Yi Sun

CONTACT INFORMATION

Address: Department of Mathematics, Columbia University, New York, NY 10027.
Email: yisun@math.columbia.edu
Webpage: yisun.io

RESEARCH INTERESTS

Representation theory, integrable systems, and applications to probability theory and random matrices.

EMPLOYMENT

Columbia University New York, NY
Simons Fellow (2016–present).

EDUCATION

Massachusetts Institute of Technology Cambridge, MA
Ph.D., Mathematics (2011–2016), advised by Pavel Etingof.

University of Cambridge Cambridge, UK
M.A.St., Mathematics, with distinction (2010–2011).

Harvard University Cambridge, MA
A.M., Mathematics (2006–2010).
A.B., Mathematics, *magna cum laude*, 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^{th} Place, 2009.
COMAP Math Contest in Modeling, Outstanding Winner, SIAM Prize, 2008 and 2009.
Intel Science Talent Search, 2^{nd} Place, 2006.
International Mathematical Olympiad, Silver Medal, 2006.
Asian Pacific Mathematics Olympiad, Gold Medal, 2005.
International Physics Olympiad, Gold Medal, 2004.

MATHEMATICS RESEARCH

13. *Spiked covariances and principal components analysis in high-dimensional random effects models* (with Z. Fan and I. Johnstone), preprint, 2018. arXiv:1806.09529
12. *Affine Macdonald conjectures and special values of Felder-Varchenko functions* (with E. Rains and A. Varchenko), Selecta Mathematica N. S. (2017). arXiv:1610.01917
11. *Laguerre and Jacobi analogues of the Warren process* (single author, with an appendix by A. Sarantsev), submitted, 2016. arXiv:1610.01635
10. *Traces of intertwiners for quantum affine algebras and difference equations (after Etingof-Schiffmann-Varchenko)* (single author), Transformation Groups (2017). arXiv:1609.09038
9. *Matrix models for multilevel Heckman-Opdam and multivariate Bessel measures* (single author), submitted, 2016. arXiv:1609.09096
8. *Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions* (single author), Communications in Mathematical Physics **347** (2016), 573-653. arXiv:1508.03918
7. *The polynomial representation of the type A_{n-1} rational Cherednik algebra in characteristic $p \mid n$* (with S. Devadas), Communications in Algebra **45** (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

38. Yale: Geometry, Symmetry, and Physics Seminar — April 2018
Affine Macdonald conjectures and special values of Felder-Varchenko functions

37. Simons Society of Fellows Retreat — February 2018
A probabilistic view on random covariance matrices

36. PCMI: Research Program on Random Matrices — July 2017
Algebraic structures for multilevel eigenvalue densities

35. Rochester: Probability Seminar — April 2017
Laguerre and Jacobi analogues of the Warren process

34. Perimeter Institute: Mathematical Physics Seminar — April 2017
Affine Macdonald conjectures and special values of Felder-Varchenko functions

33. Rutgers: Lie Group / Quantum Mathematics Seminar — April 2017
Affine Macdonald conjectures and special values of Felder-Varchenko functions

32. Columbia-Princeton Probability Day — March 2017
Laguerre and Jacobi analogues of the Warren process

31. ESI: Workshop on Elliptic Hypergeometric Functions — March 2017
Affine Macdonald conjectures and special values of Felder-Varchenko functions

30. Columbia: Probability Seminar — November 2016
Laguerre and Jacobi analogues of the Warren process

29. Columbia: Mathematical Physics Seminar — October 2016
Affine Macdonald conjectures and special values of Felder-Varchenko functions

28. IESC: QIS's, CFT's, and Stochastic Processes (poster) — September 2016
Laguerre and Jacobi analogues of the Warren process

27. MIT: Infinite-Dimensional Algebra Seminar — March 2016
Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions

26. MIT: Integrable Probability Seminar — February 2016
Laguerre and Jacobi analogues of the Warren process

25. HCM: Asymptotic Analysis in Strongly Coupled Systems (poster) — January 2016
Laguerre and Jacobi analogues of the Warren process

24. NIPS 2015 (poster) — December 2015
From random walks to distances on unweighted graphs

23. ETH Zurich: ITS Talks in Theoretical Sciences 2015 — November 2015
Random matrices and representation theory

22. UC Berkeley: RTGC Seminar — November 2015
Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions

21. ETH Zurich: Mathematical Physics Seminar — October 2015

Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions

20. NEU: Geometry, Physics and Representation Theory Seminar — October 2015
Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions

19. Columbia: Mathematical Physics Seminar — October 2015
Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions

18. Yale: Geometry, Symmetry, and Physics Seminar — September 2015
Traces of intertwiners for quantum affine $\mathfrak{sl}_2$ and Felder-Varchenko functions

17. FPSAC 2015 (poster) — July 2015
A representation-theoretic proof of the branching rule for Macdonald polynomials

16. Clay Math Inst.: Random Polymers and Algebraic Combinatorics — May 2015
A representation-theoretic proof of the branching rule for Macdonald polynomials

