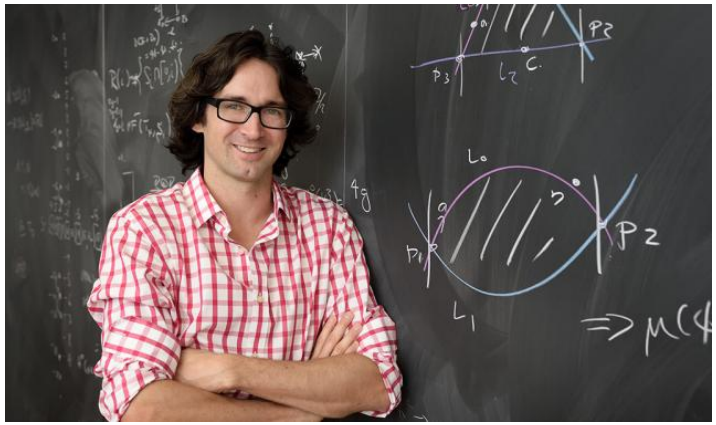
Matthew Hedden

Presented by Jen Hom



Matthew Hedden

- University of Notre Dame, BA Math and Physics, 2001
- Columbia University, PhD Math, 2005. Advisor: P. Ozsváth
- NSF Postdoc at Princeton, CLE Moore Instructor at MIT
- 2009 – present: faculty at Michigan State University (Full Professor since 2019)

Funding and Awards

- Continuous NSF funding since 2005
  - NSF postdoc 2005 – 2007
  - NSF CAREER grant 2012 – 2017
  - 3 standard NSF grants
  - 2 NSF conferences grants
- Sloan Fellowship 2011 – 2013
- AMS Invited Address, 2020
- Teaching awards
  - College of Natural Science Teacher-Scholar Award, MSU
  - J. S. Frame Teaching Excellence Award, MSU

Publications

30 published papers, 3 submitted

- 4 in *Advances in Mathematics*
- 4 in *Geometry & Topology* (top journal in field)
- 1 in *JEMS*
- 2 in *JDG*
- 1 in *Crelle*
- 1 in *Commentarii*
- 2 in *IMRN*
- 2 in *American Journal of Mathematics*
- 1 pending revision at *Inventiones*

Mentoring and Service

- 6 PhD students, 5 current PhD students
  - PhD students obtained postdocs at Rice University, CalTech, Duke, Max Planck, KIAS, etc
- 5 postdocs
- Co-organized 8 conferences since 2012, plus a pending proposal for a semester-long program at ICERM

Research

Geometry and topology, with an emphasis on applications of symplectic and contact geometry, gauge theory, and quantum algebra to the study of low-dimensional manifolds.

What sets Hedden apart: The **breadth** of the tools that he uses to study low-dimensional topology

Research

Classical knot invariants: Alexander polynomial, Jones polynomial

Modern knot invariants: Knot Floer homology, Khovanov homology

Two numerical invariants, τ and s, coming from knot Floer homology and Khovanov homology were conjectured to be equal until:

Theorem (Hedden–Ording, 2008)

The invariants τ and s are not equal.

Called a "landmark paper" by P. Ozsváth

Research

Let $Kh(L)$ denote the Khovanov homology of the link L

Question

If $Kh(L_1) = Kh(L_2)$, is $L_1 = L_2$?

Kronheimer-Mrowka: Yes if L_1 =unknot

Theorem (Hedden–Ni, 2013)

Yes, if L_1 is the unlink.

Research

Hedden also has results in gauge theory, symplectic and contact geometry, cobordism, categorification, singularities. (Too many to list here.) For example:

Theorem (Hedden–Kim–Park–Mark, 2018)

There are infinitely many irreducible manifolds with the same homology groups as $S^1 \times S^2$, but which are not surgery on a knot.

Answers a question of Aschenbrenner, Friedl and Wilton.

