

Arend Bayer

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Research interests

Applications of derived categories within algebraic geometry

Stability conditions, wall-crossing

Birational geometry of moduli spaces

Gromov–Witten invariants, Donaldson–Thomas invariants

Education

2006 Ph.D. at *MPI für Mathematik, Bonn, Germany*, supervised by Yu. I. Manin

2003 Diplom at *University of Bonn, Germany*; thesis supervised by Yu. I. Manin

1999 *University of Cambridge, England*, Master of Advanced Study (“Part III”)

Employment

2012– University of Edinburgh: Lecturer, Reader, Professor of Algebraic Geometry (2017–)

2009–2012 Assistant Professor (Tenure Track) at University of Connecticut

Spring 2009 Postdoctoral fellowship at the MSRI, Berkeley

2006–2008 Post-Doc at the University of Utah

Awards

Invited speaker at the ICM 2022

ERC Consolidator grant “Wall-Crossing and Algebraic Geometry”, 6/2019–5/2024

Research Professorship, MSRI Spring 2019

CoI of EPSRC Programme Grant “Enhancing Representation Theory, Noncommutative Algebra and Geometry”, 2019–2025

Whittaker prize 2016 of the Edinburgh Mathematical Society

Whitehead prize 2016 of the London Mathematical Society

University of Cambridge Adams prize in Mathematics 2015

ERC starting grant “Wall-Crossing and Birational Geometry”, 12/2013–5/2019

Personal NSF grants 2008–2011 and 2011–2014.

Visiting Fellowship, Isaac Newton Institute Cambridge, UK, Spring 2011

Postdoctoral fellowship at the MSRI, Berkeley, Spring 2009

Advisees

PhD students: Rebecca Tramel (2011–15; then post-doc at UI Urbana-Champaign). Soheyla Feyzbaksh (2014–18; then post-doc at Imperial College). Sjoerd Beentjes (2014–18; then ERC post-doc with Ben Davison in Edinburgh), Fatemeh Rezaee (2016–20; then post-doc at Loughborough), Augustinas Jacovskis (2019–).

Post-docs: Ciaran Meachan (2013–15).

Chunyi Li (2014–17); now Royal Society Research Fellow, University of Warwick.

Matthew Woolf (2015–16).

Alice Rizzardo (2016–17), now Lecturer, University of Liverpool.

Seun-Jo Jung (2016–17), now research fellow at KIAS.

Diletta Martinelli (2016–18), now Assistant Professor, University of Amsterdam.

Laura Pertusi (Autumn 2018).

Current post-docs: Qingyuan Jiang (2019–). Naoki Koseki (2019–). Shizhou Zhang (2019–). Giulia Gugiatti (2020–21). Fei Xie (2020–).

Service**Editorial work/Refereeing**

Editorial Advisor, *Bulletin/Journal/Proceedings/Transactions of the LMS* (2014–).

Editor, *Proceedings of the Royal Society of Edinburgh Sect. A* (2015–19).

Editor, *Selecta Mathematica* (2017–).

Frequent refereeing and informal quick opinions (JAMS, *Inventiones*, *Duke*, *Compositio*, *Crelle*, *Algebraic Geometry*, *Journal of Algebraic Geometry*, *Commentarii Mathematici Helvetici*, *Geometry & Topology*, ...)

Reviewer for grant application: NSF (also as panelist), NSA, ERC (European), FRS-FNRS (Belgium), Royal Society, DFG (Germany), CONICYT (Chile), UKRI (UK).

Member of EPSRC Peer Review College (regularly asked to review grant applications), EPSRC panelist (twice).

Carnegie Research Assessor.

Tenure evaluations/external hiring evaluations (U. Michigan, Penn State, U South Carolina, Tel Aviv)

Conferences co-organised

Weekly online *Derived seminar*, <https://sites.google.com/view/derivedseminar/>, 2021.

Workshop *Derived Categories, Moduli Spaces and Deformation Theory*, Cetraro, June 2019

ICMS workshop “Constructions and Obstructions in Birational Geometry”, Edinburgh, November 2018.

School and Conference *Moduli Spaces, Mirror Symmetry and Enumerative Geometry*, August 2016, ICTP Trieste.

Second *British Algebraic Geometry* (BrAG) meeting, Edinburgh, April 2016.

Concentration period and workshop on *Geometry from stability conditions* (part of the 2014/15 EPSRC symposium on *Derived Categories*), Warwick, February 2015.

First BrAG meeting, Warwick, September 2014.

