KATHERINE E. STANGE

UNIVERSITY OF COLORADO, BOULDER
math.colorado.edu/~kstange

RESEARCH AREAS

Algebraic number theory and arithmetic geometry, including Kleinian groups, elliptic curves and abelian varieties, integer sequences, cryptography, arithmetic dynamics.

EDUCATION

Ph.D. 2008 Brown University
under Joseph H. Silverman

M.Sc. 2003 Brown University

B.Math. 2001 University of Waterloo

ACADEMIC POSITIONS

Faculty

2018-present The University of Colorado, Boulder
Associate Professor

2012-2018 The University of Colorado, Boulder
Assistant Professor

Visiting

Fall 2019 The Institute for Computational and Experimental Research in Mathematics (ICERM)
Research Fellow, Semester program on Illustrating Mathematics

Postdoctoral

2011-2012 Stanford University
NSF Postdoctoral Fellow

2009-2011 Simon Fraser University, Pacific Institute for the Mathematical Sciences, and the University of British Columbia
NSERC/PIMS/NSF Postdoctoral Fellow

2008-2009 Harvard University
NSF Postdoctoral Fellow and Junior Lecturer

RESEARCH AWARDS

Research Grants

2022-2023 CU Boulder Growth Grant, $8,721.56

2021-2022 Simons Fellows, Simons Foundation, $94,489

2018-2019 Co-PI, CU Boulder RIO QuEST, $50,000
with Krister Shalm and Paul Beale

2017-2022 PI, NSF CAREER, CNS-1652238, $539,975

2016-2018 PI, NSF EAGER, DMS-1643552, $200,000

2016-2017 PI, NSA, Young Investigators, $40,000

2014-2015 PI, NSA, Young Investigators, $40,000

Conference Grants

2020 PI, NSA, Mathematical Sciences Program, $15,000
with Jeff Achter, in support of CNTA XVI

2019-2022 PI, NSF, DMS 1936672, $12,735
with Hanson Smith, Jeff Achter, Ozlem Ejder, in support of Front Range Number Theory Days

2019 RIO Faculty Conference Support $1,625

with Hanson Smith, in support of Front Range Number Theory Days

Postdoctoral Awards

2008-2012 NSF MSPRF, $108K

2009-2011 NSERC (Canada) Postdoctoral Fellowship, $80K
"Most outstanding candidate at the Postdoctoral level, Mathematics"

2009-2011 PIMS Postdoctoral Fellowship

PUBLICATIONS

La Matematica

Orienteering with one endomorphism
Sarah Arpin‡, Mingjie Chen‡, Kristin E. Lauter, Renate Scheidler, Katherine E. Stange and Ha T. N. Tran
La Matematica (2023) *early online publication* doi:10.1007/s44007-023-00053-2

Experimental Mathematics

Algebraic Number Starscapes
Edmund Harriss, Katherine E. Stange, Steve Trettel
Experimental Mathematics, 31:4 (2022) 1098–1149.
doi:10.1080/10586458.2022.2102094

Involve

Algebraic Number Starscapes
Ryan Ibarra, Henry Lembeck, Mohammad Ozaslan, Hanson Smith, Katherine E. Stange
Experimental Mathematics, 15:2 (2022) 299–317. doi:10.2140/involve.2022.15.299

CRYPTO 2021

Improved torsion point attacks on SIDH variants
Victoria de Quehen, Péter Kutas, Chris Leonardi, Chloe Martindale, Lorenz Panny, Christophe Petit, Katherine E. Stange
Advances in Cryptology – CRYPTO 2021, Part 3, vol. 12827 of *Springer Lecture Notes in Computer Science* (2021), 432–470. doi:10.1007/978-3-030-84252-9_15

SIAM Journal on Applied Algebra and Geometry

Algebraic aspects of solving Ring-LWE, including ring-based improvements in the Blum-Kalai-Wasserman algorithm
Katherine E. Stange
SIAM Journal on Applied Algebra and Geometry, 5:2 (2021), 366–387.
doi:10.1137/19M1280442

Journal of Number Theory

A family of monogenic S_4 quartic fields arising from elliptic curves
T. Alden Gassert††, Hanson Smith and Katherine E. Stange
Journal of Number Theory, 197 (2019), pp. 361-382. doi:10.1016/j.jnt.2018.09.026

