

# Ian Tobasco

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CONTACT INFORMATION	Ian Tobasco Rutgers University Department of Mathematics 110 Frelinghuysen Road Piscataway, NJ 08854-8019 USA	<i>e-mail:</i> <a href="mailto:i.tobasco@rutgers.edu">i.tobasco@rutgers.edu</a> <i>web:</i> <a href="http://www.iantobasco.com">www.iantobasco.com</a>
EMPLOYMENT	<b>Rutgers University</b> , New Brunswick, NJ September 2023 –  Associate Professor of Mathematics  <b>University of Illinois Chicago</b> , Chicago, IL August 2019 – August 2023  Assistant Professor of Mathematics  <b>University of Michigan</b> , Ann Arbor, MI September 2016 – July 2019  James Van Loo Postdoctoral Fellow and Assistant Professor of Mathematics	
EDUCATION	<b>Courant Institute of Mathematical Sciences</b> , New York University, New York, NY September 2011 – September 2016  Ph.D. in Mathematics <ul style="list-style-type: none"><li>• Thesis Title: <i>Variational analysis of compressed thin elastic sheets and the phase diagrams of mean field spin glasses</i></li><li>• Advisor: Robert V. Kohn</li></ul> <b>University of Michigan</b> , Ann Arbor, MI September 2007 – April 2011  B.S.E. in Aerospace Engineering, Minor in Mathematics <i>Summa Cum Laude</i>	
AWARDS	<b>Grants</b>  2023–2026 Army Research Office Grant (co-PI: ARO-W911NF2310137) 2022–2027 National Science Foundation CAREER Award (PI: DMS-2145225, DMS-2350161) 2018–2021 National Science Foundation Research Grant (PI: DMS-1812831, DMS-2025000)  <b>Honors and Prizes</b>  2022 University of Illinois Chicago Researcher of the Year Award Rising Star in Natural Sciences and Engineering 2016 Courant Institute Kurt O. Friedrichs Prize “for an outstanding dissertation in mathematics” 2015 Courant Institute Wilhelm T. Magnus Memorial Prize “for significant contributions to the mathematical sciences”	

1. H. Xu, I. Tobasco, and P. Plucinsky, *Derivation of an Effective Plate Theory for Parallelogram Origami from Bar and Hinge Elasticity*, Journal of the Mechanics and Physics of Solids **192** (2024) 105832.
2. Y. Zheng, I. Tobasco, P. Celli, and P. Plucinsky, *Modelling Planar Kirigami Metamaterials as Generalized Elastic Continua*, Proceedings of the Royal Society A **479** (2023) 20220665.
3. B. Song, G. Fantuzzi, and I. Tobasco, *Bounds on Heat Transfer by Incompressible Flows between Balanced Sources and Sinks*, Physica D **444** (2023) 133591.
4. I. Tobasco, Y. Timounay, D. Todorova, G. C. Leggat, J. D. Paulsen, and E. Katifori, *Exact Solutions for the Wrinkle Patterns of Confined Elastic Shells*, Nature Physics **18** (2022) 1099–1104. (On the September 2022 cover of Nature Physics; featured in Quanta Magazine\*, Physics Today†, and New Scientist‡.)
5. Y. Zheng, I. Niloy, P. Celli, I. Tobasco, and P. Plucinsky, *Continuum Field Theory for the Deformations of Planar Kirigami*, Physical Review Letters **128** (2022) 208003.
6. I. Tobasco, *Optimal Cooling of an Internally Heated Disc*, Philosophical Transactions of the Royal Society A **380** (2022) 20210040.
7. I. Tobasco, *Curvature-Driven Wrinkling of Thin Elastic Shells*, Archive for Rational Mechanics and Analysis **239** (2021) 1211–1325.
8. A. Souza, I. Tobasco, and C. R. Doering, *Wall-to-Wall Optimal Transport in Two Dimensions*, Journal of Fluid Mechanics **889** (2020) A34.
9. C. R. Doering and I. Tobasco, *On the Optimal Design of Wall-to-Wall Heat Transport*, Communications on Pure and Applied Mathematics **72** (2019) 2385–2448.
10. A. Jagannath and I. Tobasco, *Bounds on the Complexity of Replica Symmetry Breaking for Spherical Spin Glasses*, Proceedings of the American Mathematical Society **146** (2018) 3127–3142.
11. I. Tobasco, D. Goluskin, and C. R. Doering, *Optimal Bounds and Extremal Trajectories for Time Averages in Nonlinear Dynamical Systems*, Physics Letters A **382** (2018) 382–386.
12. I. Tobasco, *Axial Compression of a Thin Elastic Cylinder: Bounds on the Minimum Energy Scaling Law*, Communications on Pure and Applied Mathematics **71** (2018) 304–355.
13. I. Tobasco and C. R. Doering, *Optimal Wall-to-Wall Transport by Incompressible Flows*, Physical Review Letters **118** (2017) 264502.
14. A. Jagannath and I. Tobasco, *Low Temperature Asymptotics in Spherical Mean Field Spin Glasses*, Communications in Mathematical Physics **352** (2017) 979–1017.
15. S. Conti, H. Olbermann, and I. Tobasco, *Symmetry Breaking in Indented Elastic Cones*, Mathematical Models and Methods in Applied Sciences **27** (2017) 291–321.
16. A. Jagannath and I. Tobasco, *Some Properties of the Phase Diagram for Mixed  $p$ -Spin Glasses*, Probability Theory and Related Fields **167** (2017) 615–672.

