

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: people.math.sc.edu/ballard/ Phone: +1 517 402 4071
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	All articles appear at https://arxiv.org/a/ballard_m_1.html With Alexander Duncan, Alicia Lamarche, and Patrick McFaddin. <i>Exceptional collections, rationality, and rational points</i> . (In preparation) With Alexander Duncan, Alicia Lamarche, and Patrick McFaddin. <i>Coflasque resolutions and Brauer group invisibility</i> . (In preparation)	

- With Nitin Chidambaram, David Favero, Patrick McFaddin, and Robert Vandermolten. *A kernel for the Grassmann flop*. arXiv:1904.12195.
- With Alexander Duncan and Patrick McFaddin. *Derived categories of centrally-symmetric smooth toric Fano varieties*. arXiv:1812.09392.
- With Colin Diemer and David Favero. *Kernels from compactifications*. arXiv:1710.01418.
- 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

Southeastern Conference Visiting Faculty Travel Award. \$1,800. 2019–2020.
University of South Carolina College of Arts & Sciences Teaching Incubator Fellow. \$10,000. 2019–2021.
Fields Institute, co-PI/organizer. \$475,000 CAD. 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.
VIGRE Graduate Fellowship. 2006–2007.
ARCS Fellowship. 2002–2005.

LECTURES (PAST 5 YEARS)

Arithmetic, rationality, and derived categories. Mirror Symmetry and Related Topics. Miami. January 2020. Upcoming.
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.
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.
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.

Orlov spectra in algebraic geometry and beyond. Invited lecture. AMS Summer Institute in Algebraic Geometry. University of Utah. July 2015.

Mirror Symmetry through exceptional collections. Lecture series. Geometric Algebra: Bridges between commutative algebra, noncommutative geometry and representation theory. Fields Institute. July 2015.

Derived categories of moduli spaces of sheaves on rational surfaces. Homological Mirror Symmetry and Hodge Theory. University of Warwick. June 2015.

A problem in linear algebra and its connection with homological algebra. Analysis, Logic, and Physics Seminar. Virginia Commonwealth University. April 2015.

Wall crossing for derived categories of moduli spaces of sheaves on rational surfaces. Algebra Geometry. Oberwolfach. March 2015.

Generation spectra: how complex is a category. Colloquium. Pennsylvania State University. February 2015.

Generation spectra: how complex is an algebra, how complex is a category. Colloquium. University of Nebraska. January 2015.

Wall crossing in moduli problems and semi-orthogonal decompositions. Colloquium. University of Oregon. January 2015.

Geometry and homological algebra of GLSMs. Computational and Commutative Algebra Seminar. Cornell University. December 2014.

Windows, compactifications, and kernels. Wall Crossing, Quantum Integrable Systems, and TQFT. Simons Center for Geometry and Physics. November 2014.

Wall crossing in moduli problems and semi-orthogonal decompositions. Workshop on Moduli Spaces, Derived Geometry, and Representation Theory. of North Carolina-Chapel Hill. October 2014.

Wall crossing in moduli problems and semi-orthogonal decompositions. Algebraic Geometry Seminar. Ohio State University. October 2014.

Wall crossing in moduli problems and semi-orthogonal decompositions. Algebra and Number Theory Seminar. Emory University. September 2014.

Wall crossing in moduli problems and derived categories. Algebraic Geometry Seminar. University of Georgia. September 2014.

Orlov spectra. Algebra and Number Theory Seminar. Clemson University. September 2014.

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 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

- Alicia Lamarche. Ph.D., USC, Mathematics, Expected 2020.
- Robert Vandermolen. Ph.D., USC, Mathematics, Expected 2020.
- Keller Vandebogert, Ph.D., USC, Mathematics, Expected 2022. (co-advised with Andrew Kustin)
- Patrick McFaddin. Postdoc, USC. 2016 - 2019. Currently tenure-track assistant professor at Fordham University.
- Jessisa Otis, M.S., USC, Mathematics. 2019.
- Blake Farman. Ph.D., USC, Mathematics. 2018. Currently visiting assistant professor at Lafayette College.
- Ross Berkowitz. Masters, UPenn, Mathematics, May 2011.

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

ORGANIZING

- Thematic Program on Homological Mirror Symmetry. Fields Institute. August-December 2019.
- USC Graduate Colloquium 2015-2016.
- USC Algebraic Geometry, Commutative Algebra, and Number Theory Seminar 2013-2016.
- 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.