Curriculum Vitæ of Jean-Luc Thiffeault (2026-05-26)

Contact Information

Jean-Luc Thiffeault

Department of Mathematics
Van Vleck Hall, Room 503
480 Lincoln Dr.
University of Wisconsin
Madison, WI 53706
USA
Tel.: 1-608-263-4089
Fax: 1-608-263-8891

e-mail: jeanluc@math.wisc.edu
www: https://www.math.wisc.edu/~thiffeault (Reprints available)

Education

September 1995–December 1998
Ph.D. in Physics
University of Texas at Austin

September 1993–August 1995
M.A. in Physics
University of Texas at Austin

September 1990–May 1993
B.S. in Physics
McGill University, Montréal, Canada

Post-PhD Positions Held

September 2013–present
Professor of Mathematics, University of Wisconsin – Madison

June 2023–May 2026
Chair, Department of Mathematics, University of Wisconsin – Madison

September 2010–August 2013
Associate Professor of Mathematics, University of Wisconsin – Madison

August 2007–August 2010
Assistant Professor of Mathematics, University of Wisconsin – Madison

October 2007–December 2007
Reader in Applied Mathematics, Imperial College London, Department of Mathematics (on leave)

January 2003–October 2007
Lecturer in Applied Mathematics, Imperial College London, Department of Mathematics (on leave after August 2007)

July 2001–December 2002
Associate Research Scientist, Columbia University,
Department of Applied Physics and Applied Mathematics

June 1999–June 2001
Postdoctoral Research Fellow, Columbia University,
Department of Applied Physics and Applied Mathematics

January 1999–May 1999
Postdoctoral Research Fellow, University of Texas at Austin, Department of Physics

Visiting Positions

July 2019
CNRS Visiting Professor, Université Aix–Marseille, France

January 2015–May 2015
Visiting Fellow, Trinity College, Cambridge, UK.

September 2009–June 2010
Long-term Visitor, Institute for Mathematics and its Applications, Minneapolis, MN.

June 2009–July 2009
CNRS Visiting Professor, Université de Toulon-Var, France

February 2007–May 2007
CNRS Visiting Professor, Centre de Physique Théorique, Université de Marseille, France

2007–present
June 2005–August 2005
July 2004
June 2003–August 2003
June 2002–August 2002
June 2000–August 2000
June 1999–August 1999
Guest Investigator, Woods Hole Oceanogaphic Institution

Honors and Awards

Fellow of the Society for Industrial and Applied Mathematics	2026
Fellow of the American Physical Society	2022
Plenary speaker, APS–DFD Meeting	2020
Lecturer, Fluids & Health Conference, Cargèse, Corsica	2019
Hassan Aref Memorial Lecturer, VirginiaTech	2016
Lecturer, Complex and Dynamical Systems Summer Program, ICTS–Bangalore	2016
Van Vleck Professorship	2015–2019
AMS Invited Address, SIAM Annual Meeting	2014
Plenary speaker, AMS Central Section Meeting	2014
Plenary speaker, SIAM Dynamical Systems Meeting	2013
SIAM Outstanding Paper Prize	2012
Principal Lecturer, Woods Hole GFD Summer Program	2010
Honored Instructor (awarded by students)	2010
Faculty of the GFD Summer Program at the Woods Hole Oceanographic Institution	2002–present
FCAR Postgraduate Scholarship	1997–98
WHOI Geophysical Fluid Dynamics Fellowship	1996
NSERC Postgraduate Scholarship	1993–97
NSERC Summer Research Scholarship	1993
Horace Watson Medal and Prize in Physics	1993
J. W. McConnell Award	1992
Anne Molson Scholarship	1992
NSERC Summer Research Scholarship	1992
Hewlett-Packard Prize in Science	1991
E. P. Aikman Prize in Physics	1991
E. R. Crawford Scholarship	1991

Publications

Published in Refereed Journals

77. Oakley, B. W., Bonner, G., and J.-L.T. (2023) "Optimal spatially-dependent diffusion tensors," *Nonlinearity*, **36**, 6777–6797.

76. Ventrella, F. M., Pujara, N., Boffetta, G., Cencini, M., J.-L.T., and De Lillo, F. (2023) "Microswimmer trapping in surface waves with shear," *Proceedings of the Royal Society A*, **479**, 20230280 (16 pages).

75. Pujara, N., and J.-L.T. (2023) "Wave-averaged motion of small particles in surface gravity waves: effect of particle shape on orientation, drift, and dispersion," *Physical Review Fluids*, **8**, 074801 (16 pages).

74. Bonner, G., J.-L.T., and Valkó, B. (2022) "On a random entanglement problem," *IMA Journal of Applied Mathematics*, **87**, 1090–1120.

73. J.-L.T. and Guo, J. and (2022) "Anisotropic active Brownian particle with a fluctuating propulsion force," *Physical Review E*, **106**, L012603 (6 pages).

72. J.-L.T. (2022) "The mathematics of burger flipping," *Physica D*, **439**, 133410 (12 pages).

71. Di Labbio, G., J.-L.T., and Kadem, L. (2022) "Braids in the heart: Global measures of mixing for cardiovascular flows," *Flow*, **2**, E12 (21 pages).

70. Klünker, A., Padberg-Gehle, K., and J.-L.T. (2022) "Open-flow mixing and transfer operators," *Philosophical Transactions of the Royal Society A*, **380**, 202110028 (22 pages)

69. J.-L.T. (2022) "Moving forward by shaking sideways," *Symmetry* **14**(3), 620 (8 pages).

68. Ma, K. Pujara, N., and J.-L.T. (2022) "Reaching for the surface: Spheroidal microswimmers in surface gravity waves," *Physical Review Fluids* **7**, 014310 (13 pages).

67. J.-L.T. (2021) "Nonuniform mixing," *Physical Review Fluids* **6**, 090501 (20 pages). **Invited perspective article**

66. Chen, H., and J.-L.T. (2021) "Shape matters: A Brownian microswimmer in a channel," *Journal of Fluid Mechanics* **916**, A15–37.

