JARED SPECK

ADDRESS

Prof. Jared Speck
Vanderbilt University
Department of Mathematics
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CONTACT INFORMATION

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RESEARCH INTERESTS

- Nonlinear PDEs
- Geometry
- General relativity
- Fluid mechanics
- Singularity formation
- Mathematical physics
- Kinetic theory

EMPLOYMENT

- **Vanderbilt University**, Nashville, TN
  Stevenson Professor, Mathematics Department, *August 2023 - present*

- **Vanderbilt University**, Nashville, TN
  Professor, Mathematics Department, *June 2022 - July 2023*

- **Vanderbilt University**, Nashville, TN
  Associate Professor, Mathematics Department, *July 2018 - May 2022*

- **Massachusetts Institute of Technology**, Cambridge, MA
  Cecil and Ida B. Green Career Development Associate Professor of Mathematics, Mathematics Department, *July 2016 - August 2018*

- **Massachusetts Institute of Technology**, Cambridge, MA
  Assistant Professor, Mathematics Department, *July 2011 - June 2016*

- **NSF/MSRI Postdoctoral Fellow at Princeton University**, Princeton, NJ
  Postdoctoral Researcher, Mathematics Department, *August 2010 - June 2011*

- **University of Cambridge**, Cambridge, UK
  Postdoctoral Researcher, Department of Pure Mathematics and Mathematical Statistics, *September 2009 - July 2010*

- **Princeton University**, Princeton, NJ
  Lecturer, Mathematics Department, *September 2008 - May 2009*

- **Rutgers University**, Piscataway, NJ
  Lecturer and Teaching Assistant, Mathematics Department, *January 2007 - May 2008*

- **Rutgers University**, Piscataway, NJ
  Research Assistant, Mathematics Department, *September 2004 - December 2006*

EDUCATION

- **Rutgers University**, Piscataway, NJ, *PhD*, Mathematics, *May 2008*,
  Advisors: Michael Kiessling and A. Shadi Tahvildar-Zadeh
  Dissertation: On the Questions of Local and Global Well-Posedness for the Hyperbolic PDEs Occurring in Some Relativistic Theories of Gravity and Electromagnetism, 125 pages

- **University of Maryland**, College Park, MD
  BS, Mathematics, *May 2002*, *Summa Cum Laude*

VISITING POSITIONS

- Fellow and Visiting Scholar at St. Catherine's College, University of Cambridge, Fall 2022

PUBLICATIONS

- Disconzi, M. and Speck J.,*The existence of dynamic stars in General Relativity: Local well-posedness for the Einstein-Euler system with a physical vacuum boundary in spherical symmetry*, preprint available upon request, 150 pages

- Abbrescia, L., Blue, P., Sbierski, J., and Speck J., *A quasilinear wave with a supersonic shock in a weak solution interrupting the classical development*, preprint available at https://arxiv.org/abs/ https://arxiv.org/abs/2511.07594, (2025), 27 pages

- Abbrescia, L. and Speck J., *Remarkable localized integral identities for 3D compressible Euler flow and the double-null framework*, Annales Henri Poincaré, **249**, no. 10, (2025), 137 pages, https://doi.org/10.1007/s00205-024-01997-7

- Luk, J. and Speck J., *The stability of simple plane-symmetric shock formation for 3D compressible Euler flow with vorticity and entropy*, Analysis & PDE, **17**, no. 3, (2024), 831-941, https://msp.org/apde/2024/17-3/p02.xhtml

- Abbrescia, L. and Speck J., *The geometry of maximal globally hyperbolic developments for 3D compressible fluids terminating in shocks*, accepted for publication in Notices of the American Mathematical Society, (2025), 1-17

- Abbrescia, L. and Speck J., *The relativistic Euler equations: ESI notes on their geo-analytic structures and implications for shocks in 1D and multi-dimensions*, Classical and Quantum Gravity, **36**, (2023), 1-80, https://iopscience.iop.org/article/10.1088/1361-6382/ad059a

- Fournodavlos G., Rodnianski, I., and Speck, J., *Stable Big Bang formation for Einstein's equations: The complete sub-critical regime,* Journal of the American Mathematical Society, **36**, no. 3, (2023), 827-916, https://www.ams.org/journals/jams/2023-36-03/S0894-0347-2023-01015-X/

- Abbrescia, L. and Speck J., *The emergence of the singular boundary from the crease in 3D compressible Euler flow*, preprint available at https://arxiv.org/abs/2207.07107, (2022), 266 pages

- Disconzi, M., Luo, C., Mazzone, G., and Speck, J., *Rough sound waves in 3D compressible Euler flow with vorticity,* Selecta Mathematica, **28**, no. 5, (2022), 1-153, https://doi.org/10.1007/s00029-021-00733-3

- Rodnianski, I. and Speck, J., *On the nature of Hawking's incompleteness for the Einstein-vacuum equations: The regime of moderately spatially anisotropic initial data*, Journal of the European Mathematical Society, **24**, no. 1, (2022), 167-263, https://doi.org/10.4171/jems/1092

- Luk, J. and Speck, J., *The hidden null structure of the compressible Euler equations and a prelude to applications*, Journal of Hyperbolic Differential Equations, **17**, no. 1, (2020), 1-60, https://www.worldscientific.com/doi/10.1142/S0219891620500010

