

Matthew Robert Ballard

CONTACT INFORMATION	University of South Carolina Department of Mathematics 1523 Greene Street Columbia, South Carolina USA	Email: ballard@math.sc.edu Webpage: www.matthewrobertballard.com Office Phone: +1 803 777-7529
CITIZENSHIP	Born January 3, 1980 in Lansing, Michigan, United States.	
INTERESTS	Algebraic and arithmetic geometry, noncommutative algebra, derived categories, and mirror symmetry.	
POSITIONS	University of South Carolina , Columbia, South Carolina USA Associate Professor (with tenure) January 2018 - Current	
	Institute for Advanced Study , Princeton, New Jersey, USA Member September 2016 - July 2017	
	Institut Henri Poincaré , Paris, France Member of Program of Mathematics of String Theory June - July 2016	
	University of South Carolina , Columbia, South Carolina USA Assistant Professor August 2013 - December 2017	
	University of Vienna , Vienna, Austria Senior Researcher July 2012 - July 2013	
	University of Wisconsin , Madison, Wisconsin USA Van Vleck Visiting Assistant Professor September 2011 - May 2012	
	University of Pennsylvania , Philadelphia, Pennsylvania USA Postdoctoral Researcher August 2008 - May 2011	
EDUCATION	University of Washington , Seattle, Washington USA Ph.D., Mathematics. June 2008. Advisor: Charles Doran. Thesis title: <i>Derived categories of quasi-projective schemes</i> .	
	California Institute of Technology , Pasadena, California USA B.S. with honor, Mathematics. June 2002.	
PAPERS AND PREPRINTS	Articles appear at https://arxiv.org/a/ballard_m_1.html With Alicia Lamarche. <i>Detecing rational points with étale exceptional collections</i> . In preparation. With Alexander Duncan, Alicia Lamarche, and Patrick McFaddin. <i>Consequences of the existence of exceptional collections in arithmetic and rationality</i> . arXiv:2009.10175. Submitted. With Alexander Duncan, Alicia Lamarche, and Patrick McFaddin. <i>Separable algebras and coflasque</i>	

resolutions. arXiv:2006.06876. Submitted.

With Colin Diemer and David Favero. *Kernels from compactifications*. arXiv:1710.01418. Submitted.

With Nitin Chidambaram, David Favero, Patrick McFaddin, and Robert Vandermolen. *Kernels for Grassmann flops*. arXiv:1904.12195. To appear in Journal de Mathématiques Pures et Appliquées.

With Alexander Duncan and Patrick McFaddin. *Derived categories of centrally-symmetric smooth toric Fano varieties*. arXiv:1812.09392. To appear in Mathematische Nachrichten.

With Blake Farman. *A category of kernels for noncommutative projective schemes*. arXiv:1709.06470. To appear in Journal of Noncommutative Geometry.

With Alexander Duncan, Patrick McFaddin. *The toric Frobenius morphism and a conjecture of Orlov*. European Journal of Mathematics. 5 (2019), no. 3, 640-645.

With Alexander Duncan, Patrick McFaddin. *On derived categories of arithmetic toric varieties*. Annals of K-Theory 4 (2019), no. 2, 211-242.

With David Favero and Ludmil Katzarkov. *Variation of Geometric Invariant Theory quotients and derived categories*. Journal für die reine und angewandte Mathematik (Crelle). Issue 746 (2019) 235–304.

With Dragos Deliu, David Favero, M. Umut Isik, and Ludmil Katzarkov. *On the derived categories of degree d hypersurface fibrations*. Mathematische Annalen 371 (2018), no. 1-2, 337–370.

With Dragos Deliu, David Favero, M. Umut Isik, and Ludmil Katzarkov. *Homological Projective Duality via variation of Geometric Invariant Theory quotients*. Journal of the European Mathematical Society. Volume 19 Issue 14 (2017) 1127-1158.

Wall crossing for derived categories of moduli spaces of sheaves on rational surfaces. Algebraic Geometry 4 (3) (2017) 263–280.

With Dragos Deliu, David Favero, M. Umut Isik, and Ludmil Katzarkov. *Resolutions in factorization categories*. Advances in Mathematics. 295 (2016) 195-249.

