

# Curriculum Vitae

## David Jekel

### 1 Summary

I am a mathematician working on the interactions between *von Neumann algebras* and *random matrix theory*, through the lenses of entropy, optimal transport, stochastic control, and continuous model theory.

I obtained my Ph.D. in 2020 from UCLA with Dimitri Shlyakhtenko. In 2020-2023, I was an NSF postdoctoral fellow at UCSD with Todd Kemp. In 2023-2024, I was a postdoc at the Fields Institute for the thematic program on operator algebras, and then a postdoc at York University. In 2024-2025, I am a postdoc at University of Copenhagen with Magdalena Musat and Mikael Rørdam.fellow at the Fields Institute for Research in Mathematical Sciences.

I am committed to excellence in teaching both in the classroom and in reading courses and mentorship of students and young researchers. I have put a lot of thought and time into teaching so that students can most effectively learn and be supported in their identity and their goals. Besides teaching courses, I have continued to meet with undergraduates and graduate students for reading courses and research collaboration as well as being involved in several networks to support early-career researchers and promote diversity in mathematics.

This CV is organized into five sections: Education, Research Experience, Teaching Experience, Outreach, and Honors.

### 2 Education

#### Ph. D. at University of California, Los Angeles

- **Degree:** Ph.D. in Mathematics.
- **Graduation date:** June 12, 2020.
- **Advisor:** Dimitri Shlyakhtenko.
- **Dissertation:** Evolution equations in non-commutative probability theory.
- **Dissertation committee:** Dimitri Shlyakhtenko, Sorin Popa, Terence Tao, Mario Bonk.
- **GPA:** 4.00.

#### Undergraduate at University of Washington, Seattle

- **Degrees:** B.S. in Math and B. A. in (Greek and Roman) Classics, with Honors.
- **Graduation date:** June 12, 2015.
- **GPA:** 3.99.
- Research on resistor networks under James Morrow.
- Math honors thesis on free boundary problems under Tatiana Toro, exposition of Caffarelli's paper "Lipschitz free boundaries are  $C^{1,\alpha}$ ."
- Classics senior essay under Catherine Connors.

### 3 Research Experience

#### Published and Accepted Papers

Citation counts are listed below based on Google Scholar and checked by hand in September 2023. The counts include preprints and exclude self-citations (defined as citations from any paper where I was an author). The **total non-self citation count is 72** from these published and accepted papers.

- Isaac Goldbring, David Jekel, Srivatsav Kunnawalkam Elayavalli, and Jennifer Pi. Uniformly Super McDuff  $\text{II}_1$  factors. *Math. Ann* 391:2757-2781 (2025). arXiv:2303.02809  
**3 non-self citations**
- Ben Hayes, David Jekel, and Srivatsav Kunnawalkam Elayavalli. Consequences of the random matrix solution of the Peterson-Thom conjecture. *Anal. PDE*, to appear. arXiv:2308.14109  
**0 non-self citations**
- Ben Hayes, David Jekel, and Srivatsav Kunnawalkam Elayavalli. Property (T) and strong 1-boundedness for von Neumann algebras. *J. Math. Inst. Jussieu*, to appear arXiv:2107.03278  
**3 non-self citations**
- David Jekel and Jennifer Pi. An elementary proof of the inequality  $\chi \leq \chi^*$  for conditional free entropy. *Doc. Math.* 29.5: 1085-1124 (2024) arXiv:2305.02574  
**0 non-self citations**
- David Jekel. Optimal transport for types and convex analysis for definable predicates in tracial  $W^*$ -algebras. *J. Funct. Anal.* 287.9:110583 (2024). arXiv:2308.11058  
**0 non-self citations**
- Ben Hayes, David Jekel, and Srivatsav Kunnawalkam Elayavalli. Vanishing first cohomology and strong 1-boundedness for von Neumann algebras, *J. Noncommut. Geom.* 18.2:383-409 (2024). arXiv:2110.12324  
**1 non-self citation**
- David Jekel. Free probability and model theory of tracial  $W^*$ -algebras. In *Model theory of operator algebras*, ed. Isaac Goldbring. De Gruyter, Boston, Berlin (2023).  
**2 non-self citations.**
- David Jekel. Covering entropy for types in tracial  $W^*$ -algebras, *J. Log. Anal.* 15.2:1-68 (2023). arXiv:2204.02582  
**2 non-self citations.**
- Wilfrid Gangbo, David Jekel, Kyeongsik Nam, and Dimitri Shlyakhtenko. Duality for optimal couplings in free probability. *Comm. Math. Phys.* 396:903-981 (2022). arXiv:2105.12351  
**6 non-self citations.**
- David Jekel, Wuchen Li, and Dimitri Shlyakhtenko. Tracial non-commutative smooth functions and the free Wasserstein manifold. *Diss. Math.* 580:1-150 (2022). arXiv:2101.06572.  
**8 non-self citations.**
- Ethan Davis, David Jekel, and Zhichao Wang. Tree convolution for measures with unbounded support. *Lat. Am. J. Prob. Math. Stat.* 18.2:1585-1623 (2021). arXiv:2102.01214.  
**0 non-self citations**
- Ben Hayes, David Jekel, Brent Nelson, and Thomas Sinclair. A Random Matrix Approach to Absorption Theorems for Free Products.” *Internat. Math. Res. Not.*, 2021.3:1919–1979 (2021). arXiv:1912.11569.  
**10 non-self citations.**
- David Jekel. Conditional Expectation, Entropy, and Transport for Convex Gibbs Laws in Free Probability. *Internat. Math. Res. Not.* 2022.6:4514-4619 (2022). arXiv:1912.11569.  
**3 non-self citations.**
- David Jekel and Weihua Liu. An operad of non-commutative independences defined by trees. *Diss. Math.* 553:1-100 (2020). arXiv:1901.09158.  
**14 non-self citations.**
- David Jekel. An Elementary Approach to Free Entropy Theory for Convex Potentials. *Analysis & PDE* 13.8:2289-2374 (2020). arXiv:1805.08814.  
**5 non-self citations.**
- David Jekel. Operator-Valued Chordal Loewner Chains and Non-Commutative Probability. *Journal of Functional Analysis* 278.10:108452, arXiv:1711.02611.  
**11 non-self citations.**
- David Jekel, Avi Levy, Will Dana, Austin Stromme, Collin Litterell. Algebraic Properties of Generalized Graph Laplacians: Critical Groups, Electrical Networks, and Homological Algebra. *SIAM J. Discrete Math.* 32.2:1040-1110 (2018). arXiv:1604.07075  
**2 non-self citations**