- Speck, J., *Stable ODE-type blowup for some quasilinear wave equations with derivative-quadratic nonlinearities*, Analysis & PDE, **13**, no. 1, (2020), 93-146, https://msp.org/apde/2020/13-1/p03.xhtml

- Speck, J., *A new formulation of the 3D compressible Euler equations with dynamic entropy: Remarkable null structures and regularity properties*, Archive for Rational Mechanics and Analysis, **234**, no. 3, (2019), 1223-1279, https://link.springer.com/article/10.1007/s00205-019-01411-7

- Speck, J., *Multidimensional nonlinear geometric optics for transport operators with applications to stable shock formation*, Pure and Applied Analysis, **1**, no. 3, (2019), 447-514, https://msp.org/paa/2019/1-3/p04.xhtml

- Disconzi, M. and Speck, J., *The relativistic Euler equations: Remarkable null structures and regularity properties*, Annales Henri Poincaré, **20**, no. 7, (2019), 2173-2270, https://link.springer.com/article/10.1007/s00023-019-00801-7

- Hadžić, M., Shkoller, S., and Speck, J., *A priori estimates for solutions to the relativistic Euler equations with a moving vacuum boundary*, Communications in Partial Differential Equations, **44**, no. 10, (2019), 859-906, https://www.tandfonline.com/doi/full/10.1080/03605302.2019.1583250

- Speck, J., *The maximal development of near-FLRW data for the Einstein-scalar field system with spatial topology S^3*, Communications in Mathematical Physics, **364**, no. 3, (2018), 879-979, https://link.springer.com/article/10.1007/s00220-018-3272-z

- Luk, J. and Speck, J., *Shock formation in solutions to the 2D compressible Euler equations in the presence of non-zero vorticity*, Inventiones Mathematicae, **214**, no. 1, (2018), 1-169, https://link.springer.com/article/10.1007/s00222-018-0799-8

- Rodnianski, I. and Speck, J., *Stable Big Bang formation in near-FLRW solutions to the Einstein-scalar field and Einstein-stiff fluid systems*, Selecta Mathematica, **24**, no. 5, (2018), 4293-4459, https://link.springer.com/article/10.1007%2Fs00029-018-0437-8

- Rodnianski, I. and Speck, J., *A regime of linear stability for the Einstein-scalar field system with applications to nonlinear Big Bang formation*, Annals of Mathematics, **187**, no. 1, (2018), 65-156, http://annals.math.princeton.edu/2018/187-1/p02

- Speck, J., *Shock formation for 2D quasilinear wave systems featuring multiple speeds: Blowup for the fastest wave, with non-trivial interactions up to the singularity*, Annals of PDE, **4**, no. 1, (2018), 1-131, https://link.springer.com/article/10.1007%2Fs40818-017-0042-8

- Speck, J., *Finite-time degeneration of hyperbolicity without blowup for quasilinear wave equations*, Analysis & PDE, **10**, no. 8, (2017), 2001-2030, https://msp.org/apde/2017/10-8/p07.xhtml

- Speck, J., *A summary of some new results on the formation of shocks in the presence of vorticity*, in Nonlinear Analysis in Geometry and Applied Mathematics; Harvard University Center of Mathematical Sciences and Applications, **1**, (2017), 133-157, https://www.intlpress.com/site/pub/pages/books/items/00000491/index.php

- Speck, J., Holzegel, G., Luk, J., and Wong, W., *Stable shock formation for nearly simple outgoing plane symmetric waves*, Annals of PDE, **2**, no. 2 (2016), 1-198, http://link.springer.com/article/10.1007/s40818-016-0014-4

- Speck, J., *Shock formation in small-data solutions to 3D quasilinear wave equations*, AMS Mathematical Surveys and Monographs, Vol. 214, (2016), 515 pages, http://bookstore.ams.org/surv-214

- Holzegel, G., Klainerman, S., Speck, J., and Wong W., *Shock formation in small-data solutions to 3D quasilinear wave equations: An overview*, Journal of Hyperbolic Differential Equations, **13**, no. 1, (2016), 1-105, http://www.worldscientific.com/doi/abs/10.1142/S0219891616500016

- Hadžić, M. and Speck, J., *The global future stability of the FLRW solutions to the dust-Einstein system with a positive cosmological constant*, Journal of Hyperbolic Differential Equations, **12**, no. 1, (2015), 87-188, http://www.worldscientific.com/doi/abs/10.1142/S0219891615500046

- Speck, J., *The global stability of the Minkowski spacetime solution to the Einstein-nonlinear system in wave coordinates*, Analysis & PDE, **7**, no. 4, (2014), 771-901, http://dx.doi.org/10.2140/apde.2014.7.771

- Speck, J., *The stabilizing effect of spacetime expansion on relativistic fluids with sharp results for the radiation equation of state*, Archive for Rational Mechanics and Analysis, **210**, no. 2, (2013), 535-579, https://link.springer.com/article/10.1007/s00205-013-0655-3

- Rodnianski, I. and Speck, J., *The nonlinear future stability of the FLRW family of solutions to the irrotational Euler-Einstein system with a positive cosmological constant*, Journal of the European Mathematical Society, **15**, no. 6, (2013), 2369-2462, https://link.springer.com/article/10.1007/s00029-012-0090-6

