

Ana Caraiani

CONTACT INFORMATION

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RESEARCH INTERESTS

The Langlands program, algebraic number theory, arithmetic geometry, representation theory.

EDUCATION

Ph.D. in Mathematics, Harvard University 9/2007–6/2012

- Thesis: Local-global compatibility and the action of monodromy on nearby cycles
- Advisor: Richard Taylor

B.A. in Mathematics, Summa cum Laudae, Princeton University 9/2003–6/2007

EMPLOYMENT

Hausdorff Chair, University of Bonn 9/2022–

Royal Society University Research Fellow and Professor, Imperial College London 9/2021–

Royal Society University Research Fellow and Reader, Imperial College London 9/2019–8/2021

Royal Society University Research Fellow and Senior Lecturer, Imperial College London 8/2017–8/2019

Bonn Junior Fellow, Hausdorff Center for Mathematics 8/2016–8/2017

Veblen Research Instructor and NSF Postdoctoral Fellow, Princeton University and Institute for Advanced Study 9/2013–7/2016

L.E. Dickson Instructor and NSF Postdoctoral Fellow, University of Chicago 9/2012–8/2013

VISITING POSITIONS

Bonn Research Fellow, Hausdorff Center for Mathematics 10/2018–8/2022

PUBLICATIONS AND PREPRINTS

1. “The cohomology of Shimura varieties with torsion coefficients”, 24 pages, to appear in *Proceedings of the ICM 2022*.
2. “The geometric Breuil-Mézard conjecture for two-dimensional potentially Barsotti-Tate Galois representations”, joint with M. Emerton, T. Gee and D. Savitt, arXiv:2207.05235, 24 pages, submitted.
3. “Components of moduli stacks of two-dimensional Galois representations”, joint with M. Emerton, T. Gee and D. Savitt, arXiv:2207.05237, 71 pages, submitted.
4. “Local geometry of moduli stacks of two-dimensional Galois representations”, joint with M. Emerton, T. Gee and D. Savitt, arXiv:2207.14337, 55 pages, to appear in *Proceedings of the International Colloquium on ‘Arithmetic Geometry’, TIFR Mumbai, Jan. 6-10, 2020*.
5. “On the étale cohomology of Hilbert modular varieties with torsion coefficients”, joint with M. Tamiozzo, arXiv:2107.10081, 49 pages, submitted.
6. “New frontiers in Langlands reciprocity”, *EMS Magazine* 119 (2021).

7. “Vanishing theorems for Shimura varieties at unipotent level”, joint with D. Gulotta and C. Johansson, arXiv:1910.09214, 38 pages, to appear in *Journal of the EMS*.
8. “On the generic part of the cohomology of non-compact unitary Shimura varieties”, joint with P. Scholze, arXiv:1909.01898, 87 pages, submitted.
9. “Potential automorphy over CM fields”, joint with P. Allen, F. Calegari, T. Gee, D. Helm, B. Le Hung, J. Newton, P. Scholze, R. Taylor, and J. Thorne, arXiv:1812.09999, 216 pages, to appear in *Annals of Math*.
10. “Shimura varieties at level $\Gamma_1(p^\infty)$ and Galois representations”, joint with D. Gulotta, C.Y. Hsu, C. Johansson, L. Mocz, E. Reinecke and S.C. Shih, *Compositio Math.* 156 (2020), no. 6, 1152–1230.
11. “Perfectoid Shimura varieties”, in *Perfectoid spaces: Lectures from the 2017 Arizona Winter School*, edited by Bryden Cais, Mathematical Surveys and Monographs 242, American Mathematical Society, 2019, 245–297.
12. “Patching and the p -adic Langlands program for $GL_2(Q_p)$ ”, joint with M. Emerton, T. Gee, D. Geraghty, V. Paskunas and S.W. Shin, *Compositio Math.* 154 (2018), no. 3, 503–548.
13. “Kisin modules with descent data and parahoric local models”, joint with B. Levin, *Ann. Sci. École Norm. Sup.*, 4e série, 51 (2018), 181–213.
14. “On the generic part of the cohomology of compact unitary Shimura varieties”, joint with P. Scholze, *Annals of Math.* 186 (2017), no. 3, 647–766.
15. “ p -adic q -expansion principles on unitary Shimura varieties”, joint with E. Eischen, J. Fintzen, E. Mantovan and I. Varma, *Directions in Number Theory: Proceedings of the WIN3 Workshop* (2016), Springer, 197–244.
16. “On the image of complex conjugation in certain Galois representations”, joint with B.V. Le Hung, *Compositio Math.* 152 (2016), No. 7, 1476–1488.
17. “Patching and the p -adic local Langlands correspondence”, joint with M. Emerton, T. Gee, D. Geraghty, V. Paskunas and S.W. Shin, *Cambridge Journal of Math.* 4 (2016), No. 2, 197–287.
18. “Local-global compatibility and monodromy for $l = p$ ”, *Algebra & Number Theory* 8 (2014), no. 7, 1597–1646.
19. “Local-global compatibility and the action of monodromy on nearby cycles”, *Duke Mathematical Journal* 161 (2012), no. 12, 2311–2413.
20. “Multiplicative semigroups related to the $3x + 1$ problem”, *Adv. Appl. Math.* 45 (2010), no. 3, 373–389.