65. Oakley, B. W., J.-L.T., and Doering, C. R. (2021) "On mix-norms and the rate of decay of correlations," *Nonlinearity* **34**, 3762–3782.

64. Feng, Y., Feng, Y., Iyer, G., and J.-L.T. (2020) "Phase separation in the advective Cahn–Hilliard equation," *Journal of Nonlinear Science* **30** (6), 2821–2845.

63. Filippi, M., Budišić, M., Allshouse, M. R., Atis, S., J.-L.T., and Peacock, T. (2020) "Using braids to quantify interface growth and coherence in a rotor-oscillator flow," *Physical Review Fluids* **5**, 054504 (26 pages).

62. Wen, W., and J.-L.T. (2019) "Winding of a Brownian particle around a point vortex," *Philosophical Transactions of the Royal Society A* **377**, 20180347 (16 pages).

61. Morrell, T., Spagnolie, S., and J.-L.T. (2019) "Velocity fluctuations in a dilute suspension of viscous vortex rings," *Physical Review Fluids*, **4** (4), 044501 (19 pages).

60. Chaudhary, G., Ewoldt, R. H., and J.-L.T. (2019) "Unraveling hagfish slime," *Journal of the Royal Society Interface* **16**, 20180710 (11+5 pages).

59. Sturman, R., and J.-L.T. (2019) "Lyapunov exponents for the random product of two shears," *Journal of Nonlinear Science* **29** (2), 593–620.

58. J.-L.T. (2018) "The mathematics of taffy pullers," *Mathematical Intelligencer* **40**, 26–35.

57. Marcotte, F., Doering, C. R., Young, W. R., and J.-L.T., (2018) "Optimal heat transfer and optimal exit times," *SIAM Journal on Applied Mathematics* **78**, 591–608.

56. Aref, H., *et al.* (2017) "Frontiers of chaotic advection," *Reviews of Modern Physics* **89**, 025007.

55. Mueller, P., and J.-L.T. (2017) "Fluid transport and mixing by an unsteady microswimmer," *Physical Review Fluids* **2**, 013103 (22 pages).

54. Spagnolie, S. E., Wahl, C., Lukasik, J., and J.-L.T. (2017) "Microorganism billiards," *Physica D* **341**, 33–44.

53. Sondak, D., Hawley, C., Heng, S., Vinsonhaler, R., Lauga, E., and J.-L.T. (2016) "Can phoretic particles swim in two dimensions?" *Physical Review E* **94**, 062606 (9 pages).

52. Budišić, M., and J.-L.T. (2015) "Finite-time braiding exponents," *Chaos* **25**, 087407 (12 pages).

51. J.-L.T. (2015) "Distribution of particle displacements due to swimming microorganisms," *Physical Review E* **92**, 023023 (13 pages).

50. Tumasz, S. E., and J.-L.T. (2013) "Estimating topological entropy from the motion of stirring rods," *Procedia IUTAM* **7**, 117–126.

49. Tumasz, S. E., and J.-L.T. (2013) "Topological entropy and secondary folding," *Journal of Nonlinear Science* **23**, 511–524.

48. Puckett, J. G., Lechenault, F., Daniels, K. E., and J.-L.T. (2012) "Trajectory entanglement in dense granular materials," *Journal of Statistical Mechanics: Theory and Experiment*, **2012**, P06008 (13 pages).

47. J.-L.T. (2012) "Using Multiscale Norms to Quantify Mixing and Transport," *Nonlinearity* **25**, R1–R44. **Invited review article**

46. Allshouse, M. R., and J.-L.T. (2012) "Detecting Coherent Structures Using Braids," *Physica D* **241**, 95–105.

45. Finn, M. D., and J.-L.T. (2011) "Topological Optimization of Rod-stirring Devices," *SIAM Review* **53**, 723–743. **Cover image. 2012 SIAM Outstanding Paper Prize.**

44. Thomases, B., Shelley, M., and J.-L.T. (2011) "A Stokesian Viscoelastic Flow: Transition to Oscillations and Mixing," *Physica D* **240**, 1602–1614.

43. J.-L.T., Gouillart, E., and Dauchot, O. (2011) "Moving Walls Accelerate Mixing," *Physical Review E* **84**, 036313 (8 pages).

42. Lanneau, E., and J.-L.T. (2011) "On the Minimum Dilatation of Braids on the Punctured Disc," *Geometriae Dedicata* **152**, 165–182.

41. Lin, Z., J.-L.T., and Doering, C. R. (2011) "Optimal Stirring Strategies for Passive Scalar Mixing," *Journal of Fluid Mechanics* **675**, 465–476.

40. Lanneau, E., and J.-L.T. (2011) "On the Minimum Dilatation of pseudo-Anosov Homeomorphisms on Surfaces of Small Genus," *Annales de l'Institut Fourier* **61**, 105–144.

39. Lin, Z., J.-L.T., and Childress, S. (2011) "Stirring by Squirmers," *Journal of Fluid Mechanics* **669**, 166–177.

38. Gouillart, E., Dauchot, O., J.-L.T. (2011) "Measures of Mixing Quality in Open Flows with Chaotic Advection," *Physics of Fluids* **23**, 013604 (11 pages).

37. J.-L.T., and Doering, C. R. (2011) "The Mixing Efficiency of Open Flows," *Physica D* **240**, 180–186.

36. J.-L.T., and Childress, S. (2010) "Stirring by Swimming Bodies," *Physics Letters A* **374**, 3487–3490 (4 pages). **Covered by** *Physics World* **as a News item (**`https://physicsworld.com/a/fish-swishing-mixes-the-oceans/`**)**

35. Ó Náraigh, L., and J.-L.T. (2010) "Nonlinear Dynamics of Phase Separation in Thin Films," *Nonlinearity* **23**, 1559 (25 pages).

34. Gouillart, E., J.-L.T., and Dauchot, O. (2010) "Rotation Shields Chaotic Mixing Regions from No-slip Walls," *Physical Review Letters* **104**, 204502 (4 pages).

