

Daniel M. Abrams

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Professional preparation

Massachusetts Institute of Technology (Cambridge, MA) Postdoctoral Research Fellow in Mathematical Sciences Department of Earth, Atmospheric and Planetary Sciences	2006–2009
Cornell University (Ithaca, NY) Ph.D. in Theoretical and Applied Mechanics, May 2006	2001–2006
California Institute of Technology (Pasadena, CA) Bachelor of Science with honors in Applied Physics, June 2000	1996–2000

Appointments and honors

Northwestern University Department of Engineering Sciences and Applied Mathematics <i>Assistant Professor</i>	2009–Present
Northwestern Institute on Complex Systems (NICO) <i>Faculty Member</i>	2011–Present
Northwestern University Department of Physics and Astronomy <i>Assistant Professor (by courtesy)</i>	2013–Present
James S. McDonnell Foundation <i>Scholar, Complex Systems</i>	2010–Present
Northwestern University Searle Center for Teaching Excellence <i>Searle Fellow</i>	2011–2012
Fulbright Program / Council for International Exchange of Scholars <i>Visiting Scholar, UNSAAC University Department of Physics, Cusco, Peru</i>	2010
NSF / MIT Department of Earth, Atmospheric, and Planetary Sciences <i>Mathematical Sciences Postdoctoral Research Fellow</i>	2006–2009
NSF East Asia and Pacific Summer Institute Fellow (SNU, Seoul, Korea)	Summer 2006
NSF Graduate Research Fellow	2003–2006
US ED Foreign Language Area Study Grantee (Quechua)	Summer 2003
IGERT Fellow for Interdisciplinary Research	2001–2003
Field Research Fellow, US Antarctic Program Project S-157 (Ice Stream C, Antarctica)	2000–2001
Teagle and LA Philanthropic Foundation Foundation Scholar	1999, 2000, 2002
Eagle Scout	1996

Publications

Total citations = 1174, *h*-index = 11 (Google Scholar data as of 09/16/14)

