Mykhaylo Shkolnikov

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Academic positions

01/2023-present	**Department of Mathematical Sciences, Carnegie Mellon University.**
	Visiting Professor.
07/2020-present	**ORFE Department, Princeton University.**
	Associate Professor.
10/2018-present	**Program in Applied & Computational Mathematics, Princeton University.**
	Associated Faculty Member.
07/2017-present	**Bendheim Center for Finance, Princeton University.**
	Affiliated Faculty Member.
07/2015-06/2020	**ORFE Department, Princeton University.**
	Assistant Professor.
07/2014-06/2015	**Department of Mathematics, Princeton University.**
	Assistant Professor.
07/2012-06/2014	**Department of Statistics, UC Berkeley.**
	Postdoctoral Fellow.
01/2012-05/2012	**Mathematical Sciences Research Institute, Berkeley.**
	Postdoctoral Fellow.

Education

09/2007-01/2012	**Stanford University.**
	PhD in Mathematics.
	Thesis topic: "Competing particle systems and their applications".
	Thesis advisor: Amir Dembo.
08/2007	**Ludwig-Maximilians University, Munich, Germany.**
	Diploma in Mathematics, *passed with distinction*.
	Specialization: Mathematical Finance, minor: Computer Science.
	Thesis topic: "Affine matrix-valued diffusions".
	Thesis advisor: Damir Filipović.
03/2006	**Ludwig-Maximilians University, Munich, Germany.**
	Vordiplom in Mathematics (minor: Computer Science), *passed with distinction*.

Honors and awards

07/2021-present	NSF grant DMS-2108680 "Probabilistic Approach to Singular Free Boundary Problems and Applications".
07/2021	Princeton Engineering Commendation List for Outstanding Teaching.
06/2019	Early Career Prize by the Activity Group on Financial Mathematics & Engineering at the Society for Industrial and Applied Mathematics (SIAM).
05/2019	E. Lawrence Keyes, Jr./Emerson Electric Co. Faculty Advancement Award by the School of Engineering and Applied Science, Princeton University.
11/2018	Erlang Prize by the Applied Probability Society of the Institute for Operations Research and the Management Sciences (INFORMS).
07/2018-06/2021	NSF grant DMS-1811723 "Large-scale behavior of interacting particle systems".
05/2018-06/2020	Princeton SEAS innovation award "Particle models of neural synchronization".
05/2017	NSF grant DMS-1713013 "Mathematical Finance, Probability, and PDE Conference", co-PI.

Publications/Preprints

1. "Affine matrix-valued diffusions" (2007). *Diploma thesis. Ludwig-Maximilians University, Munich.*

2. "Competing particle systems evolving by i.i.d. increments" (2009). *Electron. J. Probab.* **14**, pp. 728–751.

3. "Competing particle systems evolving by interacting Lévy processes" (2011). *Ann. Appl. Probab.* **21**, pp. 1911–1932.

4. "Large systems of diffusions interacting through their ranks" (2012). *Stoch. Proc. Appl.* **122**, pp. 1730–1747.

5. "Concentration of measure for systems of Brownian particles interacting through their ranks" (2014). Joint work with S. Pal. *Ann. Appl. Probab.* **24**, pp. 1482–1508.

6. "Two models for stochastic losses given default" (2012). Joint work with S. Farinelli. *J. Credit Risk* **8**, paper 4.

7. "Large volatility-stabilized markets" (2013). *Stoch. Proc. Appl.* **123**, pp. 212–228.

8. "Convergence rates for rank-based models with applications to portfolio theory" (2013). Joint work with T. Ichiba and S. Pal. *Probab. Theory Related Fields* **156**, pp. 415–448.

9. "On the one-sided Tanaka equation with drift" (2011). Joint work with I. Karatzas and A. N. Shiryaev. *Electron. Commun. Probab.* **16**, pp. 664–677.

10. "Strong solutions of stochastic equations with rank-based coefficients" (2013). Joint work with T. Ichiba and I. Karatzas. *Probab. Theory Related Fields* **156**, pp. 229–248.

