

David Holmes

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Research area

Number theory and algebraic geometry.

Academic positions

- 2014≤ **Assistant Professor**, *University of Leiden*, (tenured since June 2017).
- 2012 - 2014 **Postdoc**, *University of Leiden*.
- 4 - 8/2012 **Visiting researcher**, *University of Hamburg*.
- 2008 - 2012 **PhD with Samir Siksek**, *University of Warwick*, awarded 10 Dec 2012.
- 2007 - 2008 **Part III Mathematics**, *Christ's College Cambridge*, Distinction.
- 2004 - 2007 **BSc Mathematics**, *University of Warwick*, 1st class Hons.

Publications

- 2019 **Extending the double ramification cycle by resolving the Abel-Jacobi map**, arXiv:1707.02261, , <https://doi.org/10.1017/S1474748019000252>, *Journal of the Institute of Mathematics of Jussieu*.
- 2019 **Multiplicativity of the double ramification cycle (with Aaron Pixton and Johannes Schmitt)**, arXiv:1711.10341, *Doc. Math.* 24, 545-562 (2019), DOI: 10.25537/dm.2019v24.545-562.
- 2019 **Explicit arithmetic intersection theory and computation of Néron-Tate heights (with Steffen Muller and Raymond van Bommel)**, arXiv:1809.06791, *Math. Comp.* <https://doi.org/10.1090/mcom/3441>.
- 2019 **Torsion points and height jumping in higher-dimensional families of abelian varieties**, arXiv:1604.04563, <https://doi.org/10.1142/S179304211950101X>, *International Journal of Number Theory*.
- 2019 **Néron models of jacobians over base schemes of dimension greater than 1**, *J. Reine Angew. Math.* 747 (2019), 109–145. DOI 10.1515/crelle-2016-0014, arXiv:1402.0647.
- 2018 **Singularity of the biextension metric for families of abelian varieties (with J. Burgos Gil and R. de Jong)**, arXiv:1604.00686, *Forum of Mathematics, Sigma*, 6, E12. doi:10.1017/fms.2018.13.

- 2018 **Extending the Double Ramification Cycle using Jacobians** (*with J. Kass and N. Pagani*), arXiv:1712.07098, European Journal of Mathematics (2018) 4: 1087. <https://doi.org/10.1007/s40879-018-0256-7>.
- 2017 **Positivity of the height jump divisor** (*with J. Burgos Gil and R. de Jong*), arXiv:1701.00370, International Mathematics Research Notices, Volume 2019, Issue 7, April 2019, Pages 2044–2068, <https://doi.org/10.1093/imrn/rnx169>.
- 2017 **Néron models and the height jump divisor** (*with O. Biesel and R. de Jong*), arXiv:1412.8207, Trans. Amer. Math. Soc. 369 (2017), 8685–8723.
- 2016 **Quasi-compactness of Néron models, and an application to torsion points**, Manuscripta Math doi:10.1007/s00229-016-0887-2, arXiv:1604.01155.
- 2015 **The Brauer-Manin obstruction on Kummer varieties and ranks of twists of abelian varieties** (*with R. Pannekoek*), Bull. London Math. Soc. **47**, arXiv:1404.3641.
- 2015 **Asymptotics of the Néron height pairing** (*with R. de Jong*), Math. Res. Lett. **22**, No. 5, arXiv:1304.4768.
- 2014 **An Arakelov-theoretic approach to naïve heights on hyperelliptic jacobians**, New York J. Math. **20**, arXiv:1207.5948.
- 2012 **Computing Néron-Tate heights of points on hyperelliptic jacobians**, J. Number Theory **132**, arXiv:1004.4503.

Preprints

- 2019 **Empirical and dynamic approaches for modelling the yield and N content of European grasslands** (*with Martha Dellar, Kairsty Topp, Guillermo Pardo, Agustin del Prado, Nuala Fitton, Georgios Banos, Eileen Wall*), submitted.
- 2019 **The norm of the saturation of a binomial ideal, and applications to Markov bases**, arxiv:1907.10268.
- 2018 **Fields of definition of curves of a given degree** (*with Nick Rome*), arXiv:1901.11294, submitted.
- 2016 **Fine compactified moduli of enriched structures on stable curves** (*with Owen Biesel*), arXiv:1607.08835, submitted.
- 2014 **A Néron model of the universal jacobian**, arXiv:1412.2243, submitted.
- 2012 **Néron-Tate heights on the jacobians of high-genus hyperelliptic curves**, PhD thesis.

International conference talks

- 2019 **Arithmetic Intersection Theory and Computation of Néron-Tate heights**, *Rational Points 2019*, (contributed talk), Workshop at Franken-Akademie Schloss Schney.