Fall 2010 AGNES meeting at University of Connecticut, September 2010.

Co-founder of the biannual conference series *AGNES - Algebraic Geometry Northeastern Series*.

Western algebraic geometry seminar (WAGS), University of Utah, November 2008.

Administrative roles

2019 *Convenor* of Athena SWAN working group on work/life balance.

2016– *Deputy Director of Research* for the School of Mathematics. *Ethics Officer* (2017–).

2014–2015 *Convenor* of the Post-Doc “Working Party” for the School of Mathematics.

The WP reviewed all aspects of the School’s support for post-docs, and a large number of our recommendations were adopted by the School.

2012– Member of hiring panels for Lecturer/Reader positions (2014, 2017, 2018, 2019);

Member of over 10 hiring panels for post-doc positions.

2016 External member of hiring committee at Heriot-Watt University, Edinburgh.

Teaching experience.

Due to my ERC and EPSRC grants, and a period of parental leave, I had no teaching obligation since 12/2013. During that time, I volunteered for the following roles related to teaching (in addition to mentoring five PhD students):

- Undergraduate final year project supervision (2014, 2015, 2018, 2019, 2020, 2021)
- Reading courses for 1st year PhD students (2015, 2019)
- Teaching organisation: As convenor of the *Post-doc working party* (2014–15) I led the introduction of a new framework for post-doc teaching within the School of Maths. This included improved support and feedback for their teaching, and allowed them to take on more responsibility and build a track record in teaching.

Courses taught

- 2012–2013 Course organizer and joint lecturer “Calculus and its applications”, Spring 2013; Tutoring in workshops
- 2009–2012 Instructor at University of Connecticut for:
Honors’ Calculus II, Geometry,
Applied Linear Algebra, Multivariable Calculus, Probability
Graduate courses: Geometry of derived categories, Algebraic Geometry 1 & 2,
Introduction to Geometry/Topology.
- 2006–2008 Instructor at University of Utah for:
Undergraduate courses: Calculus 1 & 2, Business Calculus
Graduate courses: Real Analysis, Topics in Algebraic geometry
- 2002–2004 Weekly tutoring at a school for mathematics tutoring of high school students
- 2001–2002 Teaching assistant (Lineare Algebra 1 & 2, Analysis 3) at University of Bonn
- 1997–2006 Coach for the German team at the International Mathematical Olympiad

Publications

- With A. Perry. Kuznetsov’s Fano threefold conjecture via K3 categories and enhanced group actions. Preprint.
- With E. Macrì. The unreasonable effectiveness of wall-crossing in algebraic geometry. arXiv:2201.03654. To appear in *Proceedings of the ICM 2022*.
- With S. Beentjes, S. Feyzbakhsh, G. Hein, D. Martinelli, F. Rezaee, B. Schmidt. The desingularization of the theta divisor of a cubic threefold as a moduli space. arXiv:2011.12240.
- With M. Lahoz, E. Macrì, H. Nuer, A. Perry, P. Stellari. Stability conditions in families. arXiv:1902.08184.
- Complement of spherical objects on K3 surfaces. Appendix to “On entropy of spherical twists” by Genki Ouchi, arXiv:1705.01001.
- With C. Li. Brill-Noether theory for curves on generic abelian surfaces. arXiv:1704.03456. *Pure Appl. Math. Q.* 13 (2017), no. 1 (Special Issue in Honor of Yuri Manin), 49–76.
- With M. Lahoz, E. Macrì, P. Stellari. Stability conditions on Kuznetsov components. arXiv:1703.10839.
- A short proof of the deformation property of Bridgeland stability conditions. *Math. Ann.* 375, 1597–1613 (2019) arXiv:16060.02169.
- Wall-crossing implies Brill-Noether. Applications of stability conditions on surfaces. Proceedings of the AMS Summer Institute on Algebraic Geometry, Salt Lake City 2015 (*Proc. Sympos. Pure Math.*, 97.1, AMS, 3–27.) arXiv:1604.08261.
- With A. Craw and Z. Zhang. Nef divisors for moduli spaces of complexes with compact support. arXiv:1602.00863. *Selecta Mathematica*, 23(2):1507–1561, 2017.
- With E. Macrì, P. Stellari. The space of stability conditions on abelian threefolds, and on some Calabi-Yau threefolds. *Inventiones mathematicae*, pages 1–65, published online May 2016. arXiv:1410.1585.
- With Tom Bridgeland. Derived automorphism groups of K3 surfaces of Picard rank 1, 2013. *Duke Mathematical Journal*, 166(1):75–124, 2017. arXiv:1310.8266.
- With B. Hassett, Y. Tschinkel. Mori cones of holomorphic symplectic varieties of K3 type. Mori cones of holomorphic symplectic varieties of K3 type. *Annales Scientifiques de l’ENS*, 48(5):941–950, 2015. arXiv:1307.2291.
- With E. Macrì. MMP for moduli of sheaves on K3s via wall-crossing: nef and movable cones, Lagrangian fibrations. *Inventiones mathematicae*, 198(3):505–590, 2014. arXiv:1301.6968.
- With E. Macrì. Projectivity and birational geometry of Bridgeland moduli spaces. *Journal of the AMS*, 27(3):707–752, 2014. arXiv:1203.4613.
- With A. Bertram, E. Macrì, Y. Toda. Bridgeland stability conditions on threefolds II: An application to