With Colin Diemer, David Favero, Ludmil Katzarkov, and Gabriel Kerr. *The Mori Program and non-Fano toric Homological Mirror Symmetry*. Transactions of the AMS. 367 (2015) 8933-8974.

With David Favero and Ludmil Katzarkov. *A category of kernels for equivariant factorizations and its implications for Hodge theory, I*. Publications mathématiques de l’IHÉS 120 (2014), no. 1, 1-111.

With David Favero and Ludmil Katzarkov. *A category of kernels for equivariant factorizations, II: further implications*. Journal de Mathématiques Pures et Appliquées 102 (2014), no. 4, 702-757.

With David Favero and Ludmil Katzarkov. *Orlov spectra: bounds and gaps*. Inventiones Mathematicae 189 (2012), no. 2, 359-430.

With David Favero. *Hochschild dimensions of tilting complexes*. International Mathematical Research Notices 2012 (2012), no. 11, 2607-2645.

Derived categories of sheaves on singular schemes with an application to reconstruction. Advances in Mathematics 227 (2011), no. 2, 895-919.

Equivalences of derived categories of sheaves on quasi-projective schemes. arXiv:0905.3148.

Sheaves on local Calabi-Yau varieties. arXiv:0801.3499.

Meet homological mirror symmetry in Modular Forms and String Duality. Fields Institute Communications, 54, AMS, Providence, RI, 2008.

Derived categories of sheaves on quasi-projective schemes. Thesis. 2008.

BOOKS

Superschool on derived categories and D-branes. Edmonton, Canada, July 17–23, 2016. Lectures from the PIMS Superschool. Edited with Charles Doran, David Favero and Eric Sharpe. Springer

Proceedings in Mathematics & Statistics, 240. Springer, Cham, 2018.

AWARDS

Simons Foundation Collaboration Grant, PI. \$42,000. 2020–2025.

University of South Carolina ASPIRE - I, Tracks 3 and 4. \$15,000. 2020–2022.

University of South Carolina College of Arts & Sciences Teaching Incubator Fellow. \$10,000. 2019–2021.

Fields Institute, co-PI/organizer. \$475,000 CAD. Supported four full-time postdocs and multiple graduate students. 2019.

Southeastern Conference Visiting Faculty Travel Award. \$1,800. 2019.

University of South Carolina College of Arts & Sciences Travel Grant. \$456. 2019.

National Science Foundation Standard Grant, PI DMS-1501813. \$140,000. 2015–2019.

University of South Carolina Breakthrough Star. 2018.

Pacific Institute for the Mathematical Sciences, co-PI/organizer. \$10,000 CAD. 2016.

Research in Pairs – Scheme 4 London Mathematical Society, co-PI. \$1,800. 2016.

National Security Agency Young Investigators Grant, PI \$18,574 2015–2017 (conflicted with NSF award).

Simons Foundation Collaboration Grant, PI. \$35,000. 2014–2015.

National Science Foundation Standard Grant, co-PI/organizer DMS-1343512. \$14,620. 2013.

LECTURES (PAST 5 YEARS)

Exceptional collections and rationality. Algebraic Geometry Seminar. University of Michigan, Ann Arbor. March 2021.

Some comments on semi-orthogonal decompositions from quantum spectra. Workshop on Mirror Symmetry. Institute of the Mathematical Sciences of the Americas. Miami. January 2021.

Rationality and exceptional collections for toric varieties. Hodge Theory and Rationality. Institute of the Mathematical Sciences of the Americas. Miami. October 2020.

Arithmetic, rationality, and derived categories. Mirror Symmetry and Related Topics. Institute of the Mathematical Sciences of the Americas. Miami. January 2020.

From strings to solutions of polynomial equations. Colloquium. Aarhus University. January 2020.

From flips to functors. Interactions between Brauer Groups, Derived Categories and Birational Geometry of Projective Varieties. Banff International Research Station. November 2019.

Arithmetic, rationality, and derived categories. Texas A& M. October 2019.

Tori and permutation modules. Texas Algebraic Geometry Symposia. October 2019.