- 1) S.H. Lee, R. Ffrancon, D.M. Abrams, B.J. Kim and M.A. Porter, "Matchmaker, matchmaker, make me a match: Migration of populations via marriages in the past," *in press at Physical Review X*. [arxiv.org/abs/1310.7532] [journal article, accepted]
- 2) D.M. Abrams, A. Slawik, and K. Srinivasan, "Nonlinear oscillations and bifurcations in silicon photonic microresonators," *Physical Review Letters* **112**, 123901 (2014). [[doi:10.1103/PhysRevLett.112.123901](https://doi.org/10.1103/PhysRevLett.112.123901)] [journal article, published]
- 3) M.J. Panaggio, B. Ottino-Loffler, P. Hu, and D.M. Abrams, "Symmetry breaking in optimal timing of traffic signals on an idealized two-way street," *Physical Review E* **88**, 032801 (2013). [[doi:10.1103/PhysRevE.88.032801](https://doi.org/10.1103/PhysRevE.88.032801)] [journal article, published]
- 4) F.A. McRobie, G. Morgenthal, D.M. Abrams, and J. Prendergast, "Parallels between wind and crowd loading of bridges," *Philosophical Transactions of the Royal Society A* **371**, 20120430: 1-17 (2013). [[doi:10.1098/rsta.2012.0430](https://doi.org/10.1098/rsta.2012.0430)] [journal article, published]
- 5) M.J. Panaggio and D.M. Abrams, "Chimera states on a flat torus," *Physical Review Letters* **110**, 094102 (2013). [[doi:10.1103/PhysRevLett.110.094102](https://doi.org/10.1103/PhysRevLett.110.094102)] [journal article, published]
- 6) D.M. Abrams and M.J. Panaggio, "A model balancing cooperation and competition can explain our right-handed world and the dominance of left-handed athletes," *Journal of the Royal Society Interface* **09** (75), 2718-2722 (2012). [[doi:10.1098/rsif.2012.0211](https://doi.org/10.1098/rsif.2012.0211)] [journal article, published]
- 7) D.M. Abrams, H.A. Yaple, and R.J. Wiener, "Dynamics of social group competition: Modeling the decline of religious affiliation," *Physical Review Letters* **107**, 088701 (2011). [[doi:10.1103/PhysRevLett.107.088701](https://doi.org/10.1103/PhysRevLett.107.088701)] [journal article, published]
- 8) A.P. Petroff, O. Devauchelle, D.M. Abrams, A.E. Lobkovsky, A. Kudrolli, and D.H. Rothman, "Geometry of valley growth," *Journal of Fluid Mechanics* **673**, 245–254 (2011). [[doi:10.1017/S002211201100053x](https://doi.org/10.1017/S002211201100053x)] [journal article, published]
- 9) D.M. Abrams and R.J. Wiener, "A model of peak production in oilfields," *American Journal of Physics* **78** (1), 24–27 (2010). [[doi:10.1119/1.3247984](https://doi.org/10.1119/1.3247984)] [journal article, published]
- 10) D.M. Abrams, A.E. Lobkovsky, A.P. Petroff, K.M. Straub, B. McElroy, D.C. Mohrig, A. Kudrolli, and D.H. Rothman, "Growth laws for channel networks incised by groundwater flow," *Nature Geoscience* **2**, 193–196 (2009). [[doi:10.1038/ngeo432](https://doi.org/10.1038/ngeo432)] [journal article, published]
- 11) D.M. Abrams, R.E. Mirollo, S.H. Strogatz, and D.A. Wiley, "Solvable model for chimera states of coupled oscillators," *Physical Review Letters* **101**, 084103 (2008). [[doi:10.1103/PhysRevLett.101.084103](https://doi.org/10.1103/PhysRevLett.101.084103)] [journal article, published]
- 12) B. Eckhardt, E. Ott, S.H. Strogatz, D.M. Abrams, and F.A. McRobie, "Modeling walker synchronization on the Millennium Bridge," *Physical Review E* **75**, 021110 (2007). [[doi:10.1103/PhysRevE.75.021110](https://doi.org/10.1103/PhysRevE.75.021110)] [journal article, published]
- 13) R.H. Wiener and D.M. Abrams, "A physical basis for Hubbert's decline from the midpoint empirical model of oil production," *WIT Transactions on Ecology and the Environment* **105**, 377 (2007). [[doi:10.2495/ESUS070371](https://doi.org/10.2495/ESUS070371)] [journal article, published]
- 14) D.M. Abrams, "Two coupled oscillator models: The millennium bridge and the chimera state," Ph.D. Dissertation, Cornell University (2006). [hdl.handle.net/1813/3271] [dissertation, accepted]
- 15) D.M. Abrams and S.H. Strogatz, "Chimera states in a ring of nonlocally coupled oscillators,"

International Journal of Bifurcations and Chaos **16**, 21 (2006). [[doi:10.1142/S0218127406014551](https://doi.org/10.1142/S0218127406014551)] [journal article, published]

- 16) S.H. Strogatz, D.M. Abrams, F.A. McRobie, B. Eckhardt, and E. Ott, "Crowd synchrony on the Millennium Bridge," *Nature* **438**, 43 (2005). [[doi:10.1038/438043a](https://doi.org/10.1038/438043a)] [journal article, published]
- 17) D.M. Abrams and S.H. Strogatz, "Chimera states for coupled oscillators," *Physical Review Letters* **93**, 174102 (2004). [[doi:10.1103/PhysRevLett.93.174102](https://doi.org/10.1103/PhysRevLett.93.174102)] [journal article, published]
- 18) D.M. Abrams and S.H. Strogatz, "Modelling the dynamics of language death," *Nature* **424**, 900 (2003). [[doi:10.1038/424900a](https://doi.org/10.1038/424900a)] [journal article, published]
- 19) J.C. Lang, D.M. Abrams, and H. De Sterck, "The influence of societal individualism on a century of tobacco use: modelling the prevalence of smoking," *under review*. [arxiv.org/abs/1407.2188] [journal article, published]
- 20) M.J. Panaggio and D.M. Abrams, "Chimera states on the surface of a sphere," *under review*. [arxiv.org/abs/1405.2047] [journal article, under review at *Physical Review E*]
- 21) H.A. Yapel and D.M. Abrams, "A continuous generalization of the Ising model," *in revision*. [arxiv.org/abs/1306.3528] [journal article, in revision]
- 22) M.J. Panaggio and D.M. Abrams, "Chimera states: Coexistence of coherence and incoherence in networks of coupled oscillators," *invited review article under review at Nonlinearity*. [arxiv.org/abs/1403.6204] [journal article, under review at *Nonlinearity*]

