JOE MOELLER

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EMPLOYMENT

California Institute of Technology June 2024 - Present
Postdoctoral Scholar

Montgomery College Spring 2024
Adjunct Faculty

University of Maryland, College Park Feb 2023 - Jan 2024
Visiting Postdoctoral Associate

National Institute of Standards and Technology February 2021 - Feb 2023
NRC Postdoctoral Research Associate

University of California, Riverside Summer 2017 - Spring 2019
Research Assistant, DARPA's CASCADE project
Funded by **Metron Scientific Solutions Inc.**

EDUCATION

Ph.D. Mathematics December 2020
University of California, Riverside
Advisor: John C. Baez
Thesis: The Grothendieck Construction in Categorical Network Theory

M.S. Mathematics September 2020
University of California, Riverside

B.S. Pure Mathematics June 2015
University of California, Riverside. *magna cum laude*

PUBLICATIONS AND PREPRINTS

- *Colored Petri nets are monoidal double functors*, with Jade Master.
  Under review.
  Available at arXiv:2510.01946.
- *Categorical Lyapunov theory II: Stability of systems*, with Aaron Ames and Sébastien Mattenet.
  Available at arXiv:2505.22968.
- *Categorical Lyapunov theory I: Stability of flows*, with Aaron Ames and Paulo Tabuada.
  Under review.
  Available at arXiv:2502.15276.
- *Extensions of representation stable categories.*
  Under review.
  Available at http://www.tac.mta.ca/tac/volumes/44/31/44-31abs.html.
- *2-Rig extensions and the splitting principle*, with John C. Baez and Todd Trimble.
  Theory and Applications of Categories, Vol. 44, 2025, No. 31, pp 964-1019.
  Available at arXiv:2410.05598.

- *Schur functors and categorified plethysm*, with John C. Baez and Todd Trimble.
  Higher Structures, Vol. 8, Issue 1, 2024.
  Available at https://higher-structures.math.cas.cz/articles/Vol8Iss1.
- *Compositional thermostatics*, with John C. Baez and Owen Lynch.
  Journal of Mathematical Physics, Vol. 64, Issue 2, 2023.
  Available at doi.org/10.1063/5.0089375.
- *Network models*, with John C. Baez, John Foley, and Blake S. Pollard.
  Theory and Applications of Categories, Vol. 35, No. 20, pp 700–744, 2020.
  Available at http://www.tac.mta.ca/tac/volumes/35/20/35-20abs.html.
- *Noncommutative network models.*
  Mathematical Structures in Computer Science, Vol. 30, Issue 1, 2020, pp. 14-32. doi: https://doi.org/10.1017/S0960129519000161
- *Monoidal Grothendieck construction*, with Christina Vasilakopoulou.
  Theory and Applications of Categories, Vol. 35, 2020, No. 31, pp 1159–1207.
  Available at http://www.tac.mta.ca/tac/volumes/35/31/35-31abs.html.
- *Network models from Petri nets with catalysts*, with John C. Baez and John Foley.
  Compositionality, Vol. 1, Issue 4, 2019. doi: https://doi.org/10.32408/compositionality-1-4

INVITED & CONTRIBUTED TALKS

- *A categorical framework for Lyapunov theory* — 7 July 2025
  American Control Conference 2025
  Denver, CO
- *Lyapunov's theorem for coalgebras* — 17 June 2025
  CALCO 2025
  Glasgow, Scotland
- *A categorical approach to Lyapunov stability* — 6 June 2025
  8th International Conference on Applied Category Theory
  Gainesville, FL
- *Categorical Lyapunov Theory* — 8 Jan 2025
  Joint Mathematics Meeting, Special Session on Applied Category Theory
  Seattle, WA
- *A categorical approach to Lyapunov stability* — 16 Oct 2024
  Caltech, Information, Geometry, and Physics Seminar
- *Syntax and semantics as a strategy for applying category theory* — 15 Mar 2024
  Caltech, Ames–Burdick group meeting
- *The Grothendieck construction for linearly distributive categories.* — 7 Jan 2023
  Joint Mathematics Meeting 2023, Boston
- *How the Grothendieck construction treats categories equipped with extra structure.* — 18 Nov 2022
  University of Louisiana, Lafayette's Topology Seminar
- *Categorified plethysm* — 11-13 March 2022
  AMS Spring Southeastern Sectional Meeting (Cancelled due to COVID)
  Special Session on Homotopy Theory
- *Schur functors and categorified plethysm* — 8 Dec 2021
  Johns Hopkins University
  Category Theory Seminar