- Speck, J., *The nonlinear future stability of the FLRW family of solutions to the Euler-Einstein system with a positive cosmological constant*, Selecta Mathematica, **18**, no. 3, (2012), 633-715, http://dx.doi.org/10.1007/s00029-012-0090-6
- Speck, J., *The nonlinear stability of the trivial solution to the Maxwell-Born-Infeld system*, Journal of Mathematical Physics, **53**, no. 8, (2012), 1-83, http://scitation.aip.org/content/aip/journal/jmp/53/8/10.1063/1.4740047

- Speck, J. and Strain, R., *Hilbert expansion from the Boltzmann equation to relativistic fluids*, Communications in Mathematical Physics, **304**, no. 1, (2011), 229-280, https://link.springer.com/article/10.1007/s00220-011-1207-z

- Speck, J., *The non-relativistic limit of the Euler-Nordström system with cosmological constant*, Reviews in Mathematical Physics, **21**, no. 7, (2009), 821-876, https://www.worldscientific.com/doi/abs/10.1142/S0129055X09003748

- Speck, J., *Well-posedness for the Euler-Nordström system with cosmological constant*, Journal of Hyperbolic Differential Equations, **6**, no. 2, (2009), 313-358, https://www.worldscientific.com/doi/abs/10.1142/S0219891609001885

HONORS AND AWARDS

- Stevenson Professorship (endowed chair), *2023*

- Chancellor's Faculty Fellow at Vanderbilt University, *2021*

- Rutgers 250 Fellow, *2016*

- Cecil and Ida B. Green Career Development Assistant Professor of Mathematics, *2015*

- Sloan Research Fellowship, Alfred P. Sloan Foundation, *2014*

- NSF Mathematical Sciences Research Institutes Post Doctorate Fellowship, *2010*

- TA Teaching Excellence Award, Rutgers University, *Spring 2007*

- Graduate Student Seminar Award, Rutgers University, *Spring 2005*

GRANTS AND FELLOWSHIPS

- NSF award # 2349575, PI, "Geometric Techniques for Studying Singular Solutions to Hyperbolic Partial Differential Equations in Physics," $330,901, *June 2024 - May 2027*

- Chancellor's Faculty Fellowship, Vanderbilt University, $80,000, *July 2021 - June 2023*

- NSF award # 2054184, PI, "Geometric Methods for Singular Solutions to Nonlinear Hyperbolic Partial Differential Equations," $336,065, *June 2021 - May 2025*

- NSF award # 1954162, co-PI, "2020 Shanks Workshop on Mathematical Aspects of Fluid Dynamics," $12,000, *February 2022*

- NSF CAREER award #1414537 (a transferred version of #1454419), PI, "Geometric Methods in Hyperbolic Partial Differential Equations," $140,923, *September 2018 - March 2022*
- NSF CAREER award #1454419, "Geometric Methods in Hyperbolic Partial Differential Equations," $448,388, *July 2015 - September 2018*

- NSF award #1162211, PI, "The Global Analysis of Fluids in General Relativity," $147,379, *July 2012 - June 2015*

- Alfred P. Sloan Foundation, Sloan Research Fellowship, $50,000, *September 2014 - September 2016*

- Solomon Buchsbaum Research Grant, PI, $49,994, *July 2011 - June 2015*

- GAANN Fellowship, Rutgers University, *2003 - 2005*

MENTORING

- **Postdoctoral Researchers**
  Leonardo Abbrescia: *NSF Postdoctoral Research Fellow in Mathematics, July 2020 - July 2023; VandyGRAF Fellow in Mathematics, August 2023 - July 2024, currently tenure-track at Georgia Institute of Technology;* Dongxiao Yu: *VandyGRAF Fellow in Mathematics, July 2024 - present*

- **PhD Students**
  Sifan Yu: *graduated December 2023, currently a postdoc at the National University of Singapore;* Will McDermott, *Fall 2023 - present*

TEACHING

- **Vanderbilt University**
  Seminar in Analysis, *Spring 2021*
  Methods of Mathematical Physics, *Fall 2020, Fall 2024, Spring 2026*
  Graduate Real Analysis: *Fall 2019, Spring 2020, Fall 2021*
  Introduction to Linear Algebra: *Fall 2018, Fall 2020, Spring 2022, Fall 2023, Spring 2024, Fall 2025*
  Introduction to PDEs: *Spring 2019*
  Graduate-Level Independent Study Courses: *Fall 2018, Spring 2019, Fall 2019, Spring 2020, Fall 2020, Fall 2022, Spring 2023, Fall 2024, Spring 2025, Fall 2025*

- **MIT**
  Calculus: *Fall 2012, Fall 2013, Fall 2014, Fall 2016, Fall 2017*
  Lectures on Shock Formation: *Spring 2016*
  Introduction to Real Analysis: *Spring 2012*
  Introduction to PDEs: *Fall 2011, Spring 2017, Spring 2018*

- **Princeton University**
  Calculus II: *Spring 2009*
  Calculus II: *Fall 2008*
  Junior Math Seminar Coordinator: *Spring 2009*

- **Rutgers University**
  Ordinary Differential Equations: *2006*
  Introduction to Linear Algebra: *2007*

INVITED TALKS

- The Geometric Analysis of Maximal Developments, Part III, Workshop on "Partial Differential Equations of Classical Physics," The Simons Center for Geometry and Physics, Stony Brook, NY, *July 2025*

