

Eric Bucher

Curriculum Vitae

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Academic Positions

- 2016- **Visiting Assistant Professor**, *Michigan State University*.
- 2012-2016 **Graduate Teaching Assistant**, *Louisiana State University*.
- 2008-2010 **Graduate Teaching Instructor**, *Oregon State University*.

Non-Academic Positions

- 2011-2012 **Sales and Marketing Manager**, *Bright Crown Limited*.
- 2010-2011 **Development and Operations Manager**, *Canterbury Subways Limited*.

Education

- 2012-2016 **Ph.D. in Mathematics**, *Louisiana State University*.
Advisor: Milen Yakimov
Thesis: Cluster Algebras and Green Sequences
- 2008-2010 **M.S. in Mathematics**, *Oregon State University*.
Advisor: Holly Swisher
Thesis: The Partition Function and Ramanujan Congruences
- 2005-2008 **B.S. in Mathematics**, *Gonzaga University*.
Graduated Magna Cume Laude

Research Interests

- Cluster algebras
- Algebraic combinatorics
- Representation theory and Lie algebras

Papers

Publications

- 2017 E. Bucher, M. Mills, *Maximal green sequences for cluster algebras associated with the n -torus with arbitrary punctures*. **Journal of Algebraic Combinatorics** DOI 10.1007/s10801-017-0778-y
- 2017 E. Bucher, M. Yakimov, *Recovering the topology of surfaces from cluster algebras*. **Mathematische Zeitschrift** DOI:10.1007/s00209-017-1901-4
- 2016 E. Bucher *Maximal green sequences for cluster algebras associated to orientable surfaces with boundary*. **Arnold Math Journal** 2, 487 (2016)

Preprint

- 2016 E. Bucher, J. Matherne, *A cancellation-free antipode formula for the restriction-contraction matroid Hopf algebra*. arxiv1612.04343

In preparation

- 2017 E. Bucher, G. Muller, *Scattering diagrams from surfaces*
2017 E. Bucher, M. Shapiro, *Cluster structures for train tracks from surfaces*.
2017 E. Bucher, J. Machacek, *Connections between Bruhat orders and labeled chip firings*.
2017 E. Bucher, E. Runburg, A. Yeck, E. Zewde *Maximal green sequences for grid quivers*.

Awards, Honors, and Distinctions

- 2017 **AMS Simons Travel Grant** Amount \$4000
2016 **Student Senate Travel Grant Award** Amount \$2250
2015 **Pasquale Porcelli Award for Graduate Student Research Excellence**
2015 **David Oxley Graduate Student Teaching Award**
2014 **Mathematical Research Community Travel Grant**
2014-2016 **GAANN Fellowship**
2012-2013 **VIGRE Fellowship**

Teaching Experience

Michigan State University

- Spring 2018 Transitions to Mathematics (Course coordinator)
Fall 2017 Graduate Representation Theory
Fall 2017 Transitions to Mathematics (Course coordinator)
Spring 2017- CIM Faculty Member

The Center for Instruction Mentoring focuses preparing our incoming graduate teaching instructors for teaching. We work with them throughout the year with various "best teaching practice" workshops, an initial overview of the MSU system, and most importantly through ongoing mentoring. The CIM community includes myself and 3 full time faculty, and my duties consisted of performing student teaching observations (with feedback), holding mentoring meetings, developing and implementing teacher training exercises, curriculum development, and most importantly working directly with the first time instructors to create a smooth transition to their new roles as educators.

- Summer 2017 Abstract Algebra I
Spring 2017 Honors Calculus II
Fall 2016 Calculus I (Sections 14 and 17)

Louisiana State University

- Summer 2016 Lead Instructor, *LSU Math Summer Camp*

This summer program is 4 week long math camp. I worked as one of the primary instructors and organizers for this all day camp. We created a themed set of activities that each the students would do through out the day, which culminated in them working in groups on their own personal research projects. I was in charge of coming up with the curriculum, teaching students, supervising and mentoring projects. Topics and activities included: 3d printing and modeling, cryptography scavenger hunt, exploration of infinities, trip to LIGO Gravitational Wave Lab, Monty Hall Problem with live goats.

Fall 2015 Calculus II
Full teaching, lesson planning, grading, and administrative responsibilities.

Fall 2014 Calculus I
Full teaching, lesson planning, grading, and administrative responsibilities.

Summer 2014 Geometry in Education (*teaching aid*)
Taught in the context of the LaMSTI program, a grant funded Master's program for current high school educators. The program is designed to integrate higher level math understanding into the K-12 mathematics classroom.