Comments from letters

"Matt Hedden stands in the **top tier among all geometric topologists who have entered the field in the last twenty years** . . . In the last twenty years, Ozsváth and Szabó have advised almost 40 PhD students. The total number of people who have entered into low-dimensional geometric topology in that time is at least double that number... **Among them all, I can find only two who might offer reasonable comparisons to Hedden.** These are Jake Rasmussen (PhD 2003, now at Oxford) and Ciprian Manolescu (PhD 2004, now at Stanford). . . . His presence will enhance the status and visibility of any department he joins."
- Professor C. Livingston, University of Indiana

Comments from letters

"This is an enthusiastic recommendation for Matt Hedden for a senior position at a strong research university . . . has established himself as a leading figure in low dimensional topology. . . . **a real opportunity for a department to hire a powerful mathematician at his prime**."
- Professor T. Mrowka, MIT

"Matt is a leading mathematician at the interface between low-dimensional topology, gauge theory, and symplectic geometry. He has **proved a number of fundamental results in the field**, and has been quite remarkably producing research at a steady pace over the years."
- Professor P. Ozsváth, Princeton

Hiring Case for Teena Gerhardt

Presented by Dan Margalit

Vitals

- B.S. (with honors) in Math from Stanford in 2002
- Ph.D. from MIT in 2007 under Lars Hesselholt
- Zorn postdoctoral fellow at Indiana 2007-2010
- Assistant professor at Michigan St 2010-2017
- Associate professor at Michigan St 2017-present
- Studies Algebraic Topology

Awards

- NSF CAREER Award 2012
- MSRI Eisenbud Professor 2020
- Two NSF Standard Awards 2010 & 2018
- AMS Invited Address, Central Section Meeting 2019
- MIT Presidential Fellowship 2002
- Goldwater Scholarship 2001
- Teaching Awards
  - College of Natural Science Fritz Excellence in Teaching Award 2019
  - College of Natural Science Teaching Prize 2016
  - Michigan State University Teacher-Scholar Award, 2014
  - Etc.

Publications

- Journal of Algebra: A*
- Journal of Topology: A
- Proceedings of the AMS: A
- Algebraic & Geometric Topology : A
- Documenta Mathematica: A
- Journal of K Theory: A
- Journal of Pure and Applied Algebra: A

Grades are from the Australian Math. Soc.

Mentoring, Conferences, & Outreach

- 2 NSF REU Grants
- 7 NSA REU Grants
- Women in Topology ‘16, ‘19
- 1 Postdoc
- 3 Ph.D. students
- GROW, AWM, Women in Topology…
- 16 conferences since 2011
- Numberphile videos: 450K views

Research

Algebraic K-theory: ring $A \rightsquigarrow$ sequence of groups $K_i(A)$

Invented in the late 1950s by Alexander Grothendieck in his study of intersection theory on algebraic varieties.

Connected to number theory: it includes quadratic reciprocity and the theory of embeddings of number fields into the real and complex numbers.

Applications to motivic homotopy theory, classification of manifolds, special values of L-functions, etc.

Research

Algebraic K-theory: ring *A* $\rightsquigarrow$ sequence of groups $K_i(A)$

Unknown even for simple groups such as $\mathbb{Z}/p^2$

Hesselholt-Madsen ‘97: Incomplete calculation of $A[x]/x^n$ for *A* a finitely generated $\mathbb{F}_p$ algebra

Gerhardt’s ‘97 thesis completes the calculations.

Research

w/ Angeltveit & Hesselholt, computed K-theory of the ideal (x) in $\mathbb{Z}[x]/x^n$

This completed computations started by Soule, who computed the rank of these groups. No progress had been made since the 1980s.

Used their theory to compute the low-dim K-groups of $\mathbb{Z}[C_2]$

Potential applications to differential topology (pseudo-isotopy theory).

Letters

Professor Teena Gerhardt has my highest recommendation. She's an internationally renowned researcher, working on difficult, important problems in an active area of mathematics. She is a gifted teacher and lecturer. Finally, her tireless service to the field and to the community at large are inspirational.

– Michael Hill, UCLA

Letters

Dr. Gerhardt is a highly respected member of the homotopy theory and K-theory communities... Her articles have had considerable influence on the development of algebraic K-theory over the past decade.

Dr. Gerhardt has a very strong publication record. She writes difficult and deep papers, which have had substantial impact on the algebraic K-theory...

- Kathryn Hess, EPFL (Lausanne)

Letters

Gerhardt…is an ideal candidate for recruitment at this level due to her combination of research expertise in algebraic K-theory, topological Hochschild homology (THH), and equivariant stable homotopy theory, and her real leadership in mentoring, teaching, and service.

Gerhardt's recent work has been at the forefront of the exciting developments in equivariant stable homotopy theory and its connections to THH and algebraic K-theory…

- Brooke Shipley, UIC

Letters

Teena has an impressive research record, and is easily one of the best algebraic topologists under 40 working today… her lectures are inspiring… She would make an excellent addition to any top tier math department.

- Michael Mandell, Indiana