- The Geometric Analysis of Maximal Developments, Part II, Workshop on "Partial Differential Equations of Classical Physics," The Simons Center for Geometry and Physics, Stony Brook, NY, *July 2025*

- The Geometric Analysis of Maximal Developments, Part I, Workshop on "Partial Differential Equations of Classical Physics," The Simons Center for Geometry and Physics, Stony Brook, NY, *July 2025*

- The Characteristic Initial Value Problem for the Compressible Euler Equations, Analysis Seminar, Princeton University, Princeton, NJ, *March 2025*

- The Einstein-Euler Free Boundary Problem in Spherical Symmetry, PDE/Analysis Seminar, MIT, Cambridge, MA, *February 2024*

- The Einstein-Euler Free Boundary Problem in Spherical Symmetry, Princeton Gravity Initiative, Princeton University, Princeton, NJ, *April 2024*

- Singularity Formation for the Equations of Einstein and Euler, Invited Address at the American Mathematical Society's Southeastern Sectional Meeting, Florida State University, Tallahassee, FL, *March 2024*

- The Structure of the Maximal Development for Shock-Forming 3D Compressible Euler Solutions, International Conference on Geometric Analysis of Ricci Curvature, Guangxi Center for Mathematical Research (GXCMR), Nanning, China, Virtual talk, *January 2024*

- The Structure of the Maximal Development for Shock-Forming 3D Compressible Euler Solutions, International Program on "Recent Advances in Nonlinear PDEs and Their Applications," The Chinese University of Hong Kong, Hong Kong, Virtual talk, *November 2023*

- The Structure of the Maximal Development for Shock-Forming 3D Compressible Euler Solutions, Hyperbolic & Dispersive PDE Seminar, Rutgers University, New Brunswick, NJ, *September 2023*

- The Structure of the Maximal Development in 3D Compressible Euler Flow, Workshop on "Singularity Formation in General Relativity and Dispersive PDEs," International Centre for Mathematical Sciences, Edinburgh, UK, *May 2023*

- Advances in the Theory of Multi-Dimensional Shock Waves, International Conference on Geometric Analysis and Hyperbolic Equations, Guangxi, China, Virtual talk, *December 2022*

- Advances in the Theory of Multi-Dimensional Shock Waves, PDE Colloquium, University of Münster, Münster, Germany, *December 2022*

- Advances in the Theory of Multi-Dimensional Shock Waves, PDE Seminar, University of Cambridge, Cambridge, UK, *November 2022*

- Advances in the Theory of Multi-Dimensional Shock Waves, London Analysis Seminar, University College London, London, UK, *October 2022*

- The Formation of Shocks in 3D Compressible Euler Flow: The Structure of the Maximal Development, Analysis Seminar, Brown University, Providence, RI, Virtual talk *April 2022*

- The Mathematical Theory of Shock Waves in Multi-Dimensional Relativistic and Non-relativistic Compressible Euler Flow, "Special Program on General Relativity," CMSA, Harvard University, Cambridge, MA, Virtual talk, *April 2022*

- Stable Big Bang Formation in General Relativity: The Sub-Critical Regime, American Physical Society Session "Progress and Challenges in Analytic Gravity," New York, NY, Virtual talk, *April 2022*

- Advances in the Mathematical Theory of Shock Waves in 3D Compressible Euler Flow, UC Riverside Analysis Seminar, Riverside, CA, Virtual talk, *March 2022*

- The Mathematical Theory of Shock Waves in Relativistic and Non-Relativistic Compressible Euler Flow, Mathematical Perspectives of Gravitation beyond the Vacuum Regime, The Erwin Schrödinger Institute for Mathematical Physics, Vienna, Austria, Virtual Talk, *February 2022*

- The Relativistic Euler Equations: Remarkable Structures and Applications; Lectures I-IV, Mathematical Perspectives of Gravitation beyond the Vacuum Regime, The Erwin Schrödinger Institute for Mathematical Physics, Vienna, Austria, Virtual Talk, *February 2022*

- Advances in the Mathematical Theory of Shock Waves, UCLA-USC Analysis and PDE Seminar, Virtual talk, *November 2021*

- Dynamically Stable Cosmological Singularities: The Sub-Critical Regime, Workshop on "Mathematical Aspects of General Relativity," MFO, Oberwolfach, Germany, Virtual talk, *September 2021*

- Advances in the Mathematical Theory of Shock Waves, University College London, London, UK, Virtual talk, *June 2021*

- Advances in the Mathematical Theory of Shock Waves, Princeton Graduate Student Analysis Seminar, Princeton, NJ, Virtual talk, *May 2021*

- Stable Big Bang Formation in General Relativity: The Complete Sub-Critical Regime, University of Kentucky Student Analysis and PDE Seminar, University of Kentucky, Lexington, KY, Virtual talk, *May 2021*

- A New Formulation of Relativistic Euler Flow: Miraculous Geo-Analytic Structures and Applications, The Chinese University of Hong Kong, Hong Kong, Virtual talk, *May 2021*

- Cosmological Singularities in General Relativity: The Complete Sub-Critical Regime, Black Hole Initiative, Harvard University, Cambridge, MA, Virtual talk, *April 2021*

- A New Formulation of Relativistic Euler Flow: Miraculous Geo-Analytic Structures and Applications, Mathematical Perspectives of Gravitation beyond the Vacuum Regime, The Erwin Schrödinger Institute for Mathematical Physics, Vienna, Austria, Virtual Talk, *February 2021*