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\*<https://www.quantamagazine.org/the-new-math-of-wrinkling-patterns-20220922/>

†<https://physicstoday.scitation.org/doi/full/10.1063/PT.3.5117>

‡<https://www.newscientist.com/article/2335299-researchers-have-worked-out-the-rules-for-how-some-things-wrinkle/>

17. A. Jagannath and I. Tobasco, *A Dynamic Programming Approach to the Parisi Functional*, Proceedings of the American Mathematical Society **144** (2016), 3135–3150.
18. D. Sanjaya, K. Fidkowski, and I. Tobasco, *Adjoint-Accelerated Statistical and Deterministic Inversion of Atmospheric Contaminant Transport*, Computers and Fluids **100** (2014), 291–307.
19. D. Viswanath and I. Tobasco, *Navier-Stokes Solver Using Green's Functions I: Channel Flow and Plane Couette Flow*, Journal of Computational Physics **251** (2013), 414–431.

### Preprint

1. G. Fantuzzi and I. Tobasco, *Sharpness and Non-Sharpness of Occupation Measure Bounds for Integral Variational Problems*. preprint at arXiv:2207.13570

### RESEARCH INTERESTS

Calculus of Variations and Partial Differential Equations with interests in Elasticity Theory (wrinkle patterns, packing and confinement), Mechanical Metamaterials (kirigami, origami), Fluid Dynamics (optimal heat transfer, bounds on turbulent transport), Spin Glasses

### TEACHING

**Rutgers University**, New Brunswick, NJ

*Course Instructor*

- Topics in Analysis — Applied Variational Analysis, Fall 2024
- Functional Analysis II, Spring 2024
- Elementary Differential Equations, Fall 2023

**University of Illinois Chicago**, Chicago, IL

*Course Instructor*

- Classical Methods of Partial Differential Equations, Spring 2023
- Analysis I, Spring 2023
- Advanced Topics in Applied Math — Applied Variational Analysis, Fall 2021
- Multivariable Calculus, Fall 2021
- Advanced Partial Differential Equations, Fall 2020
- Intro. to Advanced Mathematics, Fall 2020
- Intro. to Probability, Fall 2019
- Reading course on Calculus of Variations, Fall/Winter 2019

**University of Michigan**, Ann Arbor, MI

*Course Instructor*

- Graduate Minicourse on Elasticity and Geometry, Summer 2019
- Honors Multivariable Calculus, Fall 2017/2018
- Graduate Minicourse on Calculus of Variations, Summer 2017
- Honors Ordinary Differential Equations, Winter 2017
- Ordinary Differential Equations, Fall 2016

