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		Citizenship	USA

RESEARCH INTERESTS

TOPOLOGY: low-dimensional topology, knot theory

DIFFERENTIAL GEOMETRY: symplectic geometry, contact geometry, holomorphic curves

MATHEMATICAL PHYSICS: topological string theory

PROFESSIONAL EMPLOYMENT

EADS FAMILY PROFESSOR OF MATHEMATICS	2016–present
Mathematics Department, Duke University, Durham, NC	
ASSOCIATE PROFESSOR OF MATHEMATICS	2011–2016
Mathematics Department, Duke University, Durham, NC	
ASSISTANT PROFESSOR OF MATHEMATICS	2006–2011
Mathematics Department, Duke University, Durham, NC	
FIVE-YEAR POSTDOCTORAL FELLOW	2001–2006
American Institute of Mathematics, Palo Alto, CA	
LECTURER AND VISITING SCHOLAR	2002–2006
Department of Mathematics, Stanford University, Stanford, CA	

VISITING POSITIONS

RESEARCH MEMBER	Spring 2010
Mathematical Sciences Research Institute, Berkeley, CA	
VISITING ASSISTANT PROFESSOR	Spring 2007
Department of Mathematics, Princeton University, Princeton, NJ	
MEMBER	2001–2002
School of Mathematics, Institute for Advanced Study, Princeton, NJ	

EDUCATION

PH.D. IN MATHEMATICS	June 2001
Massachusetts Institute of Technology, Cambridge, MA	
Dissertation: “Invariants of Legendrian links”, Tomasz Mrowka, advisor	
A.B. IN MATHEMATICS AND PHYSICS, <i>summa cum laude</i>	June 1996
Harvard University, Cambridge, MA	

AWARDS, GRANTS, AND HONORS**NATIONAL SCIENCE FOUNDATION GRANTS**

DMS-1707652	2017–2020
“Holomorphic Invariants in Symplectic Topology”	
DMS-1406371	2014–2018
“Knots and Contact Topology Through Holomorphic Curves”	
CAREER grant DMS-0846346	2009–2015
“Symplectic Field Theory and Low-Dimensional Topology”	
DMS-0706777	2007–2010
“Holomorphic Curves and Low-Dimensional Topology”	

FELLOW OF THE AMS

Inducted 2019

American Mathematical Society

**TOP 5% OF UNDERGRADUATE INSTRUCTORS IN ARTS & SCIENCES
(COURSE EVALUATIONS)**

Spring 2017

Duke University

BASS SOCIETY OF FELLOWS

2016–present

Duke University

SIMONS FELLOW IN MATHEMATICS

2015–2016

Simons Foundation

AMERICAN INSTITUTE OF MATHEMATICS SQUARE GRANT

2014–2017

“Sheaf Theory and Legendrian Knots”

with Dan Rutherford, Vivek Shende, Steven Sivek, David Treumann, and Eric Zaslow

AMS INVITED ADDRESS

October 2012

“From holomorphic curves to knot invariants via the cotangent bundle”

American Mathematical Society Southeastern Section Meeting, Tulane University

AIM FIVE-YEAR FELLOW

2001–2006

American Institute of Mathematics

**NATIONAL DEFENSE SCIENCE AND ENGINEERING GRADUATE
(NDSEG) FELLOW**

1996–1999

US Department of Defense

PUTNAM FELLOW

1993, 1994, 1995

William Lowell Putnam Mathematical Competition

GOLD MEDALIST

1992, 1993

International Mathematical Olympiad

PUBLICATIONS

(Papers are available at <http://math.duke.edu/~ng/math/>.)