- *Schur functors and categorified plethysm* — 3 Dec 2021
  University of Nevada, Reno
  Algebraic & Geometric Topology Seminar
- *The Grothendieck construction and monoidal categories* — 18 Nov 2021
  Open House in Category Theory
- *2-Plethories* — 13 Nov 2021
  Category Theory Virtual Novemberfest
- *Introduction to category theory via combinatorics* — 21 Oct 2021
  Talk Math With Your Friends seminar
- *Abstract Schur functors* — 30 Aug - 4 Sept 2021
  Category Theory 20→21
- *Noncommutative network models* — 16 July 2021
  Applied Category Theory 2021
- *2-Plethories* — 10 June 2021
  Categories and Companions Symposium
- *Network operads from monoidal species* — 23 April 2021
  Applied Topology in Albany seminar
- *Network models* — Fall 2020
  UNAM Category Theory Seminar
- *Monoidal Grothendieck construction* — Spring 2020
  MIT Categories Seminar
- *Monoidal Grothendieck construction* — 12 Mar 2020
  Topics in Category Theory 2020
- *Introduction to operads* — Fall 2019
  UCR Math Graduate Student Seminar
- *Petri nets with catalysts* — 12 June 2019
  Quantum Physics and Logic 2019
- *Monoidal Grothendieck construction* — Spring 2019
  Fourth Symposium on Compositional Structures
- *Categorical network theory* — Fall 2018
  UCSB Quantum Algebra and Topology Seminar
- *Noncommutative network models* — Fall 2018
  First Symposium on Compositional Structures
- *Noncommutative network models* — Spring 2018
  UCR Network Theory Seminar
- *Generalized graph products in network theory* — Spring 2018
  University of California, Riverside
  Graduate Student Seminar
- *Operads for modeling networks* — Fall 2017
  AMS Fall Western Sectional Meeting
  Special Session on Applied Category Theory

- *The Grothendieck construction and symmetric monoidal categories* Spring 2017
  University of California, Riverside
  Graduate Student Seminar

ACADEMIC EVENT ORGANIZATION

Conferences & Workshops

- **Applied Category Theory 2023** 31 July - 4 Aug 2023
  Organizing Chair
  University of Maryland, College Park
- **Compositional Structures in Systems Engineering and Design** 3-4 Nov 2022
  Conference chair
  NIST workshop held at the National Cybersecurity Center of Excellence
- **Special Session on Applied Category Theory** Fall 2019
  Co-organizer
  AMS Fall Western Sectional Meeting
- **Math Connections 2018 at UCR** Spring 2018
  Co-organizer

Seminars

- **ACT@UCR online seminar** Spring 2020
  Co-organizer
- **Exploring Equity in Mathematics Seminar** Winter 2020
  UCR Math department
  Co-organizer
- **UCR Category Theory Seminar** Spring 2017
  Organizer

OTHER ACTIVITIES

- Program Committee member, *Applied Category Theory 2022*, Spring 2022
- Research Project Mentor, *Applied Category Theory Adjoint School* 2022
  Project: Compositional thermodynamics
- Program Committee member, *Applied Category Theory 2021*, Spring 2021
- Participant of the *Applied Category Theory Adjoint School*, 2018
  Project: Unification of the logic of causality
  Project Mentor: Aleks Kissinger
- Graduate Student Researcher, Metron Scientific Solutions Inc., Reston, VA.
  Working on DARPA's Complex Adaptive System Composition and Design Environment (CASCADE) program.
  Summer 2017 - Spring 2019
- Vice President of UCR's Graduate Student Chapter of the American Mathematical Society,
  Includes organizing the Math Gradute Student Seminar
  Fall 2017 - Summer 2018

TEACHING

UMD, Adjunct Professor

Intro to Statistics, Ordinary Differential Equations, Trigonometry

UCR, Secondary Lecture

Precalculus, Calculus for Life Sciences

UCR, Teaching Assistant

Lower division: First Year Calculus, Ordinary Differential Equations, Applied Linear Algebra, Discrete Structures

Upper division: Probability and Statistics, Optimization, Combinatorics, Real Analysis, Complex Analysis, Advanced Linear Algebra, Intro to Sets and Proof

MENTORING

Applied Category Theory Adjoint School

- **Adjoint School 2022, Mentor** Spring & Summer 2022
  I was the mentor for one of four research groups in the 2022 Adjoint School summer research program. I, along with my co-mentor, Spencer Breiner, and our TA, Owen Lynch, guided four graduate students through reading research papers, writing blog posts featured on the n-Category Café blog, and then one week of in-person guided research. Topic: Compositional structures in thermodynamics.

UCR, Undergraduate Research Mentor

- From July 2020 to January 2022, Ethan Kowalenko and I worked with Sadaf Kadir, an undergrad at UCR double majoring in math and physics. Due to her interest in physics, Ethan's interest in algebra, and my interest in category theory, we decided to work on topological quantum field theories. Sadaf has now graduated from UCR and is attending Stanford as a Ph.D. student studying astrophysics. Sadaf is incredibly talented and energetic, and will be successful wherever she goes and whatever she does.
- Spring 2020: Lead four undergraduate students in studying Joyal's species and their utility in combinatorics.
- Spring 2017: Lead four undergraduate students in studying how the shape of entries of large matrices affect rank, with applications in image processing.