Curriculum Vitae
Henry Kvinge

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Education/Employment

2017 –	**Postdoctoral Fellow**, Pattern Analysis Lab, Colorado State University
2011-2017	**Ph.D. in Mathematics,** University of California, Davis. Advisor: Monica Vazirani. Thesis: *A Categorification of the Crystal Isomorphism* $B^{1,1} \otimes B(\Lambda_i) \cong B(\Lambda_{\sigma(i)})$ *and a Graphical Calculus for the Shifted Symmetric Functions*
2004-2010	**B.S. in Mathematics, B.A. in Biochemistry,** University of Washington, *Magna Cum Laude* Advisor: Sara Billey.

Languages and other tools: Python, C++, CUDA, Matlab, Git, LaTeX

Research interests

Data science: Pattern recognition in high-dimensional data sets, geometric data analysis, machine learning, dimensionality reduction methods, use of Grassmann and flag manifolds in data analysis, connections to representation theory, hyperspectral imaging, compressive sensing, GPU computing.

Representation theory and combinatorics: Categorical and combinatorial representation theory, Heisenberg categories and Kac-Moody 2-categories, symmetric groups and their generalizations, symmetric functions, connections to noncommutative probability theory, crystal graphs.

Synergistic Activities

- *Single pixel hyperspectral video* (2017-present): This project concerns innovations in compressive sensing and is being carried out as a collaboration with our industrial partner, Physical Sciences Inc. Funded by a DoD STTR, the goal is to develop an innovative sensor that enables low-cost infrared hyperspectral imaging though the use of novel sampling algorithms which provide real-world chemical plume detection capability with compressed data. My contributions include:
  1. Developing and testing the compressive sensing algorithms.
  2. Producing a software package for the use of these algorithms in a device.
- *Single pixel flash 3D imaging* (2017-2018): The goal of this project, also in collaboration with Physical Sciences Inc. and funded through a DoD STTR, is to develop a compact infrared flash 3D imaging sensor employing compressive sensing (CS) approaches. My contributions include:
  1. Developing and testing compressive sensing algorithms specific to depth images.
  2. Producing a software package for the use of these algorithms in a device.
- *Consultant for virtual reality algorithm development* (Sept. 2018 - present): The Biomedical Sciences Department at Colorado State University is currently working to incorporate virtual reality in both research and undergraduate education. As a mathematician with experience in image processing and big data, I am currently consulting with Dr. Tod Clapp and his team on how to both improve the algorithms that they are currently using to create virtual anatomical environments (including removing distracting artifacts) and develop new algorithmic features that will help researchers, physicians, and students better understand the biological structures that they are observing.

- *Expert witness for redistricting* (Nov. 2017): I have been trained as an expert witness in geometry for redistricting cases at "Geometry of Redistricting Workshop" at Duke University.

Publications, submissions, and preprints

Data science:

- Henry Kvinge and Mark Blumstein, *Letting symmetry guide visualization: multidimensional scaling on groups*, submitted CVPR 2019, arXiv:1812.03362 (2018).
- Henry Kvinge, Elin Farnell, Michael Kirby and Chris Peterson, *Monitoring the shape of weather, soundscapes, and dynamical systems: a new statistic for dimension-driven data analysis on large data sets*, accepted to IEEE International Conference on Big Data, Seattle 2018. arXiv:1810.11562
- Henry Kvinge, Elin Farnell, Michael Kirby, and Chris Peterson, *Too many secants: a hierarchical approach to secant-based dimensionality reduction on large data sets*, 2018 IEEE High Performances Extreme Computing Conference (HPEC), Waltham, MA, USA, 2018, pp. 1-7. doi: 10.1109/HPEC.2018.8547515
- Henry Kvinge, Elin Farnell, Michael Kirby and Chris Peterson, *A GPU-Oriented Algorithm Design for Secant-Based Dimensionality Reduction*, 2018 17th International Symposium on Parallel and Distributed Computing (ISPDC), Geneva, Switzerland, 2018, pp. 69-76. doi: 10.1109/ISPDC2018.2018.00019. arXiv:1807.03425
- Elin Farnell, Henry Kvinge, Michael Kirby and Chris Peterson, *Endmember Extraction on the Grassmannian*, 2018 IEEE Data Science Workshop (DSW), Lausanne, Switzerland, 2018, pp. 71-75. doi: 10.1109/DSW.2018.8439109. arXiv:1807.01401

