

# ROBERT J. BUCKINGHAM

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## Employment      **University of Cincinnati**

Professor of Mathematics  
2020–Present.

Associate Professor of Mathematics  
2014–2020.

Assistant Professor of Mathematics  
2009–2014.

**Centre de Recherches Mathématiques, Université de Montréal**  
Postdoctoral Fellow, theme year on Probabilistic Methods in Mathematical Physics  
2008–2009.

**University of Michigan, Ann Arbor**  
Postdoctoral Assistant Professor of Mathematics  
2005–2008.

## Education      **Duke University**, Durham, NC.

Ph.D. in Mathematics, May 2005.  
Advisor: Professor Stephanos Venakides  
M.A. in Mathematics, December 2001.

**Massachusetts Institute of Technology**, Cambridge, MA.  
S.B. in Mathematics, June 2000.  
S.B. in Physics, June 2000.

## Publications      *Published or In-Press:*

“**Large-degree asymptotics of rational Painlevé-IV functions associated to generalized Hermite polynomials.**” *International Mathematics Research Notices* **2020** (2020): 5534–5577.

“**A representation of joint moments of CUE characteristic polynomials in terms of Painlevé functions,**” with Estelle Basor, Pavel Bleher, Tamara Grava, Alexander Its, Elizabeth Its, and Jonathan Keating. *Nonlinearity* **32** (2019): 4033–4078.

“**Large-order asymptotics for multiple-pole solitons of the focusing nonlinear Schrödinger equation**” with Deniz Bilman. *Journal of Nonlinear Science* **29**, 2185–2229 (2019).

“**Nonintersecting Brownian bridges on the unit circle with drift,**” with Karl Liechty. *Journal of Functional Analysis* **276** (2019): 1717–1772.

- “The  $k$ -tacnode process,”** with Karl Liechty. *Probability Theory and Related Fields* doi.org/10.1007/s00440-018-0885-2 (2018).
- “Large deformations of the Tracy-Widom distribution I. Non-oscillatory asymptotics,”** with Thomas Bothner. *Communications in Mathematical Physics* **359** (2018): 223–263.
- “Semiclassical soliton ensembles for the three-wave resonant interaction equations,”** with Robert Jenkins and Peter Miller. *Communications in Mathematical Physics* **354** (2017): 1015–1100.
- “Large-degree asymptotics of rational Painlevé-II functions: critical behaviour,”** with Peter D. Miller. *Nonlinearity* **28** (2015): 1539–1596.
- “Large-degree asymptotics of rational Painlevé-II functions: noncritical behaviour,”** with Peter D. Miller, *Nonlinearity* **27** (2014): 2489–2577.
- “Spectra of random Hermitian matrices with a small-rank external source: supercritical and subcritical regimes,”** with Marco Bertola, Seung-Yeop Lee, and Virgil Pierce, *Journal of Statistical Physics* **153** (2013): 654–697.
- “The sine-Gordon equation in the semiclassical limit: dynamics of fluxon condensates,”** with Peter D. Miller, *Memoirs of the American Mathematical Society* **225**, number 1059 (2013): 1–136.
- “The sine-Gordon equation in the semiclassical limit: critical behavior near a separatrix,”** with Peter D. Miller, *Journal d’Analyse Mathématique* **118** (2012): 397–492.
- “Spectra of random Hermitian matrices with a small-rank external source: The critical and near-critical regimes,”** with Marco Bertola, Seung-Yeop Lee, and Virgil Pierce, *Journal of Statistical Physics* **146** (2012): 475–518.
- “Semiclassical spectral confinement for the sine-Gordon equation,”** *Mathematics and Computers in Simulation* **82** (2012): 1030–1037.
- “Total integrals of Painlevé II solutions,”** with Jinho Baik, Jeffery DiFranco, and Alexander Its, *Nonlinearity* **22** (2009): 1021–1061.
- “Asymptotics of Tracy-Widom distributions and the total integral of a Painlevé II function,”** with Jinho Baik and Jeffery DiFranco, *Communications in Mathematical Physics* **280** (2008): 463–497.
- “Exact solutions of semiclassical non-characteristic Cauchy problems for the sine-Gordon equation,”** with Peter D. Miller, *Physica D* **237** (2008): 2296–2341.
- “Long-time asymptotics of the nonlinear Schrödinger equation shock problem,”** with Stephanos Venakides, *Communications on Pure and Applied Mathematics* **60** (2007): 1349–1414.
- “Volume determination for bulk material in bunkers,”** with Suhail Ahmed, Pierre Gremaud, Cory Hauck, Christopher Kuster, Masa Prodanovic, Tony Royal, and Valentin Silantsev, *International Journal for Numerical Methods in Engineering* **61** (2004): 2239–2249.
- “Thin film traveling waves and the Navier slip condition,”** with Michael Shearer and Andrea Bertozzi, *SIAM Journal on Applied Mathematics* **63** (2003): 722–744.

