

JAMES RICKARDS

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

POSITIONS

Postdoctoral Fellow | *Mentor: Katherine E. Stange* 2021 - 2024
University of Colorado Boulder Boulder, CO

EDUCATION

Doctor of Philosophy | *Advisor: Henri Darmon* 2016 - 2021
McGill University Montreal, QC

Thesis title: Intersections of closed geodesics on Shimura curves

Master of Arts 2019
Trinity College, University of Cambridge Cambridge, UK

Master of Mathematics 2015 - 2016
Trinity College, University of Cambridge Cambridge, UK

Bachelor of Arts (Hons) | *Major: Mathematics* 2012 - 2015
Trinity College, University of Cambridge Cambridge, UK

RESEARCH INTERESTS

Computational number theory, algebraic number theory, thin groups, arithmetic Fuchsian groups, binary quadratic forms, quaternion algebras, Shimura curves, circle packings, visualization.

PUBLICATIONS AND PREPRINTS

7. The Local-Global Conjecture for Apollonian circle packings is false 2023
Summer Haag, Clyde Kertzer, James Rickards, Katherine E. Stange
Submitted

6. The Apollonian staircase 2023
James Rickards
Accepted to IMRN

5. Improved computation of fundamental domains for arithmetic Fuchsian groups 2022
James Rickards
Math. Comp. **91** (2022), no. 338, pp. 2929-2954

4. Hecke operators acting on optimal embeddings in indefinite quaternion algebras 2022
James Rickards
Acta Arith. **204** (2022) no. 4, pp. 347-367

3. Counting intersection numbers of closed geodesics on Shimura curves 2023
James Rickards
Res. Number Theory **9** (2023), no. 2, Paper No. 20, 45 pp.

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

- 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>
- 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
Computation of supersingular ℓ and L isogeny graphs, significantly more efficient than the live Sage implementation.
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>

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

- Renormalization, computation and visualization in Geometry, Number Theory and Dynamics** Sept 2023
The not-so-local-global conjecture CIRM
- LuCaNT** Jul 2023
Software demo: Computing fundamental domains for congruence arithmetic Fuchsian groups in PARI/GP ICERM
- Number Theory Informed by Computation** Aug 2022
Fast fundamental domains for arithmetic Fuchsian groups in PARI/GP Park City Mathematics Institute
- 16th Atelier PARI/GP 2022** Jan 2022
Fundamental Domains for Shimura curves U. Franche-Comté (participated online)
- Lattices and Cohomology of Arithmetic Groups: Geometric and Computational Viewpoints** Oct 2021
Improved computation of fundamental domains for arithmetic Fuchsian groups BIRS (online)

Front Range Number Theory Day Counting intersection numbers on Shimura curves	Sept 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

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
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
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).

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 | McGill University

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)

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

2021 - present

Organizer for the Canadian team

PAPER REVIEW

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

OTHER SERVICE

Committee member for two comprehensive oral exams at CU Boulder.

SKILLS

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

Programming:

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