- 2017 **A universal resolution of the Abel-Jacobi map**,
Moduli of curves in Gothenburg, Chalmers University of Technology, Gothenburg.
- 2017 **A universal resolution of the Abel-Jacobi map**,
Workshop on Moduli spaces of Curves, Integrable Systems and related subjects,
Institut de Mathématiques de Bourgogne, Dijon.
- 2017 **Arakelov geometry of hyperelliptic curves**,
Workshop on Arithmetic of Hyperelliptic Curves, ICTP Trieste.
- 2017 **Numerical verification of the Conjecture of Birch and Swinnerton-Dyer for some hyperelliptic Jacobians**,
Rational Points 2017, (contributed talk),
Workshop at Franken-Akademie Schloss Schney.
- 2015 **A Néron model of the universal jacobian**,
Summer Research Institute in Algebraic Geometry, (contributed talk), Salt Lake City.
- 2015 **Néron models and heights in families**,
Rational Points 2015, (contributed talk),
Workshop at Franken-Akademie Schloss Schney.
- 2014 **Néron models of jacobians over base-schemes of dimension greater than 1**,
AriVaF - ARithmétique des VARIétés en Familles, closing conference, (invited speaker), Bordeaux.
- 2013 **Rational points on Kummer varieties**,
Rational Points - Geometric, Analytic and Explicit Approaches, (invited speaker),
University of Warwick.
- 2013 **Heights in families of abelian varieties**,
Rational Points 2013, (contributed talk),
Bayreuth.
- 2011 **Computations on the jacobians of high-genus curves**,
Foundations of Computational Mathematics, (invited speaker),
Budapest.
- 2010 **Canonical heights on hyperelliptic curves**,
Rational Points 3, (contributed talk),
Bayreuth.

Seminar and colloquium talks

- 2019 **Geometry of the double ramification cycle**,
Algebraic geometry seminar,
Imperial College.
- 2018 **A formula for the canonical double ramification cycle**,
Algebraic geometry seminar,
ETH Zürich.
- 2018 **Néron models over bases of higher dimension**,
Arithmetic geometry seminar,
Bayreuth.

- 2018 **The Abel-Jacobi map and the double ramification cycle**,
Algebraic geometry seminar,
Regensburg.
- 2018 **Extending the Abel-Jacobi map**,
Algebraic geometry seminar,
University of Colorado at Boulder.
- 2018 **Extending the Abel-Jacobi map**,
Algebraic geometry seminar,
Colorado State.
- 2018 **Extending the Abel-Jacobi map**,
Algebraic geometry seminar,
Liverpool.
- 2017 **Compactifying the double ramification cycle**,
Algebraic geometry seminar,
ETH Zürich.
- 2017 **Compactifying the double ramification cycle**,
IRTG1800 summer school,
Texel island.
- 2017 **Enriched structures on stable curves**,
Algebraic geometry seminar,
Roma III.
- 2017 **Rational torsion points and String theory**,
Number theory seminar,
Copenhagen.
- 2017 **Rational torsion points and String theory**,
Linfoot Seminar,
Bristol.
- 2017 **Rational torsion points and Gromov-Witten theory**,
Number Theory Seminar,
Oldenburg.
- 2016 **Modular curves and the double ramification cycle**,
Séminaire Variétés Rationnelles,
ENS Paris.
- 2016 **Compactifying the double ramification locus**,
Algebraic geometry seminar,
Dijon.
- 2016 **A Néron model of the universal jacobian**,
Algebraic Geometry Seminar,
KTH Stockholm.
- 2016 **A Néron model of the universal jacobian**,
Algebraic Geometry Seminar,
MPI Bonn.

- 2016 **A Néron model of the universal jacobian**,
London Geometry and Topology seminar,
Imperial College London.
- 2016 **Torsion points, Néron models and height jumping**,
MAGIC seminar,
Imperial College London.
- 2015 **Degenerating families of jacobians**,
Dutch-Belgian algebraic geometry seminar,
Leiden, Netherlands.
- 2015 **A Néron model of the universal jacobian**,
Algebraic geometry seminar,
Mainz, Germany.
- 2015 **A Néron model of the universal jacobian**,
Seminarium z Arytmetyki, Geometrii i Algebry,
Poznan, Poland.
- 2015 **A Néron model of the universal jacobian**,
Algebraic geometry seminar,
Coimbra, Portugal.
- 2015 **A Néron model of the universal jacobian**,
Algebraic geometry seminar,
Jussieu, Paris.
- 2015 **Complexity of rational solutions to polynomial equations**,
General mathematics colloquium,
Universiteit van Amsterdam.
- 2015 **A Néron model of the universal jacobian**,
Geometry and Algebra, Geometry and Analysis seminar,
Utrecht University.
- 2015 **Néron models over higher dimensional bases**,
Algebra seminar,
Leiden University.
- 2014 **Degenerations of jacobians of algebraic curves over high-dimensional bases**,
Research Trimester on Multiple Zeta Values, Multiple Polylogarithms, and Quantum Field Theory,
ICMAT, Madrid.
- 2014 **Rational points on Kummer varieties**,
Intercity number theory seminar,
University of Leiden.
- 2013 **Distribution of rational points on Kummer varieties**,
Algebra, geometry and number theory seminar,
University of Leiden.
- 2012 **Rational points on Kummer varieties**,
Number theory seminar,
KU Leuven.

