

Emmy Murphy

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Research Interests

Symplectic and contact topology, h -principles, and geometric topology.

Employment

Assistant Professor, Northwestern University, 2016–Present

Assistant Professor, Massachusetts Institute of Technology, 2014 – 2017

C L E Moore Instructor, Massachusetts Institute of Technology, 2012 – 2014

Education

Ph.D. Mathematics, Stanford University, 2012

B.S. Mathematics, University of Nevada, Reno, 2007

Publications

- “Differential algebra of cubic planar graphs”
joint with R. Casals, with an appendix by K. Sackel
<https://arxiv.org/abs/1705.01034> (2017)
- “Legendrian fronts for affine varieties”
joint with R. Casals
<https://arxiv.org/abs/1610.06977> (2016)
- “Conformal symplectic geometry of cotangent bundles”
joint with B. Chantraine
<https://arxiv.org/abs/1606.00861> (2016)
To appear in *Journal of Symplectic Geometry*.
- “Subflexible symplectic manifolds”
joint with K. Siegel
<http://arxiv.org/abs/1510.01867> (2015)
Geometry & Topology, **22**, no. 4, 2367–2401. (2018)

- “Making cobordisms symplectic”
joint with Y. Eliashberg
<http://arxiv.org/abs/1504.06312> (2015)
- “Geometric criteria for overtwistedness”
joint with R. Casals and F. Presas
<http://arxiv.org/abs/1503.06221> (2015)
- “Amenable groups and the smooth topology of 4-manifolds”
joint with M. Freedman and L. Guth
<http://arxiv.org/abs/1503.05497> (2015)
Journal of Topology and Analysis **9**, no. 1, 1–14. (2017)
- “Existence and classification of overtwisted contact structures in all dimensions”
joint with M. S. Borman and Y. Eliashberg
<http://arxiv.org/abs/1404.6157>(2014)
Acta Mathematica **215**, no. 2, 281–361. (2015)
- “Closed exact Lagrangians in the symplectization of contact manifolds”
<http://arxiv.org/abs/1304.6620> (2013)
- “Constructing exact Lagrangian immersions with few double points”
joint with T. Ekhholm, Y. Eliashberg, and I. Smith
<https://arxiv.org/abs/1303.0588> (2013)
Geometric and Functional Analysis **23**, no. 6, 1772–1803. (2013)
- “Lagrangian caps”
joint with Y. Eliashberg
<https://arxiv.org/abs/1303.0586> (2013)
Geometric and Functional Analysis **23**, no. 5, 1483–1514. (2013)
- “Loose Legendrians and the plastikstufe”
joint with K. Niederkrüger, O. Plamenevskaya, and A. Stipsicz
<https://arxiv.org/abs/1211.3895> (2012)
Geometry & Topology, **17**, no. 3, 1791–1814. (2013)
- “Loose Legendrian embeddings in high dimensional contact manifolds”
<http://arxiv.org/abs/1201.2245> (2012)

Awards and Honors

- Invited speaker, International Congress of Mathematicians; 2018
- Séminaire Bourbaki presentation of my work with Borman and Eliashberg on higher dimensional contact structures, given by Patrick Massot; March 2017
- AWM Birman Research Prize in Topology and Geometry; 2017

- Radcliffe Institute for Advanced Studies Fellowship; academic year 2016–2017
- Académie Royale de Belgique prize for an original contribution to the existence of contact structures; 2015
- UNR College of Science Young Alumni of the Year; 2015
- Sloan Research Fellowship; 2015
- NSF award 1510305, 2015-2018
- Research Training Grant Fellow at MIT; academic year 2012–2013
- Program Associate; Symplectic and Contact Geometry and Topology Program; MSRI; academic year 2009–2010
- Regional Topology and Geometry Fellowship at Stanford; August 2007 - June 2009

Invited Talks

Lecture series

- “ h -principles in contact and symplectic geometry”, five lectures
 h -principles summer graduate school
Tambara Institute of Mathematical Sciences, July 2018
- “Introduction to h -principles”, five lectures
 h -principles summer graduate school
Tambara Institute of Mathematical Sciences, June 2018
- “Applications of flexibility in high dimensional contact geometry”, five lectures
Developments in Contact and Symplectic Topology (LMS–CMI research school)
Glasgow University June 2016
- “Lefschetz fibrations, contact geometry, and flexibility”, three lectures
Geometry and related topics seminar
Research Institute for Mathematical Sciences, Kyoto University, March 2016
- “Existence of contact structures and overtwistedness in all dimensions”, four lectures
Stein Manifolds, Contact Structures and Knots conference
Centre International de Rencontres Mathématiques, September 2015
- “Loose Legendrian embeddings in high dimensional contact manifolds”, two lectures
H-principle in Houat workshop, June 2015
- “Equivalent notions of high dimensional overtwistedness”, four lectures
Gökova Geometry-Topology Conference, May 2015
- “Flexibility in higher-dimensional contact geometry”, two lectures
Workshop on Contact Geometry in Dimension Three and Higher
University College London, July 2014