33. J.-L.T. (2010) "Braids of Entangled Particle Trajectories," *Chaos* **20**, 017516 (14 pages).
Featured as a Research Highlight in *Chaos***; Most downloaded article from February to June 2010.**

32. Gouillart, E., Dauchot, O., J.-L.T., and Roux, S. (2009) "Open-flow Mixing: Experimental Evidence for Strange Eigenmodes," *Physics of Fluids* **21**, 023603 (11 pages).

31. Ó Náraigh, L., and J.-L.T. (2008) "Bounds on the Mixing Enhancement for a Stirred Binary Fluid," *Physica D* **237**, 2673–2684.

30. Gouillart, E., Dauchot, O., Dubrulle, B., Roux, S., and J.-L.T. (2008) "Slow Decay of Concentration Variance Due to No-slip Walls in Chaotic Mixing," *Physical Review E* **78**, 026211 (17 pages).

29. J.-L.T., Finn, M. D. , Gouillart, E., and Hall, T. (2008) "Topology of Chaotic Mixing Patterns," *Chaos* **18**, 033123 (8 pages).

28. Okabe, T., Eckhardt, B., J.-L.T., and Doering, C. R. (2008) "Mixing Effectiveness Depends on the Source-sink Structure: Simulation Results," *Journal of Statistical Mechanics: Theory and Experiment* **2008**, P07018 (13 pages).

27. J.-L.T., and Pavliotis, G. A. (2008) "Optimizing the Source Distribution in Fluid Mixing," *Physica D* **237**, 918–929.

26. Ó Náraigh, L., and J.-L.T. (2007) "Dynamical Effects and Phase Separation in Cooled Binary Fluid Films," *Physical Review E* **76**, 035303 (4 pages).

25. Gouillart, E., Kuncio, N., Dauchot, O., Dubrulle, B., Roux, S., and J.-L.T. (2007) "Walls Inhibit Chaotic Mixing," *Physical Review Letters* **99**, 114501 (4 pages). **Covered by** *Physics World* **as a News item (**`https://physicsworld.com/a/sticky-walls-slow-mixing/`**)**

24. Shaw, T. A., J.-L.T., and Doering, C. R. (2007) "Stirring up Trouble: Multi-scale Mixing Measures for Steady Scalar Sources," *Physica D* **231**, 143–164.

23. Finn, M. D., and J.-L.T. (2007) "Topological Entropy of Braids on the Torus," *SIAM Journal on Applied Dynamical Systems* **6**, 79–98.

22. Ó Náraigh, L., and J.-L.T. (2007) "Bubbles and Filaments: Stirring a Cahn–Hilliard Fluid," *Physical Review E* **75**, 016216 (11 pages).

21. J.-L.T., and Finn, M. D. (2006) "Topology, Braids, and Mixing in Fluids," *Philosophical Transactions of the Royal Society A* **364**, 3251–3266.

20. Roy, A., Mahadevan, L., and J.-L.T. (2006) "Fall and Rise of a Viscoelastic Fluid Filament," *Journal of Fluid Mechanics* **563**, 283–292.

19. Finn, M. D., J.-L.T., and Gouillart, E. (2006) "Topological Chaos in Spatially Periodic Mixers," *Physica D* **221**, 92–100.

18. Doering, C. R., and J.-L.T. (2006) "Multiscale Mixing Efficiencies for Steady Sources," *Physical Review E* **74**, 025301 (4 pages).

17. Gouillart, E., J.-L.T., and Finn, M. D. (2006) "Topological Mixing with Ghost Rods," *Physical Review E* **73**, 036311 (8 pages).

16. J.-L.T. (2005) "Measuring Topological Chaos," *Physical Review Letters* **94**, 084502 (4 pages).

15. J.-L.T., Doering, C. R., and Gibbon, J. D. (2004) "A Bound on Mixing Efficiency for the Advection–Diffusion Equation," *Journal of Fluid Mechanics* **521**, 105–114.

14. J.-L.T. (2004) "Stretching and Curvature along Material Lines in Chaotic Flows," *Physica D* **198**, 169–181.

13. J.-L.T. (2004) "The Strange Eigenmode in Lagrangian Coordinates," *Chaos* **14**, 531–538.

12. Spiegel, E. A., and J.-L.T. (2003) "Fluid Equations for Rarefied Gases," *Physics of Fluids* **15**, 3558–3567.

11. J.-L.T., and Childress, S. (2003) "Chaotic Mixing in a Torus Map," *Chaos* **13**, 502–507.

10. J.-L.T. (2003) "Advection–Diffusion in Lagrangian Coordinates," *Physics Letters A* **309**, 415–422.

9. J.-L.T. (2003) "Finite Extension of Polymers in Turbulent Flow," *Physics Letters A* **308**, 445–450.

8. J.-L.T., and Boozer, A. H. (2003) "The Onset of Dissipation in the Kinematic Dynamo," *Physics of Plasmas* **10**, 259–265.

7. J.-L.T. (2002) "Derivatives and Constraints in Chaotic Flows: Asymptotic Behaviour and a Numerical Method," *Physica D* **172**, 139–161.

6. J.-L.T. (2001) "Covariant Time Derivatives for Dynamical Systems," *Journal of Physics A* **34**, 5875–5885.

5. J.-L.T., and Morrison, P. J. (2001) "The Twisted Top," *Physics Letters A* **283**, 335–341.

4. J.-L.T., and Boozer, A. H. (2001) "Geometrical Constraints on Finite-time Lyapunov Exponents in Two and Three Dimensions," *Chaos* **11**, 16–28.

3. Smith, J. P., J.-L.T., and Horton, W. (2000) "Dynamical Range of the WINDMI Model: An Exploration of Possible Magnetospheric Plasma States," *Journal of Geophysical Research—Space Physics* **105**(A6), 12983–12996.

2. J.-L.T., and Morrison, P. J. (2000) "Classification and Casimir Invariants of Lie–Poisson Brackets," *Physica D* **136**, 205–244.