GRANTS

- ERC Starting Grant “ p -adic arithmetic geometry, torsion classes, and modularity”, €1,469,805.00 2019–2024
- Royal Society Research Grant for Research Fellows, £92,148.00 2018–2023
- Royal Society University Research Fellowship, £450,094.81 2017–2022
- NSF Grant DMS-1501064 (PI), \$159,469 2015–2017
- NSF Mathematical Sciences Postdoctoral Research Fellowship, \$150,000 2012–2015

SELECTED AWARDS AND HONORS	· Philip Leverhulme Prize	2020
	· Prize of the European Mathematical Society	2020
	· Fellow of the American Mathematical Society	2020
	· President's Award for Outstanding Early Career Research, Imperial College	2019
	· Whitehead Prize, London Mathematical Society	2018
	· Von Neumann Fellowship, IAS (declined in order to go on maternity leave)	Spring 2018
	· James Mills Peirce Fellowship for Graduate Study, Harvard University	2007-2010
	· William Lowell Putnam Fellowship for Graduate Study, Harvard University	2007-2009
	· George B. Covington Prize, Department of Mathematics, Princeton University	2007
	· Middleton Miller Prize, Department of Mathematics, Princeton University	2007
	· Alice T. Schafer Prize, Association for Women in Mathematics	2007
	· Member of 1st place Putnam team	2006
	· Andrew H. Brown Prize, Department of Mathematics, Princeton University	2006
	· Putnam Fellow and Elizabeth Lowell Putnam Prize	2003, 2004
	· Gold Medal, International Mathematical Olympiad	2002, 2003
	· Silver Medal, International Mathematical Olympiad	2001
TEACHING EXPERIENCE	· Teaching accreditation: Fellow of the Higher Education Academy	September 2019
	· Algebraic number theory (M3P15), Imperial College London	Spring 2019
	· Seminar on the Weil Conjectures, University of Bonn	Summer 2017
	· Étale cohomology, University of Bonn	Winter 2016/2017
	· Linear algebra and applications (MAT202, 2 sections), Princeton University	Spring 2015
	· Topics in Number Theory: Introduction to Modular Forms and L -functions (MAT 419), Princeton University	Spring 2014
	· Numbers, Equations and Proofs (MAT214), Princeton University	Fall 2013
	· Linear algebra and differential equations (Math 21b, 2 sections), Harvard University	Spring 2012
· Multivariable calculus (Math 21a), Harvard University	Fall 2008, 2009, 2010	
MAJOR INVITED LECTURES	· Invited Speaker, 2022 ICM (r ¹)	July 2022
	· Morning Lecture, British Mathematical Colloquium, King's College	June 2022
	· EMS Prize Lecture, 8th ECM, Slovenia (r)	June 2021
	· AMS Current Events Bulletin, AMS/MAA Joint Math Meetings (r)	January 2021
	· Plenary talk, Journées Arithmétiques, Caen, France	July 2017
	· Arizona Winter School, minicourse (4 talks)	March 2017
	· Sophus Lie Days, Cornell (2 talks)	April 2015
	· MSRI/Evans lecture, Berkeley	November 2014

¹Denotes a talk delivered remotely.