**Departmental Service**

- Rutgers University Mathematics Colloquium co-organizer, Fall 2024 –
- Rutgers University Graduate Admissions Committee, Spring 2024
- University of Illinois Chicago Tenure Track Faculty Search Committee, Fall 2021 – Winter 2022
- University of Illinois Chicago Analysis and Applied Math Seminar co-organizer, Fall 2019 – Winter 2023
- University of Illinois Chicago Dept. of Mathematics, Statistics, and Computer Science Colloquium co-organizer, Fall 2019 – Winter 2021

**University Service**

- University of Illinois Chicago Honors College Faculty Fellow, Fall 2020 – Winter 2023

**Service to the Profession***Editor*

- Communicating Editor of the Journal of Nonlinear Science, March 2023 –

*Reviewer*

- National Science Foundation Division of Mathematical Sciences Panelist
- Journal Referee (Analysis & PDE, Archive for Rational Mechanics and Analysis, Communications in Mathematical Physics, Communications on Pure and Applied Mathematics, ESAIM: Control, Optimisation and Calculus of Variations, Interfaces and Free Boundaries, Journal of Elasticity, Journal of Fluid Mechanics, Journal of the Mechanics and Physics of Solids, Journal of Nonlinear Science, Nonlinear Analysis, Physics Letters A, Physical Review E, Pure and Applied Functional Analysis, SIAM Journal on Applied Dynamical Systems, SIAM Journal on Mathematical Analysis)

*Conference mini-symposia, workshop, and summer school co-organizer*

- 2026 Boulder School for Condensed Matter and Materials Physics on “Geometry and Topology of Soft Matter”
- International Conference on Free Boundary Problems: Theory and Applications 2024 Thematic Session on “Free Boundaries in Materials Science”
- Society for Industrial and Applied Mathematics 2024 Mathematical Aspects of Materials Science Meeting Mini-symposium on “Mechanical metamaterials: recent advances in modeling, computation, and experiment”
- American Institute of Mathematics 2022 SQuaRE Workshop on “Studying PDE dynamics via optimization with integral inequality constraints”
- Banff International Research Station 2022 Focussed Research Group on “Studying PDE Dynamics via Optimization with Integral Inequality Constraints”
- Banff International Research Station University of British Columbia–Okanagan 2022 Workshop on “Equilibrium and Non-Equilibrium Pattern Formation in Soft Matter: From Elastic Solids to Complex Fluids”
- Society for Industrial and Applied Mathematics 2021 Mathematical Aspects of Materials Science Meeting Mini-symposium on “Soft materials: patterns, instabilities, and controlled deformations”\*

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\*online

- American Institute of Mathematics 2021 SQuaRE Workshop on “Studying PDE dynamics via optimization with integral inequality constraints”<sup>†</sup>
- Banff International Research Station 2020 Focussed Research Group on “Studying PDE Dynamics via Optimization with Integral Inequality Constraints”<sup>†</sup>
- Society for Industrial and Applied Mathematics 2020 Mathematical Aspects of Materials Science Meeting Mini-symposium on “Soft materials: patterns, instabilities, and controlled deformations”<sup>†</sup>
- American Mathematical Society 2018 Fall Central Sectional Meeting Special Session on “Analytical and Numerical Aspects of Turbulent Transport”
- Society for Industrial and Applied Mathematics 2018 Annual Meeting Mini-symposium on “Transport, Mixing, and Optimality in Fluids”