1. J.-L.T., and Horton, W. (1996) "Energy-conserving Truncations for Convection with Shear Flow," *Physics of Fluids* **8**, 1715–1719.

Papers in Refereed Conference Proceedings

C4. J.-L.T., and Kamhawi, K. (2008) "Chaotic Geodesics," Proceedings of the Conference on *Chaos, Complexity, and Transport*, Le Pharo, Marseille, June 2007.

C3. J.-L.T. (2008) "Scalar Decay in Chaotic Mixing," in *Transport and Mixing in Geophysical Flows*, Proceedings of the Gran Combin Summer School, Valle d'Aosta, Italy, 14–24 June 2004. *Lecture Notes in Physics* **744**, 3–35 (Springer-Verlag, Berlin).

C2. Hong, S., J.-L.T., Fréchette, L., Modi, V. (2003) "Numerical Study of Mixing in Microchannels with Patterned Zeta Potential Surfaces," Paper presented at IMECE 2003, ASME International Mechanical Engineering Congress & Exposition, Washington, D.C., November 16–21.

C1. J.-L.T., and Morrison, P. J. (1998) "Invariants and Labels in Lie–Poisson Systems," Proceedings of the 13th Florida Workshop in Astronomy and Physics. *Annals of the New York Academy of Sciences* **867**, 109–119.

Selected News Articles, Unrefereed Proceedings, Contributed Papers, and Technical Reports

O9. J.-L.T. (2023) "Ineffective diffusivity," Journal of Fluid Mechanics **972**, F1, October.

O8. J.-L.T. (2014) "The complexity of entanglements," SIAM News, December.

O7. J.-L.T., and Budišić, M. (2014) "Braidlab: A Software Package for Braids and Loops," `http://arxiv.org/abs/1410.0849`

O6. Obuse, K., and J.-L.T. (2012) "A low-Reynolds-number treadmilling swimmer near a semi-infinite wall," *IMA Volume on Natural Locomotion in Fluids and on Surfaces: Swimming, Flying, and Sliding*, edited by Stephen Childress, Anette (Peko) Hosoi, William W. Schultz, and Z. Jane Wang.

O5. J.-L.T. (2010) "Chaos in the Gulf," *Science* **330**, 458–459, October 2010. **Invited Perspective Article on the Gulf Oil Spill.**

O4. J.-L.T., Lanneau, E., and Matz, S. (2009) "The Cat's Cradle, Stirring, and Topological Complexity," *Dynamical Systems Magazine*, April 2009.

O3. J.-L.T., Gouillart, E., and Finn, M. D. (2005) "The Size of Ghost Rods," in *Workshop on Analysis and Control of Mixing with Applications to Micro and Macro Flow Processes,* Udine, Italy, 1 July 2005. (Springer Verlag).

O2. Spiegel, E. A., and J.-L.T. (2003) "Continuum Equations for Stellar Dynamics," in *Stellar Astrophysical Fluid Dynamics: Proceedings of the Chateau de Mons meeting* (Cambridge University Press, U.K.).

O1. J.-L.T. (1997) "Long-wave Instability in Double-diffusive Marangoni Convection," Woods Hole Oceanographic Institution Technical Report, WHOI-97-10, 269–286.

Books

Braids and Dynamics, Springer (2022).

Theses

December 1998

Ph.D. Dissertation
"Classification, Casimir Invariants, and Stability of Lie–Poisson Systems."
Institute for Fusion Studies Report No. 847, 1–150.

August 1995

Master's Thesis
"Modeling Shear Flow in Rayleigh–Bénard Convection."
Institute for Fusion Studies Report No. 715, 1–62.

Invited Presentations

More than **160 invited research seminars and colloquia** at various institutions, including Alberta, Arizona, Bath, Brandeis, Brigham-Young, Boston U., Birmingham, Bristol, Carnegie–Mellon, Cambridge, Chicago, Columbia, Durham, Edinburgh, Exeter, Georgiatech, Harvard, Imperial College London, Leeds, Los Alamos, McGill, Michigan, Minnesota, MIT, New York University, U. North Carolina, NC State, NJIT, Northwestern, Nottingham, Oxford, Penn State, Princeton, Rice, Scripps, Simon Fraser, Stanford, Sydney, Texas, Toronto, Tulane, University College London, UCLA, UCSB, UCSC, UCSD, Wisconsin, Woods Hole, and Yale.

Selected Invited Presentations at Conferences and Workshops

Talk at the *Conference on Applied Geometry and Topology*, University of Pennsylvania, Philadelphia, PA, 29 September 2023.

Talk at the *Workshop on Transport and Scale Interactions in Geophysical Flows*, Oberwolfach, Germany, 20 July 2023.

Plenary speaker at the *Closing Meeting of the Priority Program on Turbulent Superstructures*, Seeheim, Germany, 2 May 2023.

Talk at the *Workshop on Topological Methods in Mathematical Physics*, Erice, Italy, 6 September 2022 (online).

Talk at the *Gordon Research Conference on Fluids in Disease Transmission and Contamination*, Mount Holyoke College, MA, 16 August 2022.

Plenary speaker at the *Charlie Doering Symposium*, University of Michigan, Ann Arbor, MI, 26 May 2022.

Talk at the *Mechanics of Life Workshop*, Flatiron Institute, New York, NY, 25 May 2022.

Lectures at Universidade Federal, Rio de Janeiro, Brazil, May 3–12 2022 (online).

Plenary speaker at *APS–Division of Fluid Dynamics* Annual Meeting, Chicago, IL, 23 November 2020 (online).

Lectures at the Summer School *Fluids & Health 2019: Fluid Dynamics of Disease Transimission*, Cargèse, Corsica, 24–25 July 2019.

Inaugural joint Higgs/Maths Colloquium, University of Edinburgh, Scotland, 21 March 2019.

Talk at the *Workshop on Complex Fluids in Biological Systems*, Banff International Research Station, Alberta, Canada, 28 July 2018.

Talk at *Dynamics Days 2018*, Denver, CO, 6 January 2018.

