Karl Liechty

Curriculum Vitae

Contact Information

Department of Mathematical Sciences
DePaul University
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Mathematical Interests

- Analysis, probability, and mathematical physics, including:
  random matrix theory, asymptotic methods, integrable systems, statistical physics, Riemann–Hilbert analysis, determinantal processes, orthogonal polynomials.

Education

- **Indiana University-Purdue University Indianapolis** — Indianapolis, IN
  Ph.D., Mathematics — August, 2010
  Advisor: Pavel Bleher
- **Indiana University-Purdue University Indianapolis** — Indianapolis, IN
  M.S., Mathematics — May, 2007
- **Indiana University** — Bloomington, IN
  B.M., Jazz Studies — August, 2003
  Minors: Mathematics and Spanish

Academic Appointments

- **DePaul University, Department of Mathematical Sciences** — Chicago, IL
  Professor — 2025 – present
  Associate Professor — 2018 – 2025
  Assistant Professor — 2014 – 2018
- **University of Michigan** — Ann Arbor, MI
  Postdoctoral Assistant Professor — 2011 – 2014

Administrative Appointments

- **DePaul University** — Chicago, IL
  Associate Chair, Department of Mathematical Sciences — 2022 – present

Visiting Positions

- **Institut Mittag-Leffler** Djursholm, Sweden
  Research Visitor Fall 2024
  Program on "Random Matrices and Scaling Limits"
- **Mathematical Sciences Research Institute** Berkeley, CA
  Research Member Fall 2021
  Program on "Universality and Integrability in Random Matrix Theory and Interacting Particle Systems"

  Postdoctoral Member Fall 2010
  Program on "Random Matrix Theory, Interacting Particle Systems and Integrable Systems"

Publications

- **Book**

  1. *Random matrices and the six-vertex model*, with P. Bleher. CRM Monograph Series, 32, American Mathematical Society, 2014. x+224 pp.

- **Refereed Articles Published/Accepted**

  22. **Boundary statistics in the six-vertex model with DWBC**, with V. Gorin. To appear in *Communications on Pure and Applied Mathematics.* doi.org/10.1002/cpa.22254.
  21. **Bordered and Framed Toeplitz and Hankel Determinants with Applications to Integrable Probability**, with R. Gharakhloo. In *Recent Developments in Orthogonal Polynomials*, Contemporary Mathematics, 822, American Mathematical Society, 2025. preprint: arxiv:2401.01971.
  20. **Airy process with wanderers, KPZ fluctuations, and a deformation of the Tracy–Widom GOE distribution**, with G.B. Nguyen and D. Remenik, *Annales de l'Institut Henri Poincaré - Probabilités et Statistiques.* **58**(4) 2250–2283 (2022). doi:10.1214/21-AIHP1229
  19. **Monotone subsets in lattices and the Schensted shape of a Sós permutation**, with T. Kyle Petersen, *Combinatorial Theory*, **2**(2) Paper No. 9, 41 pp. (2022). doi.org/10.5070/C62257875.
  18. **The Fourier extension method and discrete orthogonal polynomials on an arc of the circle**, with J.S. Geronimo, *Advances in Mathematics* **365** 107064 (57pp) (2020). doi.org/10.1016/j.aim.2020.107064.
  17. **Asymptotics of free fermions in a quadratic well at finite temperature and the Moshe–Neuberger–Shapiro random matrix model**, with D. Wang, *Annales de l'Institut Henri Poincaré - Probabilités et Statistiques.* **56**(2) 1072–1098 (2020). doi:10.1214/19-AIHP994
  16. **The k-tacnode process**, with R. Buckingham, *Probability Theory and Related Fields* (2019). doi.org/10.1007/s00440-018-0885-2.