- “Flexibility in higher-dimensional contact geometry”, four lectures
Université de Nantes Séminaire de Géométrie Topologie et Algèbre, January 2014
- “Lagrangian caps in high dimensional symplectic manifolds”, two lectures
Institute for Basic Sciences Center for Geometry and Physics seminar, January 2014
- “Flexibility in high dimensional contact and symplectic topology”, five lectures
Geometría Simpléctica con Técnicas Algebraicas
Centré International de Mathématiques et d’Informatique, June 2013
- “Loose Legendrian embeddings in high dimensional contact manifolds”, three lectures
Massachusetts Institute of Technology Symplectic Coffee Seminar, February 2013

Colloquia

- “Flexibility in symplectic and contact geometry”
International Congress of Mathematicians
Rio de Janeiro, August 2018
- “Contact geometry and knot theory”
University of Oregon, April 2018
- “Stein manifolds and contact geometry”
Western Michigan University, April 2018
- “Planar graphs and Legendrian surfaces”
Georgia Tech, December 2017
- “Planar graphs and Legendrian surfaces”
University of Illinois Urbana–Champagne, October 2017
- “Planar graphs, Legendrian surfaces, and contact homology”
University of Chicago, May 2017
- “Planar graphs and Legendrian surfaces”
Indiana University–Purdue University Indianapolis, February 2017
- “A contact topologist’s perspective on mirror symmetry”
ETH Zürich, December 2016
- “String theory and surrealism” (non-mathematical audience)
Radcliffe Institute for Advanced Study, November 2016
- “Mirror symmetry for affine varieties via geometric topology and Legendrian knot theory”
Rice University, September 2016
- “Flexibility in symplectic and contact geometry”
Northwestern University, November 2015
- “Questions in symplectic and contact flexibility”
Ludwig Maximilian University of Munich, June 2015

- “Existence of overtwisted contact structures on high dimensional manifolds”
University of California, Los Angeles, November 2014
- “Lagrangian caps in \mathbb{C}^2 ”
University of Nevada, Reno, June 2012

Conference talks

- “Flexibility in contact geometry”
Contact geometry conference
Cittadella dei Musei, Sardinia, June 2018
- “Non-exact Lagrangian fillings”
Workshop on Immersed Lagrangian Cobordisms
University of Ottawa, April 2018
- “Arboreal singularities and loose Legendrians”, given at two locations:
 - Arboreal singularities workshop
American Institute of Mathematics, March 2018
 - Holomorphic Curves and Symplectic Topology conference
Institut Mittag-Leffler, August 2017
- “Graph Legendrians and SL_2 local systems”, given at two locations:
 - Texas Geometry and Topology Conference
University of Texas Austin, November 2017
 - Symplectic geometry workshop – celebrating the work of Simon Donaldson
Isaac Newton Institute for Mathematical Sciences, August 2017
- “The Legendrian DGA of cubic planar graphs”
Georgia International Topology Conference
University of Georgia, May 2017
- “Overtwistedness phenomena in general geometries”
Engel structures workshop
American Institute of Mathematics, April 2017
- “A frontal view of Lefschetz fibrations”, given at eight locations:
 - The Indian Mathematics Consortium & American Mathematics Society joint meeting
Banaras Hindu University, December 2016
 - Texas Geometry and Topology Conference
Texas A & M, November 2016
 - Yamabe Memorial Symposium
University of Minnesota, September 2016
 - Symplectic Techniques in Hamiltonian Dynamics conference
Instituto de Ciencias Matemáticas Geometry, June 2016