Synergistic activities

Teaching and training:

- Worked with School of the Art Institute of Chicago on new collaborative course "Data as art" (2013).
- Developed new course material (including problems drawn from research) while teaching "Modeling Coupled Oscillators and Sync," "Models in Applied Math," "Methods of Applied Math," "Engineering Analysis 4," and "Vector Calculus" at Northwestern (2009-2014), "Nonlinear Physics" at UNSAAC (Peru, 2010), "Modeling in Environmental Geoscience" at MIT (2008).
- Mentored undergraduate and graduate student researchers.
- Produced Antarctic sundials and distributed them to high school physics teachers for use in planetary science lab exercises (2001).

Development of research tools:

Created and distributed numerical simulation notes and code: coupled oscillator systems (2008), chaotic Taylor-Couette fluid system (2002). Code has been used for research and as a pedagogical tool at Pacific University.

Development of databases to support research and education:

Through field research and census bureaus, compiled shared databases on language competition (2003-present), evolution of religious affiliation (2010-2011), handedness in athletics (2011), and international smoking dynamics (2014).

Broadening participation of underrepresented groups:

Lectured on math, science, computer skills, and the US educational system at civil institutions in Bolivia, Peru, and Nicaragua (2003-2010). Translated large portions of book "Nonlinear Dynamics and Chaos" into Spanish (2010).

Current and pending research grant support

Funded:

NSF REU Site: \$2,877,794.00 (3 years: research mentor, not PI) <i>Preparing a Diverse Workforce through Interdisciplinary Astrophysics Research</i>	2014–Present
NICO seed grant: \$10,000.00 (1 year, co-PI) <i>Exploiting synchronization in traffic dynamics</i>	2012–2013
NICO seed grant: \$10,000.00 (1 year, co-PI) <i>Experimental Observation of Chimeras</i>	2013–2014
James S. McDonnell Foundation: \$278,860.00 (4 years, PI) <i>Studying Complex Systems: Modeling social dynamics in competitive systems</i>	2010–Present
Fulbright Commission: \$18,350.00 (6 months, PI) <i>US Scholar program in Peru: Nonlinear dynamics and complex physical systems</i>	2009–2010

Under review and planned:

NSF Faculty Early Career Development (CAREER) Program: \$407,556.00 (5 years, PI) <i>New tools for networked nonlinear oscillatory systems</i>
Materials Research Science & Engineering Center (MRSEC) seed grant: \$10,000.00 (1 year, co-PI) <i>Exploiting nonconvex free energy to design materials with inverted phase transitions</i>
NSF Sustainability Research Networks Competition: \$12,000,000.00 (5 years, investigator) <i>Learning cities: The sustainable and economic reinvention of rapidly changing cities</i>
NSF Sustainability Research Networks Competition (different group): \$12,000,000.00 (5 years, investigator) <i>Heartland Urban Metabolism Sustainability Research Network (HUM-SRN)</i>
NSF Research Training Groups in the Mathematical Sciences – in preparation (4 years, co-PI) <i>A research training group in quantitative biological modeling</i>
NSF Applied Mathematics – in preparation (3 years, PI) <i>New tools for networked nonlinear oscillatory systems</i>
NSF Physics of Living Systems – in preparation (3 years, PI) <i>Nonlinear dynamics of human and animal social systems</i>

Collaborators and other affiliations

Olivier Devauchelle	Institut de Physique du Globe de Paris / CNRS, France
Robyn Ffranco	Cardiff University
David Hysell	Cornell University (graduate advisor)
Beom Jun Kim	Sungkyunkwan University, S. Korea
Arshad Kudrolli	Clark University
SangHoon Lee	University of Oxford, England
Alex E. Lobkovsky	NIH
Brandon McElroy	University of Wyoming
F. Allan McRobie	Cambridge University
Rennie Mirollo	Boston College
David C. Mohrig	University of Texas at Austin
Guido Morgenthal	Bauhaus-Universität, Germany
Alex P. Petroff	Rockefeller University
Mason A. Porter	University of Oxford, England
John Prendergast	Novacem / Imperial College, London, England
Richard H. Rand	Cornell University (graduate advisor)
Daniel H. Rothman	MIT (postdoc. sponsor)