15. **Nonintersecting Brownian bridges on the unit circle with drift**, with R. Buckingham, *Journal of Functional Analysis* **276** 1717–1772 (2019). doi.org/10.1016/j.jfa.2018.05.021.
14. **Propagation of singular behavior for Gaussian perturbations of random matrices**, with T. Claeys, A.B.J. Kuijlaars, and D. Wang, *Comm. Math. Phys.* **362**, 1–54 (2018). doi.org/10.1007/s00220-018-3195-8.
13. **Domain wall six-vertex model with half-turn symmetry**, with P. Bleher, *Constructive Approximation* **47** 141–162 (2018). doi.org/10.1007/s00365-017-9405-3.
12. **Nonintersecting Brownian bridges between reflecting or absorbing walls**, with D. Wang, *Advances in Mathematics* **309** 155–208 (2017). doi.org/10.1016/j.aim.2016.10.024.
11. **Two Lax systems for the Painlevé II equation, and two related kernels in random matrix theory**, with D. Wang, *SIAM Journal on Mathematical Analysis* **48**(5) 3618–3666 (2016). doi.org/10.1137/16M1056080.
10. **Nonintersecting Brownian motions on the unit circle**, with D. Wang, *Annals of Probability* **44**(2), 1134–1211 (2016). doi.org/10.1214/14-AOP998.
9. **Six-vertex model with partial domain wall boundary conditions: ferroelectric phase**, with P. Bleher, *Journal of Mathematical Physics* **56**(2) (2015), 023302, 28 pp. doi.org/10.1063/1.4908227.
8. **Riemann-Hilbert approach to the six-vertex model**, with P. Bleher, in P. Deift and P. Forrester (Eds.) "Random Matrix Theory, Interacting Particle Systems and Integrable Systems," MSRI Publications, Cambridge University Press, 39–56 (2014).
7. **Tail decay for the distribution of the endpoint of a directed polymer**, with T. Bothner, *Nonlinearity* **26**(5), 1449–1472 (2013). doi.org/10.1088/0951-7715/26/5/1449.
6. **On the joint distribution of the maximum and its position of the Airy$_2$ process**, with J. Baik and G. Schehr, *Journal of Mathematical Physics* **53**(8) (2012), 083303, 13 pp. doi.org/10.1063/1.4746694.
5. **Nonintersecting Brownian motions on the half-line and discrete Gaussian orthogonal polynomials**, *Journal of Statistical Physics* **147**(3), 582–622 (2012). doi.org/10.1007/s10955-012-0485-y.
4. **Uniform asymptotics for discrete orthogonal polynomials with respect to varying exponential weights on a regular infinite lattice**, with P.M. Bleher, *International Mathematics Research Notices* **2011**(2), 342–386 (2011). doi.org/10.1093/imrn/rnq081.
3. **Exact solution of the six-vertex model with domain wall boundary condition. Antiferroelectric phase**, with P.M. Bleher, *Communications on Pure and Applied Mathematics* **63**, 779–829 (2010). doi.org/10.1002/cpa.20311.
2. **Exact solution of the six-vertex model with domain wall boundary condition. Critical line between ferroelectric and disordered phases**, with P.M. Bleher, *Journal of Statistical Physics* **134**(3), 463–485 (2009). doi.org/10.1007/s10955-009-9688-2.

1. **Exact solution of the six-vertex model with domain wall boundary conditions. Ferroelectric phase**, with P.M. Bleher, *Communications in Mathematical Physics* **286**, 777–801 (2009). doi.org10.1007/s00220-008-0709-9.