11. "Competing particle systems and their applications" (2011). *PhD thesis. Stanford University.*

12. "Some universal estimates for reversible Markov chains" (2013). *Electron. J. Probab.* **18**, article 11.

13. "On a non-linear transformation between Brownian martingales" (2012). Preprint available at *arxiv.org/abs/1205.3218*.

14. "Limits of multilevel TASEP and related processes" (2015). Joint work with V. Gorin. *Ann. Inst. Henri Poincaré Probab. Stat.* **51**, pp. 18–27.

15. "Small time central limit theorems for semimartingales with applications" (2015). Joint work with S. Gerhold, M. Kleinert and P. Porkert. *Stochastics* **87**, pp. 723–746.

16. "Systems of Brownian particles with asymmetric collisions" (2016). Joint work with I. Karatzas and S. Pal. *Ann. Inst. Henri Poincaré Probab. Stat.* **52**, pp. 323–354.

17. "Fluctuations of martingales and winning probabilities of game contestants" (2013). Joint work with D. Aldous. *Electron. J. Probab.* **18**, article 47.

18. "Large deviations for diffusions interacting through their ranks" (2016). Joint work with A. Dembo, S. R. S. Varadhan and O. Zeitouni. *Comm. Pure Appl. Math.* **69**, pp. 1259–1313.

19. "Multidimensional sticky Brownian motions as limits of exclusion processes" (2015). Joint work with M. Z. Racz. *Ann. Appl. Probab.* **25**, pp. 1155–1188.

20. "Large deviations for interacting Bessel-like processes and applications to systemic risk" (2013). Joint work with T. Ichiba. Preprint available at *arxiv.org/abs/1303.3061.*

21. "Intertwining diffusions and wave equations" (2013). Joint work with S. Pal. Preprint available at *arxiv.org/abs/1306.0857.*

22. "Time-reversal of reflected Brownian motions in the orthant" (2013). Joint work with I. Karatzas. Preprint available at *arxiv.org/abs/1307.4422.*

23. "Multilevel Dyson Brownian motions via Jack polynomials" (2015). Joint work with V. Gorin. *Probab. Theory Related Fields* **163**, pp. 413–463.

24. "Interacting particle systems at the edge of multilevel Dyson Brownian motions" (2017). Joint work with V. Gorin. *Adv. Math.* **304**, pp. 90–130.

25. "Forward performance processes in incomplete markets and ill-posed HJB equations" (2016). Joint work with R. Sircar and T. Zariphopoulou. *SIAM J. Financial Math.* **7**, pp. 588–618.

26. "A construction of infinite Brownian particle systems" (2015). Preprint available at *arxiv.org/abs/1504.06211.*

27. "Stochastic Airy semigroup through tridiagonal matrices" (2018). Joint work with V. Gorin. *Ann. Probab.* **46**, pp. 2287–2344.

28. "SPDE limit of the global fluctuations in rank-based models" (2018). Joint work with P. Kolli. *Ann. Probab.* **46**, pp. 1042–1069.

29. "Intertwinings of beta-Dyson Brownian motions of different dimensions" (2018). Joint work with K. Ramanan. *Ann. Inst. Henri Poincaré Probab. Stat.* **54**, pp. 1152–1163.

30. "Particle systems with singular interaction through hitting times: application in systemic risk modeling" (2019). Joint work with S. Nadtochiy. *Ann. Appl. Probab.* **29**, pp. 89–129.

31. "Edge of spiked beta ensembles, stochastic Airy semigroups and reflected Brownian motions" (2019). Joint work with P. Y. Gaudreau Lamarre. *Ann. Inst. Henri Poincaré Probab. Stat.* **55**, pp. 1402–1438.

32. "Dynamics of observables in rank-based models and performance of functionally generated portfolios" (2018). Joint work with S. A. Almada Monter and J. Zhang. *Ann. Appl. Probab.* **29**, pp. 2849–2883.