1. **Legendrian contact homology in \mathbb{R}^3**
Joint with John Etnyre.
56 pages, arXiv:1811.10966.
2. **Representations, sheaves, and Legendrian $(2, m)$ torus links**
Joint with Baptiste Chantraine and Steven Sivek.
50 pages, arXiv:1805.03603.
3. **Higher genus knot contact homology and recursion for colored HOMFLY-PT polynomials**
Joint with Tobias Ekholm.
65 pages, arXiv:1803.04011.
4. **A complete knot invariant from contact homology**
Joint with Tobias Ekholm and Vivek Shende.
Inventiones Mathematicae **211** (2018), no. 3, 1149–1200.
5. **Knot contact homology, string topology, and the cord algebra**
Joint with Kai Cieliebak, Tobias Ekholm, and Janko Latschev.
Journal de l'École Polytechnique — Mathématiques **4** (2017), 661–780.
6. **The cardinality of the augmentation category of a Legendrian link**
Joint with Dan Rutherford, Vivek Shende, and Steven Sivek.
Mathematical Research Letters **24** (2017), no. 6, 1845–1874.
7. **Augmentations are sheaves**
Joint with Dan Rutherford, Vivek Shende, Steven Sivek, and Eric Zaslow.
102 pages, arXiv:1502.04939.
8. **Obstructions to Lagrangian concordance**
Joint with Christopher Cornwell and Steven Sivek.
Algebraic & Geometric Topology **16** (2016), no. 2, 797–824.
9. **Legendrian contact homology in the boundary of a subcritical Weinstein 4-manifold**
Joint with Tobias Ekholm.
Journal of Differential Geometry **101** (2015), no. 1, 67–157.
10. **Topological strings, D-model, and knot contact homology**
Joint with Mina Aganagic, Tobias Ekholm, and Cumrun Vafa.
Advances in Theoretical and Mathematical Physics **18** (2014), no. 4, 827–956.
11. **On transverse invariants from Khovanov homology**
Joint with Robert Lipshitz and Sucharit Sarkar.
Quantum Topology **6** (2015), no. 3, 475–513.
12. **A topological introduction to knot contact homology**
In *Contact and Symplectic Topology*, Bolyai Soc. Math. Stud. **26** (Springer, Berlin, 2014), 485–530.
13. **Satellites of Legendrian knots and representations of the Chekanov–Eliashberg algebra**
Joint with Dan Rutherford.

- Algebraic & Geometric Topology* **13** (2013), no. 5, 3047–3097.
14. **Knot contact homology**
Joint with Tobias Ekholm, John Etnyre, and Michael Sullivan.
Geometry & Topology **17** (2013), 975–1112.
 15. **An atlas of Legendrian knots**
Joint with Wutichai Chongchitmate.
Experimental Mathematics **22** (2013), no. 1, 26–37.
 16. **Combinatorial knot contact homology and transverse knots**
Advances in Mathematics **227** (2011), no. 6, 2189–2219.
 17. **Filtrations on the knot contact homology of transverse knots**
Joint with Tobias Ekholm, John Etnyre, and Michael Sullivan.
Mathematische Annalen **355** (2013), no. 4, 1561–1591.
 18. **Legendrian and transverse twist knots**
Joint with John Etnyre and Vera Vértesi.
Journal of the European Mathematical Society **15** (2013), no. 3, 451–512.
 19. **Grid diagrams, braids, and contact geometry**
Joint with Dylan Thurston.
Proceedings of 15th Gökova Geometry–Topology Conference 2008, 120–136 (Gökova Geometry–Topology Conference (GGT), Gökova, 2009).
 20. **Rational Symplectic Field Theory for Legendrian knots**
Inventiones Mathematicae **182** (2010), no. 3, 451–512.
 21. **A family of transversely nonsimple knots**
Joint with Tirasan Khandhawit.
Algebraic & Geometric Topology **10** (2010), no. 1, 293–314.
 22. **A skein approach to Bennequin type inequalities**
International Mathematics Research Notices **2008**, Art. ID rnn116, 18 pp.
 23. **Transverse knots distinguished by knot Floer homology**
Joint with Peter Ozsváth and Dylan Thurston.
Journal of Symplectic Geometry **6** (2008), no. 4, 461–490.
 24. **On arc index and maximal Thurston–Bennequin number**
Journal of Knot Theory and Its Ramifications **21** (2012), no. 4, 1250031, 11 pp.
 25. **A Legendrian Thurston–Bennequin bound from Khovanov homology**
Algebraic & Geometric Topology **5** (2005), 1637–1653.
 26. **The correspondence between augmentations and rulings for Legendrian knots**
Joint with Joshua Sabloff.
Pacific Journal of Mathematics **224** (2006), no. 1, 141–150.
 27. **Plane curves and contact geometry**
Proceedings of Gökova Geometry–Topology Conference 2005, 162–171 (Gökova Geometry–Topology Conference (GGT), Gökova, 2006).
 28. **Conormal bundles, contact homology, and knot invariants**
In *The interaction of finite type and Gromov–Witten invariants (BIRS 2003)*, *Geometry & Topology Monographs* **8** (2006), 129–144.