MINICOURSES

- IHES Summer School on the Langlands Program (3.5 hours, joint with Sug Woo Shin) July 2022
- Alpbach Workshop (4.5 hours) June 2022
- School in Arithmetic Geometry, Essen (5 hours) September 2018
- Algebraic Groups and Geometrization of Local Langlands, ENS Lyon (4 hours) June 2018
- UK–Japan Winter School 2018 on Number Theory (2 hours) January 2018
- Texel Island Summer School (4 hours) August 2017
- Arizona Winter School (4 hours) March 2017
- The Langlands correspondence in arithmetic and geometry, KIAS, (5 hours) August 2016

OTHER INVITED TALKS

- Arithmetic geometry, Hodge theory, regulators, periods, and heights, Cambridge June 2022
- Franco-Asian Summer School on Arithmetic Geometry, Luminy (r) June 2022
- VaNTAGe Seminar (r) May 2022
- Simons Symposium on p -adic Hodge theory May 2022
- Number Theory Web Seminar (r) April 2022
- EMS 30th anniversary, ICMS, Edinburgh March 2022
- Non-archimedean geometry and applications, Oberwolfach February 2022
- Hamburg Colloquium (r) January 2022
- Queen Mary Algebra and Number Theory seminar November 2021
- Warwick Colloquium November 2021
- Zoom Algebraic Geometry seminar (r) October 2021
- Heilbronn Annual Conference (r) September 2021
- Arithmetic geometry - Takeshi 60, Tokyo (r) September 2021
- Arithmetic of Shimura varieties over global fields, Cetraro August 2021
- EWM Minisymposium at the 8th ECM, Slovenia (r) June 2021
- Séminaire Arithmétique et Géométrie Algébrique, Orsay (r) May 2021
- Darmstadt Colloquium (r) May 2021
- Hausdorff Colloquium, University of Bonn (r) April 2021
- University of Minnesota Colloquium (r) November 2020
- Berkeley–Caltech–Stanford number theory seminar (r) November 2020
- MIT number theory seminar (r) November 2020
- ETH number theory seminar (r) October 2020
- Recent Advances in Modern p -adic Geometry (r) August 2020
- Cross-Atlantic Representation Theory and Other Topics (r) May 2020
- Princeton/IAS number theory seminar (r) April 2020
- Warwick number theory seminar February 2020
- Arithmetic study group, Durham January 2020
- Guest talk in Paris study group on my work January 2020
- International Colloquium on Arithmetic Geometry, Tata Institute, Mumbai January 2020
- Zürich colloquium in mathematics November 2019

- Modular representation theory, Clay Math Institute, Oxford October 2019
- University of Bonn Arbeitsgemeinschaft Arithmetische Geometrie seminar July 2019
- Arithmetic Geometry in Carthage, Tunisia June 2019
- Program on Serre conjectures and the p -adic local Langlands program, Padova June 2019
- Cambridge number theory seminar April 2019
- Caltech number theory seminar April 2019
- Colloquium, Caltech April 2019
- UCLA number theory seminar April 2019
- Hot Topics: Recent progress in the Langlands program, MSRI (2 talks) April 2019
- Colloquium, University of Sheffield February 2019
- Algebraic groups, Lie algebras, and their representations, Max Planck Institute for Mathematics, Bonn November 2018
- Oxford number theory seminar November 2018
- Plenary talk, Young Researchers in Algebraic Number Theory, Sheffield November 2018
- Cohomology of algebraic varieties, Luminy October 2018
- Special seminar, University of Regensburg July 2018
- Swiss Number Theory Days 2018, Basel June 2018
- Séminaire de Géométrie Arithmétique Paris–Pékin–Tokyo, IHES January 2018
- Instruments of algebraic geometry, Bucharest, Romania September 2017
- Max Planck Number Theory seminar July 2017
- Darmstadt Algebra seminar July 2017
- University of Bonn Arbeitsgemeinschaft Arithmetische Geometrie seminar (2 talks) June 2017
- p -adic Hodge theory and automorphic forms, Beijing June 2017
- Dutch Intercity number theory seminar, Amsterdam May 2017
- Simons Symposium on p -adic Hodge theory May 2017
- Modularity and diophantine equations: Exploring Wiles's universe, Barcelona Mathematical Days April 2017
- University of Zürich number theory seminar April 2017
- Arbeitsgemeinschaft: Higher Gross Zagier Formulas, Oberwolfach April 2017
- Local zeta functions and the arithmetic of moduli spaces: a conference in memory of Jun-Ichi Igusa, Johns Hopkins University March 2017
- Colloquium, Oxford March 2017
- Essen Oberseminar February 2017
- Special session on Automorphic forms and arithmetic, JMM, Atlanta January 2017
- Deformation theory, completed cohomology, Leopoldt conjecture and K -theory, Luminy December 2016
- London-Paris number theory seminar, Paris November 2016
- Members' seminar, IAS October 2016
- University of Bonn Arbeitsgemeinschaft Arithmetische Geometrie seminar October 2016
- Arithmetic geometry, Oberwolfach August 2016
- Geometric methods in the mod p Langlands correspondence, Pisa (2 talks) June 2016