- Stable Big Bang Formation in General Relativity: The Complete Sub-Critical Regime, Analysis & PDE Seminar, University of California at Berkeley, Virtual talk, *November 2020*

- A New Formulation of Relativistic Euler Flow: Miraculous Geo-Analytic Structures and Applications, Mathematical and Computational Approaches for the Einstein Field Equations with Matter Fields, Institute for Computational and Experimental Research in Mathematics, Providence, RI, Virtual talk, *October 2020*

- Stable Big Bang Formation in General Relativity: The Complete Sub-Critical Regime, Joint UCLA-Caltech Analysis Seminar, Virtual talk, *October 2020*

- Singularity Formation in General Relativity, Mathematical and Computational Approaches for Solving the Source- Free Einstein Field Equations, The Institute for Computational and Experimental Research in Mathematics, Providence, RI, Virtual talk, *October 2020*

- Advances in the Mathematical Theory of Shock Waves, AMS Sectional Special Session on Conservation Laws and Nonlinear Wave Equations, Penn State University, State College, PA, Virtual talk, *October 2020*

- Remarkable Integral Identities for 3D Compressible Euler Flow, Analysis Seminar, Princeton University, Princeton, NJ, Virtual talk, *April 2020*

- New Formulations of Relativistic and Non-Relativistic Compressible Euler Flow: Miraculous Geo-Analytic Structures and Applications, General Relativity and Geometric Analysis Seminar, Columbia University, New York, NY, *February 2020*

- A New Formulation of Relativistic Euler Flow: Miraculous Geo-Analytic Structures and Applications, Texas Analysis and Mathematics Symposium, Rice University, Houston, TX, *January 2020*

- A New Formulation of Relativistic Euler Flow: Miraculous Geo-Analytic Structures and Applications, International Conference on Geometric Analysis and Hyperbolic Equations, Guangxi, China, *December 2019*

- A Remarkable Formulation of Compressible Euler Flow and Applications, Southern California Analysis & PDE Conference, University of California San Diego, La Jolla, CA, *November 2019*

- A New Formulation of Multi-Dimensional Compressible Euler Flow with Vorticity and Entropy: Miraculous Geo-Analytic Structures and Applications to Shocks, Seminar, Institute for Advanced Study, Princeton, NJ, *June 2019*

- A New Formulation of Multi-Dimensional Compressible Euler Flow with Vorticity and Entropy: Miraculous Geo-Analytic Structures and Applications to Shocks, Analysis Seminar, University of California San Diego, La Jolla, CA, *March 2019*

- Singularity Formation in General Relativity, AMS Joint Mathematics Meetings Special Session on "Problems in Partial Differential Equations," Baltimore, MD, *January 2019*

- Singularity Formation in General Relativity, Math Department Colloquium, Michigan State University, East Lansing, MI, *November 2018*

- Singularity Formation in General Relativity, General Relativity Session at the International Congress on Mathematical Physics, Montreal, Canada, *July 2018*

- Nonlinear Geometric Optics and Applications to Stable Singularity Formation, SIAM Conference on "Nonlinear Waves and Coherent Structures," Anaheim, CA, *June 2018*

- Singularity Formation in General Relativity, AMS Joint Mathematics Meetings Special Session on "Mathematical Problems in Relativistic Physics: Classical and Quantum," Boston, MA, *April 2018*

- Shock Formation for Multi-Dimensional Fluid Equations and Related Multiple Speed Systems, Shanks Workshop on "Mathematical Aspects of Fluid Dynamics," Vanderbilt University, Nashville, TN, *March 2018*

- The Formation of Shock Waves in the Presence of Vorticity, Analysis Seminar, Brown University, Providence, RI, *February 2018*

- The Formation of Singularities in General Relativity, Black Hole Initiative, Harvard University, Cambridge, MA, *January 2018*

- Breakdown Results for Solutions to Hyperbolic PDEs, AMS Fall Sectional Meeting, State University of New York at Buffalo, Buffalo, NY, *September 2017*

- Degenerate Behavior in Solutions to Hyperbolic PDEs, Lecture to SPUR students and faculty, MIT, Cambridge, MA, *July 2017*

- The Formation of Shock Singularities in Solutions to Wave Equation Systems with Multiple Speeds, Analysis Seminar, Michigan State University, East Lansing, MI, *April 2017*

- The Formation of Shock Waves in the Presence of Vorticity, Analysis Seminar, University of Pittsburgh, Pittsburgh, PA, *March 2017*

- An Overview on Recent Progress on the Formation of Shock Singularities, Department Colloquium, Rutgers University, New Brunswick, NJ, *November 2016*

- The Formation of Shock Waves in the Presence of Vorticity, Keynote speaker at "A Day of Revolutionary Thinking" conference, Rutgers University, New Brunswick, NJ, *November 2016*

- Shock Formation in Solutions to the 2D Compressible Euler Equations in the Presence of Nonzero Vorticity, Focused Research Group Conference in Analysis, Massachusetts Institute of Technology, Cambridge, MA, *September 2016*

- Shock Formation in Solutions to the Compressible Euler Equations, Aspects of General Relativity Workshop Program, Harvard University, Cambridge, MA, *May 2016*
- Shock Formation in Solutions to the 2D Compressible Euler Equations in the Presence of Vorticity, Keynote Lecture at the Annual Shanks Conference, Vanderbilt University, Nashville, TN, *May 2016*