29. **Framed knot contact homology**
Duke Mathematical Journal **141** (2008), no. 2, 365–406.
30. **Legendrian solid-torus links**
Joint with Lisa Traynor.
Journal of Symplectic Geometry **2** (2005), no. 3, 411–443.
31. **Knot and braid invariants from contact homology II**
Geometry & Topology **9** (2005), 1603–1637.
32. **Knot and braid invariants from contact homology I**
Geometry & Topology **9** (2005), 247–297.
33. **Problems in low dimensional contact geometry**
Joint with John Etnyre.
In *Topology and Geometry of Manifolds, Proc. Sympos. Pure Math.* **71** (2003), 337–357.
34. **Invariants of Legendrian links and coherent orientations**
Joint with John Etnyre and Joshua Sabloff.
Journal of Symplectic Geometry **1** (2002), no. 2, 321–367.
35. **Computable Legendrian invariants**
Topology **42** (2003), no. 1, 55–82.
36. **Maximal Thurston–Bennequin number of two-bridge links**
Algebraic & Geometric Topology **1** (2001), 427–434.
37. **The rook on the half-chessboard, or how not to diagonalize a matrix**
Joint with Kiran Kedlaya.
American Mathematical Monthly **105** (1998), no. 9, 819–824.
38. **Hamiltonian decomposition of lexicographic products of digraphs**
Journal of Combinatorial Theory Series B **73** (1998), no. 2, 119–129.
39. **Hamiltonian decomposition of complete regular multipartite digraphs**
Discrete Mathematics **177** (1997), no. 1-3, 279–285.
40. **k -ordered hamiltonian graphs**
Joint with Michelle Schultz.
Journal of Graph Theory **24** (1997), no. 1, 45–57.

INVITED TALKS

Lecture series and minicourses

“KNOT CONTACT HOMOLOGY, STRING TOPOLOGY, & TOPOLOGICAL STRINGS” Jan. 2018
Mirror Symmetry and Related Topics Conference, Simons Collaboration on Homological Mirror Symmetry, Miami.

“KNOT CONTACT HOMOLOGY AND AUGMENTATION VARIETIES” August 2016
Hamilton Geometry & Topology Workshop, The Hamilton Mathematics Institute, Trinity College, Dublin.

“CONORMAL BUNDLES, KNOT INVARIANTS, AND TOPOLOGICAL STRINGS” Jan. 2015
SwissMAP Geometry & Topology Conference, Engelberg, Switzerland.

- “GRID DIAGRAMS AND CONTACT GEOMETRY” August 2014
Combinatorial Link Homology Theories, Braids, and Contact Geometry, ICERM.
- “KNOT CONTACT HOMOLOGY AND APPLICATIONS” July 2012
Contact and Symplectic Topology Summer School and Conference, Rényi Institute.
- “KNOTS AND THE TOPOLOGY OF THREE-MANIFOLDS” July 2010
Conference “O Gosto pela Matemática”, Fundação Calouste Gulbenkian, Lisbon.
- “LEGENDRIAN KNOTS” January 2010
Introductory Workshop: Homology Theories of Knots and Links, MSRI.
- “CONTACT GEOMETRY AND THREE-DIMENSIONAL TOPOLOGY” August 2009
Summer Graduate Workshop: Symplectic and Contact Geometry and Topology, MSRI.
- “LEGENDRIAN SYMPLECTIC FIELD THEORY” August 2008
Holomorphic Curves: Algebraic Structures and Geometric Application, Stanford.
- “KNOTS AND SYMPLECTIC TOPOLOGY” October 2006
Salomon Bochner Lectures in Mathematics, Rice.
- “INVARIANTS OF KNOTS AND LINKS VIA SFT” August 2006
Workshop on Symplectic Field Theory, Universität Leipzig.
- “KNOT INVARIANTS FROM CONTACT HOMOLOGY” June 2003
Courbes Holomorphes et Topologie de Contact, CNRS summer school, Berder, France.