- Workshop on Shimura varieties and related topics, Taipei June 2016
- Workshop on the p -adic Langlands program and related topics, Indiana University, Bloomington May 2016
- Advances in geometric representation theory, University of Michigan (2 talks) May 2016
- Arbeitsgemeinschaft: The geometric Langlands conjecture, Oberwolfach April 2016
- Colloquium, UCLA March 2016
- UCLA number theory seminar March 2016
- Colloquium, Yale February 2016
- Colloquium, University of Wisconsin January 2016
- Special mathematics seminar, MIT January 2016
- Colloquium, University of Washington January 2016
- Colloquium, Berkeley January 2016
- Colloquium, UC Irvine January 2016
- Northwestern number theory seminar January 2016
- UCSD number theory seminar January 2016
- Colloquium, UCSD January 2016
- BU number theory seminar January 2016
- Colloquium, University of Toronto January 2016
- Hausdorff Center for Mathematics seminar, Bonn December 2015
- Colloquium, UIUC December 2015
- UT Austin number theory seminar December 2015
- IAS Members' Seminar December 2015
- Colloquium, Michigan State University December 2015
- Colloquium, University of Pennsylvania December 2015
- Colloquium, Rice University December 2015
- Colloquium, Boston College December 2015
- Michigan Group, Lie and Number theory seminar November 2015
- Colloquium, University of Southern California November 2015
- Colloquium, University of Notre Dame November 2015
- University of Minnesota Lie Theory seminar November 2015
- Colloquium, University of Minnesota November 2015
- University of Pennsylvania Algebra seminar November 2015
- Harvard/MIT Algebraic Geometry seminar October 2015
- BU Number theory seminar October 2015
- Joint Columbia-CUNY-NYU number theory seminar October 2015
- Wisconsin number theory seminar October 2015
- University of Chicago number theory seminar October 2015
- Northwestern number theory seminar October 2015
- AMS Central Fall Sectional Meeting (Chicago, IL), special session on The Langlands program and related topics October 2015
- Motives and automorphic forms, Clay Math Institute, Oxford September 2015