INVITED SEMINARS  
AND COLLOQUIA

- Mathematics Colloquium & Graduate Student Colloquium, Louisiana State University, Baton Rouge, LA (Oct. 2024)
- Joint Math & Michigan Center for Applied and Interdisciplinary Mathematics Colloquium, University of Michigan, Ann Arbor, MI (Sept. 2024)
- Mathematics Colloquium, University of Arizona, Tucson, AZ (Apr. 2024)
- Mathematics Colloquium, Michigan State University, East Lansing, MI (Mar. 2024)
- Mechanics and Computation Seminar, Stanford University, Stanford, CA (Feb. 2024)
- Math Colloquium, New Jersey Institute of Technology, Newark, NJ (Dec. 2023)
- Mechanical Engineering and Materials Science Seminar, Yale University, New Haven, CT (Nov. 2023)
- Math Colloquium, Temple University, Philadelphia, PA (Oct. 2023)
- Math Colloquium, Courant Institute, New York City, NY (Feb. 2023)
- Math Colloquium, Rutgers University, New Brunswick, NJ (Jan. 2023)\*
- PDE–Applied Math Seminar, University of Maryland, College Park, MD (Dec. 2022)
- Applied and Computational Mathematics Seminar, University of Wisconsin–Madison, Madison, WI (Dec. 2022)
- Geometry and Packing in Materials Science and Biology Webinar (GEOMPACK) (Nov. 2022)\*
- Applied Mathematics and Statistics Postdoc Seminar, Johns Hopkins University, Baltimore, MD (Feb. 2022)\*
- Mathematics and Statistics Colloquium, Loyola University, Chicago, IL (Dec. 2021)
- Applied Mathematics Seminar, Technische Universität Dresden, Dresden, Germany (Nov. 2021)\*
- Aerospace Engineering Chair’s Distinguished Lecture, University of Michigan, Ann Arbor, MI (Nov. 2021)
- Nonlinear Analysis Seminar, Rutgers University, Piscataway, NJ (May 2021)\*
- Applied Analysis Seminar, Heidelberg University, Heidelberg, Germany (Apr. 2021)\*

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<sup>†</sup>cancelled due to COVID-19

\*online

- Engineering Mathematics Seminar, University of Bristol, Bristol, England (Apr. 2021)\*
- Math Colloquium, University of Wisconsin–Madison, Madison, WI (Mar. 2021)\*
- Soft Matter Series Seminar, Nordic Institute for Theoretical Physics, Stockholm, Sweden (Mar. 2021)\*
- Aerospace and Mechanical Engineering Seminar, University of Southern California, Los Angeles, CA (Feb. 2021)\*
- Applied Math Colloquium, Northwestern University, Evanston, IL (Feb. 2021)\*
- Applied Math Seminar, University of Washington, Seattle, WA (Jan. 2021)\*
- Computational, Applied Mathematics and PDE Seminar, University of Chicago, Chicago, IL (Nov. 2020)\*
- Analysis, Dynamics and Applications Seminar, University of Arizona, Tucson, AZ (Oct. 2020)\*
- Complex Systems Seminar, University of Michigan, Ann Arbor, MI (Feb. 2020)
- PDE & Differential Geometry Seminar, University of Connecticut, Storrs, CT (Feb. 2020)
- Joint Math/Physics Colloquium, Syracuse University, Syracuse, NY (Feb. 2019)
- Applied Math Colloquium, Massachusetts Institute of Technology, Boston, MA (Feb. 2019)
- Math & Stat Colloquium, Queen’s University, Kingston, Canada (Feb. 2019)
- Math Colloquium, University of Toronto, Toronto, Canada (Jan. 2019)
- Math Colloquium & Applied Math Seminar, University of Utah, Salt Lake City, UT (Jan. 2019)
- Applied Math Seminar, University of Waterloo, Waterloo, Canada (Jan. 2019)
- Math Colloquium, University of California Los Angeles, Los Angeles, CA (Jan. 2019)
- Frontiers in Computing + Mathematical Sciences, California Institute of Technology, Pasadena, CA (Jan. 2019)
- Applied and Interdisciplinary Mathematics Seminar, University of Michigan, Ann Arbor, MI (Dec. 2018)
- MSCS Colloquium, University of Illinois Chicago, Chicago, IL (Nov. 2018)
- Applied Math Seminar, University of Utah, Salt Lake City, UT (Oct. 2018)
- Analysis Seminar, Courant Institute, New York City, NY (Oct. 2018)
- Analysis of Fluids Seminar, Princeton University, Princeton, NJ (Oct. 2017)
- Applied and Interdisciplinary Mathematics Seminar, University of Michigan, Ann Arbor, MI (Sept. 2017)
- Analysis and Applied Math Seminar, University of Toronto, Toronto, Canada (Apr. 2017)
- Applied Math Seminar, Courant Institute, New York City, NY (Mar. 2017)
- PDE and Analysis Seminar, University of Pittsburgh, Pittsburgh, PA (Jan. 2017)
- Differential Equations Seminar, University of Michigan, Ann Arbor, MI (Dec. 2016)

