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# Toby Gee

## Employment

2013– **Professor**, *Imperial College London*
2011–2013 **Senior Lecturer**, *Imperial College London*
2010–2011 **Assistant Professor**, *Northwestern University*
2008–2010 **Benjamin Peirce Lecturer**, *Harvard University*
2007–2008 **Postdoctoral Researcher**, *Northwestern University*
2004–2007 **EPSRC Postdoctoral Fellow**, *Imperial College London*

## Fellowships

2011–2013 **Sloan Research Fellowship**, *Alfred P. Sloan Foundation*
2007–2010 **Miller Fellowship**, *University of California, Berkeley (declined)*
2004–2007 **Title A Fellow**, *Trinity College, Cambridge*

## University education

2001–2004 **PhD**, *Imperial College London*, (advisor: Prof. Kevin Buzzard)
2000–2001 **Part III**, *Cambridge*, with distinction
1997–2000 **BA in Mathematics**, *Cambridge*, Senior Wrangler

## Grants

2023–2027 **Simons Foundation Collaboration (joint PI)**, *$8,000,000*
2020–2025 **ERC Advanced Grant (PI)**, *€2,195,110*
2016–2021 **Royal Society Wolfson Research Merit Award (PI)**, *£50,000*
2014–2019 **EPSRC Grant (joint with Kevin Buzzard)**, *£620,441*
2012–2017 **ERC Starting Grant (PI)**, *€1,131,339*
2012–2016 **Marie Curie Career Integration Grant (PI)**, *€100,000*
2011–2012 **NSF Standard Grant (PI) (modification of grant below)**, *$45,445*
2011–2014 **NSF Standard Grant (PI) (declined due to return to UK)**, *$242,160*
2011–2013 **Sloan Fellowship (PI) (declined due to return to UK)**, *$50,000*
2008–2011 **NSF Standard Grant (PI)**, *$97,856*
2004–2007 **EPSRC Postdoctoral Fellowship (PI)**, *£105,602*

## Awards, prizes and distinctions

2024 Fellow of the Royal Society

2013 Fellow of the American Mathematical Society

2012 Leverhulme Prize

2012 Whitehead Prize (London Mathematical Society)

## Editorships

2023– Editorial board, Duke Mathematical Journal

2015–2023 Editorial board, Selecta Math

2013–2018 Editorial board, Math. Annalen

2013 Editorial Advisor for the Bulletin, Journal and Proceedings of the London Mathematical Society

## Teaching

2011– Undergraduate and masters courses across algebra and number theory, Imperial College London

2010–2011 Graduate algebra and undergraduate calculus, Northwestern University

2008–2010 Graduate courses and undergraduate calculus, Harvard University

2004–2007 Undergraduate number theory, Imperial College London

## Departmental Service

2014– Promotions committee (chair from 2019 to date), Department of Mathematics, Imperial College London

2013–2017 Research committee, Department of Mathematics, Imperial College London

2011– Organiser of number theory study groups and seminars, Imperial College London

## Doctoral students

2022– Siqi Yang (joint with Lassina Dembele and Fred Diamond)

2017–2021 Ashwin Iyengar (joint with James Newton)

2015–2019 Andrea Dotto

2011–2015 Jack Shotton

2011–2013 Christian Johansson (joint with Kevin Buzzard)

## Postdocs mentored

2024– Kalyani Kansal

2022– Jeff Manning

2022– Yu Min

2021–2024 Jack Sempliner

2020–2023 Alice Pozzi

2016–2019 Carl Wang-Erickson

2015–2017 Yiwen Ding

2014–2016 James Newton

2014–2017 Olivier Taïbi

2013–2019 Rebecca Bellovin

## Conferences organised

2018 Scientific advisory board, special trimester on "Groupes algébriques et géométrisation du programme de Langlands", ENS Lyon, France

