

JAMES RICKARDS

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McNally North 120, Department of Mathematics and Computing Science
Saint Mary's University
Halifax, NS

POSITIONS

Assistant Professor Saint Mary's University	2024 - present Halifax, NS
Postdoctoral Fellow <i>Mentor: Katherine E. Stange</i> University of Colorado Boulder	2021 - 2024 Boulder, CO

EDUCATION

Doctor of Philosophy <i>Advisor: Henri Darmon</i> McGill University Thesis title: Intersections of closed geodesics on Shimura curves	2016 - 2021 Montreal, QC
Master of Arts Trinity College, University of Cambridge	2019 Cambridge, UK
Master of Mathematics Trinity College, University of Cambridge	2015 - 2016 Cambridge, UK
Bachelor of Arts (Hons) <i>Major: Mathematics</i> Trinity College, University of Cambridge	2012 - 2015 Cambridge, UK

RESEARCH INTERESTS

Computational number theory, algebraic number theory, thin (semi)groups, arithmetic Fuchsian/Kleinian groups, binary quadratic forms, quaternion algebras, Shimura curves, circle packings, continued fractions, visualization.

PUBLICATIONS AND PREPRINTS

9. Prime and thickened prime components in Apollonian circle packings Elena Fuchs, Holley Friedlander, Piper Harris, Catherine Hsu, James Rickards, Katherine Sanden, Damaris Schindler, Katherine E. Stange Accepted to Proceedings of Women in Number Theory VI.	2024
8. Reciprocity obstructions in semigroup orbits in $SL(2, \mathbb{Z})$ James Rickards, Katherine E. Stange Accepted to Duke Mathematical Journal	2024
7. The local-global conjecture for Apollonian circle packings is false Summer Haag, Clyde Kertzer, James Rickards, Katherine E. Stange Annals of Mathematics (2) 200(2): 749-770 (September 2024)	2024
6. The Apollonian staircase James Rickards International Mathematics Research Notices, Volume 2024, Issue 2, January 2024, pp. 1340-1372	2024
5. Improved computation of fundamental domains for arithmetic Fuchsian groups James Rickards Mathematics of Computation 91 (2022), no. 338, pp. 2929-2954	2022
4. Hecke operators acting on optimal embeddings in indefinite quaternion algebras James Rickards Acta Arithmetica 204 (2022) no. 4, pp. 347-367	2022

3. Counting intersection numbers of closed geodesics on Shimura curves	2023
James Rickards Research in Number Theory 9 (2023), no. 2, Paper No. 20, 45 pp.	
2. Computing intersections of closed geodesics on the modular curve	2021
James Rickards Journal of Number Theory, 225 (2021), pp. 374-408	
1. When is a Polynomial a Composition of Other Polynomials?	2011
James Rickards American Mathematical Monthly, 118 (2011), no. 4, pp. 358-363	

MEDIA

CU students follow their noses, disprove math conjecture	2023
Article about <i>The Local-Global Conjecture for Apollonian circle packings is false</i> Colorado Arts and Sciences Magazine, https://www.colorado.edu/asmagazine/2023/11/30/cu-students-follow-their-noses-disprove-math-conjecture	
The Hidden Connection That Changed Number Theory	2023
Contributed quotes Quanta Magazine, https://www.quantamagazine.org/the-hidden-connection-that-changed-number-theory-20231101/	
Two Students Unravel a Widely Believed Math Conjecture	2023
Article about <i>The Local-Global Conjecture for Apollonian circle packings is false</i> Quanta Magazine, https://www.quantamagazine.org/two-students-unravel-a-widely-believed-math-conjecture-20230810/	

CODE

Apollonian	PARI/GP
Computations for Apollonian circle packings, including basic operations, generating pictures in LaTeX, and a very efficient implementation for finding all missing curvatures up to a bound. Available at https://github.com/JamesRickards-Canada/Apollonian	
Apollonian-Prime	PARI/GP
Computations for thickened prime components of Apollonian circle packings, Available at https://github.com/JamesRickards-Canada/Apollonian-Prime	
Fundamental domains for Shimura curves	PARI/GP
Computation of fundamental domains for arithmetic Fuchsian groups. Improves on the algorithms of Voight and Page, and is significantly more efficient than the live Magma implementation (from 100 to millions of times as fast, depending on the example). Will be integrated into PARI/GP. Available at https://github.com/JamesRickards-Canada/Fundamental-Domains-for-Shimura-curves	
Isogeny	PARI/GP, Sage
Computation of supersingular ℓ and L isogeny graphs, significantly more efficient than the live Sage implementation. Includes code to seamlessly use it inside of Sage. Available at https://github.com/JamesRickards-Canada/Isogeny	
Q-Quadratic	PARI/GP
Computing with integral binary quadratic forms and quaternion algebras over \mathbb{Q} . Includes algorithms to compute intersection numbers of modular geodesics, as described in my thesis and various papers. Available at https://github.com/JamesRickards-Canada/Q-Quadratic	
Semigroup Reciprocity	PARI/GP
Computation of orbits of semigroups, including efficient implementation of missing numbers in an orbit. This package accompanies the paper <i>Reciprocity obstructions in semigroup orbits in $SL(2, \mathbb{Z})$</i> , and includes methods to check various results. Available at https://github.com/JamesRickards-Canada/Semigroup-Reciprocity	