Kartik Srinivasan	NIST	
Kyle M. Straub	Tulane University	
Steven H. Strogatz	Cornell University	(graduate advisor)
Richard Wiener	Research Corporation / U. Arizona	
Daniel A. Wiley	University of Maryland	

Advisees

Informal

Chris L. Follett	MIT undergrad (<i>now postdoc at MIT</i>)	2007-2009
Alex P. Petroff	MIT grad (<i>now postdoc at Rockefeller University</i>)	2007-2009
David C. Forney	MIT grad (<i>now at SmartDrive Systems</i>)	2007-2009
Samuel Rivier	Syracuse University grad	2009-2010

Undergraduate research advisor

Peiguang Hu	Nat'l U. Singapore (<i>now grad at MIT</i>)	2011-2012
Bertrand Ottino-Loffler	Caltech (<i>now grad at Cornell</i>)	2012
Elizabeth A. Kocha	Northwestern (<i>now at Iron Horse Interactive</i>)	2012-2014
Daniel P. Thomas	Northwestern (<i>grad at Northwestern</i>)	2013-2014
William E. Krinsman	Northwestern	2014-Present
Evan M. Gray	Northwestern	2014-Present

Postdoctoral

Rosangela Follmann	Northwestern	2014 (shared)
Jiang Xin	Northwestern	2014-2015 (expected)

On thesis committee

Tiffany M. Psemeneke	Northwestern (<i>now at US government agency</i>)	2009-2011
John C. Lang	University of Waterloo	2013-Present
Yang Yang	Northwestern (Physics)	2012-Present

Graduate research advisor

Haley A. Yaple	Northwestern	2009-2013
PhD Dissertation: <i>Mathematical models for the dynamics of competitive systems, with applications to religious shift and ferromagnetism.</i> (now tenure track faculty at Carthage College)		
Mark J. Panaggio	Northwestern	2010-2014
PhD Dissertation: <i>Spot and spiral chimera states: Dynamical patterns in networks of coupled oscillators.</i> (now postdoc at at Rose Hulman Institute of Technology)		
Alex Slawik	Northwestern University	2011-Present
<i>PhD expected summer 2015.</i>		
Sara M. Clifton	Northwestern University	2013-Present
<i>PhD expected summer 2017.</i>		
Chuoqiao Yang	Northwestern University	2014-Present
<i>PhD expected summer 2018.</i>		

Invited (*) and contributed (†) seminars

- 1) *Workshop on collective dynamics in coupled oscillator systems, November 24, 2014 (Weierstrass Institute, Berlin, Germany). "Limits for chimera states." *Keynote speaker.*
- 2) *University of Catania, Italy, October, 2014. "Chimera States."
- 3) *University of Copenhagen, Denmark, October, 2014. TBD.
- 4) *Kavli Frontiers of Science Symposium Indonesia, June 22, 2014 (Medan, Indonesia). "A model for the origin of biological ornaments."
- 5) *James S. McDonnell Foundation Complex Systems Scholars & Postdoc Conference, May 29, 2014 (Atlanta, GA). "Languages, leavers, lefties and lunch."
- 6) *Network Frontier Workshop, December 4, 2013 (Evanston, IL). "Lefties, languages and (religious) leavers: Network structure and social group competition dynamics."
- 7) *Cornell University Center for Applied Math, November 11, 2013 (Ithaca, NY). "Sinister stability of asymmetry: A mathematical model for the origin of left-handedness."
- 8) *Kavli Frontiers of Science Symposium Indonesia, June 26, 2013 (Bali, Indonesia). "Left-handedness."
- 9) *Brown bag seminar, Northwestern University Department of Physics, June 5, 2013 (Evanston, IL). "A doubly-continuous generalization of the Ising model."
- 10) †Conference on dynamical systems, Society for Industrial and Applied Math, May 21, 2013 (Snowbird, UT). "A mathematical model for the origin of left-handedness."
- 11) *University of Michigan Center for the Study of Complex Systems, September 18, 2012 (Ann Arbor, MI). "A mathematical model for the origin of left-handedness (with evidence from professional sports)."
- 12) *Conference on dynamical systems, differential equations and applications, American Institute of Mathematical Sciences, July 2, 2012 (Orlando, FL). "A mathematical model for the origin of left-handedness."
- 13) *Northwestern University SIAM student chapter, inaugural lecture, January 20, 2012 (Evanston, IL). "A model for the Millennium Bridge instability."
- 14) *Conference on sociophysics, École Polytechnique / Centre National de la Recherche Scientifique, November 14, 2011 (Paris, France). "Modeling the decline of religion."
- 15) *Northwestern Institute for Complex Systems, November 2, 2011 (Evanston, IL). "Modeling the decline of religion: do social networks matter?"
- 16) *University of Illinois Coordinated Science Laboratory, October 19, 2011 (Urbana, IL). "Competition in social systems: mathematical models of religious affiliation."
- 17) †Conference on dynamical systems, Society for Industrial and Applied Math, May 25, 2011 (Snowbird, UT). "Modeling the dynamics of social competition."
- 18) *Ohio State University Applied Mathematics, April 28, 2011 (Columbus, OH). "Competition in social systems: three and a half models."
- 19) †American Physical Society March Meeting, March 21, 2011 (Dallas, TX). "Competition in social systems: three and a half models."
- 20) *Korean Science and Engineering Foundation / East Asia Pacific Summer Institute reunion conference, March 12, 2011 (New York, NY). "Career development ideas."