Spring 2014 Business Calculus (*recitation*)

Fall 2013 Business Calculus (*recitation*)

Summer 2013 Calculus in Education (*teaching aid*)
Taught in the context of the LaMSTI program, a grant funded Master's program for current high school educators. The program is designed to integrate higher level math understanding into the K-12 mathematics classroom.

Oregon State University

Spring 2010 Excursions in Mathematics (*recitation*)

Winter 2010 Discrete Mathematics (*recitation*)

Fall 2009 Introduction to Proofs (*recitation*)

Spring 2009 Excursions in Mathematics (*recitation*)

Winter 2009 Business Calculus (*recitation*)

Fall 2008 College Algebra (*recitation*)

Other

2017- Undergraduate Research Mentor, *Michigan State University*.

I currently work with three undergraduate researchers. We have developed projects that they are working on and I feel confident that they will result in publications. We meet weekly throughout the school year and more frequently over the summer. They are scheduled to present a poster at the upcoming MIGHTY Meeting at Grand Valley State University.

2013-2014 ACT Preparatory Instructor, *100 Black Men Youth Charity*.

I prepared a curriculum and taught an 8 week ACT prep course for students. The supplies were provided by the 100 Black Men Community organization and we saw remarkable progress from the students.

Summer 2013 ACT Preparatory Instructor, *β College Early Start Program*.

A similar program to the one above, except these were taught as one week "book camps" throughout the summer. This program was also a joint venture with 100 Black Men and we were able to help over 200 students from at risk neighborhoods.

2011 Student Teacher, *Rangiora High School*.

Interesting Fact I did my student teaching at Rangiora High School in the immediate aftermath of the Christchurch February 2011 earthquake. There were multiple displaced schools sharing the same location. One school would meet in the morning and go straight through without any breaks in between classes, and then another school would run in the evening. There were many administrative and teaching difficulties during this unusual scenario, but I think both as educators and as a city we persevered strongly.

Service & Organizational Activities

- Spring 2017- Centor for Instruction in Mathematics Faculty Member, *Michigan State University*.
- Fall 2016- Founding Organizer - MSU Cluster Algebra Seminar, *Michigan State University*.
Started this new seminar at MSU. Our seminar was mostly focused on bringing in outside speakers to create an excitement amongst our graduate students for this new topic.
- 2015-2016 Coach/Organizer - LSU High School Math Competition Team, *Louisiana State University*.
Coached and organized a high school math team to compete in the Harvard Mathematics Competition
- Spring 2015 Volunteer Assistant - AWM Middle School Math Day, *Louisiana State University*.
Help teach at the the middle school math day on know theory. The project was supported by the AWM and focused on creating entertaining math projects for middle school students.
- Summer 2015 Lead Organizer - GEAX Orientation Program, *Louisiana State University*.
This is the LSU graduate student orientation program. I was the lead organizer for this project which included arranging 2 weeks of math talks, logistical talks, and organizing the welcoming social events. I was in charge of the budget as well as all administrative duties.
- Spring 2015 Exhibitor - Baton Rouge STEM Expo, *Louisiana State University*.
I organized and represented LSU at the Baton Rouge Middle School STEM Expo. This included setting up an exhibit and a series of activities to engage students of all ages. We received an award for most engaging exhibit, despite many other more child friendly exhibits; the Baton Rouge Zoo brought 17 different kinds of snakes. My team and I are very excited that we could make mathematics engaging to this level of audience and take great pride in what we accomplished.
- 2014-2016 Organizer - Cluster Algebra Seminar, *Louisiana State University*.
Organized and gave talks at the weekly seminar.
- Summer 2014 Committee Member - GEAX Orientation Program, *Louisiana State University*.
See above.
- Summer 2014 LaMSTI Documentarian, *Louisiana State University*.
After my initial summer with the LaMSTI program I got asked to create a promotional video for the program. I made an assortment of videos to help guide students interested in the program. They ranged from a 5 minute commercial that was posted on the programs webpage; to a longer hour long video designed for students who are interested in applying for videos. The videos included a combination of student interviews, faculty interviews, and snippets from the classroom activities. I did all the artistic editing and filming for the videos, as well as concept directing. The videos were used by Dr. James Madden (program coordinator) when he did his talk about math education at the Joint Math Meetings in 2015.
- Summer 2014 Volunteer Mathematics Tutor, *100 Black Men Youth Charity*.
I volunteered to tutor mathematics for high school students as part of an initiative for the community program 100 Black Men. This program focuses on helping at risk students succeed in school.
- Spring 2013 Exhibitor - Baton Rouge Middle School Math Competition, *Louisiana State University*.
See above.
- 2010-2012 Volunteer Junior Basketball Coach, *Burnside High School*.
Players aged 16-18.
- 2006-2008 Volunteer Friday Nights Basketball Coach, *Spokane Youth Leagues*.
TPlayers aged 7-10.
- 2006-2008 Undergraduate Mathematics Tutor, *Gonzaga University*.