Grants and Contracts

- External grants (funded)
  - Mathematical Association of America — Summer 2022
    National REU Program at DePaul University, PI — $31,358, funded
  - Simons Foundation Collaboration Grant for Mathematicians — 2015 – 2022
    Random matrix theory and applications, PI — $35,000, funded
  - AMS-Simons Travel Grant — 2015–2017
    $4000, funded

- External grants (not funded)
  - AMS-Simons Research Enhancement Grant for — 2024 – 2027
    Primarily Undergraduate Institution (PUI) Faculty, PI — $9000, not funded
  - AMS-Simons Research Enhancement Grant for — 2023 – 2026
    Primarily Undergraduate Institution (PUI) Faculty, PI — $6000, not funded
  - National Science Foundation Division of Mathematical Sciences — 2019 – 2022
    Integrable probability and integrable systems, PI — $106,626, not funded
  - National Science Foundation Division of Mathematical Sciences — 2018 – 2021
    Random matrix theory and integrable systems, PI — $106,860, not funded

- Internal grants
  - DePaul University CSH Faculty Summer Research Grant — 2025
    The vertically symmetric six-vertex model — $6000, funded
  - DePaul University CSH Faculty Summer Research Grant — 2022
    The flattening of a watermelon — $5800, funded
  - DePaul University URC Competitive Paid Research Leave — Spring 2020
    Transitions from random matrix to classical statistics — $5700, funded
    (Leave was delayed until Fall 2021 due to COVID 19 pandemic)
  - DePaul University CSH Faculty Summer Research Grant — 2019
    Transitions from random matrix to classical statistics — $5700, funded
  - DePaul University URC Competitive Course Release Grant — 2018
    Integrable probability and integrable systems — Course release granted
  - DePaul University Office of Provost Faculty Initiatives Grant — 2017
    $1500 awarded for hiring of research assistant
  - DePaul University CSH Faculty Summer Research Grant — 2015
    Gap probabilities for the tacnode process — $4200, funded

Teaching Experience

- Undergraduate courses taught (DePaul University):
  MAT 130 (Precalculus), MAT 137 (Business Statistics), MAT 150-2 (Calculus I, II, and III), MAT 260-1 (Mulitvariable calculus I and II), MAT 348 (Applied statistical methods), MAT 351-3 (Probability & Statistics I, II, and III)

- Graduate and crosslisted courses taught (DePaul University): MAT 435 (Measure Theory), MAT 337/437 (Complex Analysis), MAT 452 (Probability & Statistics II), MAT 355/455 (Stochastic Processes), MAT 515 (Financial Modeling), MAT 640 (Multivariate Calculus for Teachers), MAT 672 (Linear Algebra for Teachers)

- Undergraduate (MAT 399) and graduate (MAT 599) independent studies

Stochastic Calculus (3 students)	Spring 2025
Advanced Probability (1 student)	Spring 2024
Stochastic Calculus (1 student)	Spring 2024
Stochastic Calculus (1 student)	Spring 2021
Integrable PDEs (1 student)	Fall 2020
Mathematical Statistics (4 students)	Summer 2020
Applied Probability (1 student)	Fall 2017
Mathematical Statistics (1 student)	Summer 2017
Introductory Probability & Statistics (1 student)	Spring 2015

- Student research supervised

Umid Ahmadali (USRP) Summer 2025
Topic: *Six-vertex model with partial domain wall boundary conditions*

Malaeka Amir (URAP) Fall 2024
Topic: *Exact sampling using coupling from the past*
Paper, *Exact Sampling of the Six-Vertex Model Using Coupling from the Past,* accepted for publication in DePaul Discoveries

Rose Bittle (USRP) Summer 2024
Topic: *Understanding Musical Tonality Through Graphical Systems*
Paper, *Modifications to the Spiral Array: A Computational Approach to Music Analysis,* accepted for publication in DePaul Discoveries

An Luu and Matthew Galvan Summer-Fall 2022
Topic: *Quasi-random graphs*

Guadalupe Juarez, Lorena Rojas, Leslye Rodriguez, and Rachel Taylor Summer 2022
Summer REU at DePaul (co-advised with Dr. Emily Barnard)
Topic: *The pop stack sorting map on maximal tubings*

Jason Echevarria – Master's thesis (reader) 2022
Thesis title: *Opinion Profile Dynamics with Uniform Bounded Confidence*

Enrique Leon – Independent undergraduate study Fall 2020
Topic: *Integrable PDEs*