· Johns Hopkins number theory seminar	September 2015
· Algebraic Geometry Bootcamp, University of Utah	July 2015
· Around Langlands correspondences, Université Paris Sud, Orsay	June 2015
· Journées arithmétiques a Lyon, ÉNS Lyon	June 2015
· IAS Program for Women and Mathematics, Princeton Day	May 2015
· p -adic methods in the theory of classical automorphic forms, CRM, Montreal	March 2015
· UCLA number theory seminar	December 2014
· Automorphic forms, Shimura varieties, Galois representations and L -functions (Michael Harris' 60th birthday conference), MSRI	December 2014
· UT Austin number theory seminar	November 2014
· Bay Area Number Theory and Arithmetic Geometry Day, Berkeley	November 2014
· Connections for Women: New Geometric Methods in Number Theory and Automorphic Forms, MSRI	August 2014
· Algebraische Zahlentheorie, Oberwolfach	July 2014
· Arithmétique des varietes de Shimura et des formes automorphes et Applications, Luminy, France	July 2014
· University of Bonn Arbeitsgemeinschaft Arithmetische Geometrie seminar	June 2014
· Caltech number theory seminar	May 2014
· Johns Hopkins and University of Maryland Algebra and Number Theory Day	April 2014
· Hot Topics Workshop on Perfectoid Spaces, MSRI	February 2014
· Princeton/IAS number theory seminar	December 2013
· Princeton junior number theory seminar (2 talks)	December 2013
· CUNY collaborative number theory seminar	November 2013
· University of Pennsylvania Galois seminar	November 2013
· Purdue number theory seminar	April 2013
· University of Chicago number theory seminar	April 2013
· Stanford number theory seminar	April 2013
· UIUC number theory seminar	March 2013
· Colloquium, Caltech	March 2013
· Southern California Number Theory Days	March 2013
· UT Austin number theory seminar	March 2013
· AWM Workshop, JMM, San Diego	January 2013
· UIC number theory seminar	November 2012
· Workshop on p -adic cohomology and its applications to arithmetic geometry, Tohoku University, Sendai, Japan	October 2012
· Towards a local proof of Local Langlands workshop, UIC (2 lectures)	May 2012
· BU number theory seminar	March 2012
· Workshop on Shimura varieties, Fields Institute, Toronto	March 2012
· Workshop for graduate students, Fields Institute, Toronto (2 lectures)	March 2012
· University of Michigan Lie groups and number theory seminar	March 2012
· University of Pennsylvania Galois seminar	February 2012

	· MIT number theory seminar	February 2012
	· Caltech number theory seminar	December 2011
	· University of Chicago number theory seminar	October 2011
	· Northwestern number theory seminar	October 2011
	· Harvard number theory seminar	October 2011
	· Workshop on Shimura varieties and Rapoport-Zink spaces, Tokyo, Japan	July 2011
	· Automorphic forms seminar, Jussieu	June 2011
	· Workshop on Galois representations and automorphic forms, IAS	March 2011
	· Galois representations seminar, IAS	January 2011
	· Program for Women and Mathematics, Institute for Advanced Study	May 2007
OUTREACH TALKS	· Invited Speaker, Invariants, Oxford (r)	March 2021
	· Invited Speaker, Trinity College Maths Society, Cambridge (r)	March 2021
	· Inspirational Lecture, Imperial College	November 2020
	· Invited speaker, LMS Prospects in Mathematics, University of Bath (r)	September 2020
	· Invited Speaker, European Girls' Math Olympiad, Busteni, Romania	April 2016
	· Invited Speaker, Women in Math and Statistics, Harvard	April 2016
PHD STUDENTS	· Bence Hevesi (primary supervisor)	2020–2024 (expected)
	· Louis Jaburi (primary supervisor)	2020–2023 (expected)
	· Mafalda Santos (primary supervisor)	2018–2022 (expected)
	· Pol van Hoften (primarily advised by James Newton)	2017–2021
	· Supervised London School of Geometry and Number Theory mini-projects for: Mafalda Santos, Gabriel Micolet, Abigail Burton, Soham Karwa, Bence Hevesi	2018–
POSTDOCS MENTORED	· Alice Pozzi (supported by my Leverhulme Prize)	2022–2023
	· Sally Gilles (supported by my ERC Starting Grant)	2020–2022
	· João Lourenço (supported by my ERC Starting Grant)	2020–2021
	· Rong Zhou (supported by my ERC Starting Grant)	2020
	· Matteo Tamiozzo (supported by my ERC Starting Grant)	2019–2022
CONFERENCE ORGANISATION	· Co-organiser, Panorama of Mathematics II, Hausdorff Center for Mathematics	October 2023
	· Co-organiser (with Frank Calegari, Laurent Fargues, and Peter Scholze) of the Hausdorff Trimester Program “The arithmetic of the Langlands Program”, HIM, Bonn. This includes the organization of one summer school and two major conferences. The program was originally scheduled for Summer 2020 and rescheduled due to Covid-19.	Summer 2023
	· Member of the Scientific Committee for Journées Arithmétiques	Summer 2023
	· Member of the Scientific Advisory Board for Women in Numbers Europe 4	August 2022
	· Co-organiser (with Jessica Fintzen), Community-building in the Langlands program, University of Bonn	August 2022
	· Co-organiser (with Ahmed Abbes, Ariane Mézard, Takeshi Saito, Takeshi Tsuji, and Weizhe Zheng), Franco-Asian Summer School on Arithmetic Geometry, Luminy	May 2022