Talk at *Workshop on Irregular Transport: Analysis and Applications*, Basel, Switzerland, 26 June 2017.

Plenary speaker at *IMA Conference on Nonlinearity and Coherent Structures*, University of East Anglia, Norwich, UK, 20 June 2017.

Talk at *Mathematics of Turbulence Reunion Meeting*, Lake Arrowhead, CA, 5 June 2017.

Talk at *Workshop on Braids in Algebra, Geometry and Topology*, International Centre for Mathematical Sciences, Edinburgh, Scotland, 24 May 2017.

Talk at *Mathematics of Turbulence Reunion Meeting*, Lake Arrowhead, CA, 9 June 2016.

Plenary speaker at *Frontiers in Applied and Computational Mathematics*, NJIT, 5 June 2015.

Plenary speaker (**Third AMS Invited Address**) at *SIAM Annual Meeting*, Chicago, 2014.

Plenary speaker at *SIAM Conference on Applications of Dynamical Systems*, Snowbird, Utah, 2013. (9 plenary speakers out of 800 participants.)

Talk at *Workshop on Tangled Magnetic Fields in Astro- and Plasma Physics*, International Centre for Mathematical Sciences, Edinburgh, Scotland, October 2012.

Plenary speaker at *Workshop on Topological Fluid Dynamics (IUTAM Symposium)*, Newton Institute, Cambridge, UK, July 2012.

Minisymposium talks (2) at *AIMS Conference on Dynamical Systems, Differential Equations and Applications*, Orlando, FL, July 2012.

Minisymposium talk at *SIAM Conference on Nonlinear Waves and Coherent Structures*, Seattle, WA, June 2012.

"Extracting flow information from sparse Lagrangian trajectories." Talk at the *Euler Lagrangian Meeting*, Wolfgang Pauli Institute, Vienna, Austria, 7 May 2012.

Talk at *Workshop on Complex Fluids and Flows in Industry and Nature*, Vancouver, Canada, 14 July 2011.

Talk at *Workshop on Braids and Their Applications*, Pisa, Italy, 22 June 2011.

Talk at *Workshop on Waves and Stability in Continuous Media*, Brindisi, Italy, 15 June 2011.

"Topological detection of Lagrangian coherent structures." Talk at *SIAM Conference on Applications of Dynamical Systems*, Snowbird, Utah, 22 May 2011.

"Topological detection of Lagrangian coherent structures." Talk at the *Workshop on Coherent Structures*, Lorentz Centre, The Netherlands, 19 May 2011.

"Topological methods for stirring and mixing." **Plenary Talk** at the *Workshop on Physics of Mixing*, Lorentz Centre, The Netherlands, 24 January 2011.

Principal Lecturer, 2010 Summer Program in Geophysical Fluid Dynamics, Woods Hole Oceanographic Institution, Woods Hole, MA.

"Do Fish Stir the Ocean?" Talk at *Fluid Dynamics: From Theory to Experiments*, Montana State University, Bozeman, MT, 10 June 2010.

"Do Fish Stir the Ocean?" Talk at the *Workshop on Transport and Mixing in Complex and Turbulent Flows*, Institute for Mathematics and its Applications, Minneapolis, MN, 14 April 2010.

"Exact Topological Entropy for Some Non-hyperbolic Maps." Talk at the *Spring Central Section Meeting of the American Mathematical Society*, St. Paul, MN, 10 April 2010.

Lecturer, 'Tag Team Tutorials: Transport & Mixing in Incompressible Fluid Flows' (with Charles R. Doering), Institute for Mathematics and its Applications, Minneapolis, MN, Spring 2010.

"Pseudo-Anosovs with Small Dilatation." Talk at the *Spring Topology and Dynamics Conference*, Mississippi State University, 19 March 2010.

"Nonlinear Dynamics of Phase Separation in Thin Films." Talk at the *Workshop on Small scale hydrodynamics: microfluidics and thin films*, Banff International Research Station, Alberta, Canada, 8 February 2010.

"Topological Dynamics: Probing Dynamical Systems using Loops." Talk at *Chaos/Xaoc 20th Anniversary Conference*, National Academy of Sciences, Woods Hole, MA, 26 July 2009.

"pseudo-Anosovs in the Real World" (*Bouillabaisse seminar:* invited talk after conference dinner), *H. Masur 60th Birthday Conference on Teichmüller Geometry*, CIRM, Luminy, France, 25 June 2009.

"Orbits that Stir." Talk at *SIAM Conference on Applications of Dynamical Systems*, Snowbird, Utah, 20 May 2009.

"The Role of Walls in Chaotic Mixing: Experimental Results." Talk at the *Second Canada–France Congress*, Montréal, Canada, 3 June 2008.

"A Topological Theory of Rod Stirring." Talk at *Chaos, Complexity and Transport Conference: Theory and Applications*, Marseilles, France, 4–8 June 2007.

"Topological Mixing of Viscous Fluids." Talk at the *Journées de la Matière Condensée*, Université Paul Sabatier, Toulouse, France, 31 August 2006.

"Computing the Topological Entropy of Braids, Fast." Talk at the *Workshop on Computation and Topology in Dynamics*, Lorentz Centre, The Netherlands, 18 May 2006.

"Chaotic Advection in Thin Films?" Talk at the *Frontiers in Applied and Computational Mathematics* meeting, New Jersey Institute of Technology, Newark, NJ, 16 May 2006.

"Topological Chaos in Spatially Periodic Domains." Talk at the *Workshop on Analysis and Control of Mixing with Applications to Micro and Macro Flow Processes*, Udine, Italy, 1 July 2005.

"Topological Kinematics of Mixing." Talk at the *SIAM Meeting on Applications of Dynamical Systems*, Snowbird, Utah, 24 May 2005

"The Rate of Mixing of a Passive Scalar: Local and Global Views." Lectures at the *XII*$^{\text{th}}$ *Grand Combin Summer School*, Valle d'Aosta, Italy, June 2004.

