminar  
Affine Macdonald conjectures and special values of Felder-Varchenko functions October 2016
  28. IESC: QIS's, CFT's, and Stochastic Processes (poster)  
Laguerre and Jacobi analogues of the Warren process September 2016
  27. MIT: Infinite-Dimensional Algebra Seminar  
Traces of intertwiners for quantum affine  $\mathfrak{sl}_2$  and Felder-Varchenko functions March 2016
  26. MIT: Integrable Probability Seminar  
Laguerre and Jacobi analogues of the Warren process February 2016
  25. HCM: Asymptotic Analysis in Strongly Coupled Systems (poster)  
Laguerre and Jacobi analogues of the Warren process January 2016
  24. NIPS 2015 (poster)  
From random walks to distances on unweighted graphs December 2015

	23. ETH Zurich: ITS Talks in Theoretical Sciences 2015 Random matrices and representation theory	November 2015
	22. UC Berkeley: RTGC Seminar Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions	November 2015
	21. ETH Zurich: Mathematical Physics Seminar Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions	October 2015
	20. NEU: Geometry, Physics and Representation Theory Seminar Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions	October 2015
	19. Columbia: Mathematical Physics Seminar Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions	October 2015
	18. Yale: Geometry, Symmetry, and Physics Seminar Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions	September 2015
	17. FPSAC 2015 (poster) A representation-theoretic proof of the branching rule for Macdonald polynomials	July 2015
	16. Clay Math Inst.: Random Polymers and Algebraic Combinatorics A representation-theoretic proof of the branching rule for Macdonald polynomials	May 2015
	15. AISTATS 2015 (poster) Metric recovery from directed unweighted graphs	May 2015
	14. ICERM: Workshop on Limit Shapes (poster) A representation-theoretic proof of the branching rule for Macdonald polynomials	April 2015
	13. NIPS 2014: Workshop on Networks (poster) Metric recovery from directed unweighted graphs	December 2014
	12. UC Berkeley: GRASP Seminar A representation-theoretic proof of the branching rule for Macdonald polynomials	November 2014
	11. IHP: Workshop on Macdonald Processes and Hecke Algebras A new integral formula for Heckman-Opdam hypergeometric functions	May 2014
	10. MIT: Integrable Probability Seminar A new integral formula for Heckman-Opdam hypergeometric functions	April 2014
OUTREACH PRESENTATIONS	9. Math Olympiad Program 2018 Threshold signatures	June 2018
	8. MIT “Meta-Math” Meetup 2017 How to do a Literature Search	May 2017
	7. Summer Program in Applied Rationality and Cognition 2016 Problem Solving: Contests vs. Real Life	August 2016
	6. Math Olympiad Summer Program 2016 Distribution Testing: Is this die fair?	June 2016
	5. MIT Open House 2016 Universality: Mathematics in the real world	April 2016
	4. Math Olympiad Summer Program 2015 Fair coin flips from unfair coins	June 2015
	3. Math Olympiad Summer Program 2014 The Ising model	June 2014
	2. Math Olympiad Summer Program 2013 Random matrices	June 2013
	1. Math Olympiad Summer Program 2012 Random partitions and Fock space	June 2012