Compositio Mathematica

Local-Global Principles in Circle Packings
Elena Fuchs, Katherine E. Stange, and Xin Zhang
Compositio Mathematica, 155:6 (2019), pp. 1118-1170. arxiv:1707.06708

SIAM Journal of Applied Algebra and Geometry

Attacks on the Search-RLWE problem with small errors
Hao Chen‡, Kristin Lauter and Katherine E. Stange
SIAM Journal of Applied Algebra and Geometry, 1-1 (2019), pp. 665–682.
doi:10.1137/16M1096566

Transactions of the AMS

The dynamics of super-Apollonian continued fractions
Sneha Chaubey‡, Elena Fuchs, Robert Hines‡ and Katherine E. Stange
Transactions of the American Mathematical Society, 372 (2019), pp. 2287–2334.
doi:10.1090/tran/7372

Transactions of the AMS

The Apollonian structure of Bianchi groups
Katherine E. Stange
Transactions of the American Mathematical Society, 370 (2018), pp. 6169–6219.
doi:10.1090/tran/7111

SAC 2016

Security Considerations for Galois Non-dual RLWE Families
Hao Chen, Kristin Lauter and Katherine E. Stange
Selected Areas in Cryptography 2016 – SAC 2016, LNCS vol 10532, pp. 443–462.
doi:10.1007/978-3-319-69453-5_24

International Mathematics Research Notices

Visualising the arithmetic of imaginary quadratic fields
Katherine E. Stange
International Mathematics Research Notices, 12 (2018), pp. 3908–3938.
doi:10.1093/imrn/rnx006

New York Journal of Mathematics

Index divisibility in dynamical sequences and cyclic orbits modulo p
Annie S. Chen*, T. Alden Gassert†‡ and Katherine E. Stange
New York Journal of Mathematics, 2017.23, pp. 1045–1063.
http://nyjm.albany.edu/j/2017/23-45.html

International Mathematics Research Notices

Arithmetic properties of the Frobenius traces defined by a rational abelian variety
Alina Cojocaru, Rachel Davis and Alice Silverberg and Katherine E. Stange with two appendices by J-P. Serre
International Mathematics Research Notices, 2017.12, pp. 3557–3602.
doi:10.1093/imrn/rnw058

Expositiones Mathematicae

The sensual Apollonian circle packing
Katherine E. Stange
Expositiones Mathematicae, 34.4, pp. 364-395. doi:10.1016/j.exmath.2016.01.001

Research Directions in Number Theory

RLWE Cryptography for the Number Theorist
Yara Elias, Kristin E. Lauter, Ekin Ozman and Katherine E. Stange
Research Directions in Number Theory: Proceedings of the 2014 WIN3 Workshop, vol. 3 of *Association for Women in Mathematics Series*, pp. 271–290.
doi:10.1007/978-3-319-30976-7

Canadian Journal of Mathematics

Integral points on ellitic curves and explicit valuations of division polynomials
Katherine E. Stange
Canadian Journal of Mathematics, 68.5, pp. 1120–1158.
doi:10.4153/CJM-2015-005-0

CRYPTO 2015

Weak instances of Ring-LWE
Yara Elias, Kristin E. Lauter, Ekin Ozman and Katherine E. Stange
Advances in Cryptology – CRYPTO 2015, Part I, vol. 9215 of *Springer Lecture Notes in Computer Science*, pp. 63–92. doi:10.1007/978-3-662-47989-6_4

Proceedings of the AMS

A duality principle for selection games
Lionel Levine, Scott Sheffield and Katherine E. Stange
Proceedings of the American Mathematical Society, 141, pp. 4349-4356.
doi:10.1090/S0002-9939-2013-11707-7

American Mathematical Monthly

How to make the most of a shared meal: plan the last bite first
Lionel Levine and Katherine E. Stange
American Mathematical Monthly, 119.7, pp. 550-565.
doi:10.4169/amer.math.monthly.119.07.550

Journal of the Australian Mathematical Society

Algebraic divisibility sequences over function fields
Patrick Ingram, Valéry Mahé, Joseph H. Silverman, Katherine E. Stange and Marco Streng
Journal of the Australian Mathematical Society (special issue dedicated to Alf van der Poorten) 92.1, pp. 99-126. doi:10.1017/S1446788712000092