Ph.D. thesis:

- David Jekel. Evolution equations in non-commutative probability. Ph.D. Thesis, UCLA, 2020.  
**2 non-self citations.**

I also wrote an appendix to the following paper:

- Terence Tao and Dimitri Shlyakhtenko, Fractional free convolution powers. *Indiana Univ. Math. J.* 71.6 (2022), 2551-2594.

## Preprints

- Ian Charlesworth and David Jekel. Operator models and analytic subordination for operator-valued free convolution powers. arXiv:2501.09190
- David Jekel. Information geometry for types in the large- $n$  limit of random matrices. arXiv:2501.00703
- David Gao and David Jekel. Elementary equivalence and disintegration of tracial von Neumann algebras. arXiv:2410.05529
- Ben Hayes, David Jekel, Srivatsav Kunnawalkam Elayavalli, and Brent Nelson. General solidity phenomena and anti-coarse spaces for type III<sub>1</sub> factors. arXiv:2409.18106
- David Jekel, Juspreet Singh Sandhu, and Jonathan Shi. Potential Hessian ascent: The Sherrington-Kirkpatrick model. arXiv:2408.02360
- David Jekel, Lahcen Oussi, and Janusz Wysoczanski. General limit theorems for mixtures of free, monotone, and boolean independence. arXiv:2407.02276
- David Jekel and Srivatsav Kunnawalkam Elayavalli. Upgraded free independence phenomena for random unitaries. arXiv:2404.17114
- Ian Charlesworth, Rolando de Santiago, Ben Hayes, David Jekel, Srivatsav Kunnawalkam Elayavalli, Brent Nelson. On the structure of graph product von Neumann algebras. arXiv:2404.08150
- David Jekel. Combinatorial aspects of Parraud's asymptotic expansion for GUE matrices. arXiv:2402.08024
- Ilijas Farah, David Jekel, and Jennifer Pi. Quantum expanders and quantifier reduction for tracial von Neumann algebras. arXiv:2310.06197
- Ben Hayes, David Jekel, and Srivatsav Kunnawalkam Elayavalli. Consequences of the random matrix solution of the Peterson-Thom conjecture. arXiv:2308.14109
- David A. Jekel, Todd A. Kemp, and Evangelos A. Nikitopoulos. A martingale approach to noncommutative stochastic calculus. arXiv:2308.09856
- Ian Charlesworth, Rolando de Santiago, Ben Hayes, David Jekel, Srivatsav Kunnawalkam Elayavalli, Brent Nelson. Strong 1-boundedness,  $L^2$ -Betti numbers, algebraic soficity, and graph products. arXiv:2305.19463
- Ian Charlesworth, Rolando de Santiago, Ben Hayes, David Jekel, Srivatsav Kunnawalkam Elayavalli, Brent Nelson. Random permutation matrix models for graph products. arXiv:2404.07350