I worked in the drop in mathematics tutoring center at Gonzaga University. I tutored for all classes including but not limited to: College Algebra, Calculus, Differential Equations, and 300-400 level math courses.

2006-2008 Council Member - Gonzaga University Theater Sports, *Gonzaga University*.

Invited Talks

- 2017 Colloquium, *Oakland University*, Using Quiver Mutation to Study Topological Surfaces.
- 2017 Combinatorics Seminar, *Western Michigan University*, Directed Sums of Maximal Green Sequences.
- 2017 Math Club, *Western Michigan University*, The Great Escape: Surviving the 100 Prisoner Problem.
- 2017 MIGHTY Meeting, *Grand Valley State University*, Quiver Mutations: An Application of Directed Graphs.
- 2017 Graduate Research Workshop in Combinatorics, *University of Denver*, Labeled Chip Firing and Permutation Conjectures.
- 2017 AMS Sectional Meeting: Special Session, *Hunter's College*, Recovering Surface Topology from Cluster Algebras.
- 2017 Combinatorial Algebra Meets Algebraic Combinatorics, *University of Quebec at Montreal*, Recovering Surface Topology from Cluster Algebras.
- 2017 Student Colloquium, *Gonzaga University*, Explorations of the One Hundred Prisoner Problem.
- 2016 ALGECOM, *Purdue University*, Poster Session: Recovering Surface Topology from Cluster Algebras.
- 2016 CMU Algebra Seminar, *Central Michigan University*, Connections Between Topological Surfaces and Cluster Algebras.
- 2016 US-Mexico Representation Theory, *University of Southern California*, Poster Session: Recovering Surface Topology from Cluster Algebras.
- 2016 Colloquium, *Hobart and William Smith Colleges*, Sequences of Quiver Mutations on Surfaces.
- 2016 Colloquium, *University of North Alabama*, Sequences of Quiver Mutations on Surfaces.
- 2016 Colloquium, *Tarleton State University*, Sequences of Quiver Mutations on Surfaces.
- 2016 Joint Mathematics Meetings, *Seattle*, Sequences of Quiver Mutations on Surfaces.
- 2015 Southeastern Lie Theory Workshop, *North Carolina State University*, Sequences of Quiver Mutations on Surfaces.
- 2015 Graduate Student Combinatorics Conference, *University of Kentucky*, Cluster Algebras and Maximal Green Sequences.
- 2015 Joint Mathematics Meetings - Special Session on Cluster Algebras, *San Antonio, TX*, Maximal Green Sequences for Cluster Algebras from Surfaces.
- 2007 REU Seminar, *California State University - San Bernardino*, A classification of all 3 cyclic band-width critical graphs.

Conferences Attended

- 2017 MIGHTY Meeting, *Grand Valley State University*.
- 2017 Graduate Research Workshop in Combinatorics, *University of Denver and UC-Denver*.
- 2017 AMS Sectional Meeting, *Hunter's College (CUNY)*.
- 2017 Lake Michigan Workshop on Combinatorics and Graph Theory, *Western Michigan University*.

- 2017 Combinatorial Algebra Meets Algebraic Combinatorics, *University of Quebec at Montreal*.
- 2016 ALGECOM, *Purdue University*.
- 2016 US-Mexico Representation Theory Conference, *University of Southern California*.
- 2016 Hot Topics: Scattering Diagrams and Cluster Algebras, *MSRI*.
- 2016 Joint Mathematics Meetings, *Seattle, WA*.
- 2015 Lie Groups, Lie Algebras, and their Representations Workshop, *Louisiana State University*.
- 2015 Southeastern Lie Theory Workshop, *North Carolina State University*.
- 2015 Sage Days - Cluster Algebras, *Institute of Mathematics and its Applications*.
- 2015 Midwest Combinatorics Conference, *University of Minnesota*.
- 2015 Graduate Student Combinatorics Conference, *University of Kentucky*.
- 2015 Joint Mathematics Meetings, *San Antonio, TX*.
- 2014 Mathematical Research Communities - Cluster Algebras, *Snowbird Resort, UT*.
- 2014 Southeastern Lie Theory Workshop, *University of Georgia*.
- 2014 Applications of Automorphic Forms in Number Theory and Combinatorics, *Louisiana State University*.
- 2013 Southeastern Lie Theory Workshop, *Louisiana State University*.
- 2007 Research Experience for Undergraduates (REU), *California State University - San Bernardino*.