Competition Highlights: Canadian Mathematical Olympiad and Junior Olympiad (CMO/CJMO)

Paweł Prałat, James Rickards

Crux Mathematicorum, Vol. 50(8), October 2024

A beginner's guide to installing PARI on Windows computers

Tutorial for installing and using PARI/GP on Windows computers.

Available at <https://pari.math.u-bordeaux.fr/PDF/PARIwithWindows.pdf>**Polynomial Division in Number Theory**

Crux Mathematicorum, Vol. 43(10), December 2017

Parametric Solutions to the Generalized Fermat Equation

Part III essay, Cambridge, 2016

Higher Power Reciprocity Laws

Rouse Ball Mathematical Essay, Cambridge, 2015

CONFERENCE TALKS

Arithmetic groups, hyperbolic manifolds and computation

Totally geodesic surfaces in Bianchi orbifolds

Dec 2024

Université de Bordeaux

ANTS XVI

Reciprocity obstructions in continued fraction semigroups

Jul 2024

MIT

Computational Aspects of Thin Groups

The not-so-local-global conjecture

Jun 2024

NUS

Renormalization, computation and visualization in Geometry, Number Theory and Dynamics

The not-so-local-global conjecture

Sept 2023

CIRM

LuCaNT

Software demo: Computing fundamental domains for congruence arithmetic Fuchsian groups in PARI/GP

Jul 2023

ICERM

Number Theory Informed by Computation

Fast fundamental domains for arithmetic Fuchsian groups in PARI/GP

Aug 2022

Park City Mathematics Institute

16th Atelier PARI/GP 2022

Fundamental Domains for Shimura curves

Jan 2022

U. Franche-Comté (participated online)

Lattices and Cohomology of Arithmetic Groups: Geometric and Computational Viewpoints

Improved computation of fundamental domains for arithmetic Fuchsian groups

Oct 2021

BIRS (online)

Front Range Number Theory Day

Counting intersection numbers on Shimura curves

Sep 2021

Colorado State University

Front Range Number Theory Day

Fast computations of fundamental domains for Shimura curves

Apr 2021

CU Boulder (online)

Quebec-Maine Number Theory Conference

Computing with (indefinite) quadratic forms and quaternion algebras in PARI/GP

Sep 2020

Laval University (online)

Quebec-Maine Number Theory Conference

Intersection numbers of modular geodesics

Oct 2019

University of Maine

Quebec-Maine Number Theory Conference

Intersection numbers of modular geodesics

Oct 2018

Laval University

CMS Summer Meeting

Number theoretic intersection numbers on Riemann surfaces

Jun 2018

University of New Brunswick

Montreal-Toronto Workshop in Number Theory

Basic background on mock modular forms and weak harmonic Maass forms

Dec 2016

University of Montreal

SEMINAR TALKS

Undergraduate Research Seminar Apollonian circle packings and the not-so-local-global conjecture	Oct 2024 Saint Mary's University
Algebraic Geometry Seminar The not-so-local-global conjecture	May 2024 UC Davis
PU/IAS Number Theory Seminar The not-so-local-global conjecture	Apr 2024 Princeton University / IAS
Dalhousie Number Theory Seminar Quaternion algebras in number theory	Mar 2024 Dalhousie University
Dalhousie Colloquium The not-so-local-global conjecture	Mar 2024 Dalhousie University
Saint Mary's Colloquium Apollonian circle packings and thin groups	Jan 2024 Saint Mary's University
Virtual Seminar on Geometry and Topology Failure of the local-global conjecture in thin (semi)groups	Nov 2023 KIAS, South Korea
Penn State Algebra and Number Theory Seminar The not-so-local-global conjecture	Oct 2023 Penn State
University of Washington Number Theory Seminar The not-so-local-global conjecture	Oct 2023 University of Washington
Arithmetic Reflection Groups Seminar The not-so-local-global conjecture	Aug 2023 Online
Five College Number Theory Seminar The Apollonian Staircase	Nov 2022 Amherst College
Brown University Algebra and Algebraic Geometry Seminars The Apollonian Staircase	Nov 2022 Brown University
International Seminar on Automorphic Forms Counting intersection numbers on Shimura curves	May 2021 TU Darmstadt/ETH Zurich (online)
Rutgers Number Theory Seminar Intersection numbers of modular geodesics	Oct 2019 Rutgers University
Laval Number Theory Seminar Intersection numbers of modular geodesics	Oct 2019 Laval University

