

PAUL BOURGADE

Courant Institute of Mathematical Sciences
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RESEARCH INTERESTS

Probability theory; random matrices, statistical physics.

EMPLOYMENT

Courant Institute, New York University, professor (associate professor in 2014-2019)
Institute for Advanced Study, Princeton, member (2013-2014).
Harvard University, Benjamin Peirce Fellow (2010-2013). Advisor: Horng-Tzer Yau.

EDUCATION

Université Paris 6, Ph.D. in mathematics (2009). Advisor: Marc Yor.
Université Paris 6, M.S. in probability and statistics (2007).
Télécom Paris, M.S. in computer science (2007).
École Polytechnique, B.S. in mathematics and physics (2006).
Lycée Henri IV (2002).

HONORS

NSF research grant DMS#2054851, principal investigator (2021-2024).
Simons Fellow (2020-2021).
Fellow of the American Mathematical Society (2020).
Poincaré Chair, Institut Henri Poincaré and Clay Mathematics Institute (2019).
NSF research grant DMS#1812114, principal investigator (2018-2021).
Invited lecture, International Congress of Mathematicians (2018).
NSF research grant DMS#1513587, principal investigator (2015-2018).
Rollo Davidson prize (2014).
NSF research grant DMS#1208859, principal investigator (2012-2015).
Harvard University Certificate of Teaching Excellence (2011, 2012, 2013).
Concours général de mathématiques, second prize (2000).

TEACHING

Courant Institute. Complex variables (Spring 2022). Probability (Fall 2021). Basic probability (Spring 2020). Spin glasses (Spring 2020). Introduction to probability (Fall 2019). Geometry and spectrum of random regular graphs (Fall 2018). Topics in random matrix theory (Spring 2018). Stochastic calculus (Fall 2017). Introduction to probability (Spring 2017). Stochastic calculus (Fall 2016). Probability (Fall 2015). Topics in random matrix theory (Spring 2015). Probability (Fall 2014).
Harvard University. Probability (Spring 2013). Analytic number theory (Spring 2013). Random matrix theory and analytic number theory (Fall 2012). Probability (Spring 2012). Multivariate calculus (Fall 2011). Dynamical systems (Fall 2011). Calculus (Spring 2011). Algebraic combinatorics (Spring 2011). Stochastic analysis (Fall 2010).
Télécom Paris. Stochastic processes and applications (Spring 2009). Large deviations (Fall 2008). Stochastic analysis (Spring 2008), together with A.S. Üstünel.

PH.D. STUDENTS Supervision of Krishnan Mody (2017-2022), Benjamin McKenna (together with Gérard Ben Arous, 2016-2021), Lucas Benigni (together with Sandrine Péché, 2016-2019), Guillaume Dubach (2014-2019).

POSTDOCTORAL
RESEARCHERS Jiaoyang Huang (Simons fellow at Courant), Michel Pain (CNRS chargé de recherche), Lisa Hartung (professor in Mainz), David Belius (assistant professor in Basel).

PUBLICATIONS
AND PREPRINTS *Landscape complexity beyond invariance and the elastic manifold*, with G. Ben Arous and B. McKenna, prepublication (2021).

Exponential growth of random determinants beyond invariance, with G. Ben Arous and B. McKenna, prepublication (2021).

Optimal local law and central limit theorem for β -ensembles, with K. Mody and M. Pain, prepublication (2021).

The Fyodorov-Hiary-Keating conjecture. I., with L. P. Arguin and M. Radziwiłł, prepublication (2020).

Extreme gaps between eigenvalues of Wigner matrices, to appear in Journal of the European Mathematical Society (2018).

Fluctuations of the determinant of Wigner matrices, with K. Mody, Electronic Journal of Probability, vol. 24, no. 96 (2019).

Random band matrices in the delocalized phase, II: Generalized resolvent estimates, with F. Yang, H.-T. Yau and J. Yin, Journal Stat Phys, vol. 174 (2019).

Random band matrices in the delocalized phase, I: Quantum unique ergodicity and universality, with H.-T. Yau and J. Yin, Comm on Pure and App Math, vol. 13, no. 7, 1526-1596 (2020).

Distribution of the overlaps between eigenvectors of Ginibre matrices, with G. Dubach, Probability Theory and Related Fields, vol. 177, 397-464 (2020).

Maximum of the Riemann zeta function on a short interval of the critical line, with L. P. Arguin, D. Belius, M. Radziwiłł, K. Soundararajan, Comm on Pure and App Math, vol 72, 500-535 (2019). This work was part of a Bourbaki seminar by A. Harper.

