

Scott Sheffield

sheff@math.nyu.edu
(212)998-3262
<http://math.nyu.edu/faculty/sheff>

Courant Institute
251 Mercer Street
New York, NY

Education

Ph.D., Mathematics, Stanford University, April 2003
A.B., Mathematics, Harvard University, June 1998
A.M., Mathematics, Harvard University, June 1998

Recent Awards

2006 Rollo Davidson Award for “work on spatial models of probability theory and especially their relationship to stochastic (Schramm) Loewner evolutions”
NSF Postdoctoral Fellowship: DMS 0403182
NSF CAREER award: DMS 0645585, Feb. 1, 2007 – Jan. 31, 2012
2007 Sloan Research Fellowship
NSF PIRE Continuing Grant: OISE 0730136 with Charles Newman (PI), Daniel Stein, Srinivasa Varadhan, Gerard Ben Arous.

Primary Employment

Courant Institute; NYU Mathematics Department	
Spring 2007–present	Associate Professor
Institute for Advanced Study, Princeton	
Fall 2006–Spring 2007	NSF/IAS Postdoctoral Fellow
Courant Institute; NYU Mathematics Department	
Fall 2005–Spring 2006	Assistant Professor
U.C. Berkeley Mathematics Department	
Summer 2004–Summer 2005	NSF Postdoctoral Fellow
Microsoft Research	
Summer 2002–Summer 2004	Postdoctoral Researcher

Professional Activities

Organizer:	Summer 2008 World Congress in Probability and Statistical Physics Invited Session
Instructor:	Summer 2008 ICTP Summer School
Instructor:	Spring 2008 Warwick Spring Meeting
Co-organizer:	Fall 2008 CRM program on Random Surfaces, Random Functions, and Interfaces
Co-organizer/instructor:	Fall 2007 Oberwolfach Seminar on Conformal Invariance in Mathematical Physics
Co-organizer:	Summer 2007 IAS/PCMI Summer Session on Statistical Physics
Co-organizer:	Fall 2006 KITP Semester on Stochastic Geometry and Field Theory
Co-organizer:	2005–06 Courant Institute Probability Seminar
Co-organizer:	2004–05 Berkeley Probability Seminar
Committee member:	Fall 2005 Courant Math. Finance Masters Committee
Committee member:	1997–98 Harvard Undergraduate Curriculum Committee
Referee:	Research papers in <i>Acta Mathematica</i> , <i>Annals of Mathematics</i> , <i>Annals of Probability</i> , <i>Communications in Mathematical Physics</i> , <i>Duke Journal of Mathematics</i> , <i>Journal of the American Mathematical Society</i> , <i>Memoirs of the American Mathematical Society</i> , several other journals

Teaching

Primary instructor:	Two NYU courses (<i>Math. Finance</i> for undergraduates and <i>Limit Theorems</i> for graduate students)
Advisor:	Multiple mathematics Ph.D. students at NYU
Advisor:	NYU undergraduate summer researcher Julia Spencer
Teaching/course assistant:	Six Stanford courses, five Harvard courses

Collaborators and Advisors

- **Collaborators:** Amir Dembo, Stanford University; Richard Kenyon, University of British Columbia; Yevgeniy Kovchegov, Oregon State; Assaf Naor, Microsoft Research; Peter Mörters, University of Bath, Andrei Okounkov, Princeton University; Yuval Peres, U.C. Berkeley; Oded Schramm, Microsoft Research; David Wilson, Microsoft Research; Wendelin Werner, Université Paris-Sud
- **Graduate and Postdoctoral Advisors:** Christian Borgs, Microsoft Research; Jennifer Chayes, Microsoft Research; Amir Dembo, Stanford University; Yuval Peres, U.C. Berkeley; Oded Schramm, Microsoft Research; Thomas Spencer, Institute of Advanced Studies, Princeton

Selected Talks

- 7/7-11/08 Course, ICTP, Trieste, Italy
- 5/12-13/08 Invited Address, Clay Research Conference, MIT
- 3/31-4/4/08 Minicourse, Warwick, UK
- 11/4-10/07 Course, Oberwolfach Seminar, Germany
- 10/6-7/07 Invited Address, Eastern Sectional AMS Meeting, Rutgers University
- 8/5-11/07 32nd conference on Stochastic Processes and their Applications at University of Illinois at Urbana Champaign