- An Overview of Recent Progress on Shock Formation in Three Spatial Dimensions, Analysis and Geometry Seminar, Northeastern University, Boston, MA, *March 2016*

- Stable Big Crunches in General Relativity, Workshop on the Dynamics of Self Gravitating Matter, Institut Henri Poincaré, Paris, *October 2015*

- Stable Big Crunches in General Relativity, General Relativity and Gravitation: A Centennial Perspective, Penn State University, State College, PA, *June 2015*

- Shock Formation in Solutions to 3D Wave Equations, Analysis Seminar, Johns Hopkins University, Baltimore, MD, *April 2015*

- The Geometry of Waves: A Sampler on Three Decades of Outstanding Progress, Lecture to the AMS Graduate Student Chapter, Boston University, Boston, MA, *March 2015*

- Shock Formation in Solutions to 3D Wave Equations, Analysis and Applied Math Seminar, University of Toronto, Toronto, Ontario, *March 2015*

- Stable Big Bang Formation in Solutions to the Einstein-Scalar Field System, Fields Institute, Toronto, Ontario, *March 2015*

- An Overview of Recent Progress on Shock Formation in Three Spatial Dimensions, Math Department Colloquium, University of Toronto, Toronto, Ontario, *March 2015*

- Almost Monotonicity in the Einstein Equations and Its Implications for Stable Blow-Up, Program on "Mathematical Problems in General Relativity," Simons Center, Stony Brook, NY, *January 2015*

- Shock Formation in Solutions to 3D Wave Equations, Math Department Colloquium, Vanderbilt University, Nashville, TN, *October 2014*

- Stable Small-Data Shock Formation in Solutions to 3D Quasilinear Wave Equations, PDE Seminar, Brown University, Providence, RI, *January 2014*

- Stable Small-Data Shock Formation in Solutions to 3D Quasilinear Wave Equations, Analysis Seminar, Princeton University, Princeton, NJ, *October 2013*

- Stable Big Bang Formation in Near-FLRW Solutions to the Einstein-Scalar Field System, Program on "Mathematical General Relativity," MSRI, Berkeley, CA, *October 2013*
- Stable Big Bang Formation in Near-FLRW Solutions to the Einstein-Scalar Field System, Mathematical Physics Seminar, Rutgers University, New Brunswick, NJ, *March 2013*

- Stable Big Bang Formation in Near-FLRW Solutions to the Einstein-Stiff Fluid System, Analysis Seminar, Princeton University, Princeton, NJ, *March 2013*

- On Big Bang Spacetimes, Analysis Seminar, University of North Carolina, Chapel Hill, NC, *October 2012*

- On Big Bang Spacetimes, Analysis Seminar, University of Rochester, Rochester, NY, *October 2012*

- On Big Bang Spacetimes, Workshop on "Mathematical Aspects of General Relativity," MFO, Oberwolfach, Germany, *July 2012*

- The Geometric Analysis of Wave Equations, Graduate Student Lunch Seminar, Massachusetts Institute of Technology, Cambridge, MA, *April 2012*

- Global Stability Results for Relativistic Fluids in Expanding Spacetimes, Analysis Seminar, University of Pennsylvania, Philadelphia, PA, *March 2012*

- The Global Stability of the Minkowski Spacetime Solution to the Einstein-Nonlinear Electromagnetic System in Wave Coordinates, PDE Seminar, Brown University, Providence, RI, *February 2012*

- Global Stability Results for Relativistic Fluids in Expanding Spacetimes, AMS Joint Mathematics Meetings Special Session on "Stability Analysis for Infinite Dimensional Hamiltonian Systems," Boston, MA, *January 2012*

- On the Future-Stability of Solutions to the Relativistic Euler Equations in Expanding Spacetimes, Analysis Seminar, Princeton University, Princeton, NJ, *December 2011*

- On the Future-Stability of Solutions to the Relativistic Euler Equations in Expanding Spacetimes, PDE/Analysis Seminar, Massachusetts Institute of Technology, Cambridge, MA, *November 2011*

- The Global Stability of the Minkowski Spacetime Solution to the Einstein-Nonlinear Electromagnetic System in Wave Coordinates, PDE Seminar, Boston University, Boston, MA, *October 2011*

- The Global Stability of the Minkowski Spacetime Solution to the Einstein-Nonlinear Electromagnetic System in Wave Coordinates, Geometric Analysis and Partial Differential Equations Seminar, University of Cambridge, Cambridge, UK, *April 2011*

- The Global Stability of the Minkowski Spacetime Solution to the Einstein-Nonlinear Electromagnetic System in Wave Coordinates, Seminar on "Mathematical General Relativity," Université Pierre et Marie Curie, Paris, France, *March 2011*

- Geometric Methods in Hyperbolic PDEs, Departmental Colloquium, University of MD, College Park, MD, *February 2011*

- Geometric Methods in Hyperbolic PDEs, PDE Seminar, Massachusetts Institute of Technology, Cambridge, MA, *January 2011*

- The Theory of Regularly Hyperbolic Partial Differential Equations Part II, General Relativity Seminar, Princeton University, Princeton, NJ, *December 2010*

- The Theory of Regularly Hyperbolic Partial Differential Equations Part I, General Relativity Seminar, Princeton University, Princeton, NJ, *December 2010*

