

# Curriculum Vitae

## KAISA TAIPALE

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### Education

2010 Ph.D. University of Minnesota, Mathematics (advisor: Ionuț Ciocan-Fontanine)

2007 M.S. University of Minnesota, Mathematics (advisor: Ionuț Ciocan-Fontanine)

2003 Sc.B. California Institute of Technology, Pasadena, CA, Mathematics

### Employment

2013 – present MCFAM Assistant Professor, University of Minnesota, Minneapolis, MN

summer 2014 Ruby on Rails application developer, Nevelex Corporation, Minneapolis, MN

spring 2013 Visiting Assistant Professor, Cornell University, Ithaca, NY

fall 2012 Postdoctoral Fellow at fall semester program on Cluster Algebras, Mathematical Sciences Research Institute, Berkeley, CA

2010 – 2012 Visiting Assistant Professor, St. Olaf College, Northfield, MN

2009 – 2010 Workshop Leader/Lecturer for University of Minnesota Talented Youth Mathematics Program (UMTYMP)

2007 – 2010 Research Assistant (concurrent with teaching)

2007 – 2009 Workshop Leader for University of Minnesota Talented Youth Mathematics Program (UMTYMP)

2003 – 2007 Teaching Assistant for Department of Mathematics, University of Minnesota

2005 – 2007 Coordinator for Graduate Women in Mathematics (concurrent with teaching)

### Research interests

Algebraic geometry: Gromov-Witten theory and quantum K-theory; combinatorics of quantum cohomology and quantum K-theory and connections to cluster algebras. Financial mathematics: applications of data science to financial data; weather derivatives. Online education: effective methodologies for independent learning.

### Articles

1. Quantum cohomology of the Grassmannian via rim-hook rule, with Elizabeth Beazley and Anna Bertiger. Submitted. <http://arxiv.org/1403.6218>
2. *An equivariant rim hook rule for quantum cohomology of Grassmannians*, with Elizabeth Beazley and Anna Bertiger. Accepted by DMTCS.
3. *Puzzle combinatorics: results on degree-one Gromov-Witten invariants of Grassmannians via puzzle rules*, with undergraduates Erik Wyatt and Warren Shull.
4. *K-theoretic J-functions of type A flag varieties*. Int Math Res Notices 2013 2013: 3647-3677.
5. *A combinatorial case of the abelian-nonabelian correspondence*. Submitted. arXiv:math.AG/1101.1548
6. *Quantum cohomologies and the abelian-nonabelian correspondence*. PhD thesis, University of Minnesota (ProQuest Dissertations). July 2010.

### Seminars and other specialized talks

2014 Nov. AMS Sectional Meeting, Greensboro, NC: Equivariant quantum cohomology of the Grassmannian: combinatorics and geometry

- Sep. AMS Sectional Meeting, University of Wisconsin Eau Claire: Polynomials from the Grassmannian and the affine Grassmannian
- Apr. University of Pennsylvania CAGE Seminar, Philadelphia, PA: Quantum K-theory of Grassmannians
- Jan. Joint Mathematics Meetings, Baltimore, MD: An equivariant rim-hook rule for quantum cohomology of Grassmannians
- 2013 Nov. St. Olaf College Research Seminar: Vicious and osculating walkers
- Mar. AMS Sectional Meeting, University of Colorado Boulder: Computations in equivariant quantum cohomology of Grassmannians
- 2012 Nov. Virginia Tech Algebra Seminar: J-functions and quantum K-theory
- Oct. UC Berkeley Combinatorics Seminar: Combinatorics of the abelian-nonabelian correspondence
- Oct. Mathematical Sciences Research Institute Postdoctoral Seminar: A gentle introduction to quantum cohomology and K-theory
- Jul. Mathematical Society of Japan Seasonal Institute Young Participants Talk: K-theoretic J-functions of type A flag varieties
- Mar. Williams College: A conjectural quantum puzzle rule
- 2011 Apr. St. Olaf Research Seminar: Combinatorics of rings coming from Grassmannians
- 2009 Mar. AMS Sectional Meeting, University of Iowa: K-theoretic J-functions of flag varieties of type A
- Nov. St. Olaf College: Approaching the Abelian-Nonabelian Correspondence
- May U. Minnesota Math Physics Seminar: A Brief Introduction to Derived Categories
- 2008 Nov. U. Minnesota Working Seminar on Schubert Calculus: Quantum Cohomology, Gromov-Witten Theory, and Mondrian Tableaux
- Oct. U. Minnesota Math Physics Seminar: Introduction to Gromov-Witten Theory
- Oct. U. Minnesota Combinatorics Seminar: A View from the Other Side – a Combinatorial Problem in Algebraic Geometry
- Apr. U. Minnesota Junior Colloquium: Approaching the Abelian-Nonabelian Correspondence in Gromov-Witten Theory
- 2004 Nov. U. Minnesota Junior Colloquium: Elliptic, Superelliptic, Hyperelliptic! Curves in Cryptography

