

NATHANAËL BERESTYCKI

Academic Positions

Chair of Stochastics, Universität Wien	since 2018
Professor of Probability, University of Cambridge	2015-2018
Reader in Probability, University of Cambridge	2012-2015
Lecturer, University of Cambridge	2007-2012
Fellow of King's college, Cambridge	2009-2019
Postdoctoral fellow, University of British Columbia & PIMS	2005-2007

Research Interests

Probability theory, geometry and analysis. More precisely: Brownian motion, random geometry, Liouville quantum gravity, Gaussian free field, SLE, dimer model, imaginary geometry, branching and coalescing systems and relation to partial differential equations, random walks on groups, mixing times.

Education

Joint PhD (Cornell 2005 and ENS Paris 2006). Advisors: R. Durrett and J.F. Le Gall.

Invited Lecture Courses

U.K. Probability “Easter Conference”, Manchester Title: <i>Dimers and Imaginary Geometry</i> (4 hrs)	postponed
Gaussian Free Fields and Related Topics, Kyoto (RIMS), Japan. Title: <i>Dimers and imaginary geometry</i> (3 hrs)	Sept 2018
Lectures in Probability and Statistics XII, Kolkata, India. Title of lectures: <i>Introduction to the GFF and Liouville quantum gravity</i> (8 hrs)	December 2017
Les Diablerets, Switzerland Title of lectures: <i>Universality for the dimer model</i> (3 hrs)	February 2017
Chicago summer school in probability. Title of lectures: <i>Introduction to the GFF and Liouville quantum gravity</i> (12 hrs)	July 2016
Darmstadt spring school in probability. Title of lectures: <i>Introduction to the GFF and Liouville quantum gravity</i> (7.5 hrs)	April 2016
Marseille, Workshop on random walks. Title of lectures: <i>Random walks on random graphs</i> (4 hrs)	October 2015
Clay Institute, Oxford / LMS school “modern developments in probability”, Title of lectures: <i>Introduction to the GFF and Liouville quantum gravity</i> (6 hrs)	July 2015
Probability and Representation Theory, Edinburgh Title of lectures: <i>Mixing times and representation theory</i> (3 hrs)	February 2014
Ecole Polytechnique (Paris) Title of lectures: <i>Mixing times</i> . (6 hrs)	October 2011
Young European Probabilists, Eindhoven, Title of lectures: <i>Recent progress in coalescent theory</i> .	March 2009
IMPA, Rio de Janeiro, Title of lectures: <i>Recent progress in coalescent theory</i> .	January 2009

Selected Invited Lectures

Jeju (South Korea), Analysis and Geometry of Random Spaces	postponed
Tel-Aviv University, Horowitz Analysis Seminar (online)	April 2020
One World Probability Seminar (online),	March 2020
Banff, <i>Dimers, Ising model and their interactions</i> ,	Nov 2019
CIRM, Marseille. Self-interacting Random Walks, Polymers and Folding	Sept 2019
Münster, workshop on probability, SPDEs and statistical mechanics	August 2019
Porquerolles, Probability and quantum field theory. CFT, SLE, constructive aspects	June 2019
Les Diablerets, Switzerland. Workshop on Statistical Mechanics	Feb 2019
Banff, <i>Stochastic Analysis and Applications</i> , in honour of K. Burdzy's 60th birthday,	Sept. 2017
SPA, Moscow, invited session Lattice models and scaling limits.	July 2017
Oberwolfach <i>Stochastic Analysis: Geometry of Random Processes</i>	May 2017
SLE, GFF and LQG in NYC. Columbia University, New York	March 2017
Oberwolfach, Heat Kernels, Stochastic Processes and Functional Inequalities.	Dec. 2016
British Mathematical Colloquium. Morning speaker.	April 2016
Clay Institute: Advances in Probability	Sept. 2014
Banff, <i>Front Propagation and Particle Systems</i> ,	August 2014
Spin Glasses and Related Topics, Banff	July 2014
School and Workshop on Random Interacting Systems, Bath,	June 2014
Mathematical biology, particle systems and reaction-diffusion, Toulouse	March 2014
Random Walks on Groups, IHP, Paris,	January 2014
German Probability and Statistics Days, Mainz	March 2012
Stochastic Processes and Applications, Oaxaca (Mexico). Plenary speaker.	June 2011
Branching processes and coalescent processes, Beijing,	April 2011
Random Structure and Dynamics, Oxford	April 2011
Northeast Probability Seminar, New York,	November 2010
Discrete probability and geometry: the mathematics of Oded Schramm, Jerusalem,	Dec. 2009