Canadian Mathematical Bulletin

Character sums with division polynomials
Igor E. Shparlinski and Katherine E. Stange
Canadian Mathematical Bulletin, 55, pp. 850-857. doi:10.4153/CMB-2011-126-x

Algebra & Number Theory

Elliptic nets and elliptic curves
Katherine E. Stange
Algebra & Number Theory 5.2, pp. 197-229. doi:10.2140/ant.2011.5.197

Experimental Mathematics

Amicable pairs and aliquot cycles for elliptic curves (2011)
Joseph H. Silverman and Katherine E. Stange
Experimental Mathematics 20.3, pp. 329-357. doi:10.1080/10586458.2011.565253

Acta Arithmetica

Terms in elliptic divisibility sequences divisible by their indices
Joseph H. Silverman and Katherine E. Stange
Acta Arithmetica 146.4, pp. 355-378. doi:10.4064/aa146-4-4

Women in Numbers

Pairings on hyperelliptic curves
Jennifer Balakrishnan, Juliana Belding, Sarah Chisholm, Kirsten Eisenträger, Katherine E. Stange and Edlyn Teske
WIN – Women in Numbers: Research Directions in Number Theory, Fields Institute Communications 60, pp. 87-120.

SAC 2008

The elliptic curve discrete logarithm problem and equivalent hard problems for elliptic divisibility sequences
Kristin Lauter and Katherine E. Stange
Selected Areas in Cryptography 2008, vol. 5381 of *Springer Lecture Notes in Computer Science*, pp. 309-327. doi:10.1007/978-3-642-04159-4_20

PAIRING 2007

The Tate pairing via elliptic nets
Katherine E. Stange
Pairing-Based Cryptography – PAIRING 2007, vol. 4575 of *Springer Lecture Notes in Computer Science*, pp. 329-348. doi:10.1007/978-3-540-73489-5_19

TO APPEAR

MathCrypt 2023

Factoring using multiplicative relations modulo n: a subexponential algorithm inspired by the index calculus
Katherine E. Stange
arXiv:2211.06821

Proceedings of Women in Numbers 5

Orientations and cycles in supersingular isogeny graphs
Sarah Arpin, Mingjie Chen, Kristin E. Lauter, Renate Scheidler, Katherine E. Stange, Ha T. N. Tran
arXiv:2205.03976

SCHOLARSHIP OF TEACHING AND LEARNING

PRIMUS

Standards Based Grading in an Introduction to Abstract Mathematics
Katherine E. Stange
PRIMUS: Problems, Resources and Issues in Mathematics Undergraduate Studies 28.9, pp. 797–820. doi:10.1080/10511970.2017.1408044

HONORS

Association for Women in Mathematics Fellow

Class of 2021, "For leadership in the Women in Numbers Network by creating its website (the first of its kind), mentoring early-career researchers, organizing conferences, editing its proceedings volumes, and chairing its steering committee; and for service on AWM committees, including support of other research networks."

Writing Award

2013 Paul R. Halmos - Lester R. Ford Award for outstanding paper in *The American Mathematical Monthly*, awarded for joint paper with Lionel Levine, *How to make the most of a shared meal: plan the last bite first*

Exposition Award

2023 Winner (one of five), Summer of Mathematics Exposition 3 https://some.3b1b.co/, sponsored by 3blue1brown, for YouTube video *Rethinking the real line*.

OTHER ACTIVITIES

Selected Expositional Writing

On the importance of illustration for mathematical research, with Rémi Coulon, Gabriel Dorfsman-Hopkins, Edmund Harriss, Martin Skrodzki, and Glen Whitney; *Notices of the American Mathematical Society* to appear January 2024, arXiv:2307.04636.
The Ingenious Physical Factoring Devices of D.N. Lehmer, *Math Horizons* 30:2 (2022), 8–11., doi:10.1080/10724117.2022.2112892.
An illustration in number theory (2019 Lecture Sampler), *Notices of the American Mathematical Society* 66:03 (2019), 411–413, https://www.ams.org/journals/notices/201903/rnoti-p411.pdf.