### Awards and Fellowships

- 2012 Outstanding Professor Award, given by freshman students in Student Support Services program at St. Olaf College
- 2012 Selected as participant of St. Olaf's Boldt Writing Retreat, January 2012, to work on article on joint research with undergraduates Erik Wyatt and Warren Shull
- 2011 Selected as Project NExT Fellow. Project NExT (New EXperiences in Teaching) is a professional development program for recent PhDs in mathematics, run by the Mathematical Association of America
- 2011 Awarded Professional Development Grant by St. Olaf Faculty Life Committee to support participation in Project NExT
- 2010 Outstanding Professor Award, given by freshman students in Student Support Services program at St. Olaf College
- 2008 Good Teaching Award, University of Minnesota Department of Mathematics

**Teaching activities**

## Courses taught

University of Minnesota Center for Financial and Actuarial Mathematics

Preparation for Financial Mathematics: review of multivariable calculus, linear algebra, and differential equations for master's students. Second semester includes probability and Brownian motion.

Cornell University

Calculus (Math 1110) – as “course czar” I set curriculum and oversaw five instructors, managing the course of about 170 students.

St. Olaf College

Preparation for Calculus, Fall 2010, Fall 2011 (using WeBWorK)

Calculus 1, Fall 2010, Spring 2011, Spring 2012 (using some WeBWorK)

Multivariable Calculus, Spring 2011

Differential Equations, Fall 2011

Algebraic Geometry, Spring 2012

Advanced Algebraic Geometry (independent study), Fall 2011

Differential Geometry (independent study), Spring 2012

Computations of Chern Polynomials in Macaulay2 (independent research), Spring 2012

University of Minnesota Talented Youth Mathematics Program

Calculus I (Single-Variable Calculus, Sequences and Series), Spring 2012

Calculus III (Multivariable Calculus), Fall 2007 – Fall 2009 (using WeBWorK)

University of Minnesota

Honors Mathematics 3592H-3593H (Multivariable Calculus), Fall 2006 – Spring 2007

Multivariable Calculus, College of Science and Engineering, Spring 2006

Intensive Precalculus, College of Liberal Arts, Fall 2005

Calculus 1, College of Science and Engineering, Fall 2003 – Spring 2005

Other Teaching

Taught elective summer school with Southwest Super Summer Program, Southwest High School, Minneapolis, MN. Courses I taught or assisted with included Rocketry, Lego-Logo, and Salsa Dance. I also created a course called “Art and Math” that focused on symmetry, tessellations, fractals, and other connections. 1997 – 1999

**Undergraduate Research**

Under my direction, Erik Wyatt and Warren Shull explored the combinatorics of the puzzle rule for calculating Littlewood-Richardson coefficients. Erik found a puzzle analog of the rimhook rule for calculating degree 1 quantum coefficients. Warren found several results on what kinds of subtriangles can appear in the puzzle triangles. This is related to the geometry of positroid varieties. I spent January 2012 drafting the paper through St. Olaf's Boldt Faculty Writing Seminar. A copy is available at my website.

Vladimir Sotirov worked with me on a program to compute Chern polynomials of smooth projective varieties using the computer program Macaulay2. He greatly improved my code, and the code and a discussion of the results can be found on my webpage.

During summer 2012 Cameron Marcott worked with me on a project that started with total positivity and ended with him working out the subposets of the pipe dream poset given by pipe dreams that preserve the “spelling” (in terms of simple transpositions) of the permutation associated to the pipe dream. His paper was accepted by the Electronic Journal of Combinatorics.

**Outreach**

- 2014 Apr. Where have you gone, White Bear Lake? Earth Day address, Augsburg College, Minneapolis, MN.
- 2014 Feb. Education and Mathematics in a Digital World, Arden Hills/Shoreview Rotary Club.
- 2013 Spring Presentation for Totally Awesome Mathematics, Cornell University, and Undergraduate Math Club, Cornell University, on Schubert calculus
- 2012 Nov. Two presentations for the Berkeley Math Circle: Pipe Dreams and Permutations for the advanced group, Nonstandard Geometry for the intermediate group.
- 2010 – 2012 Co-organizer of activities for women in math at St. Olaf College. Each fall: Women’s Dessert Night, a panel discussion with St. Olaf alumnae and current students. Spring 2012: “Truth Values: One Girl’s Romp Through MIT’s Male Math Maze.”
- 2009 July Led one-day exploration of cryptography and geometry (geodesics/non-Euclidean geometry) for Exploring Careers in Engineering and the Physical Sciences at University of Minnesota.
- 2008 June Led three one-day explorations of cryptography (RSA algorithm) and topology (Euler characteristic) for Exploring Careers in Engineering and the Physical Sciences at University of Minnesota, including two days for girls only.
- 2001 Summer Held a SURF (Summer Undergraduate Research Fellowship) at Caltech, researching how to integrate service learning with science, engineering, and mathematics education.

