

Travis Mandel

Assistant Professor in Mathematics

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Research Interests

Algebraic-geometric aspects of mirror symmetry; theta functions for quantum and classical cluster algebras; tropical and log Gromov-Witten theory; DT-theory of quivers; the interplay of everything listed here.

Education and Employment

- University of Oklahoma, Norman, OK, 2020-present
Assistant professor
- University of Edinburgh, Edinburgh, UK, 2018-2020
Postdoctoral research associate
- University of Utah, Salt Lake City, UT, 2015-2018
Research assistant professor (postdoc)
- Centre for Quantum Geometry of Moduli Spaces, Aarhus, Denmark, 2014-2015
Postdoc
- University of Texas at Austin, Austin, TX, 2008-2014
Mathematics Ph.D. student
Advisor: Sean Keel
Graduation Date: May 2014
- Tulane University, New Orleans, LA, 2005-2008
B.S. Mathematics and Physics
- NSF Research Experience for Undergraduates, UNC Greensboro, Summer 2007
Supervisor: Francine Blanchet-Sadri
Topic: Algorithmic Combinatorics on Words

Papers

Published:

- *Tropical quantum field theory, mirror polyvector fields, and multiplicities of tropical curves*, with Helge Ruddat. IMRN, 2023.
- *Strong positivity for quantum theta bases of quantum cluster algebras*, with Ben Davison. Inventiones Math., 2021.
- *Scattering diagrams, theta functions, and refined tropical curve counts*, J. London Math. Soc., 2021.
- *Theta bases and log Gromov-Witten invariants of cluster varieties*, Trans. Amer. Math. Soc., 2021.
- *Donaldson-Thomas invariants from tropical disks*, with Man-Wai Cheung. Selecta Math. (N.S.), 2020.
- *Descendant log Gromov-Witten invariants for toric varieties and tropical curves*, with Helge Ruddat. Trans. Amer. Math. Soc., 2020.
- *Classification of Rank 2 Cluster Varieties*, SIGMA Symmetry Integrability Geom. Methods Appl., 2019.
- *Cluster algebras are Cox rings*, Manuscripta Math., 2018.
- *Theta bases are atomic*, Compos. Math., 2017.
- *Tropical Theta Functions and Log Calabi-Yau Surfaces*, Selecta Math. (N.S.), 2016.
- *Periods in Partial Words: An Algorithm*, with F. Blanchet-Sadri and Gautam Sisodia. J. Discrete Algorithms, 2012.

Preprints:

- *Fano mirror periods from the Frobenius structure conjecture*, arXiv:1903.12014.
- *Bracelets bases are theta bases*, with Fan Qin, arXiv:2301.11101.
- *Stability scattering diagrams and quiver coverings*, with Qiyue Chen and Fan Qin, arXiv:2306.04104.