2013 Summer Graduate Workshop on New Geometric Techniques in Number Theory, MSRI, Berkeley, USA

2013 Conference on Higher Rank Automorphic Forms and L-functions, Warwick, UK

2012 Conference on the $p$-adic Langlands program, Fields Institute, Toronto, Canada

## Selected recent talks

09/2024 New Advances in the Langlands Program: Geometry and Arithmetic, Oxford

09/2024 Workshop on p-adic Geometry, Chicago

07/2024 Arithmetic Geometry (Gerd Faltings' 70th birthday), Bonn

07/2024 Arithmetic Geometry, Oberwolfach

03/2024 Colloquium, Columbia University

11/2023 Workshop on $p$-adic Arithmetic Geometry, IAS, Princeton

10/2023 Cambridge University Number Theory seminar

04/2023 Colloquium, University of Chicago

02/2023 Number theory meets $p$-adic representations, Münster, Germany

11/2022 Princeton/IAS Number Theory Seminar

10/2022 Conference on Arithmetic Algebraic Geometry, Darmstadt

09/2022 $p$-adic Hodge Theory and Applications, Clay Workshop, Oxford

06/2022 Topology and Arithmetic around the Langlands Program, Stockholm

05/2022 Simons Symposium on $p$-adic Hodge Theory, Gleneagles

04/2021 Derived Galois Deformation Rings & Cohomology of Arithmetic Groups, Oberwolfach

01/2021 Automorphic forms, automorphic representations, Galois representations, Kyoto

09/2020 Serre weights conjectures and geometry of Shimura varieties, Montreal

07/2020 Local Langlands and $p$-adic methods, Bonn (cancelled)

03/2020 Interactions between group theory, number theory, combinatorics and geometry, Isaac Newton Institute, Cambridge (cancelled)

01/2020 International Colloquium on Arithmetic Geometry, Tata Institute, Mumbai

10/2019 Modularity and Moduli Spaces, Oaxaca, Mexico

10/2019 London–Paris seminar in memory of Jean-Marc Fontaine and Jean-Pierre Wintenberger, Paris

07/2019 $p$-adic modular forms and Galois representations, Sheffield

06/2019 Opening Colloquium, Cluster of Excellence, University of Münster

03/2019 International conference on arithmetic geometry, Beijing

07/2018 $p$-adic Langlands Correspondence, Shimura Varieties and Perfectoids, CIRM Luminy

07/2017 Plenary talk, Journées Arithmétiques, Caen

## Summer schools

05/2023 Summer School on the Arithmetic of the Langlands Program, Bonn (2 lectures)

07/2022 Summer school on the Langlands Program, IHES, Paris

09/2019 Hausdorff School on the Emerton–Gee stack and related topics, Bonn (5 lectures)

06/2018 Algebraic Groups and Geometrization of the Langlands Program, Lyon (4 lectures)

01/2018 UK-Japan Winter School on Number Theory, King's College London (2 lectures)

07/2013 MSRI Summer School, Berkeley (4 lectures)

03/2013 Arizona Winter School, Tucson (4 lectures)

01/2011 Winter school on Serre's Conjecture, POSTECH, South Korea (4 lectures)

## Preprints

2023 G. Boxer, F. Calegari, T. Gee, J. Newton, and J. A. Thorne. *The Ramanujan and Sato–Tate Conjectures for Bianchi modular forms*.

A. Dotto, M. Emerton, and T. Gee. *Localization of smooth $p$-power torsion representations of $GL_2(\mathbf{Q}_p)$*.

## Publications

2024 G. Boxer, F. Calegari, and T. Gee. "Cuspidal cohomology classes for $GL_n(\mathbf{Z})$". **Journal of the American Mathematical Society (to appear)**.

A. Caraiani, M. Emerton, T. Gee, and D. Savitt. "Components of moduli stacks of two-dimensional Galois representations". **Forum Math. Sigma** 12, Paper No. e31, 62.

A. Caraiani, M. Emerton, T. Gee, and D. Savitt. "The geometric Breuil-Mézard conjecture for two-dimensional potentially Barsotti-Tate Galois representations". **Algebra & Number Theory (to appear)**.

2023 P. B. Allen, F. Calegari, A. Caraiani, T. Gee, D. Helm, B. V. Le Hung, J. Newton, P. Scholze, R. Taylor, and J. A. Thorne. "Potential automorphy over CM fields". **Annals of Mathematics. Second Series** 197.3, pp. 897–1113.

A. Caraiani, M. Emerton, T. Gee, and D. Savitt. "Local geometry of moduli stacks of two-dimensional Galois representations". **Proceedings of the International Colloquium on 'Arithmetic Geometry', TIFR Mumbai, Jan. 6-10, 2020 (to appear)**.

M. Emerton and T. Gee. *Moduli stacks of étale $(\varphi, \Gamma)$-modules and the existence of crystalline lifts*. Vol. 215. **Annals of Mathematics Studies**. Princeton University Press, Princeton, NJ, pp. ix+298.