- The Global Stability of the Minkowski Spacetime Solution to the Einstein-Nonlinear Electromagnetic System in Wave Coordinates, Analysis Seminar, University of Pennsylvania, Philadelphia, PA, *November 2010*

- The Nonlinear Stability of the Maxwell-Born-Infeld System, ICMS Seminar on "Mathematical Relativity," University of Edinburgh, Edinburgh, UK, *September 2010*

- The Nonlinear Stability of the Maxwell-Born-Infeld System, Geometric Analysis and Partial Differential Equations Seminar, University of Cambridge, Cambridge, UK, *May 2010*

- The Stability of the Euler-Einstein System with a Positive Cosmological Constant, Cosmology Seminar, University of Cambridge, Cambridge, UK, *April 2010*

- The Stability of the Euler-Einstein System with a Positive Cosmological Constant, Conference on "PDEs, Relativity, and Nonlinear Waves," University of Granada, Spain, *April 2010*

- The Stability of the Euler-Einstein System with a Positive Cosmological Constant, Cosmology Seminar, University of Maryland, College Park, MD, *March 2010*

- The Stability of the Euler-Einstein System with a Positive Cosmological Constant, Seminar on "Mathematical General Relativity," Université Pierre et Marie Curie, Paris, France, *January 2010*

- The Stability of the Irrotational Euler-Einstein System with a Positive Cosmological Constant, Analysis Seminar, Princeton University, Princeton, NJ, *October 2009*

- The Stability of the Irrotational Euler-Einstein System with a Positive Cosmological Constant, Mathematical Physics Seminar, Rutgers University, New Brunswick, NJ, *October 2009*

- The Global Nonlinear Stability of the Trivial Solution to the Einstein-Maxwell-Born-Infeld System, AMS Fall Sectional Meeting, Penn State University, State College, PA, *October 2009*

- The Stability of the Irrotational Euler-Einstein System with a Positive Cosmological Constant, General Relativity Seminar, University of Cambridge, Cambridge, UK, *October 2009*

- The Stability of the Irrotational Euler-Einstein System with a Positive Cosmological Constant, Workshop on "Mathematical Aspects of General Relativity," MFO, Oberwolfach, Germany, *October 2009*

- On Christodoulou's Spherically Symmetric Gravitational Collapse for the Einstein-Scalar Field System, Conference on "Mathematical Challenges of Relativity," Snowbird, Utah, *June 2009*

- Local Existence for the Euler-Nordström System via the Method of Energy Currents, Workshop on "Nonlinear Evolution Equations," MFO, Oberwolfach, Germany, *June 2008*

- Local Existence for the Euler-Nordström System via the Method of Energy Currents, Analysis Seminar, Princeton University, Princeton, NJ, *March 2008*

- Relativistic Fluids, Mathematical Physics Seminar, Rutgers University, New Brunswick, NJ, *April 2007*

EXTERNAL SERVICE

- **Lecturer** in a mini-course on shock waves; "Shocks in multi-dimensional compressible fluids," Simons Center for Geometry and Physics, Stony Brook, NY, *July 2025*
- **Lecturer** in a 6-lecture course entitled: "The Formation and Structure of Shock Singularities in Multi-Dimensional Compressible Euler Flow and Related PDEs," University of Cambridge, Cambridge, UK, *October 2022 - December 2022*
- **Lecturer** for mini-school on "Recent advances in the mathematical theory of relativistic and non-relativistic compressible Euler flow," Erwin Schrödinger International Institute for Mathematics and Physics, *February 2022*
- **NSERC Reviewer**, *2020*
- **Reviewer for Junior Research Fellowship for University of Cambridge**, *2020*
- **Organizer** for semester-long ICERM program entitled "Advances in Computational Relativity," *Fall 2020*
- **Organizer** for ICERM workshop entitled "Mathematical and Computational Approaches for Solving the Source-Free Einstein Field Equations," *Fall 2020*
- **Organizer** for ICERM workshop entitled "Mathematical and Computational Approaches for the Field Equations with Matter Fields," *Fall 2020*
- **NSF Reviewer**, *2020*
- **NSF Panelist**, *2019, 2023*
- **External Tenure-Track Hire Evaluator** for a German university, *2019, 2021*
- **External Evaluator** for Austrian Science Fund, *2019, 2020, 2021*
- **Senior Organizer** of a two-week summer school for research-oriented undergraduates and graduate students entitled "Boston City Limits Summer School on the Geometric Analysis of Waves and Fluids – Part II," Massachusetts Institute of Technology, Cambridge, MA, *June 2018*
- **Lecturer** for Mini-School on Nonlinear Equations, Harvard University, Center for Mathematical Sciences and Applications, *December 2016*
- **Senior Organizer** of a two-week summer school for research-oriented undergraduates and graduate students entitled "Boston City Limits Summer School on the Geometric Analysis of Waves and Fluids," Massachusetts Institute of Technology, Cambridge, MA, *June 2016*
- **PhD Defense Committee**, Grigorios Fournodavlos, *2016;* Ross Granowski, *2018*
- **Senior Organizer** of a month-long program entitled "Mathematical Problems in General Relativity," Simons Center, Stony Brook, NY, *January 2015*
- **Senior Organizer** of an AIM SQUAREs workshop entitled "The Formation of Shocks" parts I,II,III, Palo Alto, CA, *April 2012, April 2013, April 2014*
- **Senior Thesis Advisor**, John Stogin, Princeton University, *Fall 2010 – Spring 2011*
- **Referee** for: *Acta Mathematica, Advances in Mathematics, AIP Advances, AMS Graduate Studies in Mathematics Series, Analysis & PDE, Annales de l'Institut Henri Poincaré, Annals of Mathematics, Annals of PDE, Annals of Physics, Calculus of Variations and Partial Differential Equations, Communications in Mathematical Physics, Communications on Pure and Applied Analysis, EMS Monographs in Mathematics, Forum of Mathematics - Pi, Inventiones Mathematicae, Journal of the American Mathematical Society, Journal of Differential Geometry, Journal of the European Mathematical Society, Journal of Differential Equations, Journal of the European Mathematical Society, Letters in Mathematical Physics, Proceedings of the Royal Society A, Selecta Mathematica, Society for Industrial and Applied Mathematics, Various conference proceedings*
- **Organizer** of AMS Joint Mathematics Meetings Special Session on