PhD students

Richard Pymar (graduated 2011), Lee Zhuo Zhao (graduated 2013), Bati Sengul (graduated 2014), Ed Mottram (graduated 2014), Henry Jackson (graduated 2016), Ellen Powell (graduated 2017), Mo-Dick Wong (graduated 2019), Antoine Jego (current), Lucas Teyssier (current), Diederik van Engelenburg (current, jointly with Marcin Lis).

Postdoctoral Associates

Ariel Yadin (Herschel Smith Fellow, 2009–2010), Arnab Sen (2010–2012), Laure Dumaz (2013–2015), Gourab Ray (2015–2017), Benoit Laslier (2015–2017), Wei Qian (2017–2019), Jonathan Hermon (2017–2019), Marcin Lis (2017–2018)

Honours

1st recipient of Bernoulli Prize, Bernoulli society	2012
Plenary speaker at Stochastic Processes and Application	2011

Grants

- FWF grant P33083 on “Scaling limits in random conformal geometry”, €390k, 2020-2024
- EPSRC fellowship, “Geometry and conformal invariance of random systems” (EP/L018896/1), £1.2M. 2014-2019
- EPSRC Programme grant, “New frontiers in Random Geometry” (EP/I03372X/1). Co-PI with G. Grimmett and J. Norris, value £1.65M. 2011-2017
- EPSRC First grant EP/G055068/1, value £290,000 2009-2013

Organisation of Conferences

- Workshop on Random Geometry, Newton institute
Co-organisers: J.-F. Le Gall, S. Sheffield. July 2018
- RaGe (random geometry) in Cambridge,
Co-organisers: G. Grimmett, J. Norris. Cambridge, June 2017.
- Interacting particle systems with applications in biology, ecology, and statistical physics. Southeaster probability colloquium, special edition in honor of Rick Durrett’s 65th birthday.
Co-organisers: J. Mattingly, J. Nolen, L. Popovic. Duke (NC), May 2017
- American Institute of Mathematics (AIM), workshop on *Mixing times of Markov chains*,
Co-organisers: E. Lubetzky, R. Oliveira, and Y. Peres. San Jose (CA), June 2016.
- Workshop on the dimer model.
Co-organisers: B. Laslier and G. Ray. Cambridge, May 2016
- Principal organiser, semester at the Newton Institute on *Random Geometry*.
Co-organisers: I. Benjamini, J.-F. Le Gall, S. Sheffield. INI (Cambridge), Spring 2015
- Geometry and Analysis of Random Processes (Easter UK Probability meeting)
Co-organisers: G. Grimmett and J. Norris. Cambridge. April 2013
- Extremes in branching Brownian motion and random walks,
with L. Addario-Berry and N. Gantert Oberwolfach, September 2013
- The geometry of discrete random structures,
with C. Goldschmidt (funded by EPSRC) Warwick, June 2012

Other Services

- Member of the Editorial boards of:
International Research Mathematical Notices (IMRN), since 2020.
Annals of Probability, since 2018.
Annals of Applied Probability, since 2016.
Electronic Journal of Probability and *Electronic Communications in Probability*, 2015–2020.
Springer Briefs in Mathematical Physics, since 2014.
Mathematical Proceedings of the Cambridge Philosophical Society, since 2014.
Theoretical Population Biology, 2009-2012 (resigned).
- External member on the scientific board of the *Heilbronn Institute for Mathematical Sciences*, U.K.

I have served as a PhD examiner and been a jury member for “habilitations” in Cambridge, Oxford, Bath, ENS Lyon, Paris Dauphine, ETH Zurich, Paris Diderot, KTH Stockholm.

Grant proposal reviews for: NSA (United states), ISF (Israel), ANR (France), NWO (Netherlands), NSERC (Canada), Royal Society (UK), EPSRC (UK), National Science Foundation (NSF), European Research Council (ERC), Swiss NSF (SNSF), WWTF (Austria).