Eleanor Marshall – Senior thesis (reader) 2018
Thesis title: *Modeling the Angular Distribution of Artificial Light at Night*

Henry Jahelka – Independent Master's study Winter 2018
Topic: *Random matrix theory*

Matthew Garvin – Independent Master's study Winter and Spring 2017
Topic: *Applied analysis and numerics for orthogonal polynomials*

Alec Diaz-Arias – Independent Master's study 2015-16
Topic: *Free probability*

Ryan Obermeyer – Master's thesis (Thesis advisor) 2015-16
Thesis title: *The Tacnode Kernel and Its Convergence to Sine, Airy, and Pearcey Kernels*

Scholarly presentations

- **Invited research presentations**

  - *Orthogonal polynomials and the six-vertex model* AMS Joint Meetings, special session on Recent Advancements in Integrable Systems and Orthogonal Polynomials, Seattle, WA. January 8, 2025
  - *The six-vertex model with DWBC* Program on "Random matrices and scaling limits", Institut Mittag-Leffler, Djursholm, Sweden. December 10, 2024
  - *Boundary statistics in the six-vertex model with DWBC* Combinatorics and Probability Seminar, Ohio State University, Columbus, OH. April 5, 2024
  - *Boundary statistics in the six-vertex model with DWBC* Geometry and Analysis Seminar, University of California Santa Cruz, Santa Cruz, CA. October 11, 2023
  - *Boundary statistics in the six-vertex model with DWBC* AMS Sectional Meeting, special session on Recent Trends in Integrable Systems and Applications, Cincinnati, OH. April 16, 2023
  - *Boundary correlations in the six-vertex model as the Laplace transform of some orthogonal polynomials* AMS Joint Meetings, special session on Orthogonal Polynomials and Applications, Boston, MA. January 7, 2023
  - *Introduction to the six-vertex model* Pacific Northwest Integrable Probability Conference, Corvallis, OR. November 4, 2022
  - *Longest increasing subsequence and the Schensted shape of some pseudo-random sequences* Program Seminar, Program on Universality and Integrability in Random Matrices and Interacting Particle Systems, Mathematical Sciences Research Institute, Berkeley, CA. October 29, 2021
  - *Airy process with wanderers, KPZ, and random matrices* Probability Seminar, University of Kansas. September 8, 2021.
  - *Airy process with wanderers, KPZ, and random matrices* Mathematical Physics and Probability Seminar, University of California, Davis. December 2, 2020
  - AMS sectional meeting, special session on Integrable Probability, Charlottesville, VA. March 13, 2020

    Cancelled due to Covid-19 Pandemic.
  - *A deformation of the Tracy–Widom GOE distribution* AMS-MAA Joint Meetings, special session on Random Matrices and Integrable Systems, Denver, CO. January 18, 2020
  - *Error bounds in Fourier extension approximations* Computational Analysis Seminar, Vanderbilt University, Nashville, TN. December 5, 2019
  - *Extreme value statistics for the Airy process with wanderers* Integrable Systems and Random Matrix Theory Seminar, University of Michigan, Ann Arbor, MI. November 25, 2019

- *Tacnode processes, winding numbers, and Painlevé II* Cincinnati Symposium on Probability Theory and Applications, University of Cincinnati, Cincinnati, OH. November 10, 2018
- *Error bounds in Fourier extension approximations* Midwest Workshop on Asymptotic Analysis, Indiana University, Bloomington, IN. October 6, 2018
- *Tacnode processes, winding numbers, and Painlevé II* Columbia University Integrable Probability Working Group Seminar, New York, NY. March 23, 2018
- *Tacnode processes, winding numbers, and Painlevé II* University California San Diego Probability Seminar, La Jolla, CA. March 15, 2018
- *Free fermions at finite temperature and the MNS matrix model* University of Virginia Probability Seminar, Charlottesville, VA. November 29, 2017
- *Nonintersecting Brownian motions on the unit circle* University of Wisconsin Probability Seminar, Madison, WI. November 17, 2017
- *Nonintersecting Brownian motions on the unit circle* AMS sectional meeting, special session on Random Matrices and Applications, Riverside, CA. November 4, 2017