TEACHING EXPERIENCE - SAINT MARY'S UNIVERSITY

Math 2305 <i>Survey of Discrete Mathematics</i>	Fall 2024 - 1 lecture 2 recitations
Math 2310 <i>Introductory Analysis</i>	Spring 2025 - 1 lecture 1 recitation
Math 3827 <i>Special Topic: Number Theory</i>	Spring 2025

TEACHING EXPERIENCE - UNIVERSITY OF COLORADO BOULDER

Math 2001 <i>Introduction to Discrete Mathematics</i>	Fall 2022 - 2 sections, Spring 2024
Math 2130 <i>Linear Algebra for Non-Math Majors</i>	Fall 2021, Spring 2022
Math 3001 <i>Analysis 1</i>	Fall 2023
Math 3110 <i>Introduction to the Theory of Numbers</i>	Spring 2022, Spring 2024
Math 8174 <i>Topics in Algebra - Quaternion Algebras (Graduate course)</i>	Spring 2023

TEACHING EXPERIENCE - OTHER

TA for PCMI graduate course	Summer 2022
TA for Jan Vonk's one week long course at the Park City Mathematics Institute graduate summer school	
Math 141 TA <i>Integral Calculus</i>	Fall 2017, Fall 2018
McGill University	

MENTORSHIP

Honours Thesis Advisor	
Co-advisor to Clyde Kertzer on symmetries in Apollonian circle packings (Fall 2023 - Spring 2024).	
2023 REU - CU Boulder	
Ran an REU jointly with Katherine E. Stange on Apollonian circle packings. Supervised one undergraduate student (Clyde Kertzer) and one first year graduate student (Summer Haag).	
Math camp leader and trainer	2015, 2017 - 2019
Mentored and trained Canadian high school students interested in contest math at four (week-long) IMO (International Mathematical Olympiad) winter camps, as well as four IMO summer camps (3 weeks long each), and one EGMO (European Girls Mathematical Olympiad) training camp (week-end).	

SCHOLARSHIPS

Vanier Canada Graduate Scholarship	2018 - 2021
\$50,000 CAD/year	
NSERC CGS D	2018 (Declined)
Schulich Fellowship <i>McGill University</i>	2016 - 2018
\$25,000 CAD/year	
Trinity College Woods Scholarship	2015 - 2016
\$25,000 CAD/year	
Cambridge Trusts Scholarship	2015 - 2016
\$25,000 CAD/year	
Blyth Cambridge Commonwealth Scholarship	2012 - 2015
\$50,000 CAD/year	
Lazaridis Olympiad Scholarship to University of Waterloo	2012 (Declined)

MATH HUSKIES

Science Atlantic	Fall 2024
Organized participation of Saint Mary's team in the Science Atlantic mathematics contest.	
Weekly training sessions	Fall 2024
Co-running training sessions preparing Saint Mary's University students for the Science Atlantic and Putnam math contests.	

CANADIAN MATHEMATICAL SOCIETY SERVICE

Canadian International Mathematical Olympiad Committee chair	2019 - present
Canadian Junior Mathematical Olympiad coordinator	2019 - present
Canadian International Mathematical Olympiad Committee member	2016 - present
Canadian Open Mathematics Challenge Problems Committee member	2013 - 2021

INTERNATIONAL MATHEMATICAL OLYMPIAD SERVICE

Team Canada Leader Observer	2019
Team Canada Leader	2017, 2018
Team Canada Deputy Leader Observer	2015

OTHER MATHEMATICAL OLYMPIAD SERVICE

Olympiade Francophone de Mathématiques

Organizer for the Canadian team

2021 - present

PAPER REVIEW

Reviewed papers for Acta Arithmetica, Commentarii Mathematici Helvetici, Communications in Algebra, Indian Journal of Pure and Applied Mathematics, Journal of Number Theory, Journal of the European Mathematical Society, Simons Collaboration, and Transactions of the American Mathematical Society.

OTHER SERVICE

Committee member for three comprehensive oral exams at CU Boulder.

SKILLS

Languages: English (native), French (limited working proficiency)

Programming:

- High proficiency: C, PARI/GP
- Medium proficiency: Python
- Some familiarity: HTML, Magma, Mathematica, Sage