	· Co-organizer (with Bhargav Bhatt, Matthew Satriano and Ila Varma), Fields Medal Symposium in honour of Peter Scholze, Fields Institute	October 2021
	· Co-organizer (with Eran Assaf, Fred Diamond, and James Newton), Workshop on p -adic Langlands, London	May 2019
	· Co-organizer (with Frank Calegari and Richard Taylor), Special session on “Automorphic forms and arithmetic”, Joint Math Meetings, Atlanta, GA	January 2017
	· Co-organizer (with Richard Taylor), Workshop on Emerging Topics: Torsion classes and modularity, IAS	November 2016
PROFESSIONAL SERVICE - EXTERNAL COMMITTEES	· LMS Research Policy Committee	2021–2024
	· LMS Prize Committee	2021–2024
	· AMS Mathematical Surveys and Monographs Editorial Committee	2021–2025
	· Royal Society International Exchanges Committee	2019–2020
	· AMS-Simons Travel Grant committee (Chair 2018-2019)	2017–2020
PROFESSIONAL SERVICE - INTERNAL COMMITTEES	· Hiring panel for Lecturer / Senior Lecturer in Number Theory, Imperial College London	January 2022
	· Search committee for Lecturer / Senior Lecturer in Number Theory, Imperial College London	Fall 2021
	· Equality, Diversity and Inclusion Committee, Imperial College London	2021–
	· Member of Chapman hiring committee at Imperial College London	2017-2018
PROFESSIONAL SERVICE - OTHER	· Editor, Mathematische Zeitschrift	August 2021–
	· Editor, La Matematica	May 2021–
	· Panel member for the DFG	March 2021
	· Editor, International Mathematical Research Notices	January 2020–
	· Internal examiner for the PhD thesis of Raffael Singer, Imperial College London	November 2020
	· External examiner for the PhD thesis of Zhiyou Wu, Cambridge University	October 2019
	· External examiner for the PhD thesis of Ben Heuer, King’s College London	August 2019
	· Advised Timo Noethel’s Erasmus Bachelor Thesis, Humboldt University	Summer 2019
	· Breakout Session Leader for Royal Society New Research Fellows’ Induction Day	November 2020
	· Co-organizer, London–Paris Number Theory Seminar	Spring 2019–
	· Co-organizer, London Number Theory Seminar	Fall 2018–
	· Co-organizer, London Number Theory Study Group	Fall 2017–
	· Organized a reading course on Shimura varieties, University of Bonn	Summer 2017
	· Ad hoc reviewer for the NSF, ERC, EPSRC, The Royal Society, DFG, Maths in Greater Paris	2017–
	· Panel member for National Science Foundation review panel	2016-17
	· Member of the jury for the PhD defense of Macarena Peche Irissarry, Université Pierre et Marie Curie	November 2016
	· Co-organizer, Princeton/IAS number theory seminar	2013-2014, 2015-2016
	· Advised Siyan Daniel Li’s junior project on “The zeta function of a modular curve”, Princeton University	Spring 2016

- Reader for Ila Varma's PhD thesis on Local-Global Compatibility, Princeton University Summer 2015
- Advised Siyan Daniel Li's summer project on Perfectoid Spaces, Princeton University Summer 2015
- Reader for Isabelle Nogues's senior thesis on p -adic Analysis, Princeton University Spring 2015
- Co-organizer, MSRI graduate student working seminar on "The geometric Satake correspondence" Fall 2014
- Co-leader, Women in Numbers 3, Banff Spring 2014
- Co-leader, Women in Numbers Europe, Luminy Fall 2013
- Advised Isabelle Nogues's junior project on Elliptic Curve Cryptography, Princeton University Spring 2014
- Referee for Journal of the AMS, Duke Math. J., Compositio, Forum of Math. Sigma, Math. Annalen, IMRN, Journal of Algebraic Geometry etc. 2013-present
- Served on professional development panels (at Algebraic Geometry Bootcamp, MSRI, Princeton, University of Chicago) 2013-present
- Co-organizer and co-founder, Women in Math Lunches, Harvard University 2008-2012