*Refereed Conference Proceedings:*

“**The semiclassical focusing nonlinear Schrödinger equation,**” with Alexander Tovbis, Stephanos Venakides, and Xin Zhou, in *Proceedings of Recent Advances in Nonlinear Partial Differential Equations and Applications: a Workshop in Honor of Peter Lax and Louis Nirenberg*, AMS Proceedings of Symposia in Applied Mathematics **65** (2007).

*Experimental Results:*

“**Fluid polygons,**” with John W. M. Bush, *Gallery of Fluid Motion, Physics of Fluids* **13** (2001): S10.

*Submitted Manuscripts:*

“**Large-degree asymptotics of rational Painlevé-IV solutions by the isomonodromy method**” with Peter Miller. arXiv:2008.00600v1 (2020).

“**Large-Order Asymptotics for Multiple-Pole Solitons of the Focusing Nonlinear Schrodinger Equation II: Far-Field Behavior**” with Deniz Bilman and Deng-Shan Wang. arXiv:1911.04327v1 (2019).

**Grants and Fellowships**

External Research Grants:

- National Science Foundation Grant DMS–1615718, *New Directions in the Asymptotics of Nonlinear Waves*, August 1, 2016–July 31, 2020.
- National Science Foundation Grant DMS–1312458, *Nonlinear Wave Dynamics: Emergent Methods and Phenomena*, August 1, 2013–July 31, 2016.
- Simons Foundation Collaboration Grant for Mathematicians Award #245775, *Universality in Stochastic Processes and Differential Equations*, September 1, 2012–July 31, 2013.

External Conference Grants:

- National Science Foundation Grant DMS–1832863, *Cincinnati Symposium on Probability Theory and Applications 2018*, September 1, 2018–August 31, 2019.
- National Science Foundation Grant DMS–1441641, *Cincinnati Symposium on Probability Theory and Applications 2014*, July 1, 2014–June 30, 2015.

Fellowships:

- Charles Phelps Taft Research Center Faculty Release Fellowship, University of Cincinnati, 2017.
- University Research Council Faculty Research Grant, University of Cincinnati, Summer 2012.
- Charles Phelps Taft Research Center Summer Research Fellowship, University of Cincinnati, 2010.
- Department of Mathematics Spring/Summer Fellowship, University of Michigan, 2007.
- VIGRE Fellowship, Duke University, 2000–2005.

**Postdoctoral  
Mentoring**

Mentor for David A. Smith (University of Cincinnati), 2013–2015.

Mentor for Rajinder Mavi (University of Cincinnati), 2019–Present.