## Conference and seminar organization

- Co-organizer of University of Copenhagen Groups and Operator Algebras Seminar, with Pieter Spaas, Ian Thompson, and Martín Blufstein García, 2024-2025 academic year.
- Co-organizer of JMM (Joint Mathematics Meetings) Special Session on Advances in Operator Algebras, with Sarah Browne and Priyanga Ganesan, January 2023.
- Co-organizer of IWOTA (International Workshop on Operator Theory and its Applications) special session, with Janusz Wysoczanski and Vitonofrio Crismale, September 2022.
- Co-organizer of Model Theory of Operator Algebras reading seminar, with Anshu, Fields Institute, Fall 2023.
- Co-organizer of UCSD functional analysis seminar, with Priyanga Ganesan, 2022-2023 academic year.
- Organizer of UCSD functional analysis seminar, 2021-2022 academic year.

## Selected conferences with invited talks

- Abu Dhabi Stochastics Days, December 6, 2024.
- Non-commutative Function Theory and Free Probability, Mathematisches Forschungsinstitut Oberwolfach, April/May 2024.
- Workshop on Operator Algebras and Applications: Free Probability, Fields Institute, November 2023.
- Virginia Operator Theory and Complex Analysis Meeting, University of Richmond, October 2023.
- Workshop on Operator Algebras and Applications: Connections with Logic, Fields Institute, August-September 2023.
- Workshop on Operator Algebras and Applications: Connections with Logic, Fields Institute, Toronto, August 2023.
- von Neumann algebras follow-up workshop to trimester program, Hausdorff Institute of Mathematics, Bonn, August 2022.
- $C^*$ -algebras workshop, Mathematisches Forschungsinstitut Oberwolfach, August 2022.
- Operator Algebras, Dynamics, and Groups, ICM Satellite Conference, University of Copenhagen, July 2022.
- AMS sectional meeting, Recent, Developments in Operator Algebras, virtual, March 26-27, 2022.
- Southern California Probability Symposium, virtual, December 11, 2021.

## Selected conferences with contributed talks

- World Congress of Probability and Statistics, Ruhr-Universität Bochum, August 2024.<sup>1</sup>
- Glasgow Late August Symbolic Dynamics, Groups, and Operators Workshops, University of Glasgow, August 2022.
- IPAM Quantitative Linear Algebra, second reunion conference, December 2021.
- Operator Theory with Its Applications, virtual, August 10-13, 2020.
- Real Algebraic Geometry with a View Toward Hyperbolic Programming and Free Probability, Oberwolfach, March 1 - 7, 2020.
- Classification Problems in von Neumann Algebras, BIRS, September 2019.
- $C^*$ -algebras at Mathematisches Forschungsinstitut Oberwolfach, August 2019.
- International Workshop on Operator Theory and its Applications, Instituto Superior Tecnico, Lisbon, July 2019.
- Great Plains Operator Algebras Symposium, Texas A & M University, May 2019.
- West Coast Operator Algebras Seminar, Seattle University, September 2018.
- Young Mathematicians in  $C^*$ -algebras, KU Leuven, August 2018.
- Extended Probabilistic Operator Algebras Seminar, University of California, Berkeley, November 2017.

## Selected Conferences Attended

- Group Operator Algebras: Classification, Structure and Rigidity, Banff International Research Station / virtual, September 2024.
- Stochastics and Geometry, Banff International Research Station / virtual, September 2024.
- Non-commutativity in the North: MikaelFest,<sup>2</sup> June 2024.
- Thematic program on Operator Algebras, Fields Institute, Toronto, Fall 2023.

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<sup>1</sup>Invited talk for a contributed session.

<sup>2</sup>Conference in honor of Mikael Rørdam's 65th birthday.

- Southeastern Analysis Meeting, virtual, March 17-18, 2021.
- Joint Mathematics meetings, virtual, January 2021.
- Young Mathematicians in  $C^*$ -algebras, University of Copenhagen, August 2019.
- Model Theory and Operator Algebras, BIRS, November 2018.
- Long Program in Quantitative Linear Algebra at IPAM, Spring 2018.
- Model Theory of Operator Algebras workshop, University of California, Irvine, September 2017.
- Dyson-Schwinger Equation workshop, Columbia University, September 2017.
- Workshop in Subfactors and Planar Algebras, MSRI, June 2017.
- Complex Analysis and Probability Workshop, Montana State University, August 2016 and 2017.
- Summer School in Analysis at the University of Chicago, Summer 2014 and Summer 2016.
- Train Tracks Seminar, University of Utah, Summer 2014.
- Summer Mathematics REU, University of Washington, Summer 2013.