#### Seminars organized

- 2011 – 2012 Co-organizer for research seminar at St. Olaf College
- 2010 – 2012 Member of Department Colloquium Committee for Mathematics, Statistics, and Computer Science at St. Olaf College
- 2006 – 2010 Undergraduate Math Club (University of Minnesota)
- 2001 – 2003 Undergraduate Math Club (Caltech – founder!)

#### Technology

Programming: written programs for algebraic geometry, combinatorics, and quantum cohomology computations in Sage, Macaulay2, and CoCoA.

Education: Completed or taking courses via Udacity and Coursera to better understand online education modalities and data science techniques.

Teaching: Used WeBWorK and Moodle for course management and online homework at University of Minnesota and St. Olaf College. Set up and currently administer independent WeBWorK server for experiments in education with FM 5001/5002.

#### Departmental and College service

- 2012 Organized faculty seminar on WeBWorK, the MAA online homework system, for St. Olaf faculty
- 2011 – 2012 Member of department research seminar committee, Department of Mathematics, Statistics, and Computer Science, St. Olaf College.
- 2010 – 2011 Member of department colloquium committee, Department of Mathematics, Statistics, and Computer Science, St. Olaf College
- 2010 – 2011 Member of ad-hoc committee on Women in the Faculty of Natural Sciences and Mathematics, St. Olaf College

**Organizing activities for conferences and meetings**

- 2012 Organizer for Project NExT panel “Publishing with Undergraduates,” MathFest, Madison, 2012.
- 2011 – 2012 Organizer for Project NExT panel “Expository Writing,” Joint Math Meetings, Boston, 2012.
- 2011 US Committee Member, Géométrie Algébrique en Liberté. Wrote and submitted NSF proposal for travel funding for US-based GAeL participants with Nathan Owen Ilten and Sam Payne. Awarded \$27,819 over three years.
- 2010 Organizing Committee Member (with V. González Alonso, N. Owen Ilten, P. Macias Marques, M. Melo, F. Viviani,): Géométrie Algébrique en Liberté XVIII, Coimbra, Portugal.
- 2009 June Organizing Committee Member (with S. Erdogan, A. López, M. Melo, I. Utku Turkmen, F. Viviani, T. Wouters): Géométrie Algébrique en Liberté XVII, Leiden, Netherlands.

**Participation in conferences and meetings**

- 2013 Mar. Participant in ICERM workshop on Whittaker Functions, Schubert calculus and Crystals. Joint research presented in poster.
- 2013 Mar. Spoke at AMS Sectional Meeting in Boulder, CO about equivariant quantum Schubert calculus
- 2012 Sep. Introductory Workshop on Clusters and Commutative Algebra, Mathematical Sciences Research Institute.
- 2012 July Mathematical Society of Japan Seasonal Institute on Schubert Calculus.
- 2012 July Sage-Combinat Days 40, Institute for Mathematics and its Applications, University of Minnesota.
- 2011 Aug. Participant in Project NExT workshop and Mathfest in Lexington, Kentucky.
- July Participant in Macaulay 2 Workshop at Institute for Mathematics and its Applications, University of Minnesota. Worked on computations of Chern polynomials of nonsingular projective varieties; currently writing documentation.
- June Participant in Cluster Algebras Workshop at University of Oregon.
- Mar. Spoke at AMS North Central Section Meeting on “K-theoretical J-functions of type A flag varieties”
- 2010 Oct. Participant in Compact Moduli and Vector Bundles at University of Georgia.
- Mar. Participant in Localization Techniques in Equivariant Cohomology at American Institute of Mathematics.
- Jan. Participant in AWM Workshop at Joint Math Meetings. Presented a poster on Quantum K-theory.
- 2009 Jul. Participant in Equivariant Gromov-Witten theory and Symplectic Vortices, CIRM, Luminy.
- Jun. Organizer of and participant in Géométrie Algébrique en Liberté XVII, Leiden, Netherlands. Presented a poster on quantum K-theory.
- Mar. Participant in Combinatorial, Toric, and Enumerative Geometry, MSRI. Official note-taker.
- Feb. Participant in Modern Moduli Theory, MSRI.
- Jan. Participant in Connections for Women: Algebraic Geometry, MSRI. Presented a poster on combinatorial results in Gromov-Witten theory.

- 2008 April Participant in Géométrie Algébrique en Liberté XVI, Aranjuez, Spain. Presented a poster on the abelian/non-abelian correspondence in Gromov-Witten theory.
- 2007 July Participant in Deformation Theory and Moduli in Algebraic Geometry, MSRI. Summer school for graduate students.
- June Participant in Derived Categories in Mathematics and Physics, University of Utah. Summer school for graduate students.
- 2006 Oct. Participant in workshop Algebraic Stacks, Oberwolfach. Workshop for graduate students and postdocs.