Conference talks

- Mini-workshop on Legendrian submanifolds, UQAM, November 2018.
- Geometric methods in symplectic and contact topology (Yashafest), Asilomar, August 2018.
- Symplectic geometry and its interactions with low-dimensional topology, Princeton, June 2018.
- Categorification in mathematical physics, Simons Center, April 2018.
- Holomorphic curves and symplectic topology, Institut Mittag-Leffler, Sweden, August 2017.
- Homological mirror symmetry: methods and structures, IAS, November 2016.
- Knots in the Triangle, NC State, May 2016.
- Interactions of gauge theory with contact and symplectic topology in dimensions 3 and 4, BIRS, March 2016.
- Augmentations and Legendrians at the IAS, IAS, February 2016.
- Recent challenges in contact geometry, CIRM, Luminy, France, June 2015.
- Physics and mathematics of knot homologies, Simons Center, June 2015.
- Quantum curves and quantum knot invariants, BIRS, June 2014.
- Low-dimensional topology after Floer, Université de Montréal, July 2013.
- Low dimensional topology, Simons Center, May 2013.
- Southern California Topology Colloquium, Caltech, March 2013.
- Interactions of gauge theory with contact and symplectic geometry in dimensions 3 and 4, BIRS, March 2013.

- Graduate Workshop on Symplectic and Contact Topology, Simons Center, October 2012.
- Holomorphic Curves and Low Dimensional Topology, Stanford, August 2012.
- Tech Topology Conference, Georgia Tech, December 2011.
- Contact and symplectic topology, Université de Nantes, June 2011.
- Interactions between contact & symplectic topology and gauge theory in dimensions 3 and 4, BIRS, March 2011.
- Categorification and Low Dimensional Topology, Stony Brook, June 2010.
- Knots, Contact Geometry and Floer Homology, Tokyo, May 2010.
- Introductory Workshop: Symplectic and Contact Geometry and Topology, MSRI, August 2009.
- Mirror Symmetry, Symplectic Geometry, and Related Topics, MIT, June 2009.
- Georgia International Topology Conference, University of Georgia, May 2009.
- Interactions of Geometry and Topology in Dimensions 3 and 4, BIRS, March 2009.
- Illinois/Indiana Symplectic Geometry Conference, UIUC, March 2009.
- AMS special session, Joint Mathematics Meetings, Washington, DC, January 2009.
- Math Institutes Modern Mathematics Workshop, Society for Advancement of Chicanos and Native Americans in Science annual conference, Salt Lake City, October 2008.
- Legendrian and Transverse Knots, AIM, September 2008.
- Gökova Geometry-Topology Conference, Gökova, Turkey, May 2008.
- Knots in Washington XXVI, George Washington University, April 2008.
- Towards Relative Symplectic Field Theory, CUNY, September 2007.
- Communicating Mathematics, University of Minnesota at Duluth, July 2007.
- Interactions of Geometry and Topology in Low Dimensions, BIRS, March 2007.
- Low Dimensional Topology, Park City Mathematics Institute, July 2006.
- Conference on 3-manifold Topology in honor of Peter Shalen, Montréal, June 2006.
- Around Khovanov homology, UQAM, October 2005.
- Holomorphic Curves Workshop, IAS, June 2005.
- Gökova Geometry/Topology Conference, Gökova, Turkey, June 2005.
- The Interaction of Finite Type and Gromov–Witten Invariants, BIRS, November 2003.
- Holomorphic Curves in Contact Geometry, AIM, August 2003.
- Symplectic Geometry and Physics Workshop, IPAM, March 2003.
- Holomorphic Curves and Low Dimensional Topology, IAS, March 2002.
- Georgia International Topology Conference, University of Georgia, May 2001.
- Contact Geometry, Stanford/AIM, December 2000.
- AMS sectional meeting special sessions: Georgetown, March 2015; Temple, October 2013; Wake Forest, September 2011; UCLA, October 2010; NC State, April 2009; Courant, April 2003; Georgia Tech, March 2002.