OTHER PUBLICATIONS	<ol style="list-style-type: none"> <li>6. <i>54<sup>th</sup> International Mathematical Olympiad</i> (with J. Berman and Z. Feng), <i>Mathematics Magazine</i> <b>86</b> (2013), 309–313.</li> <li>5. <i>53<sup>rd</sup> International Mathematical Olympiad</i> (with Z. Feng), <i>Mathematics Magazine</i> <b>85</b> (2012), 312–317.</li> <li>4. <i>52<sup>nd</sup> International Mathematical Olympiad</i> (with Z. Feng), <i>Mathematics Magazine</i> <b>84</b> (2011), 316–319.</li> <li>3. <i>51<sup>st</sup> International Mathematical Olympiad</i> (with Z. Feng and P. Loh), <i>Mathematics Magazine</i> <b>83</b> (2010), 320–323.</li> <li>2. <i>A simulation based model of traffic circles</i> (with C. Chang and Z. Fan), <i>The UMAP Journal</i> <b>30</b> (2009), 225–244.</li> <li>1. <i>hsolve: A difficulty metric and puzzle generator for Sudoku</i> (with C. Chang and Z. Fan), <i>The UMAP Journal</i> <b>29</b> (2008), 303–324.</li> </ol>
TEACHING	<p><b>US National Math Olympiad Summer Program</b> Summers 2007–2018  Instructor (2010, 2012–2018); Assistant (2007–2009). Design curriculum, give lectures, and personally coach US team to International Mathematical Olympiad.</p> <p><b>Columbia University</b> Fall 2017  Instructor for Calculus II. Evaluations: 3.9 (5.0)</p> <p><b>MIT MathROOTS</b> Summers 2015–2016  Academic Coordinator. Design curriculum, give lectures, and manage academic team, guest lectures, website, and sponsorships for first two years of outreach program teaching problem solving to underrepresented minority students. Program received media coverage on MIT homepage and in Notices of the AMS.</p> <p><b>MIT Undergraduate Research Opportunities Program</b> Fall 2012–2015  Mentor two undergraduate research projects, leading to published research paper. <ul style="list-style-type: none"> <li>• Sheela Devadas (rational Cherednik algebras in char <math>p \leq n</math>), 2014–2015.</li> <li>• Ryan Yoo (characters of rational Cherednik algebras in char <math>p &gt; n</math>), 2012–2014.</li> </ul> </p> <p><b>Massachusetts Institute of Technology</b> Spring 2015  Teaching Assistant for Differential Equations. Evaluations: 6.2 (7.0)</p> <p><b>MIT Directed Reading Program</b> January 2011  Mentor reading project on representation theory of the symmetric group.</p> <p><b>Harvard University</b> Spring 2009  Course Assistant for Probability Theory. Evaluations: 4.3 (5.0)</p>
PROFESSIONAL ACTIVITIES	<p><b>Columbia Probability Seminar</b> Fall 2016–Present  Co-organize weekly probability seminar.</p> <p><b>Summer School in Probability</b> Summer 2017  Co-organize graduate summer school “Dyson-Schwinger equations, topological expansions, and random matrices” at Columbia.</p> <p><b>MIT Interacting Particle Systems Learning Seminar</b> 2012–2013  Organize learning seminar on recent developments in interacting particle systems.</p> <p><b>Google Research</b> Summer 2010  Research intern. Research attribution and cost-sharing methods, leading to paper published in EC 2010. Mentor: Mukund Sundararajan</p>
SERVICE	<p>Reviewer for: <i>Probability Theory and Related Fields</i>, <i>Selecta Mathematica</i> (N.S.), <i>SIGMA</i>, <i>Journal of Theoretical Probability</i>.</p> <p>Qualifying Exam committee member for: Ivan Danilenko (Columbia)</p>
LANGUAGES	Mandarin (native), French (conversational)
COMPUTER	Sage, Magma, Mathematica, L <sup>A</sup> T <sub>E</sub> X, C++, Python

REFERENCES

**Pavel Etingof (advisor)**, Professor, Massachusetts Institute of Technology, [etingof@math.mit.edu](mailto:etingof@math.mit.edu).

**Alexei Borodin**, Professor, Massachusetts Institute of Technology, [borodin@math.mit.edu](mailto:borodin@math.mit.edu).

**Vadim Gorin**, Assistant Professor, Massachusetts Institute of Technology, [vadicgor@math.mit.edu](mailto:vadicgor@math.mit.edu).

**Eric Rains**, Professor, California Institute of Technology, [rains@caltech.edu](mailto:rains@caltech.edu).

**Valerio Toledano-Laredo**, Professor, Northeastern University, [V.ToledanoLaredo@neu.edu](mailto:V.ToledanoLaredo@neu.edu).

**Po-Shen Loh (teaching)**, Associate Professor, Carnegie Mellon University, [ploh@cmu.edu](mailto:ploh@cmu.edu).