- Fujita’s conjecture. *Journal of Algebraic Geometry*, 23(4):693–710, 2014. arXiv:1106.3430
- With E. Macrì, Y. Toda. Bridgeland stability conditions on threefolds I: Bogomolov-Gieseker type inequalities. *Journal of Algebraic Geometry*, 23(1):117–163, 2014. arXiv:1103.5010.
- With E. Macrì. The space of stability conditions on the local projective plane. *Duke Mathematical Journal*, 160 (2011) no. 2, 263–322. arXiv:0912.0043
- Polynomial Bridgeland stability conditions and the large volume limit. *Geometry & Topology* 13 (2009), 4:2389–2425. arXiv:0712.1083.
- With C. Cadman. Quantum Cohomology of $[\mathbb{C}^N/\mu_r]$. *Compositio Mathematica*, 146(5):1291–1322, 2010. arXiv:0705.2158.
- With Yuri I. Manin. Stability Conditions, Wall-crossing and weighted Gromov-Witten Invariants, 2006. *Moscow Mathematical Journal*, 9 (2009), 1. arXiv:math.AG/0607580.
- Semisimple quantum cohomology and blowups. *IMRN*, (40):2069–2083, 2004. math.AG/0403260.
- With Yuri I. Manin. (Semi)simple exercises in quantum cohomology. In *The Fano Conference*, pages 143–173. Univ. Torino, Turin, 2004. math.AG/0103164.

Expository writing

- Reading, and Writing, Referee Reports*. AMS Notices, March 2019, “Early Career” section.
- Transforming Modern Algebraic Geometry*. Notes on the 2017 Shaw prize awarded to János Kollár and Claire Voisin. Mathematics Today, Institute of Mathematics & its applications, August 2017.
- A tour to stability conditions*. Available on my homepage <http://www.maths.ed.ac.uk/~abayer/>.

Invited Lecture series

- Workshop on *Bridgeland stability conditions*, December 2019, University of Warwick.
- School on *Moduli and Stability*, July 2019, University of Hannover.
- Workshop on *Stability conditions*, December 2018, UI Chicago.
- Senior participant, including lecture series, at *Géométrie Algébrique en Liberté (GAeL) 2017*, Bath.
- School on *Moduli Spaces, Mirror Symmetry and Enumerative Geometry*, August 2016, ICTP Trieste.
- Summer School on *Stability conditions and geometric applications*, Nordfjordeid, Norway, June 2016.
- Hausdorff school *Derived categories*, University of Bonn, April 2016.
- CNRS program *Géométrie Algébrique / Géométrie complexe* meeting, Luminy, November 2015.
- Triangulated categories in Algebra, Geometry and Topology*, University of Warsaw, June 2014.
- Minicourses on stability*, University of Coimbra, April 2014.
- Graduate Student Workshop on Moduli Spaces and Bridgeland Stability*, UI Chicago, March 2014.
- Four lectures on “Stability conditions and birational geometry”, University of Freiburg, November 2012.
- Summer School on Mathematical String Theory 2010*, Virginia Tech, June/July 2010.
- Rencontres mathématiques de Glanon*, Glanon (France), June/July 2008.
- VIGRE Mini-Course on Derived Categories*, University of Utah, June 2007.