Talks

- **Algebraic Geometry Seminar**, University of Georgia
Bracelets bases are theta bases (November 29, 2023)
- **Algebra and representation theory seminar**, University of Oklahoma
Quiver coverings and their representations (September 22, 2023)
- **Geometry and topology seminar**, University of Oklahoma
Canonical coordinates on decorated Teichmüller space (August 30, 2023)
- **Fano search group seminar**, Imperial College London
Valuative independence of theta functions (June 29, 2023) [Slides](#).
- **Geometry, Physics, and Representation Theory Seminar**, Northeastern University
Bracelets bases are theta bases (February 23, 2023) [Slides](#), [Video](#).
- **Geometry and Topology Seminar**, University of Iowa
Bracelets bases are theta bases (February 9, 2023)
- **Resources for Alternative Methods in Pedagogy for University Professionals**, Univ. of Oklahoma
Using iClicker for calculus instruction (February 7, 2023)
- **Cluster structures on coordinate rings**, online seminar
Bracelet bases are theta bases (December 5, 2022) [Slides](#), [Video](#).
- **Northwestern University Geometry/Physics Seminar**
Bracelets bases are theta bases (November 7, 2022).
- **Mirror symmetry for Looijenga interiors and beyond**, hybrid on Zoom and at Bogazici University
Summer school: *Classification of Looijenga interiors I and II* (July 19, 2022). [Notes](#). Videos [1](#) and [2](#).
Conference: *Tropical theta functions for cluster varieties* (July 28, 2022) [Notes](#). [Video](#).
- **Freemath seminar**, online geometry seminar hosted via BBB
Bracelet bases are theta bases (February 15, 2022) [Slides](#), [Video](#).
- **Algebra and representation theory seminar**, University of Oklahoma
The atomic basis for surface skein algebras (November 19, 2021)
- **Workshop on Cluster Algebras and Related Topics**, Morningside Center of Mathematics, CAS
Bracelet bases are theta bases (August 3, 2021) [Slides/Video](#).
- **Online Algebraic Geometry Seminar**, University of Nottingham
Quantum theta bases for quantum cluster algebras (May 5, 2021) [Slides](#), [Video](#).
- **Geometry and physics seminar**, Boston University
Tropical multiplicities from polyvector fields and QFT (March 10, 2021)
- **Geometry seminar**, University of Kansas
Quantum theta bases for quantum cluster algebras (March 5, 2021)
- **QSMS Winter school on mirror symmetry and related topics (Part II)**, QSMS (online)
Quantum theta bases (February 22-23, 2021). Slides: [part 1](#), [part 2](#).
- **Cluster Algebras 2020**, Shanghai Jiao Tong University (online)
Quantum theta bases (August 27, 2020). [Slides](#).
- **Algebraic Geometry Seminar**, University of Sheffield
Tropical multiplicities from polyvector fields and QFT (April 21, 2020). [Slides](#).
- **University of Oklahoma Colloquium**
Mirror symmetry and canonical bases for quantum cluster algebras (February 18, 2020)
- **University of Minnesota Colloquium**
Mirror symmetry and canonical bases for quantum cluster algebras (December 3, 2019)
- **Geometry and Mathematical Physics Seminar**, University of Birmingham
Strong positivity for quantum cluster algebras (November 19, 2019)
- **Mirror Symmetry and Fano Varieties II**, 3CinG Workshop, Chicheley Hall
Fano mirror periods from the Frobenius structure conjecture (September 25-27, 2019)
- **ARTIN 2019**, University of Edinburgh
Strong positivity for quantum cluster algebras (September 11, 2019)
- **Logarithmic Enumerative Geometry and Mirror Symmetry**, Oberwolfach

- Tropical curve multiplicities from mirror polyvector fields* (June 17, 2019)
- **Warwick Algebraic Geometry Seminar**, University of Warwick
Tropical multiplicities from mirror polyvector fields and tropical quantum field theory (June 11, 2019)
- **Valuations and birational geometry**, Lille, France
Three-talk mini-course:
Log geometry, tropical geometry, and mirror symmetry for cluster varieties (May 13-17, 2019). [Notes](#).
- **Workshop: Classification, Computation, and Construction, New Methods in Geometry**, Warwick
Towards log quantum cohomology (October 15, 2018)
- **Workshop on Structures in Enumerative Geometry**, MSRI
Poster: *Log quantum cohomology and mirror symmetry* (March 20, 2018)
- **Algebraic and Tropical Geometry**, Yale University
Log quantum cohomology and tropical quantum field theory (March 2, 2018)
- **Cluster Algebras and Log GW Invariants in GS program**, KIAS
Three lectures (February 20-22, 2017). [Notes](#).
Descendant log GW invariants are tropical curve counts
Broken lines and theta functions
Theta functions and log GW invariants
- **FRAGMENT seminar**, Colorado State University
Descendant log Gromov-Witten theory and tropical curves (February 9, 2017)
- **Algebraic Geometry Seminar**, University of Utah
Descendant log Gromov-Witten theory and tropical curves (February 7, 2017)
Tropical curve counting and canonical bases (September 1, 2015)
- **Quivers, cluster algebra and mathematical physics**, Chinese University of Hong Kong
Theta bases and curve counting (December 20, 2016)
- **AMS Summer Institute in Algebraic Geometry**, University of Utah
Tropical curve counting and canonical bases (July 23, 2015) [Slides](#).
- **Research Seminar: Complex Geometry**, Universität Hamburg
Tropical curve counting and canonical bases (June 5, 2015)
- **Seminar on Representation Theory**, Universität Bielefeld
Tropical curve counting and canonical bases (May 27, 2015)
Also, invited special guest participant and speaker for the Cluster Algebra Reading Group session on “Scattering diagrams and their applications.”
- **Seminari di Algebra e Geometria**, Università degli Studi di Pavia
Tropical curve counting and canonical bases (May 12, 2015)
- **SFB-Kolloquium**, Johannes Gutenberg Universität Mainz
Tropical curve counts and quantum cluster varieties (Jan 22, 2015)
- **Conference on Cluster Algebras in Combinatorics and Topology**, KIAS
Tropical curve counts and a Frobenius structure on cluster algebras (Dec 13, 2014)
- **QGM Nielsen Retreat**, Sønderborg, DK
Tropical Curve Counts and a Frobenius Form for Cluster Varieties (Oct 27, 2014)
- **QGM Junior Retreat**, Aarhus University
Theta Functions on Moduli of Local Systems (Aug 13, 2014)
- **Texas Algebraic Geometry Symposium**, Rice University
Poster: *Tropical Theta Functions* (Apr 5, 2014)
- **Workshop on Mirror Symmetry and Cluster Algebras**, University of Leeds
Theta Functions on Cluster Varieties (September 12 2013)
- **MIT-RTG Mirror Symmetry Workshop**, Big Bear Lake, CA
[Gross-Hacking-Keel I](#) (May 30, 2013)
- **Graduate Geometry and Topology Current Literature Seminar**, UT Austin
How to Construct a Mirror Family (Feb 1, 2013)
- **Student Geometry Seminar**, UT Austin
[Intro to GIT](#) (Nov 26, 2013)
Cluster Varieties in Birational Geometry (Jan 22, 2013)
An Introduction to Toric Varieties from Fans (Oct 2, 2012)
Gromov-Witten Invariants and Quantum Cohomology (Oct 17, 2011)
Scattering Diagrams and Relative Gromov-Witten Invariants (Nov 30, 2010)