- 4/3/07 U. Michigan Colloquium
- 3/26-30/07 IPAM Random Shapes Conference
- 3/12/07 Cornell Probability Seminar
- 2/14/07 MIT Analysis Seminar
- 2/7/07 Princeton Colloquium
- 1/9/07 Caltech Colloquium
- 12/17/06 96th Statistical Mechanics Meeting, Rutgers University
- 12/08/06 Columbia Probability Seminar
- 11/15/06 IAS Member Seminar II
- 11/13/06 IAS Member Seminar I
- 11/09/06 U. Penn Probability Seminar
- 10/19/06 Midwestern Probability Colloquium Tutorial, Northwestern University
- 10/18/06 U. Chicago Applied Math./PDE Seminar
- 10/13/06 Courant institute Applied Math Seminar, New York
- 8/31/06 KITP Semester on Stochastic Geometry and Field Theory
- 8/4/06 IMS Annual Meeting, Rio de Janeiro, Brazil
- 6/22/06 Conference on Stochastic Processes in Mathematical Physics; Florence, Italy

- 5/5/06 Conference on SLE and Loop Measures, Cornell
- 4/22/06 Sherman Conference, University of Indiana
- 2/3/06 Courant Probability Seminar, NYU
- 1/18/06 American Institute of Mathematics ARCC workshop on Random Analytic Functions

- 1/12/06 Stanford Colloquium
- 10/29/05 A conference in honor of Peter Lax and Louis Nirenberg (on the occasion of their 80th birthdays), NYU

- 10/25/05 Princeton Mathematical Physics Seminar

9/22–24/05 Three-lecture Minicourse at Fields Institute, Toronto
 8/5/05 IMA Workshop in Minneapolis
 8/3/05 Brigham Young University Colloquium
 6/1/05 BIRS Conference in Banff
 5/4/05 Berkeley Probability Seminar
 4/8/05 MSRI Postdoctoral Seminar
 11/17/04 Berkeley Probability Seminar
 11/16/04 Berkeley Interdisciplinary Stochastic Processes Colloquium
 11/2/04 Stanford Analysis Seminar
 10/5/04 U.C. Davis Colloquium
 9/10/04 University of Utah Probability Seminar
 9/9/04 Brigham Young University Colloquium
 9/3/04 Berkeley Analysis Seminar
 7/26–31/04 6th World Congress for Bernoulli Soc./67th Ann. Meeting of IMS in
 Barcelona
 2/13/04 Courant Institute Probability Seminar
 2/12/04 Princeton Ergodic Theory Seminar and Probability Seminar
 2/10/04 Princeton Mathematical Physics Seminar
 2/6/04 Cornell Probability Seminar
 2/5/04 Cornell Colloquium
 1/20/04 University of Washington Colloquium
 11/12/03 UCLA Probability Seminar
 11/6/03 University of Wisconsin Probability Seminar
 11/3/03 University of Washington Probability Seminar
 7/17/03 ICMS Conformal Invariance Conference in Edinburgh
 7/15/03 ICMS Conformal Invariance Conference in Edinburgh
 5/19/03 Stanford Probability Seminar
 3/21/03 IHP Random Growth Conference in Paris
 1/15/03 Joint Mathematics Meeting in Baltimore
 10/19/02 Northwest Probability Seminar in Seattle
 10/14/02 Stanford Probability Seminar
 5/20/02 Stanford Probability Seminar

Publications (available at arXiv.org)

- **Book-length research papers:**

1. **Random surfaces.** Scott Sheffield. *Astérisque* 2006, No. 304 (177 pages).
Proved several conjectures (along with extensive generalizations) of Cohn, Elkies, Kenyon, and Propp about Gibbs measure classifications and random surface local statistics; classified possible slopes of smooth phases (a.k.a. crystal facets) for general class of two dimensional random surfaces.
2. **Contour lines of the two-dimensional discrete Gaussian free field.** Oded Schramm and Scott Sheffield. (132 pages). *Acta Mathematica*. **To appear.**
Proved that the chordal level lines of the discrete Gaussian free field have scaling limits that are variants of $SLE(4)$.