**Invited  
Presentations**

*Invited Talks:*

- Orthogonal Polynomials, Special Functions, Operator Theory and Applications, Online Seminar, International Centre for Mathematical Sciences, August 2020, <https://www.icms.org.uk/OPSFOTA.php>.
- Joint Mathematics Meetings, AMS Special Session on Random Combinatorial Structures, Complex Analysis, and Integrable Systems, January 2020, Denver, CO.
- CIRM Workshop on Nonlinear Dispersive Waves, June 2019, Marseille, France.
- Fields Institute, Workshop on Nonlinear Dispersive Partial Differential Equations and Inverse Scattering, May 2019, Toronto, ON.
- IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena, Session on Random Matrices, Painlevé Equations, and Integrable Systems, April 2019, Athens, GA.
- AMS Fall Central Section Meeting, Special Session on Modern Trends in Integrable Systems, October 2018, Ann Arbor, MI.
- ICTS Program on Integrable Systems in Mathematics, Condensed Matter, and Statistical Physics, July 2018, Bangalore, India.
- AIMS Conference on Dynamical Systems, Differential Equations, and Applications, Special Session on Water Waves and Other Dispersive Phenomena, July 2018, Taipei, Taiwan.
- AIMS Conference on Dynamical Systems, Differential Equations, and Applications, Special Session on Integrable Systems and Their Applications, July 2018, Taipei, Taiwan.
- AMS Spring Central Section Meeting, Special Session on Coherent Structures in Interfacial Flows, March 2018, Columbus, OH.
- Joint Mathematics Meetings, AMS Special Session on Algebraic, Analytic, and Geometric Aspects of Integrable Systems, Painlevé Equations, and Random Matrices, January 2018, San Diego, CA.
- Painlevé Equations and Applications: A Workshop in Memory of A. A. Kapaev, August 2017, Ann Arbor, MI.
- Fields Institute, Workshop on Nonlinear Dispersive Partial Differential Equations and Inverse Scattering, August 2017, Toronto, ON.
- International Linear Algebra Society Meeting, Minisymposium on Toeplitz Matrices and Riemann-Hilbert Problems, July 2017, Ames, IA.
- IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena, Session on Painlevé Equations, Integrable Systems, and Random Matrices, March–April 2017, Athens, GA.
- AMS Spring Southeastern Section Meeting, Special Session on Riemann-Hilbert Problem Approach to Asymptotic Problems in Integrable Systems, Orthogonal Polynomials and Other Areas, March 2017, Charleston, SC.

- AIM, Workshop on Painlevé Equations and Their Applications, February 2017, San Jose, CA.
- University of Michigan, Integrable Systems Seminar, January 2017, Ann Arbor, MI.
- AMS Fall Central Section Meeting, Special Session on Integrable Systems and Related Areas, October 2016, Minneapolis, MN.
- AMS Fall Central Section Meeting, Special Session on Multi-Scale Phenomena in Linear and Nonlinear PDE, October 2016, Minneapolis, MN.
- DePaul University, Colloquium, October 2016, Chicago, IL.
- AMS Fall Western Section Meeting, Special Session on Integrable Systems and Soliton Equations, October 2016, Denver, CO.
- University of Illinois Chicago, Analysis and Applied Mathematics Seminar, September 2016, Chicago, IL.
- AIMS Conference on Dynamical Systems, Differential Equations, and Applications, Special Session on Evolution Equations and Integrable Systems, July 2016, Orlando, FL.
- Fourth International Conference: Nonlinear Waves – Theory and Applications, Minisymposium on Integrable Systems and Nonlinear Waves, June 2016, Beijing, China.
- Fourth International Conference: Nonlinear Waves – Theory and Applications, Minisymposium on Asymptotic Problems in Integrable Systems and Random Matrix Theory, June 2016, Beijing, China.
- Simons Center for Geometry and Physics, Workshop on Six-Vertex Models, Dimers, Shapes, and All That, March 2016, Stony Brook, NY.
- Joint Mathematics Meetings, AMS Special Session on Integrable Systems, Painlevé Equations, and Random Matrices, January 2016, Seattle, WA.
- SIAM Conference on Analysis of PDEs, Minisymposium on Inverse Scattering and Dispersive Nonlinear Equations, December 2015, Scottsdale, AZ.
- Air Force Institute of Technology, Department of Mathematics and Statistics Seminar, October 2015, Wright-Patterson AFB, OH.
- International Symposium on Orthogonal Polynomials, Special Functions and Applications, Minisymposium on Riemann-Hilbert Problems: Analysis and Applications, June 2015, Gaithersburg, MD.
- International Symposium on Orthogonal Polynomials, Special Functions and Applications, Minisymposium on Aspects of Painlevé Equations, June 2015, Gaithersburg, MD.
- Nonlinear Evolution Equations and Dynamical Systems (NEEDS), May 2015, Santa Margherita di Pula, Sardinia, Italy.
- IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena, Session on Discrete and Ultra-discrete Integrable Systems and Painlevé Equations, April 2015, Athens, GA.
- BIRS Workshop on Modern Applications of Complex Variables: Modeling, Theory and Computation, January 2015, Banff, AB.
- SIAM Conference on Nonlinear Waves and Coherent Structures, Minisymposium