M. Emerton and T. Gee. "Moduli stacks of $(\phi, \Gamma)$-modules: a survey". **Proceedings of the International Colloquium on 'Arithmetic Geometry', TIFR Mumbai, Jan. 6-10, 2020 (to appear)**.

M. Emerton, T. Gee, and E. Hellmann. "An introduction to the categorical $p$-adic Langlands program". **Proceedings of the 2022 IHES Summer School on the Langlands program (AMS, to appear)**.

2022 F. Calegari, M. Emerton, and T. Gee. "Globally realizable components of local deformation rings". **Journal de l'Institut de Mathématiques de Jussieu** 21.2, pp. 533–602.

T. Gee. "Modularity lifting theorems". **Essential Number Theory** 1.1, pp. 73–126.

T. Gee and J. Newton. "Patching and the completed homology of locally symmetric spaces". **Journal de l'Institut de Mathématiques de Jussieu** 21.2, pp. 395–458.

2021 G. Boxer, F. Calegari, T. Gee, and V. Pilloni. "Abelian surfaces over totally real fields are potentially modular". **Publications Mathématiques. Institut de Hautes Études Scientifiques** 134, pp. 153–501.

M. Emerton and T. Gee. "'Scheme-theoretic images' of morphisms of stacks". **Algebraic Geometry** 8.1, pp. 1–132.

2019 R. Bellovin and T. Gee. "$G$-valued local deformation rings and global lifts". **Algebra & Number Theory** 13.2, pp. 333–378.

T. Gee and O. Taïbi. "Arthur's multiplicity formula for $\mathbf{GSp}\_4$ and restriction to $\mathbf{Sp}\_4$". en. **Journal de l'École polytechnique — Mathématiques** 6, pp. 469–535.

2018 T. Barnet-Lamb, T. Gee, and D. Geraghty. "Serre weights for $U(n)$". **Journal für die Reine und Angewandte Mathematik. [Crelle's Journal]** 735, pp. 199–224.

A. Caraiani, M. Emerton, T. Gee, D. Geraghty, V. Paškūnas, and S. W. Shin. "Patching and the $p$-adic Langlands program for $GL_2(\mathbf{Q}_p)$". **Compositio Mathematica** 154.3, pp. 503–548.

T. Gee, F. Herzig, and D. Savitt. "General Serre weight conjectures". **Journal of the European Mathematical Society (JEMS)** 20.12, pp. 2859–2949.

2017 F. Calegari, M. Emerton, T. Gee, and L. Mavrides. "Explicit Serre weights for two-dimensional Galois representations". **Compositio Mathematica** 153.9, pp. 1893–1907.

T. Gee, F. Herzig, T. Liu, and D. Savitt. "Potentially crystalline lifts of certain prescribed types". **Documenta Mathematica** 22, pp. 397–422.

2016 K. Buzzard and T. Gee. "Slopes of modular forms". *Families of automorphic forms and the trace formula*. **Simons Symp.** Springer, [Cham], pp. 93–109.

A. Caraiani, M. Emerton, T. Gee, D. Geraghty, V. Paškūnas, and S. W. Shin. "Patching and the $p$-adic local Langlands correspondence". **Cambridge Journal of Mathematics** 4.2, pp. 197–287.

2015 L. Dieulefait and T. Gee. "Automorphy lifting for small $l$ (appendix to: Automorphy of $Symm^5GL(2)$ and base change)". **Journal de Mathématiques Pures et Appliquées. Neuvième Série** 104.4, pp. 619–656.

M. Emerton and T. Gee. "$p$-adic Hodge-theoretic properties of étale cohomology with mod $p$ coefficients, and the cohomology of Shimura varieties". **Algebra & Number Theory** 9.5, pp. 1035–1088.

M. Emerton, T. Gee, and D. Savitt. "Lattices in the cohomology of Shimura curves". **Inventiones Mathematicae** 200.1, pp. 1–96.

T. Gee and D. Geraghty. "The Breuil-Mézard conjecture for quaternion algebras". **Université de Grenoble. Annales de l'Institut Fourier** 65.4, pp. 1557–1575.

T. Gee, T. Liu, and D. Savitt. "The weight part of Serre's conjecture for $GL(2)$". **Forum of Mathematics. Pi** 3, e2, 52.

2014 T. Barnet-Lamb, T. Gee, D. Geraghty, and R. Taylor. "Local-global compatibility for $l = p$, II". **Annales Scientifiques de l'École Normale Supérieure. Quatrième Série** 47.1, pp. 165–179.