Data science abstracts currently accepted (but pending approval):

- Henry Kvinge, Elin Farnell, Michael Kirby, and Chris Peterson, *More chemical detection through less sampling: amplifying chemical signals in hyperspectral data cubes through compressive sensing*, submitted to SPIE: Defense + Commercial Sensing. Under review.
- Elin Farnell, Henry Kvinge, Michael Kirby, and Chris Peterson, *A data-driven approach to sampling matrix selection for compressive sensing*, submitted to SPIE: Defense + Commercial Sensing. Under review.
- Elin Farnell, Henry Kvinge, Michael Kirby, and Chris Peterson, *Total Variation vs ℓ_1-regularization: A Comparison of Compressive Sensing Optimization Methods for Chemical Detection*, submitted to SPIE: Defense + Commercial Sensing. Under review.

Representation theory and combinatorics:

- Ian Holmes Kesser, Henry Kvinge, and James Wilson, *A Frobenius-Schreier-Sims Algorithm to tensor decompose algebras*, submitted to Journal of Algebra, arXiv:1812.03346 (2018).
- Henry Kvinge, *Coherent systems of probability measures on graphs for representations of free Frobenius algebras*, arXiv:1810.11555 (2018)
- Henry Kvinge, Can Ozan Oguz, and Michael Reeks, *The center of the twisted Heisenberg category, factorial Schur Q-functions, and transition functions on the Schur graph*, to appear in the Journal of Algebraic Combinatorics, arXiv:1712.09626 (2018).

  Extended abstract in Proceedings of the 30th International Conference on Formal Power Series and Algebraic Combinatorics, Séminaire Lotharingien de Combinatoire, 80B.76 (2018) 12pp.
- Henry Kvinge, Anthony Licata, and Stuart Mitchell *Khovanov's Heisenberg category, moments in free probability, and shifted symmetric functions*, to appear in Algebraic Combinatorics, arXiv:1610.04571 (2018).

  Extended abstract in Proceedings of the 29th International Conference on Formal Power Series and Algebraic Combinatorics, Séminaire Lotharingien de Combinatoire, 78B.63 (2017), 12 pp.

- Henry Kvinge and Monica Vazirani, *A combinatorial categorification of the tensor product of the Kirillov-Reshetikhin crystal $B^{1,1}$ and a fundamental crystal*, Algebr. Represent. Theory 21 (2018), no. 6, 1277-1331.

  Extended abstract in Proceedings of the 28th International Conference on Formal Power Series and Algebraic Combinatorics, Discrete Math. Theor. Comput. Sci. Proc. (2016), pp. 719-730.

Grants and fellowships

2017	Travel grant to speak at the Formal Power Series and Algebraic Combinatorics (FPSAC) Conference.
2016	Travel grant to present a poster at the Formal Power Series and Algebraic Combinatorics (FPSAC) Conference.
2015	Travel Grant to speak at AMS Fall Sectional at Loyola University
2013	Graduate Assistance in Areas of National Need Fellowship (summer)
2012	NSF VIGRE Fellowship (summer)

Selected talks

2018 December, IEEE International Conference on Big Data,
Monitoring the shape of weather, soundscapes, and dynamical systems: a new statistic for dimension-driven data analysis on large data sets

2018 November, University of Colorado Lie theory seminar,
Coherent systems of probability measures on graphs for representations of free Frobenius towers

2018 October, Workshop on representation theory, combinatorics, and geometry
Heisenberg categories, towers of algebras, and up/down-transition functions

2018 September, Conference: 2018 IEEE High Performance Extreme Computing Conference
Too many secants: a hierarchical approach to secant-based dimensionality reduction on large data sets