Numerous evaluation letters for promotion committees worldwide. External member on various hiring committees (Oxford, Leipzig...)

Publications

1. N. Berestycki and R. Durrett, (2006). A phase transition in the random transposition random walk. *Probab. Theory Rel. Fields*, 136, 203–233.
2. N. Berestycki (2006). The hyperbolic geometry of random transpositions. *Ann. Probab.*, Vol. 34(2), 429–467.
3. N. Berestycki and J. Pitman. Gibbs distributions for random partitions generated by a fragmentation process. *J. Stat. Phys.* **127**(2), 381–418 (2007).
4. J. Berestycki, N. Berestycki and J. Schweinsberg. Beta-coalescents and continuous stable random trees. *Ann. Probab.*, 35, 1835–1887 (2007).
5. J. Berestycki, N. Berestycki and J. Schweinsberg. Small-time behavior of beta-coalescents. *Ann. Inst. H. Poincaré (B): Probab. Stat.* 44(2), 214–238 (2008).
6. N. Berestycki and R. Durrett, (2008). Limiting behavior for the distance of a random walk. *Electr. J. Probab.* 13, 374–395.
7. N. Berestycki. *Recent progress in coalescent theory*. Ensaio Matemáticos, Vol. 16 (2009).
8. J. Berestycki and N. Berestycki. Kingman’s coalescent and Brownian motion. *Alea*, **6**, 239–259 (2009).
9. J. Berestycki, N. Berestycki and V. Limic. The Λ -coalescent speed of coming down from infinity. *Ann. Probab.*, 38, 207–233 (2010).
10. N. Berestycki, A. Etheridge, and M. Hutzenthaler. Survival, extinction and ergodicity in a spatially continuous population model. *Markov Proc. Rel. Fields*, 15, 265–288 (2009). Special issue “Inhomogeneous random systems”.
11. I. Benjamini and N. Berestycki. Random paths with bounded local time, *J. Eur. Math. Soc.* 12(4), 819–854 (2010).
12. I. Benjamini and N. Berestycki. An integral test for the transience of Brownian paths with limited local time. *Ann. Inst. H. Poincaré (B): Probab. Stat.*, 47, 539–558 (2011).
13. N. Berestycki, O. Schramm and O. Zeitouni. Mixing times of random k -cycles and coagulation-fragmentation chains. arXiv:1001.1894. *Ann. Probab.* 39(5), 1815–1843 (2011). Special volume in memory of Oded Schramm.
14. J. Berestycki, N. Berestycki and J. Schweinsberg. Survival of near-critical branching Brownian motion. *J. Stat. Phys.* 143(5), 833–854, (2011).
15. N. Berestycki. Emergence of giant cycles and slowdown transition in random transpositions and k -cycles. *Electr. J. Probab.* 16, 152–173 (2011).