33. "Construction of forward performance processes in stochastic factor models and an extension of Widder's theorem" (2020). Joint work with L. Avanesyan and R. Sircar. *Finance Stoch.* **24**, pp. 981–1011.

34. "Mean field systems on networks, with singular interaction through hitting times" (2020). Joint work with S. Nadtochiy. *Ann. Probab.* **48**, pp. 1520–1556.

35. "Global solutions to the supercooled Stefan problem with blow-ups: regularity and uniqueness" (2019). Joint work with F. Delarue and S. Nadtochiy. *Probab. Math. Phys.* **3**, pp. 171–213.

36. "Inverting the Markovian projection, with an application to local stochastic volatility models" (2020). Joint work with D. Lacker and J. Zhang. *Ann. Probab.* **48**, pp. 2189–2211.

37. "Zero kinetic undercooling limit in the supercooled Stefan problem" (2020). Joint work with G. Baker. *Ann. Inst. Henri Poincaré Probab. Stat.* **58**, pp. 861–871.

38. "Superposition and mimicking theorems for conditional McKean-Vlasov equations" (2020). Joint work with D. Lacker and J. Zhang. *J. Eur. Math. Soc.* **25**, pp. 3229–3288.

39. "Convergence of a time-stepping scheme to the free boundary in the supercooled Stefan problem" (2023). Joint work with V. Kaushansky, C. Reisinger, Z. Q. Song. *Ann. Appl. Probab.* **33**, pp. 274–298.

40. "Scaling limits of external multi-particle DLA on the plane and the supercooled Stefan problem" (2021). Joint work with S. Nadtochiy, X. Zhang. To appear in *Ann. Inst. Henri Poincaré Probab. Stat.* Preprint available at *arxiv.org/abs/2102.09040*.

41. "A singular two-phase Stefan problem and particles interacting through their hitting times" (2022). Joint work with G. Baker. Preprint available at *arxiv.org/abs/2203.06003. Submitted.*

42. "Stefan problem with surface tension: global existence of physical solutions under radial symmetry" (2023). Joint work with S. Nadtochiy. *Probab. Theory Related Fields* **187**, pp. 385-422.

43. "Well-posedness of the supercooled Stefan problem with oscillatory initial conditions" (2023). Joint work with S. Mustapha. Preprint available at *arxiv.org/abs/2302.13097. Submitted.*

44. "Stefan problem with surface tension: uniqueness of physical solutions under radial symmetry" (2023). Joint work with Y. Guo, S. Nadtochiy. Preprint available at *arxiv.org/abs/2306.02969. Submitted.*

45. "Deep level-set method for Stefan problems" (2023). Joint work with H. M. Soner, V. Tissot-Daguette. To appear in *J. Comput. Phys.* Preprint available at *arxiv.org/abs/2306.11601.*

Plenary talks

06/2022	Advances in Mathematical Finance and Optimal Transport (in honor of W. Schachermayer's birthday), Centro di Ricerca Matematica Ennio de Giorgi, Pisa.
05/2019	Southeastern Probability Conference, Duke University.
12/2018	Advances in Asymptotic Probability (in honor of A. Dembo's birthday), Stanford University.
10/2018	Eastern Conference on Mathematical Finance, Illinois Institute of Technology.
05/2018	Seminar on Stochastic Processes, Brown University.
09/2017	SIAM-LMS Conference on Mathematical Modelling in Finance, London.
03/2017	Western Conference in Mathematical Finance, University of Washington.
11/2015	Northeast Probability Seminar, NYU.
05/2015	Stochastic Portfolio Theory Conference, Columbia University.
03/2015	Mathematical Finance and Partial Differential Equations Conference, Rutgers.
06/2012	Probability, Control and Finance: A Conference in Honor of I. Karatzas, Columbia University.

Other invited talks

2023: TU Berlin, University of North Carolina.

2022: USC (online), Carnegie Mellon University (online), Joint Israeli Probability Seminar (online), Columbia University (online), University of Tokyo, TU Munich.