- Georgia Topology conference
University of Georgia, May 2016
- Topological and Quantitative Aspects of Symplectic Manifolds
Columbia University, March 2016
- Augmentations and Legendrians at the IAS workshop
Institute for Advanced Study, February 2016
- Lefschetz Fibrations: Rigidity and Flexibility
New Orleans, LA, January 2016
- “Mirror symmetry for the trefoil knot”
Workshop of Homological Mirror Symmetry: Methods and Structures
Institute for Advanced Study, November 2016
- “Conformal symplectic structures”
First CoSpIn Mini-workshop
Université du Québec À Montréal, June 2016
- “Flexibility in high dimensional contact geometry”
Cornell Topology Festival
Cornell University, May 2016
- “An alternative proof of Lagrangian caps using wrinkling techniques”
Wrinkles and h-Principles, Old and New conference,
Ludwig Maximilian University of Munich, June 2015
- “Existence of Liouville structures on cobordisms”, given at three locations:
 - Recent Challenges in Contact Geometry conference
Centre International de Rencontres Mathématiques, June 2015
 - Moduli Spaces in Symplectic Topology and in Gauge Theory conference
Centre International de Rencontres Mathématiques, June 2015
 - Workshop on Symplectic Flexibility
Asilomar, CA, May 2015
- “Dissolving finite index covers of 4-manifolds and connections to coarse geometry”
Redbud Topology Conference
Oklahoma State University, April 2015
- “S-immersions and wrinkled geometric structures”
I-Wrinkle workshop
San Francisco, CA, January 2015
- “Existence of overtwisted contact structures in high dimensions”, given at three locations:
 - Symplectic Topology workshop
Clay Mathematics Institute, October 2014

- Workshop on Topology and Invariants of 4-Manifolds
Simons Center for Geometry and Physics, August 2014
- Rigidity and Flexibility in Symplectic Topology and Dynamics conference
Lorentz Center, July 2014
- “Summary of the existence proof and extension to the parametric version”
Overtwistedness in High Dimensions workshop
Asilomar, CA, May 2014
- “Equivariant coverings and reduction to the universal model”
Overtwistedness in High Dimensions workshop
Asilomar, CA, May 2014
- “Exotic Lagrangians in \mathbb{C}^n ”
VIII Workshop on Symplectic Geometry, Contact Geometry, and Interactions
Instituto Superior Técnico, January 2014
- “Lagrangian caps in high dimensional symplectic manifolds”
Recent Progress in Symplectic Flexibility workshop
Asilomar, CA, April 2013
- “Loose Legendrian embeddings in high dimensional contact manifolds”, given at five locations:
 - Wrinkles and h-Principles, Old and New conference,
Ludwig Maximilian University of Munich, June 2015
 - Recent Progress in Symplectic Flexibility workshop
Asilomar, CA, April 2013
 - Graduate Workshop on Symplectic and Contact Topology
Simons Center for Geometry and Physics, October 2012
 - Contact Topology in Higher Dimensions conference
American Institute of Mathematics, May 2012
 - Conference in Contact and Symplectic Topology
Laboratoire de Mathématiques Jean Leray, June 2011
- “Lagrangian caps in \mathbb{C}^2 ”, given at two locations:
 - Joint AMS/MAA meeting Special Session on Knots, Links, and Three-Manifolds
San Diego, CA, January 2013
 - AMS sectional meeting Special Session on Symplectic and Contact Topology
Rochester, NY, September 2012

Seminar talks

- “Arboreal singularities and loose Legendrians”, given at two locations:
 - Columbia Symplectic Geometry, Gauge Theory, and Categorification Seminar, April 2018
 - Séminaire Orsay - Nantes de Géométrie Symplectique et de Contact, March 2017
- “Legendrian knots and affine varieties”, given at two locations:
 - Université de Nantes Séminaire de Géométrie Topologie et Algèbre, March 2017
 - University of Illinois, Urbana-Champaign Symplectic & Poisson Geometry Seminar, October 2016
- “The Legendrian DGA of a cubic planar graph”
ETH Zürich, December 2016
- “Rigidity and flexibility in conformal symplectic geometry”
Encounter with Mathematics 番外編 seminar, Chuo University, March 2016
- “Dissolving finite index covers of 4-manifolds and connections to coarse geometry”, given at two locations:
 - University of Georgia Topology Seminar, January 2016
 - Stony Brook University Thursday Topology Seminar, February 2015
- “Construction of locally conformal symplectic structures”, given at two locations:
 - Dartmouth Geometry and Topology Seminar, November 2015
 - Northeastern Geometry, Physics, and Representation Theory Seminar, October 2015
- “Equivalent notions of high dimensional overtwistedness”, given at three locations:
 - Princeton/IAS Symplectic Geometry Seminar, April 2015
 - Stanford University Symplectic Geometry Seminar, January 2015
 - University of California, Los Angeles Topology Seminar, November 2014
- “Flexibility among Stein manifolds”
Microsoft Station Q/University of California, Santa Barbara joint seminar, January 2015
- “Threshold sizes in contact geometry”
Microsoft Station Q Seminar, January 2015
- “Existence of overtwisted contact structures in high dimensions”, given at five locations:
 - Université Libre de Bruxelles Geometry & Topology Seminar, October 2014
 - Harvard Gauge Theory, Topology & Symplectic Geometry Seminar, September 2014
 - Instituto de Ciencias Matemáticas Geometry Seminar, July 2014
 - Boston College Geometry/Topology Seminar, May 2014
 - Columbia Symplectic Geometry, Gauge Theory, and Categorification Seminar, April 2014
- “Lagrangian caps in high dimensional symplectic manifolds”, given at five locations:

- Northwestern University Geometry/Physics Seminar, December 2013
- Centre de Recherches Mathématiques/Université de Montréal Joint Symplectic Seminar March 2013
- Princeton/IAS University Joint Symplectic Geometry Seminar, March 2013
- MIT Geometry/Topology Seminar, March 2013
- Simons Center for Geometry and Physics/Stony Brook University Joint Topology Seminar Series, February 2013
- “The plastikstufe and connect sums of contact manifolds”
Northwestern University Geometry/Physics Graduate Student Seminar, December 2013
- “Contact geometry, Legendrian curves, and parallel parking”
Smith College Lunch Seminar, November 2013
- “Flexibility phenomena of Legendrian and Lagrangian embeddings in high dimensions”
University of Massachusetts-Amherst Geometry Seminar, November 2013
- “Exact Lagrangian immersions with few transverse self-intersections”
University of Wisconsin-Madison Geometry and Topology Seminar, April 2013
- “Loose Legendrian embeddings in high dimensional contact manifolds”, given at five locations:
 - Philadelphia Area Contact/Topology Seminar
Bryn Mawr, October 2012
 - San Francisco Bay Area Joint Symplectic Geometry Seminar
Stanford, April 2012
 - Massachusetts Institute of Technology Geometry/Topology Seminar, February 2012
 - Georgia Institute of Technology Geometry/Topology Seminar, December 2011
 - Stanford Symplectic Geometry Seminar, April 2011

Teaching Experience

- Math 460-2 (Morse theory), Instructor, Northwestern. Winter 2018.
- Math 440-2 (Introduction to Homotopy theory), Instructor, Northwestern. Winter 2018.
- Math 440-1 (Introductory Differential Topology and Geometry), Instructor, Northwestern. Fall 2017.
- Math 18.937 (Introduction to h-principles), Instructor, MIT. Spring 2016.
- Math 18.100C (Introductory Real Analysis, communication intensive), Instructor, MIT. Fall 2015.
- Math 18.965 (Introductory Differential Topology and Geometry), Instructor, MIT. Fall 2014.
- Math 18.966 (Introductory Contact Geometry), Instructor, MIT. Spring 2014.
- Math 18.02 (Vector Calculus), Teaching Assistant, MIT. Spring 2015, Fall 2013, Fall 2012.
- Math 18.03 (Ordinary Differential Equations), Teaching Assistant, MIT. Spring 2013.
- Math 21 (Sequences, Series, Intro to Differential Equations), Teaching Assistant, Stanford. Spring 2012.
- Math 51 (Linear Algebra and Vector Calculus), Teaching Assistant, Stanford. Winter 2011, Winter 2010.

Service

Organizer, “Yashafest 2018” conference, Asilomar, CA. 31 participants, August 2018.

Organizer, “ h -principles summer graduate school”, Tambara Institute of Mathematics. August 2018.

Boas Assistant Professor hiring committee member, Northwestern, 2018.

Organizer, “Engel structures workshop”, American Institute of Mathematics. 29 participants, March 2017.

Scientific committee chair, “ L_3 workshop in symplectic geometry”, January 2016.

Organizer, Geometry and Topology Seminar at MIT, Fall 2013 – Spring 2016.

Graduate admission committee member at MIT, 2015

Organizer, “Overtwistedness in High Dimensions” workshop, Asilomar, CA. 23 participants, May 2014.

Organizer, “Recent Progress in Symplectic Flexibility” workshop, Asilomar, CA. \approx 25 participants, April 2013.

Personal

Born on September 4, 1986.

United States Citizen.