Mathematical Challenges of Relativity, San Francisco, *January 2010*
- **Organizer** of General Relativity Seminar, University of Cambridge, *Fall 2009 - Spring 2010*
- **Junior Organizer** of Mathematical Challenges of Relativity Conference, Snowbird, Utah, *June 2009*

VANDERBILT SERVICE

- **Vice Chair of the Department of Mathematics,** *Fall 2023 – Spring 2025*
- **Director of the VandyGRAF Initiative**, *2022 - 2025*
- **Senior Advisory Review Committee for the Dean of the College of A&S**, *Fall 2024, Spring 2025*
- **Hiring Committee for Mathematics Tenure-Line Faculty**, *Fall 2023, Fall 2024*
- **Hiring Committee for Mathematics Endowed Chair Professor of the Practice Position**, *Fall 2023*
- **Provost's Graduate Fellowship Review Committee**, *Spring 2024*
- **Mathematics Scheduling Committee**, *Fall 2024*
- **Committee on Graduate Education for College of A&S**, *Fall 2023, Spring 2024, Fall 2024, Spring 2025*
- **Hiring Committee for External Department Chair in Mathematics**, *Fall 2022 - Spring 2023*
- **NSF Postdoctoral Research Fellow Mentor**, Leonardo Abbrescia, *2020, 2021, 2022, 2023, Spring 2024*
- **Postdoctoral Mentor**, Dongxiao Yu, *Fall 2024 - present*
- **Chair of Faculty Hiring Committee in Department of Mathematics**, *2022*
- **Chair of Joint Mathematics-Physics Hiring Committee**, *2021*
- **Chair of Vanderbilt Gravity, Waves, and Fluids Working Group**, *2021*
- **Co-Founder of Vanderbilt Initiative for Gravity, Waves, and Fluids**, *2020*
- **Mathematics Tenure and Promotion Committee**, *2020*
- **Real Analysis Qualifying Exam Committee**, *2019, 2020, 2022*
- **Mathematics Undergraduate Committee**, *2019, 2020*
- **Shanks Workshop Organizer**, *Spring 2022*
- **College of Arts and Science Board of Advisors Meeting**, *Fall 2019*
- **Colloquium Organizing Committee**, *Fall 2019, Spring 2020*
- **Mathematics Postdoctoral Hiring Committee**, *Fall 2018*
- **Fisk-Vanderbilt Bridge Mentor/Master's Thesis Co-Supervisor:** Jose Arita-Escalante, *Fall 2023 - present*
- **PhD Dissertation Committee:** Brian Luczak, *Spring 2022 – Spring 2024*; Runzhang Zhong, *Fall 2022 - present*
- **Independent Study Course Supervision:** Sifan Yu, *Fall 2018, Spring 2019, Fall 2019, Spring 2020, Fall 2020;* Shaoyang Zhou, *Fall 2020;* Henry Huang, Cammie Norton, and Elijah Sheridan, *Spring 2021*; Henry Huang, *Fall 2022, Spring 2023;* Jack Kangbai and Anthony Wang, *Fall 2023, Spring 2024*; Will McDermott, *Fall 2024*
- **Supervised Senior Theses in Mathematics:** Annan Yu, *Fall 2020 - Spring 2021;* Shaoyang Zhou, *Fall 2019 - Spring 2020*, Henry Huang, *Spring 2022 - Spring 2023;* Jack Kangbai, *Fall 2023 - Spring 2024*

MIT SERVICE

- **Rewrote the Advanced Standing Exam for 18.01**, *Summer 2016*
- **Organizer** of PDE/Analysis Seminar, *Fall 2011 - Spring 2014*
- **PhD Defense Committee**, Ryan Chang, Mathematics, *2016*, Yakov Shlapentokh-Rothman, Mathematics, *2015*, Dana Mendelson, Mathematics, *2015*
- **Supervised Undergraduate Research Opportunities Program students**, Bernardo Hernandez, *Fall 2018*; Jianqiao Xia, *Fall 2017*; Julian Chaidez, *Summer 2014 and Fall 2014*; Jordan Cotler, *Summer 2013 and Summer 2014*; Whan Ghang, *Fall 2012*
- **Graduate Student Admissions Committee**, *January 2012*
- **C.L.E. Moore Instructor Hiring Committee**, *December 2011*