T. Barnet-Lamb, T. Gee, D. Geraghty, and R. Taylor. "Potential automorphy and change of weight". **Annals of Mathematics. Second Series** 179.2, pp. 501–609.

K. Buzzard and T. Gee. "The conjectural connections between automorphic representations and Galois representations". *Automorphic forms and Galois representations. Vol. 1*. Vol. 414. **London Math. Soc. Lecture Note Ser.** Cambridge Univ. Press, Cambridge, pp. 135–187.

M. Emerton and T. Gee. "A geometric perspective on the Breuil-Mézard conjecture". **Journal de l'Institut de Mathématiques de Jussieu** 13.1, pp. 183–223.

T. Gee and M. Kisin. "The Breuil-Mézard conjecture for potentially Barsotti-Tate representations". **Forum of Mathematics. Pi** 2, e1, 56.

T. Gee, T. Liu, and D. Savitt. "The Buzzard-Diamond-Jarvis conjecture for unitary groups". **Journal of the American Mathematical Society** 27.2, pp. 389–435.

2013 T. Barnet-Lamb, T. Gee, and D. Geraghty. "Congruences between Hilbert modular forms: constructing ordinary lifts, II". **Mathematical Research Letters** 20.1, pp. 67–72.

T. Barnet-Lamb, T. Gee, and D. Geraghty. "Serre weights for rank two unitary groups". **Mathematische Annalen** 356.4, pp. 1551–1598.

K. Buzzard and T. Gee. "Explicit reduction modulo $p$ of certain 2-dimensional crystalline representations, II". **Bulletin of the London Mathematical Society** 45.4, pp. 779–788.

F. Calegari and T. Gee. "Irreducibility of automorphic Galois representations of $GL(n)$, $n$ at most 5". **Université de Grenoble. Annales de l'Institut Fourier** 63.5, pp. 1881–1912.

M. Emerton, T. Gee, and F. Herzig. "Weight cycling and Serre-type conjectures for unitary groups". **Duke Mathematical Journal** 162.9, pp. 1649–1722.

T. Gee and P. Kassaei. "Companion forms in parallel weight one". **Compositio Mathematica** 149.6, pp. 903–913.

2012 T. Barnet-Lamb, T. Gee, and D. Geraghty. "Congruences between Hilbert modular forms: constructing ordinary lifts". **Duke Mathematical Journal** 161.8, pp. 1521–1580.

T. Barnet-Lamb, T. Gee, D. Geraghty, and R. Taylor. "Local-global compatibility for $l = p$, I". **Annales de la Faculté des Sciences de Toulouse. Mathématiques. Série 6** 21.1, pp. 57–92.

T. Gee and D. Geraghty. "Companion forms for unitary and symplectic groups". **Duke Mathematical Journal** 161.2, pp. 247–303.

T. Gee, T. Liu, and D. Savitt. "Crystalline extensions and the weight part of Serre's conjecture". **Algebra & Number Theory** 6.7, pp. 1537–1559.

2011 T. Barnet-Lamb, T. Gee, and D. Geraghty. "The Sato-Tate conjecture for Hilbert modular forms". **Journal of the American Mathematical Society** 24.2, pp. 411–469.

T. Gee. "Automorphic lifts of prescribed types". **Mathematische Annalen** 350.1, pp. 107–144.

T. Gee. "On the weights of mod $p$ Hilbert modular forms". **Inventiones Mathematicae** 184.1, pp. 1–46.

T. Gee and D. Savitt. "Serre weights for mod $p$ Hilbert modular forms: the totally ramified case". **Journal für die Reine und Angewandte Mathematik. [Crelle's Journal]** 660, pp. 1–26.

T. Gee and D. Savitt. "Serre weights for quaternion algebras". **Compositio Mathematica** 147.4, pp. 1059–1086.

2009 K. Buzzard and T. Gee. "Explicit reduction modulo $p$ of certain two-dimensional crystalline representations". **International Mathematics Research Notices. IMRN** 12, pp. 2303–2317.

T. Gee. "The Sato-Tate conjecture for modular forms of weight 3". **Documenta Mathematica** 14, pp. 771–800.

2008 T. Gee. "Companion forms over totally real fields". **Manuscripta Mathematica** 125.1, pp. 1–41.

2007 T. Gee. "Companion forms over totally real fields. II". **Duke Mathematical Journal** 136.2, pp. 275–284.

2006 T. Gee. "A modularity lifting theorem for weight two Hilbert modular forms". **Mathematical Research Letters** 13.5-6, pp. 805–811.