

WILLIE WAI-YEUNG WONG

Education

- 2009 Ph.D. in Mathematics, Princeton University, Princeton, NJ
Dissertation advisor: Sergiu Klainerman
Dissertation title: On the uniqueness of Kerr–Newman black holes
- 2005 B.A. with High Honors in Mathematics, Princeton University, Princeton, NJ

Research interests

Analysis of geometric wave equations. Many physical phenomena can be described by geometric wave equations, some commonly seen ones include the wavemaps equation, the membrane equation, and the equations of general relativity. I am interested in understanding the long-term behavior of solutions to these equations, usually from the perturbative point of view, where we take a special solution and study their dynamical stability under small perturbations.

Geometric methods for the analysis of hyperbolic equations and systems. Interplay of the characteristic geometry of hyperbolic systems and the qualitative behaviour of solutions, with focus on the quasilinear setting. Main problems include: decay estimates for the wave equation on curved backgrounds, low regularity local wellposedness of systems, Carleman estimates and unique continuation for systems.

Professional history

- 2015–present Assistant Professor
 Michigan State University, East Lansing, Michigan, USA
- 2011–2015 Post-doc collaborateur scientifique
 École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland
- 2009–2011 Postdoctoral research associate
 DPMMS, University of Cambridge, Cambridge, United Kingdom
- 2002, 2003 Energy Research Undergraduate Laboratory Fellow in atomic physics,
 Chemistry Division, Argonne National Laboratory, Argonne, Illinois, USA

Grants received

- Simons Collaboration Grant (PI) (2018.09 - 2023.08) \$42,000
 Project title: “Geometric analysis of the long time behavior of evolution equations”
- MathWorks Academic Support (PI) (2018.08 - 2020.05) \$40,583
 Supports the development and assessment of calculus curricular material to incorporate Lab-based computer simulations to Calculus II instruction.

Honors and awards

- NatSci Faculty Teaching Prize, 2018
- J.S. Frame Excellence in Teaching Award, 2017
- Phi Beta Kappa, inducted 2005
- US National Science Foundation Graduate Research Fellowship, 2005-2008
- International Physics Olympiad, Gold medal, 2001

Preprints

- L Abbrescia and WWY Wong. “Geometric analysis of 1 + 1 dimensional quasilinear wave equations”. *Preprint* (2019) arXiv: 1912.04692.

- L Abbrescia and WWY Wong. “Global versions of Gagliardo-Nirenberg-Sobolev inequality and applications to wave and Klein-Gordon equations”. *Submitted* (2019) arXiv: 1903.12129.
- L Abbrescia and WWY Wong. “Global nearly-plane-symmetric solutions to the membrane equation”. *Revising for resubmission* (2019) arXiv: 1903.03553.
- WWY Wong. “Dispersive estimates for Klein-Gordon equations via a physical space approach”. *Submitted* (2019) arXiv: 1909.05956.
- WWY Wong. “Small data global existence and decay for two dimensional wave maps”. *Submitted* (2017) arXiv: 1712.07684.

Refereed Research Articles

- [15] WWY Wong. “A commuting-vector-field approach to some dispersive estimates”. *Archiv der Mathematik* 110:273–289 (2018).
- [14] X An and WWY Wong. “Warped Product Space-times”. *Class. Quantum Grav.* 35:025011 (2018).
- [13] WWY Wong. “Singularities of axially symmetric time-like minimal submanifolds in Minkowski space”. *J. Hyperbolic Diff. Eq.* 15:1–13 (2018).
- [12] WWY Wong. “Global Existence for the Minimal Surface Equation on $\mathbb{R}^{1,1}$ ”. *Proc. Amer. Math. Soc., Ser. B* 4:47–52 (2017).
- [11] J Speck, G Holzegel, J Luk, and WWY Wong. “Stable Shock Formation for Nearly Simple Outgoing Plane Symmetric Waves”. *Annals of PDE* 2:10 (2016).
- [10] G Holzegel, S Klainerman, J Speck, and WWY Wong. “Shock Formation in Small-Data Solutions to 3D Quasilinear Wave Equations: An Overview”. *J. Hyperbolic Diff. Eq.* 13:1–105 (2016).
- [9] R Donniger, J Krieger, J Szeftel, and WWY Wong. “Codimension one stability of the catenoid under the vanishing mean curvature flow in Minkowski space”. *Duke Math Journal* 165:723–791 (2016).
- [8] J Krieger and WWY Wong. “On type I blow up formation for the critical NLW”. *Comm. PDE* 39:1718–1728 (2014).
- [7] WWY Wong and P Yu. “Non-existence of multiple-black-hole solutions close to Kerr–Newman”. *Comm. Math. Physics* 325:965–996 (2014).
- [6] WWY Wong. “A comment on the construction of the maximal globally hyperbolic Cauchy development”. *J. Math. Physics* 54:113511 (2013).
- [5] WWY Wong and P Yu. “On strong unique continuation of coupled Einstein metrics”. *Int. Math. Res. Notices* 2012:544–560 (2012).
- [4] WWY Wong. “Regular hyperbolicity, dominant energy condition and causality for Lagrangian theories of maps”. *Class. Quantum Grav.* 28:215008 (2011).
- [3] GW Gibbons, CM Warnick, and WWY Wong. “Nonexistence of Skymion–Skymion and Skymion–anti-Skymion static equilibria”. *J. Math. Phys.* 52:012905 (2011).
- [2] WWY Wong. “A space-time characterization of the Kerr–Newman metric”. *Ann. Henri Poincaré* 10:453–484 (2009).
- [1] MT Huang, WWY Wong, M Inokuti, SH Southworth, and L Young. “Triple ionization of Lithium by electron impact”. *Phys. Rev. Lett.* 90:163201 (2003).