Pedagogy

University of British Columbia Postdoctoral Teaching Award, 2011
Brown University Mathematics Outstanding Teaching Award, 2008
Proof of Concept, Educational YouTube Channel (3.2K subscribers, 139K views)
TRESTLE Scholar, CU Boulder, Spring 2017
Faculty Teaching Excellence Program Summer Insitute, Summer 2014
Selected professional development Be The Change: Practicing Inclusive Excellence in the Classroom (2019), Graduating Advising Workshop (2017), Inquiry Based Learning Workshop (2016)
Sheridan Center Teaching Certificate, Brown University, 2005

Standards Based Grading in a First Proofs Course, presentation at JMM 2017
Course materials incl. online videos via University of Colorado Boulder ASSETT grant

Courses Taught

Undergraduate, CU Boulder: Calculus II, Introduction to Discrete Mathematics (x8), Linear Algebra, Coding and Cryptography (x5), Combinatorics, Introduction to the Theory of Numbers
Graduate, CU Boulder: Introduction to Number Theory (x2), Introduction to Modern Algebra I, Algebraic Number Theory (x4), Topics: Arithmetic in Kleinian Groups, Topics: Elliptic Curves
University of British Columbia: Vector Calculus
Harvard University: Algebraic Number Theory, Mathematics of Symmetry
Brown University: Introductory Calculus, Multivariable Calculus, Linear Algebra

Graduate Schools Given

2023/07 · Renormalization and visualization for packing, billiard and surfaces, CIRM Luminy

Selected Talks

2022/03 · Gathering4Gardner Celebration of Mind
2022/12 · Public Lecture, The Pacific Rim Mathematical Association Congress
2022/02 · Plenary, Florida Women in Mathematics Day
2021/06 · Plenary, Arithmetic Geometry, Cryptography, and Coding Theory 2021 (CIRM)
2020/07 · Lucas Lecturer, The Nineteenth International Conference on Fibonacci Numbers and Their Applications
2020/03 · Speaker (together with Jordan Ellenberg, moderated by Terry Tao), The National Academies Webinar *Illustrating Mathematics: Abstract Geometry, Concrete Impact*
2019/03 · Invited Address, AMS Spring Joint Central and Western Sectional
2016/03 · Plenary, Alberta Number Theory Days
2016/04 · Plenary, SouthEast Regional Meeting on Numbers
2015/09 · Invited, ECC 2015
2007/09 · Invited, ECC 2007

Selected Press

Featured in *Quanta Magazine*, 2023, work on local-global for Apollonian packings
Featured in *What's Happening in the Mathematical Sciences*, Volume 12, 2022, work on Apollonian packings and Schmidt arrangements
Featured in *New Scientist* Magazine, 2011, work in game theory

Women in Mathematics

Co-organizer and refereed proceedings editor, Women in Numbers 3
Project Leader at Women in Numbers 4, Women in Numbers 5
Chair, Women in Number Theory Steering Committee, 2019-onwards
Webmaster, Women in Number Theory Steering Committee, 2016-onwards
Member, Women in Number Theory Steering Committee, 2014-onwards
AWM Advance NSF Grant, AWM Research Networks Committee member, 2017-2021
Mentor, AWM Mentor Network, 2016-onwards
Invited mentor, AWM Graduate Student Poster Session, JMM 2016, 2017

Software and Visualization

Steering Committee, Illustrating Mathematics
Co-Organizer, Illustrating Mathematics, Special Semester Fall 2019, ICERM
Director of Development, Numberscope
Author of publicly available research scripts and demos
Contributer to Sage Mathematics Software
Group leader at Sage Days 33: Women in Sage

Early Research Experiences

Director, CU Experimental Mathematics Lab, 2017-onwards Mathematics Lab Project Leader, 2017-onwards
Summer REU/G group leader, 2015, 2016, 2017, 2018
Advisor of high school student research, 2015-16
Honors Thesis advising, 2015-16, 2018-19

Outreach

YouTube channel *Proof of Concept*, 230K+ views, 6K+ subscribers
Numberscope (web tool for the general public)
Art Exhibit: Algebraic Number Starscapes, Iceland, 2020

Math Club, Colorado Academy, 2018
CU Science Ambassador, 2016
Julia Robinson Math Festival, 2012
Workshop Leader, A Taste of Pi, 2010

Supervision

Postdoctoral 2021-2024, James Rickards
Postdoctoral 2014-2016, T. Alden Gassert
Ph.D. 2022, Sarah Arpin
Ph.D. 2020, Daniel Martin, Hanson Smith
Ph.D. 2019, Robert Hines
Ph.D. 2014, Amy Feaver
M.A. 2016, Elizabeth Parsons

October 16, 2023