- 21) *Northwestern University Engineering Sciences and Applied Mathematics, November 16, 2009 (Evanston, IL). "Statistical topography: why isn't the earth flat?"
- 22) *Northwestern University Civil and Environmental Engineering, October 23, 2009 (Evanston, IL). "A model of reversible channel growth."
- 23) *Shell Oil Company, February 26, 2009 (Houston, TX). "Growth laws for channel networks."
- 24) *Northwestern University Engineering Sciences and Applied Mathematics, February 16, 2009 (Evanston, IL). "A model for the Millennium Bridge instability."
- 25) *NASA / Caltech Jet Propulsion Laboratory, January 15, 2009 (Pasadena, CA). "Growth laws for channel networks."
- 26) *University of British Columbia Physics / TRIUMF, January 13, 2009 (Vancouver, Canada). "A model of reversible channel growth."
- 27) †American Geophysical Union, December 17, 2008 (San Francisco, CA). "A model of reversible channel growth."
- 28) *Night Vision Laboratory, December 9, 2008 (Fort Belvoir, VA). "A model of reversible channel growth."
- 29) *Army Research Laboratory, November 25, 2008 (Adelphi, MD). "A model of reversible channel growth."
- 30) *System Planning Corporation, November 20, 2008 (Arlington, VA). "A model for the Millennium Bridge instability."
- 31) *Johns Hopkins University Applied Physics Laboratory, November 18, 2008 (Laurel, MD). "A model for the Millennium Bridge instability."
- 32) †International Union of Geodesy and Geophysics Conference on Mathematical Geophysics, June 18, 2008 (Spitsbergen, Svalbard, Norway). "Reversible channel growth by subsurface flow."
- 33) *Tessella Corporation, April 7, 2008 (Boston, MA). "A model for the Millennium Bridge instability."
- 34) *Seoul National University Physics, June 26, 2006 (Seoul, S. Korea). "A model for the Millennium Bridge instability."
- 35) *Niels Bohr Institute, September 3, 2005 (Copenhagen, Denmark). "A mathematical model for language death."
- 36) *Cornell University Latin American Studies, April 20, 2004 (Ithaca, NY). "Modeling language death and the decline of the Quechua language."

Press

TV

Through the Wormhole with Morgan Freeman – <i>segment of show</i>	2014
PBS' Chicago Tonight (WTTW) – <i>story covered</i>	2012
WGN News at Nine Chicago – <i>story covered</i>	2012
Fox News - <i>interview</i>	2011
MSNBC News – <i>collaborator interview</i>	2011
CNN – <i>story covered</i>	2011
Physics World – <i>interview</i>	2011

Radio

NPR's Radiolab (WNYC)	2013
NPR's "The Academic Minute" (WAMC)	2012
NPR's "Word of Mouth" (NHPR)	2012
CBS Chicago (WBBM Newsradio 780)	2012
BBC Radio 5 Live	2011
Radio New Zealand Morning Report	2011
BBC World Service's "Science in Action"	2003
Cape Talk radio, South Africa	2003
NPR's Common Ground radio	2003

Print and web

2003-2014

CNN, BBC News, NY Times, Reuters network, Agence France-Presse network, Discovery News, Eurekalert, Gizmodo, Phys.org, Science Daily, TedEd, Physics Today, others. (*See web site for selected links.*)