Arithmetic, Rationality, and Derived Categories. RRAGE: Ragnar's Ramifications in Algebra and Geometry Emerging Workshop. Fields Institute, Toronto. June 2019.

Derived categories, arithmetic, and rationality. UCL. June 2019.

Derived categories, arithmetic, and rationality. Sun-Yat Sen University. May 2019.

Exceptional collections in arithmetic geometry. M-Center Seminar. Kansas State University. March 2019.

Exceptional collections: what they are and where to find them. Colloquium. Michigan State University. January 2019.

Kernels for Grassmann flops. Wall-crossing, open GW-invariants and related topics. Pohang University of Science and Technology. October 2018.

Compactifications and kernels. A Day of Algebraic Geometry in Savannah. Georgia Southern

University, Savannah. March 2018.

Kernels for noncommutative projective schemes. Higher School of Economics, National Research University, Moscow. December 2017.

Kernels for noncommutative projective schemes. Workshop on Algebraic Geometry. University of North Carolina, Chapel Hill. November 2017.

Compactifications and kernels. Institute for the Mathematics and Physics of the Universe, Tokyo. June 2017.

Kernels for Orlov's Theorem. Matrix Factorizations in Mathematics and Physics. Simons Center for Geometry and Physics. June 2017.

Compactifications and kernels. Algebraic Geometry Colloquium. Johannes Gutenberg-University of Mainz. July 2016.

Zeta functions and phase changes for CICYs. Bethe Forum on Mirror Symmetry. University of Bonn. July 2016.

Compactifications and kernels. Algebraic Geometry Seminar. Cambridge University. May 2016.

Compactifications and kernels. Equivariant geometry and algebraic stacks. Australia National University – Kioloa. March 2016.

Derived categories of moduli spaces and wall-crossing. Algebra Seminar. University of Alberta. December 2015.

Where do derived equivalences come from? Preprojective Algebras Interacting with Singularities, Cohen-Macaulay Modules and Weighted projective Spaces. Casa Matematica Oaxaca. October 2015.

TEACHING

University of South Carolina, Columbia, South Carolina USA

Instructor

Solely responsible for lectures, exams, homework assignments, and grades.

- Math 141 Calculus I **Fall 2014, Fall 2018, Spring 2019, Fall 2019x2**
- Math 141 Honors Calculus I **Fall 2015**
- Math 142 Calculus II **Fall 2013**
- Math 241 Honors Calculus III **Fall 2017**
- Math 300 Honors Transition to Advanced Mathematics **Fall 2020**
- Math 544 Linear Algebra **Fall 2013**
- Math 546 Algebraic Structures I **Spring 2014**
- Math 701 Foundations of Algebra I **Fall 2015**
- Math 702 Foundations of Algebra II **Spring 2016**
- Math 732 Algebraic Topology I **Fall 2014**
- Math 733 Algebraic Topology II **Spring 2015**
- Math 737 Introduction to Complex Geometry I **Fall 2017**

University of Wisconsin, Madison, Wisconsin USA

Instructor

Solely responsible for lectures, exams, homework assignments, and grades.

- Math 475 Introduction to Combinatorics **Fall 2011**
- Math 541 Modern Algebra I **Spring 2012**

University of Pennsylvania, Philadelphia, Pennsylvania USA

Instructor

Solely responsible for lectures, exams, homework assignments, and grades.

- Math 104 Calculus II **Fall 2010**
- Math 114 Calculus III **Spring 2009**
- Math 505 Graduate Proseminar in Mathematics **Spring 2011**

- Math 622 Complex Algebraic Geometry I **Fall 2009**
- Math 623 Complex Algebraic Geometry II **Spring 2010**

University of Washington, Seattle, Washington USA

Instructor

Solely responsible for lectures, exams, homework assignments, and grades.