2021: Harvard University (online), University of Leeds (online), Berlin Probability Colloquium (online), Stanford University (online), SIAM conference on Financial Mathematics & Engineering (online), CIRM Workshop "Advances in Stochastic Analysis for Handling Risks in Finance & Insurance" (online), USC (online).

2020: Oxford University (online), Indiana University (online), Princeton University (online), Columbia University (online), Rutgers University (online).

2019: TU Vienna, London School of Economics, Imperial College London, Rutgers University, NUS: 4th Berlin-Princeton-Singapore Workshop on Quantitative Finance, MIT, Centre International de Recontres Mathématiques (Luminy): Integrability and Randomness in Mathematical Physics and Geometry, Toronto: SIAM Conference on Financial Mathematics & Engineering, Berlin Mathematical Finance Seminar, Nice: Annals of Applied Probability Meeting, NYU, University of Münster.

2018: The Hong Kong Polytechnic University, University of Toronto, Columbia University, Duke University, Casa Mathemática Oaxaca: Workshop on Stochastic Analysis and its Applications, Mittag-Leffler Institute: Conference on Gaussian Fields in Random Matrix Theory, Illinois Institute of Technology, University of Delaware: AMS sectional meeting, Princeton University: Program in Applied & Computational Mathematics colloquium, TU Munich.

2017: London Mathematical Finance Seminar, Columbia University, Oberwolfach: Mathematics of Quantitative Finance, University of Michigan, Oxford: Oxford-Princeton Workshop on Financial Mathematics and Stochastic Analysis, Edinburgh: Workshop on BSDEs, SPDEs and their Applications, Montréal: Mathematical Congress of the Americas (Probability Theory session), Stony Brook, University of Vienna, UT Austin.

2016: Kavli Institute for Theoretical Physics: Non-equilibrium dynamics of stochastic and quantum integrable systems, UC Santa Barbara, Rutgers University, MIT, University of Michigan: Byrne Workshop on Stochastic Analysis in Finance and Insurance, ICMS Edinburgh: At the Frontiers of Quantitative Finance.

2015: Montréal: Canadian Mathematical Society conference, University of Chicago, Princeton: Oxford-Princeton Workshop on Financial Mathematics and Stochastic Analysis, Morgan Stanley, TU Munich, University of Tokyo, CUNY, Rutgers, Princeton University, DC: AMS sectional meetings.

2014: Brown University, University of Tokyo, Johns Hopkins, Harvard University, University of Pennsylvania & Temple University, Princeton University, University of Connecticut, Columbia University, USC, UBC, University of Maryland, Georgia Tech.

Professional activities

Associate editor for *Annals of Applied Probability, Applied Mathematical Finance, Mathematical Finance.*

Conference organization: IMSI Workshop: Laplacian Growth Models (Chicago, 2023), 2 Sessions at the SIAM Conference on Financial Mathematics & Engineering (Philadelphia, 2023), 2 Sessions at the SIAM Conference on Financial Mathematics & Engineering (online, 2021), 2 Sessions at the SIAM Conference on Financial Mathematics & Engineering (Toronto, 2019), Columbia-Princeton Probability Day (Princeton, 2015, 2017, 2019, 2023), Princeton-Rutgers Math Finance Day (New Brunswick, 2018), Mathematical Finance, Probability, and PDE (New Brunswick, 2017), 9th World Congress of the Bachelier Finance Society (New York, 2016), 9th, 10th Oxford-Princeton Workshop on Financial Mathematics and Stochastic Analysis (Princeton, 2015, Oxford, 2017), Invited Session at the INFORMS Annual Meeting (Philadelphia, 2015).

Seminar organization: Carnegie Mellon Math Colloquium, Carnegie Mellon Probability/Math Finance Seminar, Princeton Financial Mathematics Seminar, Princeton Probability Seminar, Princeton Stochastic Analysis Seminar, Princeton ORFE Colloquium, UC Berkeley Probability Seminar.