Local Talks

- 2017 Combinatorics Seminar, *Michigan State University*, Constructing Maximal Green Sequences Through Subquivers.
- 2017 Cluster Algebra Seminar, *Michigan State University*, What is a Cluster Algebra? And Why an Entire Seminar?.
- 2017 Cluster Algebra Seminar, *Michigan State University*, Introducing the Amplituhedron.
- 2016 Combinatorics Seminar, *Michigan State University*, Restriction/Contraction Hopf Algebra for Matroids.
- 2016 Algebra Seminar, *Michigan State University*, Constructing Maximal Green Sequences.
- 2016 New Postdoc Lightning Talks, *Michigan State University*, Mutations and Topology.
- 2016 Dissertation Defense, *Louisiana State University*, Cluster Algebras from Surfaces.
- 2015 Crystal Bases Seminar, *Louisiana State University*, Hopf Algebras and Why We Should Care About Them.
- 2015 VIGRE Seminar on Honeycomb Combinatorics, *Louisiana State University*, Interpretations of Littlewood-Richardson Numbers for Symmetric Functions.
- 2015 GEAX Orientation Program, *Louisiana State University*, Representations of the Symmetric Group.
- 2015 OLLI, *Center for Lifetime Learning*, What Mathematicians Do: The Continuum Hypothesis and its Role in the Hilbert Questions.
- 2015 Undergraduate Summer Learning, *Louisiana State University*, Regular Polytopes and Graphs.
- 2015 Cluster Algebra Seminar, *Louisiana State University*, Scattering diagrams.
- 2015 Student Algebra and Number Theory Seminar, *Louisiana State University*, Cluster algebras constructed from orbifolds.

- 2014 Cluster Algebra Seminar, *Louisiana State University*, Introduction to cluster algebras from surfaces.
- 2014 GEAX Orientation Program, *Louisiana State University*, Rings and Intermediary Clusters.
- 2014 Math Circle (high school summer program), *Louisiana State University*, Quivers and mutations - the art of button pushing.
- 2014 VIGRE Seminar on quantum groups, *Louisiana State University*, Categorifying $\mathcal{U}_q(\mathfrak{sl}_2)$.
- 2014 Undergraduate Math Club, *Louisiana State University*, The algebraic structure of triangulations.
- 2013 VIGRE Seminar on quantum groups, *Louisiana State University*, Hopf algebras and antipodes.
- 2013 GEAX Orientation Program, *Louisiana State University*, Group Actions and Representations.
- 2013 Communicating Mathematics Seminar, *Louisiana State University*, A brief discussion of nilpotent Lie algebras.
- 2013 VIGRE Seminar on coxeter groups, *Louisiana State University*, Homology classes of certain coxeter systems.
- 2012 VIGRE Seminar on coxeter groups, *Louisiana State University*, Coxeter groups and simple roots.
- 2010 Master's Thesis Defense, *Oregon State University*, The partition function and Ramanujan congruences.
- 2009 Algebra Seminar, *Oregon State University*, Filtrations of certain partition functions.
- 2009 Algebra Seminar, *Oregon State University*, Primality testing and work by Lucas.
- 2008 Undergraduate Seminar, *Gonzaga University*, Approaching problems from different angles, the strength of a proof.
- 2007 Undergraduate Math Club, *Gonzaga University*, Cyclic Bandwidth Critical Graphs.

References

- Milen Yakimov (*adviser*), *Louisiana State University*, yakimov@math.lsu.edu.
- Misha Shapiro, *Michigan State University*, mchapiro@gmail.com.
- Kyungyong Lee, *University of Nebraska*, klee24@unl.edu.
- Greg Muller, *University of Oklahoma*, morliac@umich.edu.
- James Oxley (*teaching*), *Louisiana State University*, oxley@math.lsu.edu.
- Tsveta Sendova (*teaching*), *Michigan State University*, tsendova@math.msu.edu.