- Math 126 Calculus and Analytic Geometry III **Summer 2004**
- Math 307 Introduction to Differential Equations **Summer 2005**
- Math 308 Introduction to Linear Algebra **Summer 2007**
- Math 309 Linear Analysis **Summer 2008**

MENTORING

- Keller Vandebogert, Ph.D., UofSC, Mathematics, Expected 2021. (co-advised with Andrew Kustin)
- Alicia Lamarche. Ph.D., UofSC, Mathematics, May 2020. Currently NSF RTG Postdoctoral Fellow at University of Utah.
- Robert Vandermolen. Ph.D., UofSC, Mathematics, May 2020. Currently tenure track assistant professor at Saint Mary College of the Woods.
- Patrick McFaddin. Postdoc, UofSC. 2016 - 2019. Currently tenure-track assistant professor at Fordham University.
- Jessisa Otis, M.S., UofSC, Mathematics. 2019.
- Blake Farman. Ph.D., UofSC, Mathematics. 2018. Currently tenure track assistant professor and Capitol One Endowed Professor at University of Louisiana-Monroe.
- Ross Berkowitz. Masters, UPenn, Mathematics, May 2011. Currently Gibbs Assistant Professor at Yale University.

PROFESSIONAL MEMBERSHIP

Member of the American Mathematical Society

REVIEWER

- Reviewer for *Advances in Mathematics*, *Advances in Theoretical and Mathematical Physics*, *Algebraic Geometry*, *Applied Categorical Structures*, *Annals of K-theory*, *Communications in Algebra*, *Banff International Research Station*, *Compositio Mathematica*, *Duke Mathematical Journal*, *Inventiones Mathematicae*, *Journal of Algebra*, *Journal of Algebra and its Applications*, *Journal of Algebraic Geometry*, *Journal of Differential Geometry*, *Journal de Mathématiques Pures et Appliquées*, *Journal of Pure and Applied Algebra*, *Journal für die Reine und Angewandte Mathematik*, *Mathematical Research Letters*, *Mathematische Annalen*, *Mathematische Zeitschrift*, *Michigan Journal of Mathematics*, *NSA Mathematical Sciences Grant Program*, *NSF Algebraic Geometry Panel*, *Proceedings of the AMS*, *Proceedings of the Fields' Institute*, *Proceedings of String-Math 2013*, and *Transactions of the AMS*.

SERVICE

- Course coordinator for Calculus I 2018–2020. UofSC.
- Chair of Special Committee on Calculus Sequence. 2018. UofSC.
- co-Editor of proceedings of Superschool on Derived Categories and D-branes. 2018.
- Graduate Advisory Committee. 2015-2016, 2017-2019. UofSC.
- Mathematics Self-study Committee 2017-2018. UofSC.
- Faculty liaison for *IME* Honor Society and Gamecock Math Club 2013-2016. UofSC.
- Undergraduate mathematics advisor 2013-2015. UofSC.
- Hiring committee 2013-2016. UofSC.
- Faculty senator 2013-2016. UofSC.
- Graduate Admission Committee 2009-2011. UPenn.
- Member of Comprehensive Exam committee for Jaree Hudson, 2015; UofSC Masters Thesis committee for Marvin Jones, 2014; UofSC Ph.D. committee for Richard Oh, 2014.

ORGANIZING

- Special Session on Mathematical-Physical Aspects of Toric and Tropical Geometry at the Mathematical Congress of the Americas. July 2021.
- Special Session on Derived Categories and Birational Geometry at joint Meeting of the American Mathematical Society, Société Mathématique de France, and European Mathematical Society. July 2021.
- UofSC Algebraic, Geometry, and Number Theory Seminar 2013-2021.
- Session on Derived Categories and (Non)Commutative Algebraic Geometry. Winter Meeting of the Canadian Mathematical Society. December 2020.
- Birational, Categorical, and Derived Algebraic Geometry. Banff International Research Station. November 2020.
- Thematic Program on Homological Mirror Symmetry. Fields Institute. August-December 2019.
- UofSC Graduate Colloquium 2015-2016.
- Superschool on Derived Categories and D-branes. July 2016.
- Banff International Research Station Workshop on Homological Mirror Geometry. March 2016.
- AMS Special Session on Interactions between Algebraic and Tropical Geometry. March 2016.
- AMS Special Session on Mirror Symmetry. Southeast Section. November 2014.
- Commutative Algebra – Algebraic Geometry in the Southeast, November 2013.
- Geometry of D-branes thematic period, Erwin Schrödinger Institute, April - July 2013.
- Birational Geometry and Derived Categories conference, University of Vienna, August 2012.