Teaching experience

Instructor

MTH133 Calculus II / Michigan State University

Spring 2020

MTH943 Hyperbolic and Dispersive Equations / Michigan State University	Spring 2019
MTH133 Calculus II / Michigan State University	Spring 2019
MTH133 Calculus II / Michigan State University	Fall 2018
MTH890 Stability of Matter / Michigan State University	Summer 2018
MTH133 Calculus II / Michigan State University	Spring 2018
MTH847 PDE I / Michigan State University	Fall 2017
MTH133 Calculus II / Michigan State University	Fall 2017
MTH943 Hyperbolic and Dispersive Equations / Michigan State University	Spring 2017
MTH133 Calculus II / Michigan State University	Spring 2017
MTH133 Calculus II / Michigan State University	Fall 2016
MTH421 Analysis II / Michigan State University	Fall 2015
MTH299 Transitions / Michigan State University	Fall 2015
Mat202 Linear Algebra with Applications / Princeton University	Spring 2008
<i>Reading course supervisor</i>	
MTH990 / Michigan State University	Spring 2020
MTH890 / Michigan State University	Fall 2018
MTH890 / Michigan State University	Spring 2018
MTH890 / Michigan State University	Fall 2016
<i>Guest Instructor</i>	
Partial Differential Equations / CCA, University of Cambridge	October/November 2010
<i>Teaching Assistant</i>	
Géométrie (GC) / École Polytechnique Fédérale de Lausanne	Spring 2014
Mathématiques Générales / University of Lausanne	Fall 2013
Géométrie (EL/MX) / École Polytechnique Fédérale de Lausanne	Spring 2013
Mathématiques Générales / University of Lausanne	Fall 2012
Part II Differential Geometry / University of Cambridge	Lent term 2011
Mat451 Topics in Analysis: Introduction to General Relativity / Princeton University	Spring 2009
Mat433 Special Topics in Analysis / Princeton University	Fall 2008
RTG Summer School in Analysis and Geometry / Princeton University	Summers 2007, 2008
Program in Analysis and General Relativity / Peking University, Beijing, China	April 2007

Current PhD Students and PostDocs

Leonardo Abbrescia	PhD candidate 2015–present
Shih-Fang Yeh	PhD candidate 2018–present

Other Graduate Mentorship

Khaldoun Al-Yasiri	Dissertation Committee Spring 2016
Xin Yang	Dissertation Committee Spring 2017
Wenchuan Tian	Comprehensive Exam Committee 2017–2018
Yao Li	First year academic advisor 2017–2018
Shih-Fang Yeh	First year academic advisor 2018–2019

Arman Tavakoli
Andrew Krause

Comprehensive Exam Committee 2018
Dissertation Committee Fall 2018–present

Undergraduate Research Mentorship

Katrina Gensterblum (MSU)	Professorial Assistant Fall 2016–2018
Zhixin Wang (Xi'an Jiaotong)	Advanced Track Exchange Program Spring 2017
Nic Heilman (MSU)	Advanced Track Exchange Program Spring 2017
Zach Mccullough (MSU)	Advanced Track Exchange Program Spring 2017
Peikai Qi (Tianjin Nankai)	Advanced Track Exchange Program Fall 2017
Manuel Catacora Rios	Independent Research 2018–2020

Conferences organized

Special session on *Wave Phenomena in Fluids and Relativity* co-organizer, AMS Sectional Meeting #1150, Madison, Wisconsin. September 14–15, 2019. (with S. Shahshahani.)