- **SIAM Conference on Discrete Mathematics**, Austin, TX
Computing Periods in Partial Words (June 16, 2010)

Teaching

- **At University of Oklahoma:**
 - Spring 2024:** Calculus and Analytic Geometry IV
Abstract Algebra II
 - Fall 2023:** Abstract Algebra I
 - Spring 2023:** Calculus and Analytic Geometry I
Introduction to Abstract Algebra I
 - Fall 2022:** Differential and Integral Calculus I (large section)
 - Spring 2022:** Differential and Integral Calculus III (2 sections, including 1 honors section)
Graduate Mathematics Reading
 - Fall 2021:** Topics in algebra: Toric varieties ([course notes](#))
 - Spring 2021:** Calculus and Analytic Geometry IV (2 sections)
 - Fall 2020:** Calculus and Analytic Geometry II (2 sections)
- **At University of Utah:**
 - Calculus III: Spring 2016, Spring 2017, Spring 2018
 - Foundations of Analysis II: Fall 2017 ([course notes and homework solutions](#))
 - Foundations of Analysis I: Fall 2016
 - Calculus II: Fall 2015
- **At University of Aarhus:**
 - Cluster Varieties and GHK Mirror Symmetry: Fall 2014 ([course notes](#))
- **At University of Texas at Austin:**
 - Teaching Assistant:*
 - Integral Calculus for Science: Spring 2014
 - Integral Calculus: Summer 2012
 - Differential and Integral Calculus I: Fall 2008 - Spring 2009
 - Grader:*
 - Algebraic Structures; Curves and Surfaces: - Fall 2013
 - Linear Algebra; Real Analysis: - Summer 2010
 - Unofficial Teaching Assistant*
 - Abstract Algebra: Summer 2012
 - Discrete Mathematics: Summer 2011
 - Supplemental Instruction Teaching Assistant*
 - Differential Calculus: Fall 2009 - Spring 2010

Mentoring, Outreach, and Service

- Serving on PhD advisory committees for Chih-Kuang Lee, Shravan Saoji, and James Beyer at OU.
- **Committee/service work at OU**
 - 2023-:**
 - Cofounded and led the [Norman Math Circle at OU](#). This is a free math outreach program for local middle and high school students.
 - 2021-:**
 - Coordinator/chair for OU's Algebra and Representation Theory Seminar (ARTS).
 - Member of the undergraduate committee.
 - Volunteer helper for Math Day (Fall 2022)
 - 2021-2022:**
 - Coordinator/chair for OU's Algebra and Representation Theory Seminar (ARTS).
 - Member of the graduate, undergraduate, and math club committees.