on Inverse Scattering and Riemann-Hilbert Problems, August 2014, Cambridge, United Kingdom.

- Drexel University, Partial Differential Equations and Applied Mathematics Seminar, April 2014, Philadelphia, PA.
- University of South Florida, Colloquium, February 2014, Tampa, FL.
- Integrable Systems, Random Matrix Theory, and Combinatorics (Conference in honor of Nicholas Ercolani's 60th birthday), October 2013, Tucson, AZ.
- University of Colorado Colorado Springs, Colloquium, September 2013, Colorado Springs, CO.
- SIAM Annual Meeting, Minisymposium on Painlevé Equations, July 2013, San Diego, CA.
- Third International Conference: Nonlinear Waves – Theory and Applications, Minisymposium on Universality of Nonlinear Behaviour, June 2013, Beijing, China.
- 71st Midwest PDE Seminar, May 2013, Ann Arbor, MI.
- IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena, Session on Inverse Scattering and Riemann-Hilbert Problems: Theory and Applications, March 2013, Athens, GA.
- Northeastern University, Analysis-Geometry Seminar, January 2013, Boston, MA.
- Rice University, Analysis-Geometry Seminar, November 2012, Houston, TX.
- AMS Fall Western Section Meeting, Special Session on Asymptotic Analysis of Random Matrices, Integrable Systems, and Applications, October 2012, Tucson, AZ.
- AMS Fall Central Section Meeting, Special Session on Spectral, Scattering, and Inverse Scattering Theory, October 2012, Akron, OH.
- SIAM Conference on Nonlinear Waves and Coherent Structures, Minisymposium on Riemann-Hilbert Problems: Analysis and Computation, June 2012, Seattle, WA.
- AMS Spring Southeastern Section Meeting, Special Session on Applications of Complex Analysis in Mathematical Physics, March 2012, Tampa, FL.
- AMS Spring Western Section Meeting, Special Session on New Techniques and Results in Integrable and Near-Integrable Nonlinear Waves, March 2012, Honolulu, HI.
- University of Michigan, Applied and Interdisciplinary Mathematics Seminar, February 2012, Ann Arbor, MI.
- Joint Mathematics Meetings, AMS Special Session on Algebraic and Geometric Aspects of Integrable Systems and Random Matrices, January 2012, Boston, MA.
- University of Washington, Nonlinear Waves Seminar, May 2011, Seattle, WA.
- University of Kentucky, Analysis and PDE Seminar, April 2011, Lexington, KY.
- Rensselaer Polytechnic Institute, Colloquium, November 2010, Troy, NY.
- Case Western Reserve University, Colloquium, October 2010, Cleveland, OH.
- University of Illinois Chicago, Mathematics and its Applications Seminar, August 2010, Chicago, IL.