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\*online

- Analysis/Probability Seminar, University of Michigan, Ann Arbor, MI (Oct. 2016)
- Applied Math Colloquium & Level Set Collective Group Meeting, University of California Los Angeles, Los Angeles, CA (Jan. 2016)
- Applied and Interdisciplinary Mathematics Seminar, University of Michigan, Ann Arbor, MI (Dec. 2015)
- PDE–Applied Math Seminar, University of Maryland, College Park, MD (Nov. 2015)
- Oberseminar Analysis, Universität Bonn Institute for Applied Mathematics, Bonn, Germany (May 2015)
- Materials Working Group, Courant Institute, New York City, NY (Apr. 2015)
- Materials Working Group, Courant Institute, New York City, NY (Oct. 2014)

INVITED TALKS AT  
MEETINGS

- International Conference on Free Boundary Problems: Theory and Applications, João Pessoa City, Brazil (Aug. 2024)
- Oberwolfach Workshop on Polynomial Optimization for Nonlinear Dynamics: Theory, Algorithms, and Applications, Oberwolfach, Germany (Jul. 2024)
- Society for Industrial and Applied Mathematics Conference on Mathematical Aspects of Materials Science, Pittsburgh, PA (May 2024)
- Society of Engineering Science Annual Technical Meeting, Minneapolis, MN (Oct. 2023)
- International Congress on Industrial and Applied Mathematics, Tokyo, Japan (Aug. 2023)
- Keynote Speaker at Workshop on Nonlinear PDEs: From Continuum Mechanics to Data Science, Hausdorff Center for Mathematics, Bonn, Germany (Jul. 2023)
- Keynote Speaker at Hausdorff Summer School on Analysis of PDEs: Variational and Geometric Perspectives, Hausdorff Center for Mathematics, Bonn, Germany (Jul. 2023)
- American Society of Civil Engineers Engineering Mechanics Institute Conference, Georgia Institute of Technology, Atlanta, GA (Jun. 2023)
- Banff International Research Station Workshop on Compensated Compactness and Applications to Materials, Banff, Canada (Apr. 2023)
- Applied Analysis: From the Calculus of Variations to Materials Science, Finance and Data Science – A Celebration of the Science of Bob Kohn, Flatiron Institute, New York City, NY (Nov. 2022)
- Charlie Doering Memorial Symposium, University of Michigan, Ann Arbor, MI (May 2022)
- Society for Industrial and Applied Mathematics Conference on Mathematical Aspects of Materials Science (May 2021)\*
- American Physical Society March Meeting (Mar. 2021)\*
- Institute for Pure and Applied Mathematics Workshop on Transport and Mixing in Complex and Turbulent Flows, University of California Los Angeles, Los Angeles, CA (Jan. 2021)\*
- Plenary Talk at Chicago Area Society for Industrial and Applied Mathematics Student Conference, Northwestern University, Evanston, IL (Nov. 2020)\*