"Bounds on Mixing Efficiency." Talk at the *Second LMS Meeting on Mixing and its Applications*, Bristol, May 2004.

"A Bound on Mixing Efficiency." Talk at the *Geometrical Methods in GFD meeting*, Pitlochry, Scotland, 22 April 2004.

"Large-scale Eigenfunctions and Mixing." Talk at the *New Themes in Plasma and Fluid Turbulence* meeting, Royal Society, London, May 2003.

"Nonlinear MHD Stability and Dynamical Accessibility." Talk at the *APS Division of Plasma Physics* meeting, Orlando, FL, November 2002.

"Hamiltonian Dynamics from Lie–Poisson Brackets." Talk at the *Workshop on Hamiltonian Dynamical Systems*, Imperial College, London, 12 February 2002.

Outreach Presentations

"Making taffy with the Golden mean" Talk at *Pi day*, Duke Kunshan University, China, 5 March 2021 (online).

"Gold bug variations" Talk at *Math Club*, Madison College, Madison, WI, 17 October 2019.

"Slimy math: modeling hagfish slime" Talk at *STEAM Week*, East High, Madison, WI, 23 May 2019.

"Slimy math: modeling hagfish slime" Talk at Kromrey Middle School, Madison, WI, 9 November 2019.

"Slimy math: modeling hagfish slime" Talk at *Why Math Matters*, Madison, WI, 9 November 2018.

"The hagfish: the slimiest fish in the sea" Talk at the *Madison Math Circle*, Madison, WI, 15 October 2018.

"Mathematics of taffy pullers" Talk at *STEAM Week*, East High, Madison, WI, 22 May 2018.

"Goldbug variations" Talk at the *Madison Math Circle*, Madison, WI, 13 November 2017.

"Random entanglements" Talk at the *Math Club*, Madison College, Madison, WI, 10 November 2017.

"Mathy taffy" Talk at the *Wisconsin Science Festival*, Madison, WI, 5 November 2017.

"The mathematics of taffy pulling" Talk at the *Wisconsin Talent Search*, Madison, WI, 5 May 2017.

"The mathematics of taffy pulling" Talk at *Why Math Matters*, Madison, WI, 21 October 2016.

"Why do my earbuds keep getting entangled?" Talk at the *Madison Math Circle*, Madison, WI, 12 September 2016.

"A mathematical history of taffy pullers." Talk at the *Math Club*, Madison College, Madison, WI, 23 October 2015.

"The mathematics of juggling." Talk at the *Madison Math Circle*, Madison, WI, 4 November 2013.

"Making taffy with the Golden mean." Talk at the *Madison Math Circle*, Madison, WI, 11 February 2013.

"Making taffy with the Golden mean." Talk at the *Math Club*, Madison College, Madison, WI, 25 January 2013.

"The hagfish: the slimiest fish in the sea." Talk at the *Madison Math Circle*, Madison, WI, 5 March 2012.

"Making taffy with the Golden mean." Talk at the *Wisconsin Science, Math & Engineering Symposium*, Madison, WI, 23 February 2012.

"Making taffy with the Golden mean." Talk at the *Madison Math Circle*, Madison, WI, 7 November 2011.

"Making taffy with the Golden mean." Talk at the Krannert Art Museum, Champaign, IL, 29 October 2011.

"Stirring with braids." Talk at the *Wisconsin Math Night*, Madison, WI, 21 February 2008.

"Stirring with braids." Talk at Concord College, UK, 30 January 2007.

Teaching Experience

August 2007–present
Assistant/Associate/Full Professor of Mathematics, University of Wisconsin, Madison

Classes taught: Mathematical Fluid Dynamics (**Math 705**, Fall 2007, 2008, 2010), Braids (**Math 801**, Spring 2008), Calculus & Analytic Geometry (**Math 221**, Spring 2008, Fall 2010; **Math 217**, Spring 2009), Chaos & Dynamical Systems (**Math 415**, Fall 2008, 2015–2018, 2022), Elementary Algebraic and Geometric Topology (**Math 552**, Spring 2011), Applied Mathematical Analysis I (**Math 321**, Spring 2012–2013, 2016, Fall 2019–2020), Applied Mathematical Analysis II (**Math 322**, Fall 2011, Spring 2012, Fall 2013, Spring 2016–2017, Fall 2018, Spring 2018–2021), Methods of Applied Mathematics I (**Math 703**, Fall 2012–2013), Methods of Applied Mathematics II (**Math 704**, Spring 2017, 2019–2021, 2023), Mixing (**Math 801**, Spring 2013), Numerical Analysis II (**Math 715**, Spring 2014, 2018).

January 2003–August 2007
Lecturer/Reader in Applied Mathematics, Imperial College London
Department of Mathematics

Classes taught: Advanced Inviscid Flow Theory (Spring 2003, 2004), Mathematics for Biomedical Engineers (Autumn 2003), Inviscid Flow Theory (Autumn 2004–2006), Mathematics for Information Systems Engineers (Autumn 2004, 2005), Mathematics for Chemists (Autumn 2006).

August 1993–May 1994
Teaching Assistant, University of Texas at Austin Physics Department
Supervisor: C. Ken Shih

Conducted review sessions for the tests and homework. Participated in the writing of test questions and grading of homework assignments.