2020-2021:

- Member of the undergraduate, math club, and Karcher colloquium committees
- **Refereed** articles for many different journals.
- **Postdoc officer**, University of Edinburgh, Maths Department, 2018 – 2019.
Represent postdocs at meetings of the Good Practice Committee.
- **Mentor** for *Undergraduate Special Project* (senior thesis for student in scientific-computing emphasis)
Salt Lake City, UT, Spring 2018
Title: Eigenfaces and Facial Recognition.
- **Co-mentor** with Yuan Wang for *Independent Research Experience for Undergraduates (REU) program*,
Salt Lake City, UT, Summer 2016
Title: Geometry of Surfaces.
- **Mentor** for *Directed Reading Program*, which pairs undergraduate math students with graduate students for independent study projects. Focused on classification of semisimple Lie algebras.
Austin, TX, Spring 2013.
- **Speaker** and **Graduate student helper** for *Sunday Math Circle/Saturday Morning Math Group*
Lecture programs for middle and high school students
Austin, TX, Fall 2012
Presented: [Compass and Straightedge Constructions \(worksheet\)](#).

Conferences attended

- Bases for Cluster Algebras
Hybrid on Zoom and at Casa Matemática Oaxaca, September 2022
- Mirror symmetry for Looijenga interiors and beyond
Hybrid on Zoom and at Bogazici University, July 2022
- Workshop on Cluster Algebras and Related Topics
Morningside Center of Mathematics, CAS (online), August 2021
- QSMS Winter school on mirror symmetry and related topics (Part II)
QSMS (online), February 2021
- Cluster Algebras 2020
Shanghai Jiao Tong University (online), August 2020.
- 3CinG Workshop: Mirror Symmetry and Fano Varieties II
Chicheley Hall, September 2019
- ARTIN 2019
University of Edinburgh, September 2019
- Curve counting theories and related algebraic structures
University of Leeds, September 2019
- Logarithmic Enumerative Geometry and Mirror Symmetry
Oberwolfach, June 2019
- Summer School 2019: New Perspectives in Gromov-Witten Theory
IMJ-PRG, Sorbonne University, Paris, June 3 - June 7, 2019
- Valuations and birational geometry
Université de Lille, May 13–17, 2019
- Workshop in Geometry and Mathematical Physics
Loughborough University, March 2019
- Constructions and Obstructions in Birational Geometry
University of Edinburgh, November 2018
- Classification, Computation, and Construction, New Methods in Geometry
University of Warwick, October 2018
- Degenerate Contributions to Enumerative Invariants
Imperial College London, July-August 2018

- MSRI Workshop: Structures in Enumerative Geometry
Mathematical Sciences Research Institute, March 2018
- Cluster Algebras and Log GW Invariants in GS program
Korea Institute for Advanced Study, February 2017
- Quivers, cluster algebra and mathematical physics
Chinese University of Hong Kong, December 2016
- MSRI Hot Topics Workshop: Cluster algebras and wall-crossing
Mathematical Sciences Research Institute, March 2016
- AMS Summer Institute in Algebraic Geometry
University of Utah, July 2015
- Cluster Algebra Reading Group: Scattering diagrams and their applications
Universität Bielefeld, May 2015
- Masterclass on quantized quiver varieties
Aarhus University, March 2015
- Conference on Cluster Algebras in Combinatorics and Topology
Korea Institute for Advanced Study, December 2014
- QGM Nielsen Retreat
Sønderborg, DK, October 2014
- QGM Junior Retreat
Aarhus University, July-August 2014
- Focus Research Group Workshop on Arithmetic and Geometry of Rational Curves
Rice University, September 2013
- Workshop on Mirror Symmetry and Cluster Algebras
University of Leeds, September 2013
- 2013 MIT-RTG Mirror Symmetry Workshop
Big Bear Lake, CA, May 2013
- Texas Algebraic Geometry Symposium
Rice University, April 2014
University of Texas at Austin, April 2013
Texas A&M University, April 2012
Rice University, April 2011
University of Texas at Austin, April 2010
- Graduate Student Workshop on Moduli Spaces and Bridgeland Stability
University of Illinois at Chicago, Chicago, IL, March 2013
- Joint Math Meetings
New Orleans, LA, Jan 2011
- Compact Moduli and Vector Bundles Conference
University of Georgia, Athens, GA, Oct 2010
- SIAM Conference on Discrete Mathematics
Austin, TX, 2010