Colloquia

- Stony Brook University, October 2018.
- UCLA, April 2017.
- Rutgers University, February 2017.
- University of Oregon, April 2016.

- University of California at San Diego, January 2016.
- University of Toronto, January 2016.
- Rice University, December 2015.
- University of Virginia, November 2015.
- Princeton University, December 2014.
- Northwestern University, May 2014.
- University of California at Santa Barbara, November 2013.
- Australian National University, June 2013.
- University of Southern California, October 2012.
- Dartmouth College, May 2008.
- University of North Carolina at Chapel Hill, November 2006.
- University of California at Berkeley, February 2006.
- University of Illinois at Urbana–Champaign, January 2006.
- University of Illinois at Chicago, January 2006.
- Rutgers University, January 2006.
- University of Toronto, January 2006.
- University of Wisconsin, November 2005.
- Columbia University, September 2005.

Seminar talks

- 2018: Georgia Tech, Stony Brook University.
- 2017: Columbia University, Institute for Advanced Study.
- 2016: Columbia University, Princeton University, Temple University, University of Oregon.
- 2015: Institut Mittag-Leffler.
- 2014: University at Buffalo, Columbia University, Uppsala University, Princeton University.
- 2013: Australian National University, UC Santa Barbara, MIT.
- 2011: MIT, Columbia University, Haverford College, Simons Center.
- 2010: Princeton University.
- 2009: ETH Zürich (2).
- 2008: Stanford University, MIT.
- 2007: Columbia University (2), Princeton University, SUNY Stony Brook, University of Virginia, MIT, Harvard University.
- 2006: University of Texas, Duke University.
- 2005: Bryn Mawr College/Haverford College, University of California–Berkeley (2), Columbia University (2), Georgia Institute of Technology, University of Wisconsin, University of Southern California, University of Illinois at Urbana–Champaign.
- 2004: University of Southern California/California Institute of Technology, Stanford University.
- 2003: University of California–Berkeley, Stanford University, University of Pennsylvania, Harvard University, Haverford College.
- 2002: Columbia University, Stanford University.

- 2001: University of North Carolina, Princeton University.
- 2000: Stanford University, Harvard University.

ADVISING AND RESEARCH SUPERVISION

Postdoctoral fellows

- Dan Rutherford, Assistant Research Professor, Duke, 2008–2011.
- Christopher Cornwell, Visiting Assistant Professor, Duke, 2011–2014.
- Michael Abel, Visiting Assistant Professor and Instructor, Duke, 2015–2018.
- Ziva Myer, Elliott Assistant Research Professor, Duke, 2017–present.
- Faramarz Vafaee, Griffiths Assistant Research Professor, Duke, 2018–present.

Graduate students

- David Rose, Ph.D. spring 2012.
Dissertation: “Categorification of quantum \mathfrak{sl}_3 projectors and the \mathfrak{sl}_3 Reshetikhin–Turaev invariant of framed tangles”.
Initial placement: Busemann Assistant Professor, University of Southern California;
current position: Assistant Professor, University of North Carolina.
- Zachary Doenges, M.S. fall 2014.
- Caitlin Levenson, Ph.D. spring 2016.
Dissertation: “Augmentations and rulings of Legendrian links”.
Initial placement/current position: NSF Postdoctoral Research Fellow, Georgia Tech.
- Yu Pan, Ph.D. spring 2017.
Dissertation: “Augmentations and exact Lagrangian cobordisms”.
Initial placement/current position: CLE Moore Instructor, MIT.
- Chester Lian, current, matriculated 2013.
- Dmitry Vagner (co-advisor), current, matriculated 2013.
- Orsola Capovilla-Searle, current, matriculated 2015.