Students and Postdoctoral Fellows Supervised

Postdoctoral Fellows

Marko Budišić (*September 2013–August 2016*)

Matthew D. Finn (*October 2004–February 2007*)

PhD Students

Hieu Nguyen (current)

Gage Bonner (*PhD in Physics August 2022*; jointly supervised with Benedek Valko)

Hongfei Carrie Chen (*PhD May 2022*)

Bryan Oakley (*PhD May 2022*)

Yu Feng (*PhD May 2021*)

John Lynch (*PhD August 2019*)

Thomas Morrell (*PhD May 2019*; jointly supervised with Saverio Spagnolie)

Jacob Gloe (*May 2017–May 2018*; transferred to Michigan State)

Huanyu Wen (*PhD May 2017*)

Peter Mueller (*PhD August 2016*)

Sarah Tumasz (*PhD December 2012*)

Khalid Kamhawi (*PhD June 2009*)

Lennon O'Naraigh (*PhD February 2008*)

Emmanuelle Gouillart (*PhD October 2007*; jointly supervised with Olivier Dauchot)

Summer Research Students (GFD Program, Woods Hole)

Florence Marcotte (*2015*; jointly supervised with C. Doering and W. Young))
Kiori Obuse (*2010*)
Amanda O'Rourke (*2010*; jointly supervised with T. Shaw)
Michael Allshouse (*2010*)
Tiffany Shaw (*2005*)
Anshuman Roy (*2005*; jointly supervised with L. Mahadevan)

Undergraduate Research Students

Kaushal Nair (*2021*)
Ao Zhang (*2020–2021*)
Kunlin Ma (*2019–2021*)
Meng Tian (*2019–2020*)
Ruifu Li (*2019–2020*)
Pumeng Lyu (*2019–2020*)
Hans Zhang (*2018–2019*)
Wangping Ren (*2018–2019*)
Ruojun Wang (*2018–2019*)
Alex Flanagan (*2012–2015*)
Corey Hawley (*2016*, REU; jointly supervised with David Sondak)
Siyu Heng (*2016*, REU; jointly supervised with David Sondak)
Rebecca Vinsonhaler (*2016*, REU; jointly supervised with David Sondak)
Colin Wahl (*2013–2016*; jointly supervised with Saverio Spagnolie)
Joseph Lukasic (*2013–2014*; jointly supervised with Saverio Spagnolie)
Jay Johnson (*2012–2014*)
Natalie Cook (*2012*)
Tedman Martinez-Roja (*2011*)
Andrew Kirby (*2010*)
Matthew Harrington (*2009*)

Masters / VISP Research Students

Sophia Wiedmann (*MA, 2025*)
Robert Argus (*MA, 2025*)
Sanchita Chakraborty (*MA, 2024*)
Jiajia Guo (*VISP, 2018–2019*)
Shouwei Hui (*VISP, 2018*)
Yiding Chen (*VISP, 2017*)
Jielin Yang (*VISP, 2017*)
Claire Blackman (*MA, 2012*)
Douglas Murdoch (*MSci, 2007*)
Stanislas Pamela (*MSci, 2007*)
Sapna Hars (*MSc, 2006*)
Ophir Samson (*MSci, 2006*)
Andrew Wong (*MSci, 2006*)
Joseph Kibui (*MSci, 2005*)

Rhodri Nelson (*MSc, 2005*)

Trishna Patel (*MSci, 2005*)

Stefan Sadokierski (*MSc, 2005*)

Martin Ewart (*MSci, 2004*)

Thomas Brickell (*MSc, 2004*)

Grants Awarded and Consultations

September 2013–August 2014
World Universities Network Fund for International Research Collaboration Grant on *Topological, measure-theoretic and stochastic dynamics in fluid mixing*, Co-Pi with Rob Sturman (PI) and Georg Gottwald, £12,000.

September 2012–August 2015
NSF (CMMI) Grant on *Collaborative Research: A New Braid Theoretic Approach to Uncovering Transport Barriers in Complex Flows* (PI), $260,000 (co-PI Thomas Peacock of MIT awarded $270,000).

August 2011–July 2014
NSF (DMS) Grant on *Mixing by Microorganisms* (PI), $220,000.

August 2009–July 2011
NSF (DMS) Grant on *SCREMS: Scientific Computing Research Environments for the Mathematical Sciences*, Co-PI with Amir Assadi (PI), $183,000.

August 2008–July 2011
NSF (DMS) Grant on *Topological Characterization and Optimization of Mixing* (PI), $200,000.

June 2009–August 2013
NSF (OCE) Support Grant for the *Summer Program in Geophysical Fluids Dynamics* at the Woods Hole Oceanographic Institutiom. Co-PI with Karl Helfrich (PI), Claudia Cenedese, and Charles Doering.

October 2004–October 2007
Consultant, Saint-Gobain Recherche. In addition, SGR sponsored my graduate student, Emmanuelle Gouillart, for the duration of her PhD.

October 2004–February 2007
EPSRC Grant, "Optimisation and Intermittency of Mixing using a Bounding Approach." (£122,000). Supported a Postdoctoral Research Assistant (Now Prof. Matthew D. Finn at University of Adelaide).

December 2003
Office of Naval Research — International Field Office under the Visitor Support Program (grant of $20,000 towards travel of seven international scientists to the 2004 Summer Program in Geophysical Fluid Dynamics in Woods Hole, MA).

October 2000
NSF/DOE Partnership in Basic Plasma Science grant, "Transport in Chaotic Plasmas and Fluids." Co-written with Allen H. Boozer (PI).

Association Memberships

American Mathematical Society

American Physical Society, Lifetime Member

Society for Industrial and Applied Mathematics, Lifetime Member

Professional Acvivities

University-wide Committees

September 2017–May 2020
Letters & Sciences Curriculum Committee

September 2012–June 2013
Graduate Faculty Executive Committee

September 2012–December 2015
Physical Science Research Committee

External Committees and Other Professional Positions

2026
Crawford Prize Committee, Society for Industrial and Applied Mathematics (SIAM).

2024–2025
Irwin Oppenheim Award Committee, American Physical Society. (Chair, 2025)

2021–present
IPAM Science Advisory Board (Institute for Pure and Applied Mathematics, UCLA)

2019–present
Canadian Fluid Dynamics Symposium Standing Committee

2002–present
Faculty of the GFD Summer Program at the Woods Hole Oceanographic Institution.
The Faculty, consisting of about 25 members worldwide, is the governing body of the GFD Program, which has been running for more than 60 years.

January 2018–December 2019
Advisory Board, SIAM Activity Group on Dynamical Systems.

June 2014–June 2016
AMS Centennial Fellowship Committee.

January 2013–January 2016
Education Committee, Society for Industrial and Applied Mathematics (SIAM).