2018 June, Conference: Interactions of quantum affine algebras with cluster algebras, current algebras and categorification
Heisenberg categories, towers of algebras, and symmetric functions

2018 May, University of Washington Combinatorics Seminar
Symmetric functions, towers of algebras, and Heisenberg categories

2018 May, University of Colorado Algebraic Lie Theory Seminar
Symmetric functions, towers of algebras, and centers of Heisenberg categories

2018 March, Pacific Northwest Combinatorics Day
Centers of Heisenberg categories, symmetric functions, and the combinatorics of induction/restriction functors

2017 October, University of Colorado Algebraic Lie Theory Seminar
The Kirillov-Reshetikhin crystal $B^{1,1}$ and cyclotomic quiver Hecke algebras

2017 September, University of Virginia Algebra Seminar
Khovanov's Heisenberg category, the asymptotic representation theory of symmetric groups, and shifted symmetric functions

2017 September, Rocky Mountain Combinatorics Seminar - Colorado State University
Khovanovs Heisenberg category, moments in free probability, and shifted symmetric functions

2017 July, Formal Power Series and Algebraic Combinatorics Conference (FPSAC), London
Khovanov's Heisenberg category, moments in free probability, and shifted symmetric functions

2016 October, AMS Sectional - University of St. Thomas, Minneapolis (invited talk)
Special Session on Combinatorial Representation Theory
A surprising connection between Khovanov's Heisenberg category and the asymptotic representation theory of symmetric groups.

2016 September, Arizona State University Discrete Math Seminar
A graphical calculus for the shifted symmetric functions.
2016 March, University of Oregon, Algebra Seminar
The influence of the Kirillov-Reshetikhin crystal $B^{1,1}$ on the structure of simple cyclotomic KLR modules.
2016 February, University of Washington, Algebra and Algebraic Geometry Seminar
The influence of the KR crystal $B^{1,1}$ on the structure of simple cyclotomic KLR modules.
2016 January, UC Berkeley (invited talk)
Berkeley/Davis Combinatorics Gathering
The influence of the KR crystal $B^{1,1}$ on the structure of simple cyclotomic KLR modules.
2015 October, AMS Sectional - Loyola University, Chicago (invited talk)
Special Session on Combinatorial and Geometric Representation Theory
The influence of the KR crystal $B^{1,1}$ on the structure of simple cyclotomic KLR modules.
2015 October, UC Davis Algebra and Discrete Math Seminar
The influence of the KR crystal $B^{1,1}$ on the structure of simple cyclotomic KLR modules.
2013 September, Arizona State University Discrete Math Seminar
The Okounkov-Vershik approach to the representation theory of the symmetric group

Poster presentations

2017 December, Future Directions in Representation Theory, University of Sydney
The center of the twisted Heisenberg category, factorial Schur P-functions, and up/down transition functions on the Schur graph
2016 July, Formal Power Series and Algebraic Combinatorics Conference (FPSAC), UBC
Categorifying the tensor product of the KR crystal $B^{1,1}$ and a fundamental crystal
2016 June, US-Mexico Conference on Representation Theory, Categorification, and Noncommutative Algebra, USC
Khovanov's Heisenberg category and the asymptotic representation theory of symmetric groups

Teaching activities

Courses taught at Colorado State

2018 Fall Advanced Calculus (Math 417)

Courses taught at UC Davis

2016 Summer Combinatorics (Math 145)
2015 Winter Calculus for Biology and Medicine (Math 17B)

Service

2013 – 2016 Graduate mentor for the Women in Science and Engineering (WISE) Mentoring Program. WISE Mentoring Program aims to further gender equity in the fields of science, technology, engineering, and mathematics (STEM) by providing a supportive, gender positive environment in which students work together with mentors to achieve their academic and professional goals.

2011– 2016 Volunteer math tutor for STEM Café (formally known as Math Café), a tutoring center that serves women and other underrepresented groups in math. STEM Café provides a supportive and non-competitive study environment for women in the STEM fields. It involves weekly evening meetings, two hours in length, where members gather to study and do homework in groups.