Eigenvector Statistics of Sparse Random Matrices, with J. Huang and H.-T. Yau, Electronic Journal of Probability, vol. 22, no. 64 (2017).

The two-dimensional Coulomb plasma: quasi-free approximation and central limit theorem, with R. Bauerschmidt, M. Nikula and H.-T. Yau, Advances in Theor and Math Physics, vol. 23 number 4 (2019).

Universality for a class of random band matrices, with L. Erdős, H.-T. Yau and J. Yin, Advances in Theor and Math Physics, vol. 21, no. 3, 739-800 (2017).

Maximum of the characteristic polynomial of random unitary matrices, with L. P. Arguin and D. Belius, Comm in Math Physics, vol 349, 703-751 (2017).

Local density for two-dimensional one-component plasma, with R. Bauerschmidt, Miika Nikula and H.-T. Yau, Comm in Math Physics, vol. 356, 189-230 (2017).

Fixed energy universality for generalized Wigner matrices, with L. Erdős, H.-T. Yau and J. Yin, Comm on Pure and App Math, vol. 69, no. 10, 1815-1881 (2016). Best Paper Award at ICCM 2018.

The eigenvector moment flow and local quantum unique ergodicity, with H.-T. Yau, Communications in Mathematical Physics, vol. 350, 231-278 (2017). Distinguished paper award at ICCM 2017.

Edge universality for beta ensembles, with L. Erdős and H.-T. Yau, Communications in Mathematical Physics, volume 332, issue 1, 261-353 (2014).

The local circular law II: the edge case, with H.-T. Yau and J. Yin, Probability Theory and Related Fields, vol. 159, no. 3-4, 619-660 (2014).

The local circular law for random matrices, with H.-T. Yau and J. Yin, Probability Theory and Related Fields, vol. 159, no. 3-4, 545-595 (2014).

Strong Szegő asymptotics and zeros of the zeta function, with J. Kuan, Communications on Pure and Applied Mathematics, vol. 67, no. 6, 1028-1044 (2014).

Bulk universality of general beta ensembles with non-convex potential, with L. Erdős and H.-T. Yau, J. of Math. Phys., special issue in honor of E. Lieb's 80th birthday, vol. 53 (2012).

Universality of general beta ensembles, with L. Erdős and H.-T. Yau, Duke Mathematical Journal vol. 163, no. 6, 1127-1190 (2014).

Extreme gaps between the eigenvalues of random matrices, with G. Ben Arous, Annals of Probability, vol. 41, no. 4, 2648-2681 (2013).

A unitary extension of virtual permutations, with J. Najnudel and A. Nikeghbali, Int. Math. Research Notices vol. 2013, no. 18, 4101-4134 (2013).

Mesoscopic fluctuations of the ζ zeros, Probability Theory and Related Fields, volume 148, Numbers 3-4, 479-500 (2010).

Circular Jacobi ensembles and deformed Verblunsky coefficients, with A. Nikeghbali and A. Rouault, Int. Math. Research Notices, 23, 4357-4394 (2009).

Conditional Haar measures on classical compact groups, Annals of Probability vol 37, no. 4, 1566-1586 (2009).

Ewens measures on compact groups and hypergeometric kernels, with A. Nikeghbali and A. Rouault, Séminaire de Probabilités XLIII, Springer (2009).

The characteristic polynomial on compact groups with Haar measure: some equalities in law, with A. Nikeghbali and A. Rouault, Comptes Rendus de l'Académie des Sciences, Série I 345, 4, 229-232 (2008).

Euler's formula for $\zeta(2n)$ and products of Cauchy variables, with T. Fujita and M. Yor, Electronic Communications in Probability 12, 73-80 (2008).

The characteristic polynomial of a random unitary matrix: a probabilistic approach, with C.P. Hughes, A. Nikeghbali and M. Yor, Duke Mathematical Journal vol 145, no. 1, 45-69 (2008).

VARIOUS TEXTS

Random band matrices, proceedings of the International Congress of Mathematicians in Rio de Janeiro (2018).

Marc Yor et les matrices aléatoires, in Marc Yor - La passion du mouvement brownien, Gazette des Mathématiciens (2015).

Quantum chaos, random matrix theory, and the Riemann ζ -function, with J. Keating, Chaos Progress in Mathematical Physics, vol. 66, 2013, 125-168 (2013).

Bulk universality for one-dimensional log-gases, proceedings of the XVIIth International Congress On Mathematical Physics, World Scientific Publishing (2013).

