

JAMES RICKARDS

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Office 301, Department of Mathematics
University of Colorado Boulder
Boulder, CO

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, 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 Submitted	2024
8. Reciprocity obstructions in semigroup orbits in $SL(2, \mathbb{Z})$ James Rickards, Katherine E. Stange Submitted	2024
7. The Local-Global Conjecture for Apollonian circle packings is false Summer Haag, Clyde Kertzer, James Rickards, Katherine E. Stange Submitted	2023
6. The Apollonian staircase James Rickards IMRN, Volume 2024, Issue 2, January 2024, Pages 1340-1372	2024
5. Improved computation of fundamental domains for arithmetic Fuchsian groups James Rickards Math. Comp. 91 (2022), no. 338, pp. 2929-2954	2022
4. Hecke operators acting on optimal embeddings in indefinite quaternion algebras James Rickards Acta Arith. 204 (2022) no. 4, pp. 347-367	2022
3. Counting intersection numbers of closed geodesics on Shimura curves James Rickards Res. Number Theory 9 (2023), no. 2, Paper No. 20, 45 pp.	2023

- 2. Computing intersections of closed geodesics on the modular curve** 2021
James Rickards
J. Number Theory, **225** (2021), pp. 374-408
- 1. When is a Polynomial a Composition of Other Polynomials?** 2011
James Rickards
Amer. Math. Monthly, **118** (2011), no. 4, pp. 358-363

MEDIA

- CU students follow their noses, disprove math conjecture** 2023
Article about *The Local-Global Conjecture for Apollonian circle packings is false*
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 *The Local-Global Conjecture for Apollonian circle packings is false*
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 *Reciprocity obstructions in semigroup orbits in $SL(2, \mathbb{Z})$* , and includes methods to check various results.
Available at <https://github.com/JamesRickards-Canada/Semigroup-Reciprocity>

OTHER ACADEMIC WRITING

- 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

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

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 - UNIVERSITY OF COLORADO, BOULDER (HEAD INSTRUCTOR)

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

MENTORSHIP

Honours Thesis Advisor 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 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).	2015, 2017 - 2019

SCHOLARSHIPS

Vanier Canada Graduate Scholarship \$50,000 CAD/year	2018 - 2021
NSERC CGS D	2018 (Declined)
Schulich Fellowship <i>McGill University</i> \$25,000 CAD/year	2016 - 2018

Trinity College Woods Scholarship \$25,000 CAD/year	2015 - 2016
Cambridge Trusts Scholarship \$25,000 CAD/year	2015 - 2016
Blyth Cambridge Commonwealth Scholarship \$50,000 CAD/year	2012 - 2015
Lazaridis Olympiad Scholarship to University of Waterloo	2012 (Declined)

CANADIAN MATHEMATICAL SOCIETY SERVICE

Canadian IMO committee chair	2019 - present
Canadian Junior Mathematical Olympiad coordinator	2019 - present
Canadian IMO 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
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PAPER REVIEW

Reviewed papers for Acta Arithmetica, 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