Undergraduate students

- Tirasan Khandhawit, PRUV (Program for Research for Undergraduates with VIGRE) Fellow, 2007. Project: transversely nonsimple knots.
- Wutichai Chongchitmate, PRUV Fellow, 2009. Project: enumerating Legendrian knots.
- Alexandru Milu, PRUV Fellow, Duke, 2014. Project: the augmentation category.
- Blythe Davis, PRUV Fellow, Duke, 2018. Project: the sheaf and representation categories of Legendrian knots.

High school students

- Michael An, Evan Liang, and Aninda Manocha, 2014–2015 research through the program “Discovering Research in Mathematics”, joint between the Duke Mathematics Department and the North Carolina School of Science and Mathematics. Project: grid diagrams and transverse knots.

SERVICE AND MISCELLANEOUS

University service

- Co-director, Duke Opportunities in Mathematics (collaborative research program in mathematics for undergraduates), 2017–present.
- Search committee, Vice Provost for Undergraduate Education, Duke University, 2018.

Service to the discipline

- Editor, *Quantum Topology*, 2009–present.
- Collaborating editor, Problems section, *American Mathematical Monthly*, 2017–present.
- Member, Subcommittee for the United States Mathematical Olympiad, Mathematical Association of America, 2009–2014.
- Member, AMS Southeastern Section Program Committee, American Mathematical Society, 2014–2016.
- Reviewed for: NSF grant panel (3); Mathematical Reviews; *Acta Mathematica*, *Advances in Mathematics*, *Algebraic & Geometric Topology*, *Communications in Contemporary Mathematics*, *Compositio Mathematica*, *Comptes Rendus Académie des Sciences*, *Discrete Mathematics*, *Duke Mathematical Journal*, *Experimental Mathematics*, *Geometry & Topology*, *International Journal of Mathematics*, *International Mathematics Research Notices*, *Involve*, *Journal of Differential Geometry*, *Journal of Graph Theory*, *Journal of Knot Theory and Its Ramifications*, *Journal of Symplectic Geometry*, *Journal of the European Mathematical Society*, *Journal of the London Mathematical Society*, *Journal of Topology*, *Mathematische Annalen*, *Pacific Journal of Mathematics*, *Proceedings of the AMS*, *Proceedings of the National Academy of Sciences*, *Rose-Hulman Undergraduate Mathematics Journal*, *Topology and Its Applications*, *Transactions of the AMS*.
- Instructor for Berkeley Math Circle (for high school students), 2010; San Jose Math Circle (for middle school students), 2006; Stanford Math Circle (for high school students), 2005.
- Contributor to the online archive of solutions for the Putnam Mathematical Competition (<http://kskedlaya.org/putnam-archive>), 1997–present.

Conference organization

- Organizer for the program “Symplectic Geometry and Topology”, Institut Mittag-Leffler, Fall 2015.
- Organizer for the conferences: “Cyclic Homology and Symplectic Topology”, American Institute of Mathematics, November 2009; “Algebraic Structures in the Theory of Holomorphic Curves”, Mathematical Sciences Research Institute, November 2009; “27th Annual Geometry Festival”, Duke University, April 2012; “Workshop on Symplectic Geometry and Topology”, Uppsala University, September 2015; Fourth Duke Mathematical Journal Conference, Duke University, April 2018.
- Organizer for the special sessions: “Low dimensional topology and geometry”, AMS Southeastern Sectional Meeting, NC State University, April 2009; “Interactions of geometry and topology in low dimensions”, AMS Southeastern Sectional Meeting, Tulane

University, October 2012; “Contact geometry and low-dimensional topology”, AMS Western Sectional Meeting, UNLV, April 2015; “Low-dimensional topology”, AMS Southeastern Sectional Meeting, NC State University, November 2016.