- **Presentations given at DePaul**
  - *Where do all of the zeroes go?* Math club, DePaul University, Chicago, IL. October 4, 2024
  - *The average of the sum is the sum of the averages* Math club, DePaul University, Chicago, IL. February 2, 2024
  - *Random growth and complex integrals* REU Seminar Series, DePaul University, Chicago, IL. July 7, 2023
  - *Bicycle gears and continued fractions* Math club, DePaul University, Chicago, IL. February 3, 2023
  - *At the edge of the arctic curve* End-of-summer student research mini-conference, DePaul University, Chicago, IL. August 18, 2022
  - *The mathematics of waiting for the bus* Admitted students day, DePaul University, Chicago, IL. April 8, 2022
  - *The central limit theorem and other universalities* Math club, DePaul University, Chicago, IL. March 4, 2022
  - *Moving sofas and Conway cars* Math club, DePaul University, Chicago, IL. February 19, 2021
  - *Mathematical games* Math club, DePaul University, Chicago, IL. May 10, 2019
  - *Colorings of graphs and planes* Math club, DePaul University, Chicago, IL. January 18, 2019
  - *Where do all of the zeroes go?* Math club, DePaul University, Chicago, IL. January 26, 2018

Service

- **University Service, DePaul University**
  - Faculty council representative — 2025 – 2028
  - Faculty council representative (alternate) — 2024 – 2025
  - Digital Transformation co-creation focus group — Spring 2024
  - Digital Transformation Subject Matter Expert, Internal Portal — Winter 2025
  - University hearing board — 2023 – present
  - Committee on status of faculty — 2023 – 2026; Co-chair 2024 – 2025
  - University benefits and compensation committee — ex officio 2024 – 2025
  - Council on community engagement — 2019 – 2023
  - Public service council — 2017 – 2023
- **College of Science and Health, DePaul University**
  - CSH personnel committee — 2023 – 2026
  - CSH research committee — 2020 – 2023
  - CSH strategic plan implementation committee (research) — 2020 – 2023
  - STEM center advisory council — 2019 – 2023
  - CSH colloquium committee — 2016 – 2022; Chair 2018-19, 2022
  - Reviewer for *DePaul Discoveries*, the undergraduate research journal of CSH — 2017, 2022, 2024
- **Department of Mathematical Sciences, DePaul University; Standing Committees**
  - Math undergraduate curriculum committee — 2016 – 2019, Chair 2022 – present
  - Assessment committee — 2020 – present, Chair 2022 – present
  - Foundational mathematics committee (ex-officio) — 2022 – present
  - Diversity, Equity, and Inclusion committee — Chair 2020 – 2021
  - Scholarship committee — Chair 2015 – 2021
  - Personnel committee — 2020 – 2021
  - Promotion and tenure committee (2 cases) — 2019 – 2020
  - Math colloquium coordinator — 2016 – 2020
  - M.S. in Pure Mathematics committee — 2014 – 2016, 2017 – 2020
  - M.A. in Math. Ed. and M.S. in Math. for Teaching committee — 2014 – 2016, 2017 – 2020
  - Tenure track hiring committees — 2015-16, 2018-19, 2019-20
  - Non-tenure track hiring committees — 2018, 2019
  - Adjunct faculty evaluation committee — 2016 – 2019
- **Department of Mathematical Sciences, DePaul University; ad-hoc service**
  - Math department representative at Academic Interest Session, Fall Visit Day — October 7, 2023
  - CSH 10th anniversary event committee — Co-chair 2021
  - Ad hoc committee for new degree: B.A. in Data Science — 2016–17
  - Ad hoc committee for new concentrations for Master's in Applied Math — 2015-16