- 2012 **Explicit Arakelov theory for Néron-Tate heights on the jacobians of curves**,
Intercity number theory seminar,
University of Leiden.
- 2012 **Néron-Tate heights and Arakelov theory**,
Algebra, geometry and number theory seminar,
University of Leiden.
- 2012 **Computing Néron-Tate heights using Arakelov intersection theory**,
Number theory seminar,
University of Hamburg.
- 2010 **Applications of intersection theory to Diophantine geometry**,
Oberseminar algebraische geometrie,
Universität Zürich (UZH).
- 2010 **Applications of intersection theory to number theory**,
Oberseminar algebraische geometrie,
Ludwig Maximilians Universität München.
- 2009 **Jacobians of hyperelliptic curves**,
Junior Cambridge-Oxford-Warwick algebraic geometry seminar,
University of Cambridge.
- 2009 **Arithmetic surfaces and intersection theory**,
Number theory seminar,
University of Warwick.
- 2009 **Genus 3 jacobians**,
Number theory seminar,
University of Warwick.

Grants and awards

- 2019 **DIAMANT small grant**, *to support the Intercity Geometry Seminar, and the visit of Samouil Molcho.*
- 2015 **Clay Mathematics Institute grant**, *to attend the 2015 Summer Research Institute in Algebraic Geometry, Salt Lake City.*
- 2008-2012 **EPSRC scholarship: full funding for the Ph.D. programme**, awarded by the University of Warwick Mathematics Institute.
- 2011 **Various grants for the conference ‘Young Researchers in Mathematics’**, total £16,350.
- 2008 **Bachelor Scholarship of Christ’s College Cambridge.**
- 2008 **Christ’s College Whelan Prize in Mathematics.**

Teaching and supervising

Service

- 2017- **Studiadviseur**, *masterstudents in algebra, geometry and number theory*, Leiden.
- 2017- **Opleidingscommissie Wiskunde**, *member*, Leiden.

Qualifications

- 2015 **Basis kwalificatie onderwijs**, (*basic Dutch university teaching qualification*), Leiden.
- PhD students
- 2018-2022 **Ruihua Wang**, *Higher-dimensional Arakelov intersection theory*, Leiden, funded by CRC scholarship.
- 2018-2023 **Rosa Schwarz**, *Gromov Witten theory of Artin Stacks*, Leiden, funded by NWO.
- 2016-2019 **Garnet Akeyr**, *Alignment in families with higher-dimensional fibres*, Leiden, funded by NSERC scholarship.
- 2014-2017 **Raymond van Bommel**, *Distribution of reduction types of abelian varieties*, (cosupervised with F. Pazuki), Leiden/Copenhagen.
- 2014-2017 **Giulio Orecchia**, *Picard functors of curves over high-dimensional base schemes*, (cosupervised with Q. Liu), Leiden/Bordeaux, funded by ALGANT consortium.
- PhD defence committees
- 2018 **Chloe Martindale (Leiden/Bordeaux)**, **Ale Beshenov (Leiden/Bordeaux)**, **Nicola Damjanovic (Leiden/Bordeaux)**.
- 2016 **Dino Festi (Leiden/Milan)**.
- 2014 **Mai Hoang Bien (Leiden/Padova)**.
- Master's students
- 2017 **Rosa Schwarz**, *Intersection theory on Picard stacks of genus-0 curves*, University of Leiden.
- 2017 **Martin Heemskerk**, *Derived equivalence of singular varieties*, University of Leiden.
- 2017 **Sergej Monavari**, *Line bundles on twisted curves*, University of Leiden.
- 2016 **Arend de Jonge**, *Minimal desingularisations of aligned nodal curves*, University of Leiden.
- 6/2014 **Raymond van Bommel**, *Almost all hyperelliptic jacobians have a bad semi-abelian prime*, University of Leiden.
Now undertaking a PhD in Leiden and Copenhagen, with F. Pazuki and myself.
- 2/2014 **Erik Visse**, *Local computations on the Cassels-Tate pairing on an elliptic curve*, (with R. Newton), University of Leiden.
Now undertaking a PhD in Leiden, with R. van Luijk.
- 7/2013 **Michele Serra**, *Smooth models of curves*, University of Leiden.
Now undertaking a PhD at Konstanz University, with A. Fehm.
- Numerous additional master's thesis committees
- Bachelor students supervised
- 2018 **Wim Nijgh**, *Differential geometry via sheaves*, University of Leiden.
- 2015 **Floris Ruijter**, *Homotopy types of non-Hausdorff manifolds*, University of Leiden.
- 2014 **Anne Hommelberg**, *Compact non-Hausdorff manifolds*, University of Leiden.
- Interns
- 2016 **Noémie Gaveau**, *Origami and constructible numbers*, ENS Rennes.