Tea time in Princeton, expository article on the analogies between the statistics of random eigenvalues and zeros of L-functions, Harvard College Math. Rev. (2012).

On random matrices and L-functions, Ph.D. thesis (2009).

Random matrices and the Riemann zeta function, with M. Yor, proc. of Journées Élie Cartan 2006, 2007 et 2008, 25-40, Inst. Élie Cartan, Univ. Nancy (2009).

Lois de Poisson-Dirichlet, senior thesis (2007).

Annales des Olympiades internationales de mathématiques, book based on the exercises from the International Mathematical Olympiad, éditions Cassini (2005).

CONFERENCES AND
SEMINARS,
INVITED SPEAKER

2022. Random Matrix Theory and beyond, Stockholm, conference in honor of Kurt Johansson's 60th birthday. Random matrices and random landscapes, Ascona, conference in honor of Yan Fyodorov's 60th birthday. Probability and Mathematical physics, ICM satellite conference in Helsinki. Fourth ZiF Summer School, 2022, Bielefeld University. Midrasha Mathematicae on Random Schroedinger Operators and Random Matrices, Israel Institute of Advanced Studies, Jerusalem.

2021. Introductory Workshop: Universality and Integrability in Random Matrix Theory and Interacting Particle Systems at MSRI. Columbia-CUNY-NYU joint number theory seminar. Montréal CRM-ISM probability seminar. Seminar in Probability Theory and Statistics, Universität Basel.

2020. University of Toronto, colloquium. Courant Institute, colloquium. One world probability seminar. Universality: Random Matrices, Random Geometry and SPDEs, Oberwolfach (cancelled due to coronavirus). Oxford random matrix theory seminar. Texas Analysis and Mathematical Physics Symposium, Rice University. Minicourse at the University of British Columbia summer school in probability (cancelled due to coronavirus). University of Connecticut, probability seminar. Canadian Mathematical Society winter meeting, session on probability in number theory.

2019. Walking Through the Brownian Zoo, conference in honor of Jean-François Le Gall's 60th birthday, Paris. 121th Statistical Mechanics Conference, Rutgers University. Séminaire matrices et graphes aléatoires, Institut Henri Poincaré. Localization and Delocalization for Disordered Quantum Systems, AMS special session, Baltimore. London analysis and probability seminar, Imperial College. Gaussian fields: their geometry and applications in random matrix theory, conference at Queen Mary University. Université Paris 11, Orsay, Probability Seminar. Harvard University, Probability Seminar. Yale University, Combinatorics Seminar. Queens College, colloquium of the physics department. Mathematical physics seminar, Rutgers University. Rencontres de théorie analytique et élémentaire des nombres, Institut Henri Poincaré. Mathematical Physics seminar, Princeton University.

2018. International Congress of Mathematicians, invited lecture, Rio de Janeiro. Advances in Asymptotic Probability, conference on honor of Amir Dembo's 60th birthday, Stanford University. Optimal and Random Point Configurations, conference at the Institute for Computational and Experimental Research in Mathematics, Brown University. Minicourse at the Summer school on Log-correlated fields, University of Bonn. Random matrices and their applications, workshop at Kyoto University. Brazilian Probability School, Catholic University in Rio de Janeiro. Critical Phenomena in Statistical Mechanics and Quantum Field Theory, workshop at the Princeton Center for Theoretical Science. Midwest Probability Colloquium, Northwestern University. Forum de physique statistique, laboratoire de physique théorique de l'École normale supérieure.

2017. Minicourse on universality and quantum unique ergodicity for random matrices, at the Institut des Hautes Études Scientifiques, for the summer school on spectral properties of large random objects. Charles River Lectures on Probability and Related Topics, Harvard University. The Heilbronn Institute for Mathematical Research Annual Conference, University of Bristol. Workshop on Dyson-Schwinger equations, topological expansions and random matrices, Columbia University. Analysis seminar, Stony Brook University. Graduate Students and Postdocs Seminar, Courant Institute. Colloquium, Purdue University. Probability seminar, Purdue University. Mini-Workshop on Log-Correlated Random Fields, Columbia University. University of Virginia Probability Seminar. Joint probability seminar of the University of Pennsylvania and Temple University. University of Chicago Probability Seminar. Princeton University Probability Seminar. Stanford University Probability Seminar.

2016. École d'été de Probabilités de Saint-Flour, course on microscopic statistics of random matrices. Analysis seminar, Institute for Advanced Studies, Princeton. Methods of Modern Mathematical Physics, A Young Researcher Symposium on the Occasion of the 70th Birthday of Barry Simon, Fields institute, Toronto. Random growth models, random walks and random matrices, workshop, CRM, Montreal.