Invited talks

- VBAC 2022: Moduli Spaces and Vector Bundles*, University of Warwick, July 2022.
- Section on *Algebraic and Complex Geometry*, International Congress of Mathematics, July 2022.
- Algebraic Geometry in honour of Claire Voisin*, Institut Henri Poincaré, Paris, May 2022.
- Manin 85*, MPI Bonn, March 2022.
- Algebraic Geometry seminar*, Stanford University, March 2021.
- Algebraic Geometry seminar*, Stonybrook University, February 2021.
- Shafarevich seminar*, Steklov Institute, Moscow, November 2020.
- Algebraic Geometry seminar*, ETH Zürich, July 2020.
- Moduli spaces, Birational Geometry and derived aspects*, MFO Oberwolfach, June 2020.
- Derived Categories and Geometry in finite characteristic*, Banach Center Warsaw, July 2019.
- Birational Geometry and Moduli spaces program seminar*, MSRI Berkeley, May 2019.

Algebraic Geometry seminar, Columbia University, April 2019.
Moduli Spaces: Birational Geometry and Wall-Crossing, BIRS, Banff, Canada, October 2018.
Arithmetic and Geometry of cubic hypersurfaces, University of Hannover, August 2018.
Belgian-Dutch algebraic geometry day, Leuven, June 2018.
Seminar/colloquia talks in Oxford, Leicester, Sheffield, May 2018.
Oberwolfach workshop *Algebraic Geometry*, September 2017.
British Algebraic Geometry (BrAG) meeting, University of Cambridge, September 2017.
Abel Symposium, Svolvær Norway, August 2017.
Cycles and Moduli, ETH Zürich, March 2017.
Joint talk: *Derived categories and Chow groups of hyperkaehler and Calabi-Yau varieties*, Simons Center
Stony Brook and *Algebraic Geometry Seminar*, University of Stony Brook, September 2016.
Algebraic Geometry, Satellite conference 7th European Congress of Mathematics, Hannover, July 2016
Homological Mirror Geometry, BIRS (Banff), March 2016
Algebra Seminar, University of Sheffield, December 2015
Derived Categories and Moduli spaces, Stavanger, September 2015
AMS Summer Institute Algebraic Geometry, University of Utah, July 2015
Fourier-Mukai transforms, 35 years on, VBAC, Warwick, June 2015
Morning speaker at *The 4th Joint British Mathematical Colloquium & British Applied Mathematics Colloquium*, Cambridge, April 2015
Simons Symposium Symposium on Geometry over non-closed fields, Puerto Rico, March 2015
Workshop on *Algebraic Geometry*, MFO Oberwolfach, March 2015
Algebraisches Geometrie Seminar, University of Hannover, December 2014
Complex Geometry and Algebraic Geometry, BICMR at Peking University, July 2014
K3 surfaces and their moduli, Schiermonnikoog (Netherlands), May 2014
Geometry workshop, British Mathematics Colloquium, Queen Mary University London, April 2014
Geometry and Arithmetic of Surfaces, LMU and TU Munich, March 2014
Birational Geometry and Foliations, Hausdorff Institute for Mathematics Bonn, February 2014
Calabi-Yau manifolds, mirror symmetry and related topics, University of Tokyo, February 2014
Positivity of Linear Series and Vector Bundles, Banff International Research Station, February 2014
Workshop on Birational geometry and stability, Vietnam Institute of Advanced Study, January 2014
Algebraic Geometry Seminar, ETH Zürich, December 2013
Cambridge-Oxford Warwick (COW) algebraic geometry meeting, Cambridge, November 2013
Mathematics colloquium, University of Sheffield, October 2013
University College London/King's College Geometry Seminar, October 2013
Algebraic Geometry Seminar, Ohio State University, August 2013
Workshop on Higher Categories and Topological Quantum Field Theories, ESI Vienna, June 2013
The Geometry of Topological D-branes, Categories and Applications, ESI Vienna, June 2013
Algebraic Geometry Seminar, University of Cambridge, April 2013
2013 Texas Algebraic Geometry Symposium, University of Texas Austin, April 2013
Glasgow-Liverpool-Edinburgh-Newcastle Algebraic Geometry seminar, Liverpool, February 2013
Moduli Spaces and Mathematical Physics, Workshop at CIMAT Guanajuato, Mexico, February 2013
UK-Japan Mathematical Forum, Algebraic and Symplectic Geometry, Keio University, January 2013
Derived category, Mirror Symmetry, McKay correspondence seminar, IPMU Tokyo, Japan, January 2013
Seminario di Geometria Algebrica, University of Milano/Politecnico di Milano, December 2013, two talks
11 talks in 2012 (including Oxford, HSE Moscow, Steklov Institute Moscow, MPI Bonn, Northeastern, MIT, UIC)

12 talks in 2011 (including Chern Institute Tianjin, Zhejiang University Hangzhou, Isaac Newton Institute, Oxford)