2013
Crawford Prize Committee, Society for Industrial and Applied Mathematics (SIAM).

Schools and Meetings

Co-organizer, Workshop on *Modelling and analysis of turbulent transport, mixing and scaling*, Newton Institute, Cambridge, U.K., 7–11 March 2022. (Co-organized with Anna Mazzucato and Rahul Pandit.)

Co-organizer, Program on *Mathematical aspects of turbulence: where do we stand?*, Newton Institute, Cambridge, U.K., Spring 2022. (Co-organized with Edris Titi, Richard Kerswell, John Gibbon, et al.)

Organizer, *Charlie at GFD: An appreciation*, Memorial Workshop for Charles Doering, Woods Hole Oceanographic Institute, 6 August 2021. (Held online)

Co-organizer, Minisymposium on *Nonlinear Dynamics and Pattern Formation*, International Congress on Theoretical and Applied Mechanics, Milan, Italy, August 2021. (Held online; co-organized with Laurette Tuckerman.)

Co-organizer, Minisymposium on *Biological Fluid Dynamics*, SIAM Mathematics of Planet Earth Meeting, Orange County, CA, 3–14 August 2020. (Held online; co-organized with Lisa Fauci.)

Co-organizer, Workshop on *Form and Deformation in Solid and Fluid Mechanics*, Newton Institute, Cambridge, U.K., 18–22 September 2017. (Co-organized with Eric Lauga.)

Co-organizer, Program on *Growth, Form and Self-organisation*, Newton Institute, Cambridge, U.K., Fall 2017. (Co-organized with Arezki Boudaoud, Robert Dudley, Andrzej Herczynski, Darryl Holm, and Eric Lauga.)

Co-organizer, Conference on *Nonequilibrium Statistical Physics and Fluid Dynamics*, Brigham Young University, Provo, Utah, 23–24 May 2016. (Co-organized with Jared Whitehead.)

Co-organizer, Workshop on *Turbulent Transport and Mixing*, Institute for Pure and Applied Mathematics, Los Angeles, CA, 13–17 October 2014. (Co-organized with Annalisa Bracco, Colm-cille Caulfield, Charles Doering, and Alexander Kiselev.)

Co-organizer, Workshop on *Lagrangian Coherent Structures*, Banff International Research Station, Alberta, Canada, September 2013. (Co-organized with Thomas Peacock and George Haller.)

Co-organizer, Workshop on *pseudo-Anosovs with small dilatation*, Madison, WI, 24–25 April 2010. (Co-organized with Jordan Ellenberg.)

Co-organizer, Minisymposium on *Slow Transport and Coherent Sets in Driven Flow*, SIAM Conference on Applications of Dynamical Systems, 17–21 May 2009. (Co-organized with Gary Froyland.)

Co-organizer, Minisymposium on *Mixing in Industry and the Environment*, International Congress on Industrial and Applied Mathematics (Jointly with SIAM general meeting), Zürich, Switzerland, 16–20 July 2007. (Co-organized with Emmanuel Villermaux.)

Co-organizer, Minisymposium on *Topology and Mixing in Fluids*, SIAM Conference on Applications of Dynamical Systems, 28 May–1 June 2007. (Co-organized with Mark Stremler.)

Organizer, *London Mathematical Society Meeting on Mixing and its Applications*, Imperial College London, 8 January 2004.

Editor

Journal of Nonlinear Science, Communicating Editor, 2023–present

Nonlinearity, Associate Editor, 2022–present

Special issue of *Physica D*: Statistical Physics and Fluid Dynamics (co-editor), 2022

Special issue of *Philosophical Transcations of the Royal Society A*: Fundamental Mathematical Problems of Physical Fluid Dynamics (co-editor), 2022

Special issue of *Communications in Nonlinear Sciences and Numerical Simulations*: Mathematical Structure of Fluids and Plasmas (co-editor), 2011

Special issue of *Physica D*: Fluid Dynamics: From Theory to Experiments (co-editor), 2011

Proceedings of the 2001 Summer Program in Geophysical Fluids Dynamics
Woods Hole Oceanographic Institution
Organizer: Neil J. Balmforth

Proceedings of the 2000 Summer Program in Geophysical Fluids Dynamics
Woods Hole Oceanographic Institution
Organizer: Richard Salmon

Proceedings of the 1999 Summer Program in Geophysical Fluids Dynamics
Woods Hole Oceanographic Institution
Organizer: Neil J. Balmforth

Proceedings of the 1998 Summer Program in Geophysical Fluids Dynamics
Woods Hole Oceanographic Institution
Organizer: Neil J. Balmforth

Referee

ACS Petroleum Research Fund

Algebraic and Geometric Topology

Astrophysical Journal

Chaos: An Interdisciplinary Journal of Nonlinear Science
Classical and Quantum Gravity
Communications in Mathematical Physics
Communications in Nonlinear Science and Numerical Simulation
Computers and Geosciences
Discrete and Continuous Dynamical Systems
Dynamical Systems
Engineering and Physical Sciences Research Council (UK)
European Journal of Mechanics B
Fluid Dynamics Research
Geophysical and Astrophysical Fluids Dynamics
IMA Journal of Applied Mathematics
Involve
Journal of Fluid Mechanics
Journal of Micromechanics and Microengineering
Journal of Plasma Physics
Journal of the Atmospheric Sciences
Journal of the Royal Society – Interface
Leverhulme Trust
Mathematics Magazine
National Science Foundation (US)
Nonlinearity
Nonlinear Processes in Geophysics
Numerical Algorithms
Physica D
Physics Letters A
Physics of Fluids
Physics of Plasmas
Physical Review E
Physical Review Fluid
Physical Review Letters
Proceedings of the National Academy of Science
Proceedings of the Royal Society
Quarterly Journal of Applied Mathematics
Science
SIAM Journal on Applications of Dynamical Systems
SIAM Journal on Mathematical Analysis
SIAM Review
Springer–Verlag books
Studies in Applied Mathematics
Theoretical and Computational Fluid Dynamics
Topology and its Applications