Harvard probability seminar. Yale probability and combinatorics seminar. Clifford lectures conference for Pierre van Moerbeke, Tulane University. Probability seminar, École Polytechnique. Université Paris 6, les probabilités du vendredi. Summer school on random matrices, course on universality, University of Michigan. Optimal and Random Point Configurations: from Statistical Physics to Approximation Theory, conference at Institut Henri Poincaré. Colloquium, University of Wisconsin-Madison. Probability seminar, University of Wisconsin-Madison. Extrema of logarithmically correlated processes, characteristic polynomials, and the Riemann zeta function, Heilbronn Institute, University of Bristol.

2015. LMS-Clay Mathematics Institute, developments in modern probability, course on universality for random matrices, Oxford. Colloque en l'honneur de Marc Yor, Université Paris 6. International Congress on Mathematical Physics, invited session, Santiago. Asymptotics in integrable systems, random matrices, random processes and universality, in honor of Percy Deift's 70th birthday, workshop, Montréal. Colloquium, University of Ottawa. Seymour Sherman memorial conference, Indiana University, Bloomington. Disordered models in mathematical physics, conference, Valparaíso. Random and Other Ergodic Problems, workshop, Newton Institute, Cambridge University. Group representations in dynamical systems and geometry, conference, Marseille. Analytic Tools in Probability and Applications, workshop, IMA, University of Minnesota. AMS sectional meeting at the Loyola University in Chicago, probability session. City University of New York, probability seminar. Bloomberg Quantitative Seminar Series. Journée matrices aléatoires, Institut de Systèmes Complexes, Paris.

2014. Workshop on random matrices and random systems, Institute for Advanced Study, Princeton. New York University Probability and Mathematical Physics Seminar. MIT Probability seminar. Special session on random matrices of the joint AMS-IMU meeting, Tel Aviv. Université de Montréal, Colloquium. Oberwolfach Workshop, Stochastic Analysis: Around the KPZ Universality Class. Stochastic Processes and Applications, Buenos Aires, invited session. Recent Advances on log-gases, conference, Institut Henri Poincaré. Free Probability and Large N Limit, workshop, Berkeley. Columbia-NYU probability seminar series. Special program talk for the board of trustees, Institute for Advanced Study, Princeton. Probability seminar, Marseille. Cincinnati Symposium on Probability Theory and Applications. Combinatorics and Probability seminar, Ohio state university. Number Theory seminar, Ohio state university. NYU Graduate Student and Postdoc Seminar. Random matrix theory, États de la recherche, Institut Henri Poincaré. New approaches in probabilistic and multiplicative number theory, workshop, Montréal.

2013. Columbia University Probability Seminar. Northwestern University Analysis Seminar. Cambridge University, Probability and Statistics Seminar. Brandeis University Everytopic Seminar. Branching diffusions and Gaussian free fields in physics, probability and number theory, conference in Marseille. Random matrix theory workshop, University of Michigan. GeorgiaTech University Probability Seminar. Center of Advanced Study in Theoretical Sciences, Taiwan, lectures. Taida Institute for Mathematical Sciences, Taiwan, lectures. Université Paris 6 Random Matrix Theory Seminar. Université Paris 6 Special Probability Seminar. Institute for Advanced Study, talks by members. Société Mathématique du Canada, Réunion d'Hiver, Ottawa, invited session.

2012. International Conference on Mathematical Physics invited session, Aalborg. University of Minnesota IMA, Advances in Random Matrix Theory, minicourse. Institute of Mathematical Statistics Asia Pacific Rim Meeting, Tsukuba, invited session. Société Mathématique du Canada, Réunion d'Hiver, Montréal, invited session. Rice University Colloquium. University of British Columbia Colloquium. University of British Columbia Probability Seminar. Université Paris 11, Orsay, Probability Seminar. MIT Probability Seminar. Cornell Probability Seminar. University of Michigan Analysis/Probability Seminar. University of Wisconsin Probability Seminar. Harvard Mathematics Department Faculty Colloquium.

2011. University of Chicago Probability Seminar. AMS Spring Eastern Sectional Meeting, invited session. Monthly Random Matrices Seminar, Institut Henri Poincaré, minicourse. Brandeis Everytopic Seminar. University of Massachusetts, Boston, Physics seminar. Université Paris 6 Random Matrix Theory seminar. Université Paris 7, Institut Jacques Monod, minicourse on Random Matrices.