Referee for *Annales de l'Institut Henri Poincaré, Annals of Applied Probability, Bernoulli, Communications on Pure and Applied Mathematics, Electronic Communications in Probability, Electronic Journal of Probability, Finance and Stochastics, International Mathematics Research Notices, Journal of the American Mathematical Society, Journal of Applied Econometrics, Journal of Mathematical Physics, Journal of Theoretical Probability, Letters in Mathematical Physics, Mathematical Finance, Mathematics of Operations Research, Probability Theory and Related Fields, Proceedings of the National Academy of Sciences, SIAM Journal of Financial Mathematics, Stochastic Partial Differential Equations: Analysis and Computations, Stochastic Processes and their Applications, Stochastics.*

Administrative:

NSF panelist (2022),
ORFE Director of Graduate Studies (2020-2022),
Princeton Graduate School Curriculum Committee (2020-2022),
ORFE Search Committee for an Assistant Professor appointment in Data Science (2018-2019),
ORFE Graduate Admissions (2016, 2017, 2018, 2019, 2020).

Academic Committee Member:

PhD Defense Committee of Maria Avdeeva, Graeme Baker, Cameron Bruggeman, Joe Durante, Jacob Funk, Pierre Yves Gaudreau Lamarre, Christy V. Graves, Han Hao, Praveen Kolli, Daniel Lacker, Nongchao Li, Zhi Li, Zongxi Li, Kun Lu, Sinem Uysal, Peiqi Wang, Minghan Yan, Jiacheng Zhang, Zeyu Zhang, Tianqi Zhao.

General/Preliminary Examination Committee of Arseniy Andreev, Levon Avanesyan, Graeme Baker, Pierre Bayle, Mark Cerenzia, Jui-Hui Chung, Alexandru Damian, Jou-Hua Lai, Pierre Yves Gaudreau Lamarre, Daniel Gitelman, Miriam Gordin, Christy V. Graves, Yucheng Guo, Gulnaz Jenish, Lexie Li, Zongxi Li, Maycee Lin, Yair Shenfeld, Zongjun Tan, Shouda Wang, Jiacheng Zhang, Yunxiu Zhou.

Advising

PhD thesis supervision: Praveen Kolli (defended: 04/2018), Pierre Yves Gaudreau Lamarre (defended: 05/2020), Levon Avanesyan (defended: 12/2020), Jiacheng Zhang (defended: 05/2021), Graeme Baker (defended: 06/2023), Scander Mustapha (expected: 05/2024), Yucheng Guo (expected: 05/2026), Jou-Hua Lai (expected: 05/2026), Benjamin Budway (expected: 05/2027).

Senior thesis supervision: Alan Chung, Dhruv Bansal, Bulut Cakmak, June Chang, Luyu Cheng, Nicholas Chow, Bill Dong, Laura Fang, Allison Harris, Kavirath Jain, Arnav Joshi, Lingdian Kong, Fatomata Konteh, Alex Luo, Stella Ma, Taishi Nakase, Paul Noh, Ebo Quansah, Fangying Shi, Nathan Sima, Zhuo Qun Song, Michael Stambler, Austin Stiefelmaier, Christina Walter, Andrew Wang, William Xocoy, Sung Hyun Yoo, Sean Yun.

Academic advising: ≈ 15 undergraduate students per year.

Teaching

Carnegie Mellon University: Particles Interacting through their Mean Field and Applications to Finance (graduate).

Princeton University: Probability Theory (graduate), Probabilistic Theory of Network Games and Mean Field Interactions (graduate, co-taught with René Carmona), Stochastic Calculus (graduate), Probability and Stochastic Systems (undergraduate), Stochastic Portfolio Theory (graduate), Financial Risk Management (undergraduate), Calculus II (undergraduate), Advanced Multivariable Calculus (undergraduate).

UC Berkeley: Introduction to Probability and Statistics (undergraduate), Concepts of Probability (undergraduate).

Non-academic employment

08/2017	Consultant at the research division of INTECH Investment Management LLC, Princeton.
06/2011-08/2011, 06/2012	Internships at the research division of INTECH Investment Management LLC, Princeton.
06/29/2009-09/05/2009	Internship in Group Risk Methodology, UBS AG, Zurich.