Professional activities and service

- **Professional outreach**
  - Organizer of Chicago Math Teachers' Circles 2018 – present
  - Math Alliance Mentor 2021 – present
    Mentor for 3 students in Summer-Fall 2022
  - Chicago-Indiana Regional Math Alliance 2021 – 2023
    Sub-committee on student research

- **Outreach presentations**
  - *Can the voice of the people be heard?*, Chicago Math Teacher's Circle, Chicago, IL. February 4, 2025
  - *Chicago Math Teacher's Circles*, Math Teacher's Association of Chicago and Vicinity Annual Dinner, Chicago, IL. March 29, 2023
  - *Bicycle gears and Diophantine approximations*, Chicago Math Teacher's Circle, Chicago, IL. May 5, 2022
  - *Conway's game of life*, Chicago Math Teacher's Circle, Chicago, IL. December 1, 2020
  - *Colorings of graphs and planes*, Southwest Chicago Math Teachers' Circle, Chicago, IL. October 21, 2019
  - *Flipping coins and turning the tables*, Chicago Math Teacher's Circle Summer Jamboree, Chicago, IL. July 23, 2019
  - *Games! (but not game theory)*, Chicago Math Teacher's Circle, Chicago, IL. April 4, 2019
  - *Football and airplanes*, Chicago Math Teacher's Circle, Chicago, IL. March 14, 2019
  - *When to hold 'em*, Chicago Math Teacher's Circle, Chicago, IL. February 7, 2019
  - *Path counting and hats*, Chicago Math Teacher's Circle, Chicago, IL. October 4, 2018
  - *Colorings of graphs and planes*, Chicago Math Teacher's Circle Summer Jamboree, Chicago, IL. August 14, 2018

- **Conference organizing**
  - Organizer for Special Session *Random matrices and related structures,* AMS Sectional Meeting, University of California, Riverside November 9-10, 2019
  - Organizer for Special Session *Probabilistic models in mathematical physics,* AMS Sectional Meeting, Vanderbilt University April 14-15, 2018

- **Textbook reviewer**
  - *Random matrices*, Park City Mathematics Series; Borodin, Corwin, Guionnet, eds. 2019
  - *Real Analysis*, by Royden and Fitzpatrick, Pearson 2019
  - *Introduction to Probability*, by Anderson, Seppäläinen, and Valkó, Cambridge 2016

- **Grant reviewer**
  - Mathematics Association of America Dolciani Math Enrichment Grant Program 2024
  - Simons Collaboration Grant for Mathematicians 2017

- **Professional membership**
  – *American Mathematical Society* 2013 – present

- **Professional development**
  – DePaul Online Teaching Series Summer 2016

- **Ad hoc reviewer for scholarly journals**
  Acta Mathematica, Advances in Applied Mathematics, Annales de l'Institut Henri Poincaré (B) Probabilités et Statistiques, Annals of Applied Probability, Annals of Probability, Archiv der Mathematik, Constructive Approximation, Communications in Mathematical Physics, Computational Methods and Function Theory, Duke Mathematical Journal, International Mathematics Research Notices, Journal of Functional Analysis, Journal of Physics A: Mathematical and Theoretical, Journal of Mathematical Physics, Journal of Statistical Mechanics: Theory and Experiment, Journal of Statistical Physics, Mathematical Physics, Analysis, and Geometry (MPAG), Nonlinearity, Pure and Applied Functional Analysis, Random Matrices: Theory and Applications, Sampling Theory, Signal Processing, and Data Analysis, Signal Processing, Stochastic Processes and Applications, Symmetry, Integrability, and Geometry: Methods and Applications (SIGMA), Transactions of the American Mathematical Society

Awards and recognitions

- Gabor Szegő Prize 2015
  Awarded by the SIAM activity group on Orthogonal Polynomials and Special Functions for outstanding research by an early career mathematician

- Nominated for DePaul QIC Excellence in Teaching Award 2016, 2019, 2023, 2024