16. O. Angel, N. Berestycki, and V. Limic. Global divergence of spatial coalescents. *Probab. Theory Rel. Fields*, 152, 625–679 (2012).
17. N. Berestycki, R. Pymar. Effect of scale on long-range random graphs and chromosomal inversions. *Ann. Appl. Probab.*, 22, 1328–1361(2012).
18. J. Berestycki, N. Berestycki and J. Schweinsberg. The genealogy of branching Brownian motion with absorption. *Ann. Probab.*, 41(2), 527–618 (2013).
19. N. Berestycki, A. Etheridge and A. Veber. Large-scale behaviour of the spatial Λ -Fleming-Viot process. arXiv:1107.4254 *Ann. Inst. H. Poincaré*, 49(2), 374–401 (2013).
20. J. Berestycki, N. Berestycki, and V. Limic. A small-time coupling between Λ -coalescents and branching processes. *Ann. Appl. Probab.*, 24, 2, 449-475 (2014).
21. J. Berestycki, N. Berestycki, and V. Limic. Asymptotic sampling formulae for Λ -coalescents. *Ann. Inst. H. Poincaré*, Volume 50, Number 3 (2014), 715-731.
22. N. Berestycki, N. Gantert, P. Mörters and N. Sidorova. Galton–Watson trees with vanishing martingale limit. *J. Stat. Phys.*, 155, 4, 737–762 (2014).
23. J. Berestycki, N. Berestycki and J. Schweinsberg. Critical branching Brownian motion with absorption: survival probability. *Probab. Theor. Rel. Fields*, Volume 160, Issue 3, pp 489-520 (2014).
24. N. Berestycki and G. Kozma. Cycle structure of the interchange process and representation theory. *Bull. Soc. Math. France*, Tome 143 Fascicule 2 (2015).
25. N. Berestycki, Diffusion in planar Liouville quantum gravity. *Ann. Inst. H. Poincaré (B)*, Volume 51, Number 3 (2015), 947-964.
26. J. Berestycki, N. Berestycki and J. Schweinsberg. Critical branching Brownian motion with absorption: particle configurations. *Ann. Inst. H. Poincaré (B)*, Volume 51, Number 4 (2015), 1215-1250.
27. N. Berestycki, C. Garban and A. Sen. Coalescing Brownian flows: a new approach. *Ann. Probab.*, Volume 43, Number 6 (2015), 3177-3215.
28. N. Berestycki, C. Garban, R. Rhodes and V. Vargas. KPZ formula derived from Liouville heat kernel. *J. London Math. Soc.* (2016) 94 (1): 186-208.
29. N. Berestycki and L. Zhuo Zhao. The shape of multidimensional Brunet-Derrida particle systems. *Ann. Appl. Probab.*, 28, 2 651-687 (2018).
30. N. Berestycki and A. Yadin. Condensation of random walks and the Wulff crystal. *Ann. Inst. H. Poincaré (B)*, 55(2): 835-861 (2019).
31. N. Berestycki and B. Sengul. Cutoff for conjugacy-invariant random walks on the permutation group. *Probab. Theor. Rel. Fields*, 173, 1197–1241, (2019).
32. N. Berestycki, B. Laslier and G. Ray. Critical exponents on Fortuin–Kasteleyn weighted planar maps. *Comm. Math. Phys.*, 355, 427–462 (2017).
33. N. Berestycki, Eyal Lubetzky, Yuval Peres and Allan Sly. Random walks on the random graph. *Ann. Probab.*, 46(1): 456-490 (2018).
34. N. Berestycki. An elementary approach to Gaussian multiplicative chaos. *Electr. Comm. Probab.*, vol. 22 (2017), no.27, 1-12
35. N. Berestycki, C. Webb and M.-D. Wong. Random Hermitian matrices and Gaussian multiplicative chaos. *Probab. Theor. Rel. Fields*, 172 (2018), 103—189.

36. N. Berestycki and H. Jackson. The Rohde–Schramm theorem, via the Gaussian free field. *Israel J. Math.*, 228, 973–999 (2018).
37. N. Berestycki, B. Laslier and G. Ray. Dimers and Imaginary Geometry. *Ann. Probab.*, 48(1): 1-52 (2020).
38. N. Berestycki, E. Powell and G. Ray. A characterisation of the Gaussian free field. *Probab. Th. Rel. Fields*, 176, 1259–1301(2020).
39. N. Berestycki and R. Cerf. The random walk penalised by its range in dimension $d \geq 3$. *Ann. H. Lebesgue*, 4 (2021) 1-79.
40. N. Berestycki, E. Powell and G. Ray. $1 + \epsilon$ moments suffice to characterise the GFF. *Electr. J. Probab.*, 26: 1-25 (2021).

Preprints

1. N. Berestycki, M. Lis and W. Qian. Free boundary dimers: random walk representation and scaling limit. arXiv.
2. N. Berestycki and E. Gwynne. Random walks on mated-CRT planar maps and Liouville Brownian motion.
3. N. Berestycki, B. Laslier and G. Ray. The dimer model on Riemann surfaces, I. arxiv.
4. N. Berestycki, S. Sheffield and X. Sun. Equivalence of Liouville measure and Gaussian free field. arXiv.
5. N. Berestycki, C. Mouhot, G. Raoul. Existence of a self-accelerating front for a nonlocal reaction-diffusion equation. arXiv.
6. N. Berestycki, B. Laslier and G. Ray. A note on dimers and T-graphs. arXiv.