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

- "Conformal symplectic geometry of cotangent bundles"
  joint with B. Chantraine
  https://arxiv.org/abs/1606.00861 (2016)

- "Subflexible symplectic manifolds"
  joint with K. Siegel
  http://arxiv.org/abs/1510.01867 (2015)

- "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)
  To appear in *Journal of Topology and Analysis*

- "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, **2** (2015) 281–361.

- "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. Ekholm, Y. Eliashberg, and I. Smith
  https://arxiv.org/abs/1303.0588 (2013)
  Geometric and Functional Analysis 23, **6** (2013), 1772-1803.

- "Lagrangian caps"
  joint with Y. Eliashberg
  https://arxiv.org/abs/1303.0586 (2013)
  Geometric and Functional Analysis 23, **5** (2013), 1483-1514.

- "Loose Legendrians and the plastikstufe"
  joint with K. Niederkrüger, O. Plamenevskaya, and A. Stipsicz
  https://arxiv.org/abs/1211.3895 (2012)
  Geometry & Topology, **17** (2013), 1791-1814.

- "Loose Legendrian embeddings in high dimensional contact manifolds"
  http://arxiv.org/abs/1201.2245 (2012)

Awards and Honors

- 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

- "Applications of flexibility in high dimensional contact geometry", five lectures
  Developments in Contact and Symplectic Topoplogy (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 Sympléctica 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

- "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

- "A frontal view of Lefschetz fibrations", given at six locations:
  - Yamabe Memorial Symposium
    University of Minnesota, September 2016
    Symplectic Techniques in Hamitonian 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

- "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

- "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 18.937 (Introduction to h-principles), Instructor, Spring 2016, MIT

Math 18.100C (Introductory Real Analysis, communication intensive), Instructor, Fall 2015, MIT

Math 18.965 (Introductory Differential Topology and Geometry), Instructor, Fall 2014, MIT

Math 18.966 (Introductory Contact Geometry), Instructor, Spring 2014, MIT

Math 18.02 (Vector Calculus), Teaching Assistant, Fall 2013, MIT

Math 18.03 (Ordinary Differential Equations), Teaching Assistant, Spring 2013, MIT

Math 18.02, Teaching Assistant, Fall 2012, MIT

Math 21 (Sequences, Series, Intro to Differential Equations), Teaching Assistant, Spring 2012, Stanford

Math 19 (Introductory Calculus), Course Assistant, Fall 2011, Stanford

Math 215C (Introductory Differential Topology), Course Assistant, Spring 2011, Stanford

Math 51 (Linear Algebra and Vector Calculus), Teaching Assistant, Winter 2011, Stanford

Math 51, Teaching Assistant, Winter 2010, Stanford

Math 19, Course Assistant, Fall 2009, Stanford

Math Center (Group tutoring center, topics ranging from high school algebra to undergraduate analysis/algebra/topology), approximately 600 hours experience, Fall 2004 to Spring 2007, UNR

Service

Scientific committee chair, "L3 workshop in symplectic geometry", January 2016.

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

Graduate admission committee member at MIT, 2015

Organizer with Matthew Strom Borman and Yakov Eliashberg of a weekend workshop at Asilomar, CA: "Overtwistedness in High Dimensions". 23 attendees, May 2014.

Acted as an adviser to Francesco Lin, writing " Exact Lagrangian caps of Legendrian knots", Spring–Summer 2013.

Organizer with Yakov Eliashberg of a weekend workshop at Asilomar, CA" "Recent Progress in Symplectic Flexibility". $\approx$ 25 attendees, April 2013.

Personal

Born on September 4, 1986.

United States Citizen.

Last updated: October 3, 2016