- Symmetry Plus Integrability 2010 (Conference in honor of Yuji Kodama's 60th birthday), June 2010, San Padre Island, TX.
- IUPUI, Colloquium, October 2009, Indianapolis, IN.
- University of Colorado, Probability Seminar, April 2009, Boulder, CO.
- IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena, Session on Asymptotics of Nonlinear Waves and Related Problems, March 2009, Athens, GA.
- University of Louisville, Colloquium, February 2009, Louisville, KY.
- Central Michigan University, Colloquium, February 2009, Mount Pleasant, MI.
- Baylor University, Colloquium, February 2009, Waco, TX.
- Mississippi State University, Colloquium, February 2009, Starkville, MS.
- University of Cincinnati, Research Seminar, January 2009, Cincinnati, OH.
- Drexel University, Colloquium, January 2009, Philadelphia, PA.
- Lehigh University, Colloquium, January 2009, Bethlehem, PA.
- CRM, Séminaire Physique Mathématique, October 2008, Montreal, QC.
- BIRS Workshop on Random Matrices, Inverse Spectral Methods and Asymptotics, October 2008, Banff, AB.
- Random Matrices, Related Topics, and Applications, August 2008, Montreal, QC.
- International Workshop on Operator Theory and Applications, Special Session on Direct and Inverse Scattering Transforms for Integrable Systems and Their Semi-classical Limits, July 2008, Williamsburg, VA.
- AIMS International Conference on Dynamical Systems and Differential Equations, Special Session on Recent Developments of Analytic and Algebraic Methods in Integrable Systems and Applications, May 2008, Arlington, TX.
- University of Michigan at Flint, Mathematics Seminar, April 2008, Flint, MI.
- SIAM Southeastern-Atlantic Section Conference, Special Session on Integrable Equations, Their Special Limits, and the Riemann-Hilbert Problem Approach, March 2008, Orlando, FL.
- College of Charleston, Colloquium, February 2008, Charleston, SC.
- University of Texas - Pan American, Colloquium, February 2008, Edinburg, TX.
- SIAM Conference on Analysis of PDEs, Minisymposium on Asymptotic Behavior of Solutions to PDEs, December 2007, Mesa, AZ.
- Wayne State University, PDE Seminar, November 2007, Detroit, MI.
- Courant Institute of Mathematical Sciences, Integrable Systems and Random Matrices Working Seminar, March 2007, New York, NY.
- University of Michigan, Differential Equations Seminar, February 2007, Ann Arbor, MI.
- The Ohio State University, Applied Mathematics Seminar, October 2006, Columbus, OH.
- University of Illinois Urbana-Champaign, Joint Differential Equations and Stochastic Analysis Seminar, August 2006, Urbana-Champaign, IL.

*Invited Posters:*

- Recent Advances in Nonlinear Partial Differential Equations and Applications: A Workshop in Honor of Peter Lax and Louis Nirenberg, June 2006, Toledo, Spain.
- Integrable Systems, Random Matrices and Applications Conference in Honor of Percy Deift's 60th birthday, May 2006, New York, NY.

**Courses  
Taught**

*University of Cincinnati (Semesters):*

- Ordinary Differential Equations** (Math 7005), Fall 2012, Fall 2020.
- Topology** (Math 7004), Fall 2017.
- Rings, Fields, and Galois Theory** (Math 7003), Spring 2018.
- Complex Analysis** (Math 7001), Spring 2013.
- Applied Probability and Stochastic Processes** (Math 6008), Fall 2014.
- Mathematics of Games and Puzzles** (Honors Seminar – Math 3096), Fall 2015, Fall 2017.
- Introduction to Abstract Math** (MATH 3001), Fall 2018.
- Linear Algebra** (Math 2076), Fall 2012, Spring 2013, Spring 2020 (two sections).
- Dynamical Systems** (Math 2074), Fall 2019.
- Differential Equations** (Math 2073), Fall 2013 (two sections), Fall 2019.
- Multivariable Calculus** (Math 2063, 2063H), Fall 2014 (two sections), Spring 2018, Fall 2018.
- Calculus II** (Math 1062), Fall 2015 (two sections), Fall 2020.
- Calculus I with Pre-Calculus Review** (Math 1060), Fall 2013.

*University of Cincinnati (Quarters):*

- Probability Theory I, II, and III** (Math 634-635-636), Fall 2009 – Spring 2010.
- Ordinary Differential Equations II** (Math 617), Spring 2011.
- Abstract Algebra I, II, and III** (Math 511-512-513), Fall 2010 – Spring 2011.
- Honors Calculus IV** (Math 264H), Winter 2011.
- Honors Calculus III** (Math 253H), Fall 2010, Fall 2011.
- Calculus 0** (Math 250), Fall 2011.
- Foundations of Applied Calculus** (Math 224), Fall 2009.