76th Midwest Partial Differential Equations Seminar co-organizer, East Lansing, Michigan. November 21–22, 2015. (with C. Sparber, K. Promislow, J. Schenker, R. Schwab, and J. Kitagawa.)

Special session on the mathematical challenges of relativity co-organizer, Joint Mathematics Meetings, San Francisco, California. January 13–16, 2010. (with P. Allen, M. Eichmair, G. Holzegel, and J. Speck)

Mathematical challenges of general relativity working group co-moderator, AMS Mathematical Research Communities program, Snowbird, Utah. June 13–19, 2009. (with G. Holzegel)

Seminars organized

Analysis and PDE seminar with J. Kitagawa, J. Schenker, R. Schwab, and A. Volberg, Michigan State University. 2015–present

Geometric analysis and PDE seminar, University of Cambridge. 2010–2011

Mathematical GR student seminar with J. Speck and V. Schlue, University of Cambridge. 2009–2011

PDE study group, Princeton University. 2007–2009

Service

Math Department ad hoc committee on By-Law Revision. Spring 2020

MTH133 Course Supervisor. Spring 2020

College of Natural Science Strategic Planning Integration Committee. Spring/Summer 2020.

Math Department ad hoc committee on instructional software. Spring 2018.

Frame Award committee. Spring 2018.

MTH133 Course supervisor (with M. Iwen). Spring 2018.

Supervisor (with J. Kitagawa) for the Student PDE Seminar at Michigan State University. 2017–present.

Referee for *Acta Applicanda Mathematicae*, *AMS Contemporary Mathematics book series*, *Annals of PDE*, *Annals of Physics*, *Archive for Rational Mechanics and Analysis*, *Archiv der Mathematik*, *Calculus of Variations and Partial Differential Equations*, *Communications in Mathematical Physics*, *Discrete and Continuous Dynamical System – A*, *Journal of Differential Geometry*, *Journal of Functional Analysis*, *Journal of the LMS*, *Journal of Partial Differential Equations*, *Mathematica Scandinavica*, *Mathematical Research Letters*, *Notices of the American Mathematical Society*, *Proceedings of the American Mathematical Society*, *Proceedings of the Royal Society A*, *Selecta Mathematica*, and *Surveys in Differential Geometry*.

Regular contributor to *Mathematical Reviews/MathSciNet*.

Regular contributor to MathOverflow (<http://mathoverflow.net>).

Moderator for the Mathematics Stack Exchange (<http://math.stackexchange.com/>) discussion forum. 2010–2014

Professional organization

American Mathematical Society, 2005–present

International Consortium of Chinese Mathematicians, 2018–present

Society for Industrial and Applied Mathematics, 2018–present

Sigma Xi, 2005–present

American Association for the Advancement of Science, through the AAAS/Science Program for Excellence in Science, 2009–2011

Invited research talks (funded)

Invited Lecture at the International Conference on Geometric Analysis and Hyperbolic Equations, Guangxi Center for Mathematical Research, Nanning, China. December 16–20, 2019.

Invited Lecture at the second annual meeting of the International Consortium of Chinese Mathematicians, National Taiwan University, Taipei, Taiwan. December 27–29, 2018.

Analysis Seminar, Vanderbilt University, Nashville, Tennessee, USA. November 30, 2018.

Analysis and PDE Seminar, University of Kentucky, Lexington, Kentucky, USA. October 16, 2018.

Analysis seminar, University of Rochester, Rochester, New York, USA. March 2, 2018.

International Conference on Nonlinear Waves and General Relativity, Chinese University of Hong Kong, Hong Kong, China. December 13–15, 2017.

Colloquium, Beijing International Center for Mathematical Research, Peking University, Beijing, China. July 28, 2017.

Mini-course at the Yau Mathematical Sciences Center, Tsinghua University, Beijing, China. July 24–August 4, 2017.

Analysis seminar, Princeton University, Princeton, New Jersey, USA. April 3, 2017.

Differential Equations seminar, University of Michigan, Ann Arbor, Michigan, USA. February 9, 2017.

Analysis and applied math seminar, University of Toronto, Toronto, Canada. March 18, 2016.

PDE seminar, University of Minnesota, Minneapolis, Minnesota, USA. March 9, 2016.

Mathematical General Relativity Conference, Tsinghua Sanya International Mathematics Forum, Sanya, Hainan, China. January 5, 2016.

Special day on the Mathematics of Relativity, National Taiwan University and National Center for Theoretical Sciences, Taipei, Taiwan. December 28, 2015.

Analysis seminar, Princeton University, Princeton, New Jersey, USA. February 9, 2015.