2010. Stochastic Processes and Applications, Osaka, invited session. Harvard Mathematics Department Faculty Colloquium. Université Paris 5, Colloquium. Université de Tours Probability and Dynamical Systems Seminar. Université de Toulouse Probability Seminar. Université de Nancy Probability Seminar. Institut Henri Poincaré Stochastic Analysis Seminar.

2009. Columbia University Probability Seminar. NYU Courant Institute Probability Seminar. University of Toronto Probability Seminar. Bristol University Mathematical Physics Seminar. Colloque en l'honneur d'A. Rouault for his 60th birthday, Institut Henri Poincaré. EADS Modelling and Simulation Research Seminar. Université Paris 6 Random Matrix Theory seminar. Institut Henri Poincaré Stochastic Analysis Seminar.

2008. Conference on Random matrices, L-functions and primes, Zurich. Swiss Probability Seminar, Bern. Workshop on Number Theory and Random Phenomena, Bristol University. Université Paris 6 Random Matrix Theory Seminar. Télécom Paris Probability and Information Theory Seminar. Université Paris 6 special seminar (ANR evaluation).

SERVICE WORK

Associate editor, *Annals of Probability* (2018-).

Associate editor, *Annales de l'Institut Henri Poincaré* (2015-).

Associate editor, *European Journal of Mathematics* (2021-).

Grants reviews. Engineering and Physical Sciences Research Council, European Research Council, Israel Science Foundation, Royal Society, Natural Sciences and Engineering Research Council of Canada, Simons foundation.

Undergraduate and Master's thesis advisor: Haoyu Wang (2020), Haoling Xiang (2019), Zifan Wang (2018), Lucas Benigni (2016), Alastair Doggett (2016), Yannik Pitcan (2011).

Ph.D. committee member for Alexandre Krajenbrink (École Normale Supérieure, Physics department, 2019) Reza Gheissari (Courant, 2019), Alexis Gaal (Courant, 2019), Zhe Wang (Courant, 2018), Oliver Conway (Courant, 2017), Mihai Nica (Courant, 2017), Yiting Li (Brandeis, 2017), Alexander Rozinov (Courant, 2016), Ryan Denlinger (Courant, 2016), Insuk Seo (Courant, 2016), Thomas Leblé (Paris, 2016).

Co-organizer of Ofer Zeitouni's sixtieth birthday conference, Courant Institute (2021).

Co-organizer of the workshop Random Matrices and Applications, Courant Institute (2020). Cancelled and replaced by an online conference.

Co-organizer of Horng-Tzer Yau's sixtieth birthday conference, Banff International Research Station for Mathematical Innovation and Discovery (2019).

Organizer of minicourses on extremes in analytic number theory, Institut Henri Poincaré (2019).

NSF grant DMS# 1707943 and NYU grant from the Provost's Global Research Initiatives, co-principal investigator, for the conference *Dynamics, aging and universality in complex systems* (2017).

Co-organizer of Gérard Ben Arous' sixtieth birthday conference, Courant Institute of Mathematical Sciences (2017).

Organizer of a session for Stochastic Processes and Applications (2017).

Co-organizer of Horng-Tzer Yau's Master conference (2015).

Co-organizer of the Northeast probability seminar (2015-).

Co-organizer of the Courant probability and math. physics seminar (2014-).
Co-organizer of the Columbia-Courant joint probability seminar series (2014-).
Télécom Paris (2010).
Co-organizer of the AMS Special Session in Random Matrix Theory, Baltimore (2014).
Co-organizer of the Harvard-MIT Random Matrix Theory Seminar (2013).
Co-organizer of the Harvard probability seminar (2012-2013).
Co-organizer of the 9th Workshop on Stochastic Analysis and Related Topics, in honor of A.S. Üstünel,
Co-organizer of the Random Matrices Workshop, Institut Henri Poincaré (2009).
Co-organizer of the Stochastic Analysis Seminar, Institut Henri Poincaré (2008-2010).
Chair, Committee on Mathematics in Finance, NYU (2015-2018).
NYU Courant Institute Appointments committee (2015-2018, 2020-2021).
Harvard University qualifying exams committee (2011 and 2012).
Harvard University graduate student admissions committee (2011).

OTHER ACTIVITIES *Lycée Henri IV*, teaching high school students for the Concours général de mathématiques (2003-2007).

French Navy, military service, helicopter carrier Jeanne d'Arc (2002-2003).

PROFESSIONAL ORGANISATIONS American Mathematical Society, Corps des Mines, European Mathematical Society, Société Mathématique Française.