*University of Michigan:*

- Probability** (Math 425), Winter 2008 (two sections), Spring 2008.
- Boundary Value Problems for Partial Differential Equations** (Math 454), Winter 2007.
- Introduction to Numerical Methods** (Math 471), Fall 2006.
- Calculus III** (Math 215), Fall 2007 (two sections).
- Calculus I** (Math 115), Fall 2005 (two sections).

*Duke University (Instructor):*



**Linear Algebra and Differential Equations** (Math 107), Summer 2005.

**Laboratory Calculus II** (Math 32L), Fall 2003.

**Laboratory Calculus and Functions I** (Math 25L), Fall 2002.

*Duke University (Teaching Assistant):*

**Laboratory Calculus I** (Math 31L), Fall 2001.

**Conference  
Organization**

**Cincinnati Symposium on Probability Theory and Applications, 2018**  
(co-organizer), November 2018, Cincinnati, OH.

**77th Midwest PDE Seminar** (co-organizer), April 2016, Cincinnati, OH.

**Cincinnati Symposium on Probability Theory and Applications, 2014**  
(co-organizer), September 2014, Cincinnati, OH.

**Minisymposia  
Organized**

**“Modern Methods for Dispersive Wave Equations”** (co-organizer), IMACS  
International Conference on Nonlinear Evolution Equations and Wave Phenomena,  
April 2019, Athens, GA.

**“Probabilistic Methods in Mathematical Physics”** (co-organizer), AMS Spring  
Southeastern Section Meeting, April 2018, Nashville, TN.

**“Asymptotics and Applied Analysis”** (co-organizer), IMACS International  
Conference on Nonlinear Evolution Equations and Wave Phenomena, March–April  
2017, Athens, GA.

**“Advances in Dispersive Nonlinear Equations and Integrable Equations”**  
(co-organizer), SIAM Conference on Nonlinear Waves and Coherent Structures, Au-  
gust 2016, Philadelphia, PA.

**“Advances in Integrable Systems and Nonlinear Wave Theory”** (co-organ-  
izer), IMACS International Conference on Nonlinear Evolution Equations and Wave  
Phenomena, April 2015, Athens, GA.

**“Completely Integrable Systems and Nonlinear Dispersive Equations”**  
(co-organizer), AMS Spring Southeastern Section Meeting, March 2014, Knoxville,  
TN.

**“Randomness in Integrable Systems”** (co-organizer), IMACS International  
Conference on Nonlinear Evolution Equations and Wave Phenomena, March 2013,  
Athens, GA.

**“Recent Advances in Nonlinear Integrable Systems”** (co-organizer), SIAM  
Conference on Nonlinear Waves and Coherent Structures, August 2010, Philadel-  
phia, PA.

**“Non-Self-Adjoint Spectral Problems”** (co-organizer), IMACS International  
Conference on Nonlinear Evolution Equations and Wave Phenomena, April 2007,  
Athens, GA.

**“Semiclassical and Continuum Limits”** (co-organizer), SIAM Conference on  
Nonlinear Waves and Coherent Structures, September 2006, Seattle, WA.

**Referee**

- Advances in Mathematics.
- Communications in Mathematical Physics.
- Constructive Approximation.

- Contemporary Mathematics (AMS).
- Duke Mathematical Journal.
- Electronic Journal of Probability.
- Indiana University Mathematics Journal.
- International Mathematics Research Notices.
- Journal of Differential Equations.
- Journal of Mathematical Analysis and Applications.
- Journal of Mathematical Physics.
- Journal of Nonlinear Science.
- Journal of Physics A.
- Journal of Statistical Physics.
- Journal of Theoretical Probability.
- Mathematical Methods in the Applied Sciences.
- Mathematical Physics, Analysis and Geometry.
- Mediterranean Journal of Mathematics.
- Nonlinear Analysis: Real World Applications.
- Nonlinearity.
- Physica D.
- Physics Letters A.
- Proceedings of the American Mathematical Society.
- Random Matrices: Theory and Applications.
- Reviews in Mathematical Physics.
- SIAM Journal of Mathematical Analysis.
- Studies in Applied Mathematics.
- Transactions of the American Mathematical Society.