Christodoulou/Eichmair informal relativity seminar, ETHZ, Zurich, Switzerland. November 13, 2014.

Geometric analysis and PDE seminar, University of Cambridge, Cambridge, United Kingdom. November 3, 2014.

Mini-course for the *OX-PDE Workshop on Nonlinear Wave Equations and General Relativity*, University of Oxford, Oxford, United Kingdom. January 13 & 14, 2014. (with G. Holzegel)

OXPDE seminar, University of Oxford, Oxford, United Kingdom. November 11, 2013
 Seminar as part of the *Mathematical General Relativity* semester program, MSRI, Berkeley, California, USA. September 5, 2013
Geometry and analysis seminar, Imperial College London, London, United Kingdom. March 21, 2013
Gravitational physics seminar, University of Vienna, Vienna, Austria. December 5, 2012
Partial differential equations seminar, EPFL, Lausanne, Switzerland. April 1, 2011
Mathematical general relativity seminar, LJLL, Université Pierre et Marie Curie, Paris, France. March 21, 2011
Analysis seminar, University of Birmingham, Birmingham, United Kingdom. March 2, 2011
Analysis seminar, University of Edinburgh, Edinburgh, United Kingdom. February 7, 2011
Mathematical Relativity Workshop, ICMS, Edinburgh, United Kingdom. September 2, 2010
Relativity and cosmology seminar, Queen Mary University of London, London, United Kingdom. May 12, 2010
Relativity seminar, University of Oxford, Oxford, United Kingdom. March 9, 2010

Invited research talks (other)

Special session on *Differential Equation, Differential Geometry, and Mathematical General Relativity*, AMS Sectional Meeting #1153, University of California Riverside, Riverside, California, USA. November 9–10, 2019.
 Special session on *Analysis and Geometry of Nonlinear Evolution Equations*, Joint Mathematics Meeting, Baltimore, Maryland, USA. January 17, 2019.
 Special session on *Mathematical Problems of Relativistic Physics: Classical and Quantum*, AMS Sectional Meeting #1139, Northeastern University, Boston, Massachusetts, USA. April 21–22, 2018.
 Special session on *Evolution Equations and Applications*, AMS Sectional Meeting #1138, Vanderbilt University, Nashville, Tennessee, USA. April 14–15, 2018.
 Special session on *Recent Advances in Mathematical and Computational Aspects of Wave Propagation*, at the *AMMCS International Conference*, Waterloo, Ontario, Canada. August 20–25, 2017.
International Congress of Chinese Mathematicians, Beijing, China. August 6–11, 2016.
International Conference on Evolution Equations (in conjunction with the 31st annual Shanks Lecture), Vanderbilt University, Nashville, Tennessee, USA. May 16–20, 2016.
Special session on general relativity and related partial differential equations, AMS Fall Southeastern Meeting, Florida Atlantic University, Boca Raton, Florida. October 30, 2009

Other talks (dagger denotes teaching and outreach presentations)

†*Co-Integrate* (series on math thinking and learning), CREATE for STEM and PRIME, Michigan State University, East Lansing, Michigan, USA. January 30, 2020.
 †TOPSUM, Michigan State University, East Lansing, Michigan, USA. February 15, 2019.
 †Presentation for *Alumni Distinguished Scholarship* days, Michigan State University, East Lansing, Michigan, USA. January 25 and February 1, 2019.
 †*Conversation Among Colleagues*, Michigan State University, East Lansing, Michigan, USA. April 16, 2018.

- †*Conversation Among Colleagues*, Michigan State University, East Lansing, Michigan, USA. February 20, 2017.
- †Presentation for *Alumni Distinguished Scholarship* days, Michigan State University, East Lansing, Michigan, USA. January 27 and February 3, 2017.
- †*MSU STEM Education Alliance Meeting*, Michigan State University, East Lansing, Michigan, USA. May 5, 2016.
- Analysis and PDE seminar*, Michigan State University, East Lansing, Michigan, USA. November 11, 2015.
- Job candidate talk*, Georgia Institute of Technology, Atlanta, Georgia, USA. February 10, 2015.
- Mathematics colloquium (job candidate talk)*, Michigan State University, East Lansing, Michigan, USA. January 20, 2015.
- Mathematics colloquium (job candidate talk)*, University of California Santa Barbara, Santa Barbara, California, USA. November 25, 2014.
- Analysis seminar*, EPFL, Lausanne, Switzerland. April 11, 2014.
- Mathematical physics seminar*, University of Cambridge, Cambridge, United Kingdom. February 1, 2011
- Geometric analysis and PDE seminar*, University of Cambridge, Cambridge, United Kingdom. November 29, 2010