## 4 Teaching Experience

### Lecturer at UCSD

See the teaching statement for more detail. I taught the following courses:

- Math 10C Multivariable calculus (for non-physical science majors) (Spring 2022)
- Math 109 Introduction to Mathematical Reasoning (Winter 2022).
- Math 180A Introduction to Probability Theory (Fall 2021, Fall 2022).
- Math 130 Ordinary Differential Equations and Dynamical Systems (Winter 2023).
- Math 146 Analysis of Ordinary Differential Equations (Spring 2023).

I also have the following experience and qualifications from my work at UCSD:

- Excellent teaching reviews from students.
- Attended workshops from the Engaged Teaching Hub from the Teaching and Learning Commons.
- Proficient at using technology for in-person, hybrid, and remote instruction: Canvas, Gradescope, Piazza, Discord, Padlet, Mentimeter, iPad, Goodnotes, Zoom.
- Experienced in teaching large classes (150-200 students in lower division, 70 students in upper division).
- High student engagement using interactive techniques in lecture, participation points, office hours, and individual meetings.
- Mastery-based assessment through allowing students to correct or replace a certain number of problems/topics.

### Teaching Assistant at UCLA

Duties include teaching discussion section, grading, and holding office hours, as well as tutoring in the Student Math Center (for the lower division classes). Classes include

- Math 33A Linear Algebra (Fall 2015, Winter 2016).
- Math 33B Differential Equations (Winter 2018).
- Math 61A Discrete Structures (Fall 2017).
- Math 131A Analysis (Spring 2016).
- Math 131B Analysis (Fall 2016, Winter 2017, Winter 2019).
- Math 131C Topics in Analysis (Spring 2019).
- Math 275A Probability (graduate-level, Fall 2016).

## Teaching Assistant at University of Washington

First-year honors calculus sequence (Math 134, 135, 136) in 2013-2014, and second-year sequence (Math 334, 335, 336) in 2014-2015. Duties include teaching one class per week, grading quizzes, grading homework, and holding two office hours.

## Tutoring

- During 2018-2020, I worked as a private tutor, tutoring mostly college students in calculus, linear algebra, analysis, and abstract algebra.
- For the 2019-2020 academic year, I am a regular volunteer tutor for San Diego Refugee Tutoring.

## Mentorship and professional development

- During 2020-2021 I regularly participated in the meetings of OTTER (Operator Theory Talks for Early-Career Researchers), which is a group of in operator theory and related fields meant to equip young researchers with mathematical background and career development.
- I am currently meeting individually with some undergraduates and graduate students to give reading courses or collaborate on research projects.
- I was a judge for the Mathematical Association of America's poster contest in the 2021 Joint Mathematics Meetings.

## 5 Outreach

### San Diego Refugee Tutoring

During the 2020-2023 academic years, I volunteered as a tutor regularly on Tuesdays and Thursdays for San Diego Refugee Tutoring, an organization that tutors kids of refugee backgrounds in the City Heights neighborhood of San Diego. We helped kids with their homework and read with them in order to support their education and thriving in their new home. We also had events a couple times a year where kids have fun and receive food donations.

### Mutual aid fund for travel costs

In January 2022, the Joint Mathematics Meetings was postponed and changed to an online format due to the coronavirus. Many early-career researchers had bought non-refundable plane tickets to save costs (and some were explicitly encouraged to do so by professional programs), and they were not able to get any reimbursement for their expenses. As an early-career researcher socially connected with many other early-career researchers, I am well aware of the financial burden that grad school and postdocs can be, and the delays (and in this case impossibility) of reimbursement can make it even worse. Furthermore, this problem disproportionately affects mathematicians with families and those with less wealth and privilege. As Piper H drew attention to this issue on Twitter, I was inspired to do something and so I partnered with Christelle Vincent and Jamie Haddock to organize a mutual aid fund where established researchers could contribute money to be used to help early-career researchers who expressed greater need for their flight costs for the cancelled in-person event to be reimbursed. As of February 28, 2022, we had used to donations to reimburse \$7488.77 of travel costs for undergraduate students, graduate students, postdocs, and K-12 teachers.

### Judge for ACT-SO

On April 24, 2021, I served as a judge for the student competition for the Afro-Academic, Cultural, Technological and Scientific Olympics (ACT-SO) hosted by the NAACP of San Diego.

## 6 Awards and Honors

- Oberwolfach Simons Visiting Professor travel grant for the workshop “Free probability and non-commutative function theory” and visit to the University of Wrocław, May 2023.
- Postdoc fellowship from the National Science Foundation (2020-2023).
- Dissertation Year Fellowship from UCLA (2019-2020).
- Graduate Division Dean’s Scholarship from UCLA.
- Dean’s Medal for Natural Sciences at the UW (2015).
- Gullicksen Award for outstanding juniors in the UW math department (2013-2014).
- Jim Greenfield Classics scholarship at the UW.
- UW Freshman Presidential Medalist (2011-2012).
- National Merit Scholar (2011).