- **Gaussian free fields and Schramm-Loewner evolutions:**

1. **Harmonic explorer and its convergence to $SLE(4)$.** Oded Schramm and Scott Sheffield *Annals of Probability*, **33(6):2127–2148, 2005.**
Proved that the harmonic explorer (a natural random interface constructed from simple random walks) converges to $SLE(4)$ as mesh size gets finer.
2. **Gaussian free fields for mathematicians.** Scott Sheffield. *Probability Theory and Related Fields*. **To appear.**
Surveyed mathematical literature on the Euclidean bosonic massless free field and studied new exploration-process-based couplings of Gaussian free fields and Brownian motions.
3. **Exploration trees and conformal loop ensembles.** Scott Sheffield. *Submitted.*
Constructed and studied the conformal loop ensembles $CLE(\kappa)$, which are the “loop ensemble” analogs of SLE .
4. **Conformal radii in conformal loop ensembles.** Oded Schramm, Scott Sheffield and David Wilson. *Submitted.*
Computed conformal radii distributions for conformal loop ensembles and the expectation dimension of the conformal gasket (which is the random closed set consisting of points not surrounded by a loop). Results agree with physics literature predictions by Kenyon and Wilson, by Cardy and Ziff, and by Duplantier.

- **Dimer models, spanning trees, and tilings:**

1. **Dimers and amoebae.** Andrei Okounkov, Richard Kenyon and Scott Sheffield. *Annals of Mathematics*, **163(3):1019–1056, 2006.**
Exhibited unexpected connection between algebraic geometry and statistical physics: the surface tension of a class of perfect-matching-based random surfaces is the Legendre dual of the Ronkin function of the spectral curve of the Kastelyn operator, which turns out to be a Harnack curve. The amoeba of the curve is the phase diagram.

2. **Uniqueness of maximal entropy measure on essential spanning forests.** Scott Sheffield. *Annals of Probability*, Vol. 34, No. 3, 857–864, 2006.
Provided first correct proof that every quasitransitive amenable graph (in particular \mathbb{Z}^d) admits a unique maximal entropy measure on essential spanning forests.
3. **Dimers, tilings and trees.** Richard Kenyon and Scott Sheffield. *Journal of Combinatorial Theory Series B*, 92(2):295–317, 2004.
Produced general weight-preserving bijection between perfect matchings of weighted, bipartite planar graphs and spanning trees of so-called T-graphs.
4. **Ribbon Tilings and Multidimensional Height Functions.** Scott Sheffield. *Trans. Amer. Math. Soc.* 354 (2002), no. 12, 4789–4813.
Used multidimensional height function approach to give efficient tilability algorithm and to show that set of ribbon tilings of a simply connected grid graph is connected under local moves, thereby resolving a conjecture of Pak.

- **Game theory, PDEs, and Lipschitz extension theory**

1. **Random-turn Hex and other selection games.** Yuval Peres, Oded Schramm, Scott Sheffield, and David Wilson. *American Mathematical Monthly*. **To appear.**
Described optimal strategy for the variant of the game of Hex in which turn order is determined by a sequence of fair coin tosses. Proved similar results for more general classes of games and studied typical game trajectories when players play optimally.
2. **Markov chains in smooth Banach spaces and Gromov hyperbolic metric spaces.** Assaf Naor, Yuval Peres, Oded Schramm, and Scott Sheffield. *Duke Mathematical Journal*, 134(1):165–197, 2006.
Proved conjecture of Ball about Markov type and settled several conjectures on Lipschitz extensions and embeddings. Answered a question of Johnson and Lindenstrauss (1982) by showing that for $1 < q < 2 < p < \infty$, any Lipschitz mapping from a subset of L_p to L_q has a Lipschitz extension defined on all of L_p .
3. **Tug-of-war and the infinity Laplacian.** Yuval Peres, Oded Schramm, Scott Sheffield, and David Wilson. *To appear in JAMS.*
Proved that every Lipschitz function on a length space has a unique optimal extension—along with several related results about PDE and metric space theory—using a spatial game called tug of war.
4. **Tug of war with noise: a game theoretic view of the p -Laplacian.** Yuval Peres, Scott Sheffield. *Submitted.*
Used game theory to generalize to arbitrary p the well-known relationship between Brownian motion and the p -Laplacian for $p = 2$. Proved new results about p -capacity and p -harmonicity.

- **Percolation and large deviation theory**

1. **Linear speed large deviations for percolation clusters.** Yevgeniy Kovchegov, Scott Sheffield. *Electronic Journal of Probability*. **8 (2003), 179–183.**

Proved linear speed large deviations principle for cluster shapes in subcritical Bernoulli bond percolation.

2. **Large deviations of Markov chains indexed by random trees.** Amir Dembo, Peter Morters, Scott Sheffield. *Ann. Inst. H. Poincaré Probab. Statist.* **41 (2005), no. 6, 971–996.**

Defined and studied entropy and specific free energy for processes on certain underlying graphs which are themselves random. Proved large deviations principle for tree-indexed Markov chains.