15. AISTATS 2015 (poster) — May 2015
Metric recovery from directed unweighted graphs

14. ICERM: Workshop on Limit Shapes (poster) — April 2015
A representation-theoretic proof of the branching rule for Macdonald polynomials

13. NIPS 2014: Workshop on Networks (poster) — December 2014
Metric recovery from directed unweighted graphs

12. UC Berkeley: GRASP Seminar — November 2014
A representation-theoretic proof of the branching rule for Macdonald polynomials

11. IHP: Workshop on Macdonald Processes and Hecke Algebras — May 2014
A new integral formula for Heckman-Opdam hypergeometric functions

10. MIT: Integrable Probability Seminar — April 2014
A new integral formula for Heckman-Opdam hypergeometric functions

Outreach Presentations

9. Math Olympiad Program 2018 — June 2018
Threshold signatures

8. MIT "Meta-Math" Meetup 2017 — May 2017
How to do a Literature Search

7. Summer Program in Applied Rationality and Cognition 2016 — August 2016
Problem Solving: Contests vs. Real Life

6. Math Olympiad Summer Program 2016 — June 2016
Distribution Testing: Is this die fair?

5. MIT Open House 2016 — April 2016
Universality: Mathematics in the real world

4. Math Olympiad Summer Program 2015 — June 2015
Fair coin flips from unfair coins

3. Math Olympiad Summer Program 2014 — June 2014
The Ising model

2. Math Olympiad Summer Program 2013 — June 2013
Random matrices

1. Math Olympiad Summer Program 2012 — June 2012
Random partitions and Fock space

Other Publications

6. 54^{th} *International Mathematical Olympiad* (with J. Berman and Z. Feng), Mathematics Magazine **86** (2013), 309–313.

5. 53^{nd} *International Mathematical Olympiad* (with Z. Feng), Mathematics Magazine **85** (2012), 312–317.

4. 52^{nd} *International Mathematical Olympiad* (with Z. Feng), Mathematics Magazine **84**

(2011), 316–319.

3. 51^{st} *International Mathematical Olympiad* (with Z. Feng and P. Loh), Mathematics Magazine **83** (2010), 320–323.
2. *A simulation based model of traffic circles* (with C. Chang and Z. Fan), The UMAP Journal **30** (2009), 225–244.
1. `hsolve`*: A difficulty metric and puzzle generator for Sudoku* (with C. Chang and Z. Fan), The UMAP Journal **29** (2008), 303–324.

Teaching

US National Math Olympiad Summer Program Summers 2007–2018
Instructor (2010, 2012–2018); Assistant (2007–2009). Design curriculum, give lectures, and personally coach US team to International Mathematical Olympiad.

Columbia University Fall 2017
Instructor for Calculus II. Evaluations: 3.9 (5.0)

MIT MathROOTS 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.

MIT Undergraduate Research Opportunities Program Fall 2012–2015
Mentor two undergraduate research projects, leading to published research paper.

- Sheela Devadas (rational Cherednik algebras in char $p \leq n$), 2014–2015.
- Ryan Yoo (characters of rational Cherednik algebras in char $p > n$), 2012–2014.

Massachusetts Institute of Technology Spring 2015
Teaching Assistant for Differential Equations. Evaluations: 6.2 (7.0)

MIT Directed Reading Program January 2011
Mentor reading project on representation theory of the symmetric group.

Harvard University Spring 2009
Course Assistant for Probability Theory. Evaluations: 4.3 (5.0)

Professional Activities

Columbia Probability Seminar Fall 2016–Present
Co-organize weekly probability seminar.

Summer School in Probability Summer 2017
Co-organize graduate summer school "Dyson-Schwinger equations, topological expansions, and random matrices" at Columbia.

MIT Interacting Particle Systems Learning Seminar 2012–2013
Organize learning seminar on recent developments in interacting particle systems.

Google Research Summer 2010
Research intern. Research attribution and cost-sharing methods, leading to paper published in EC 2010. Mentor: Mukund Sundararajan

Service

Reviewer for: Probability Theory and Related Fields, Selecta Mathematica (N.S.), SIGMA, Journal of Theoretical Probability.

Qualifying Exam committee member for: Ivan Danilenko (Columbia)

Languages

Mandarin (native), French (conversational)

Computer

Sage, Magma, Mathematica, LaTeX, C++, Python

References

Pavel Etingof (advisor), Professor, Massachusetts Institute of Technology, `etingof@math.mit.edu`.

Alexei Borodin, Professor, Massachusetts Institute of Technology, `borodin@math.mit.edu`.

Vadim Gorin, Assistant Professor, Massachusetts Institute of Technology, `vadicgor@`

math.mit.edu.

Eric Rains, Professor, California Institute of Technology, rains@caltech.edu.

Valerio Toledano-Laredo, Professor, Northeastern University, V.ToledanoLaredo@neu.edu.

Po-Shen Loh (teaching), Associate Professor, Carnegie Mellon University, ploh@cmu.edu.

Last updated: June 27, 2018.