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\*online

- Plenary Talk at UIC Chicago Undergraduate Mathematics Symposium, University of Illinois Chicago, Chicago, IL (Nov. 2020)\*
- Society for Industrial and Applied Mathematics/Canadian Applied and Industrial Mathematics Society Annual Meeting, Toronto, Canada (Jul. 2020)\*
- Society for Industrial and Applied Mathematics Conference on Mathematical Aspects of Materials Science, Bilbao, Spain (May 2020)<sup>†</sup>
- American Mathematical Society Spring Central Sectional Meeting, Purdue University, West Lafayette, IN (Apr. 2020)<sup>†</sup>
- Aspen Center for Physics Workshop on Low-dimensional Solids, Aspen, CO (Feb. 2020)
- Society for Industrial and Applied Mathematics Conference on Analysis of PDE, La Quinta, CA (Dec. 2019)
- Workshop RAM3 – Recent Advances in Mechanics and Mathematics of Materials, Sapienza University of Rome, Rome, Italy (Nov. 2019)
- Society of Engineering Science Annual Technical Meeting, St. Louis, MO (Oct. 2019)
- International Congress on Industrial and Applied Mathematics, Valencia, Spain (Jul. 2019)
- Great Lakes Section Society for Industrial and Applied Mathematics Spring Meeting, University of Michigan (Apr. 2019)
- Materials Research Society Spring Meeting, Phoenix, AZ (Apr. 2019)
- Fields Institute Workshop on Scientific Computing Across Scales, Toronto, Canada (Apr. 2019)
- 83rd Midwest PDE Seminar, Indiana University, Bloomington, IN (Mar. 2019)
- American Physical Society March Meeting, Boston, MA (Mar. 2019)
- Oberwolfach Workshop on Calculus of Variations, Oberwolfach, Germany (Jul. 2018)
- Society for Industrial and Applied Mathematics Conference on Mathematical Aspects of Materials Science & Annual Meetings, Portland, OR (Jul. 2018)
- Woods Hole Oceanographic Institution Geophysical Fluid Dynamics Program, Woods Hole, MA (Jul. 2018)
- Banff International Research Station Workshop on Topics in the Calculus of Variations, Banff, Canada (May 2018)
- American Physical Society Division of Fluid Dynamics Annual Meeting, Denver, CO (Nov. 2017)
- Great Lakes Section Society for Industrial and Applied Mathematics Spring Meeting, Oakland University, Oakland County, MI (Apr. 2017)
- American Physical Society Division of Fluid Dynamics Annual Meeting, Portland, OR (Nov. 2016)
- Society for Industrial and Applied Mathematics Conference on Mathematical Aspects of Materials Science, Philadelphia, PA (May 2016)
- Society for Industrial and Applied Mathematics Conference on Analysis of PDE, Scottsdale, AZ (Dec. 2015)

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\*online

<sup>†</sup>cancelled due to COVID-19



- KI-Net Young Researchers Workshop, University of Maryland, College Park, MD (Nov. 2015)
- KI-Net Young Researchers Workshop, University of Maryland, College Park, MD (Oct. 2014)

#### POSTER SESSIONS

- Center for Nonlinear Analysis Workshop on Math Models for Pattern Formation, Carnegie Mellon University, Pittsburgh, PA (Mar. 2019)
- Nonconvexity, Nonlocality and Incompatibility — L. Truskinovky’s 60th Birthday, University of Pittsburgh, Pittsburgh, PA (May 2017)
- 6th Midwest Workshop on Control and Game Theory, University of Michigan, Ann Arbor, MI (Apr. 2017)
- New York University–Oxford Workshop on Mathematical Models of Defects and Patterns, Courant Institute, New York City, NY (Jan. 2016)
- Institute for Mathematics and its Applications Special Workshop on Mathematics and Mechanics, Eugene, OR (Oct. 2015)
- National Science Foundation PIRE Workshop on Grain Boundaries and Stochastic Homogenization, University of Leipzig, Leipzig, Germany (Jul. 2015)

#### COMMUNITY OUTREACH

- Guest Speaker at University of Illinois Chicago Young Scholars Program (Jul. 2021)
- University of Michigan Saturday Morning Physics Lecture (Nov. 2018)
- New York University Courant Splash Academics Coordinator (2012–2013) and Senior Advisor (2014)

#### STUDENTS

##### **PhD Students**

###### *Current*

Samuel Wallace

Zhimeng Wang

###### *Past*

Binglin Song (U. Michigan, co-advised with Selim Esedoglu), Thesis Title: *Balanced Heat Transport and Optimal Cooling*, 2023

##### **Undergraduate Research Mentees**

Shreya Sinha, Summer 2024 (Rutgers U. Research Experience for Undergraduates); Thomas Nguyen, Summer 2020 (U. of Illinois Chicago); Stephen Jasina, Summer 2019 (U. Michigan Research Experience for Undergraduates); Anamaria Cuza, Yuqing Liu, Osama Saeed, Winter 2019 (U. Michigan Lab of Geometry); Charles Devlin and Jaeyoon Kim, Summer 2018 (U. Michigan Research Experience for Undergraduates)

##### **University of Illinois Chicago Honors College Mentees**

Mariana Villarreal, Fall 2021 – Winter 2022; Angela Timochina, Fall 2020; Jagjit Bhatia, Fall 2020