Courses taught (at the University of Leiden unless otherwise stated)

- Spring 2019 **Curves, jacobians and moduli**, 4 lectures at the GQT summer school.
- Spring 2019 **Topics in Algebraic Geometry**, graduate seminar course.
- Spring 2019 **Lineaire Algebra 2**, undergraduate course.
- Autumn 2018 **Commutative Algebra**, national graduate course, (with Arno Kret).
- Autumn 2018 **Lineaire Algebra 1**, undergraduate course.
- Spring 2018 **Topics in Algebraic Geometry**, graduate seminar course, (with Bas Edixhoven).
- Spring 2018 **Lineaire Algebra 2**, undergraduate course.
- Autumn 2018 **Commutative Algebra**, national graduate course, (with Rob de Jeu).
- Autumn 2017 **Lineaire Algebra 1**, undergraduate course.
- Spring 2017 **Lineaire Algebra 2**, undergraduate course.
- Autumn 2016 **Lineaire Algebra 1**, undergraduate course.
- Autumn 2016 **Algebraic Geometry**, national graduate course, (with R. de Jong).
- Spring 2016 **Algebraic Geometry**, national graduate course, (with R. de Jong).
- Spring 2016 **Lineaire Algebra en Beeldverwerking**, undergraduate course.
- Spring 2016 **Lineaire Algebra 2**, undergraduate course.
- Spring 2016 **Lineaire Algebra 1**, undergraduate course.
- 2015 **Elliptic Curves**, graduate course.
- 2015 **Lineaire Algebra en Beeldverwerking**, undergraduate course.
- 2014 **Modular forms**, graduate reading course.
- 2014 **Lineaire Algebra en Beeldverwerking**, undergraduate course, (with C. Kalle).
- 2014 **Advanced algebraic geometry**, graduate course, (with B. Edixhoven).
- 2013 **Cohomology of coherent sheaves**, graduate reading course.
- 2013 **Topics in algebraic geometry**, graduate course, (with L. Taelman).
- 2013 **Extra topics in elliptic curves**, graduate reading course, (with R. Newton).
- 2012 **Elliptic curves**, graduate course, (with R. Newton).

Assistantships

- 2012 **Modular forms**, graduate course, University of Hamburg.
- 2012 **Algebra**, second year undergraduate, University of Hamburg (in German).
- 2012 **Galois theory**, third year undergraduate, University of Warwick.
- 2010 **Topics in number theory**, second year undergraduate, University of Warwick.
- 2008-2009 **Undergraduate supervisions**, University of Warwick.

Seminars and conferences organised

- 2019 **Intercity Geometry Seminar: The logarithmic Picard group and its tropicalization** (national seminar, with Chris Lazda (UvA), Adrien Sauvaget (UU) and Arne Smeets (RUN)).
- 2019 **DIAMANT meets GQT: Arithmetic and geometry** (session of the NMC (Dutch Mathematical Congress), with Martijn Kool (UU)).

- 2018 **Intercity Geometry Seminar: Mirror Symmetry and moduli spaces of Higgs bundles** (*national seminar, with Chris Lazda (UvA) and Arne Smeets (RUN)*).
- 2013 **The Shafarevich conjecture** (*seminar, with R. de Jong, A. Javanpeykar and S. Müller*), University of Leiden.
- 2012 **Arithmetic intersection theory** (*seminar, with M. Streng and D. Patel*), University of Leiden and Vrije Universiteit Amsterdam.
- 2011 **Young Researchers in Mathematics 2011** (*conference, chair of organising committee*), this is the UK's largest postgraduate mathematics conference, covering all areas of mathematics and with approximately 200 participants. In 2011 it was held at the University of Warwick.
- 2011 **Deformations of Galois representations** (*seminar, with B. Banwait*), University of Warwick.
- 2010 **Néron models of modular curves** (*seminar*), University of Warwick.

Other academic activities

- 2017- **Initiator and maintaner of Leiden Algebra YouTube channel.**
- 2014 **Selection committee for host for Young Researchers in Mathematics 2016.**
- 2010-2011 **Virtual member of the Scientific Committee of the British Mathematical Colloquium.**
- Referee for various journals.**
- Reviewer for MathSciNet.**

Languages

- English (native speaker)
- Dutch (European level A2, and given talks in Dutch)
- German (GCSE qualification and teaching experience)