

Curriculum Vitae, Nathan Thomas Carruth (盧天賜)

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Education

- 2015 – 2021 PhD, Mathematics, University of Toronto; thesis topic: Focussed Solutions to the Einstein Vacuum Equations (available online at <https://hdl.handle.net/1807/104929>).
- 2011 – 2015 Doctoral studies, Physics, University of California, Berkeley.
- 2010 – 2011 Master's of Advanced Study in Applied Mathematics, University of Cambridge; examinations passed with merit.
- 2009 – 2010 Master's of Science, Physics, Utah State University; thesis topic: Classical Foundations for a Quantum Theory of Time in a Two-dimensional Spacetime (available online at <http://digitalcommons.usu.edu/etd/708/>).
- 2004 – 2007 Bachelor's of Science, Mathematics and Physics, Utah State University, Summa Cum Laude.

Research Experience

- 2018 – present Focussed solutions to the Einstein vacuum equations in polarised translational symmetry. Toronto and Tsinghua.
- 2021 Transcranial focused ultrasound. Sunnybrook Research Institute, Toronto.
- 2017 – 2018 Modelling seizures using Wilson-Cowan equations. Krembil Research Institute, Toronto.
- 2013 – 2015 Auroral plasma physics data extraction and analysis (supporting the NASA GREECE mission) and rheometry modelling of spacecraft antennas (supporting Parker Solar Probe mission). Space Sciences Lab, Berkeley.
- 2013 – 2017 (concurrently) Theoretical studies of scattering of radio waves by spherically stratified bodies (modelling European oceans). Berkeley and Toronto.
- 2009 – 2010 Identification of the group of conformal isometries and set of spacelike hypersurfaces of spacetimes conformally isometric to $\mathbb{R}^1 \times S^1$. Utah State University.
- 2004 – 2007 Isometric embeddings of metric spaces in Banach and Hilbert spaces.

Teaching Experience

- 2021 – present Undergraduate mentor, Qiuzhen College, Tsinghua University (求真书院益友学者).
- Fall 2020 Teacher's Assistant, Mathematics Department, University of Toronto. Provided office hour/discussion/lecture support and performed marking for undergraduate engineering ODE, third-year undergraduate PDE, and third-year introductory mathematical logic.

- Summer 2020 Lecturer, Mathematics Department, University of Toronto. Designed and taught third-year complex variables (MAT334). Work also included supervising TAs and one other instructor. Course website: http://www.math.toronto.edu/ncarruth/MAT334_S20/.
- Winter 2020 Lecturer, Mathematics Department, University of Toronto. Taught first-year calculus (MAT136). Work included substituting an additional section for two weeks in the middle of term and managing an emergency transition to all-online instruction due to the Covid-19 lockdown in the second half of the term.
- Summer 2019 Lecturer, Mathematics Department, University of Toronto. Taught a third-year introductory PDE course (APM346). Selected textbook, created syllabus, determined detailed course coverage, created homework assignments, quizzes, and tests, produced detailed course lecture notes as well as review notes on background material, and supervised TA work. Much of the material produced is on the course website: http://www.math.toronto.edu/ncarruth/APM346_S19/.
- 2018 – 2019 Lecturer, Mathematics Department, University of Toronto, Mississauga. Taught first-year calculus (MAT135Y).
- 2017 – 2018 Teacher’s Assistant, Mathematics Department, University of Toronto. Held office hours, taught discussion sections, marked exams, proofread homework problems, and evaluated test and problem set marking for second-year calculus courses (including MAT237). Also taught sections and marked tests for an introductory PDE course (APM346).
- 2016 – 2017 Lecturer, Mathematics Department, University of Toronto. Taught second-year calculus.
- 2015 – 2016 Teacher’s Assistant, Mathematics Department, University of Toronto. Taught sections for first-year calculus courses; held office hours and marked tests for a second-year (theoretical) calculus course; and taught sections and marked tests for a (summer-term) introductory linear algebra course.
- 2011 – 2012 Graduate Student Instructor, University of California, Berkeley. Taught discussions and graded tests for a conceptual introduction to physics class, and taught discussions, conducted labs, and graded tests for an introductory physics class for life sciences majors.
- 2009 – 2010 Teacher’s Assistant, Utah State University Physics Department. Supervised labs for introductory physics classes for life sciences majors.
- 2006 – 2007 Grader, Utah State University Mathematics Department. Graded student papers in upper-division undergraduate real analysis and linear algebra classes.

Presentations

1. Highly localised gravitational waves in polarised translational symmetry. CMS 75th + 1 Anniversary Summer Meeting (on Zoom), June 7 2021.

Papers

1. Pulupa, M., Bale, S.D., Bonnell, J.W., Bowen, T.A., Carruth, N., Goetz, K., Gordon, D., Harvey, P.R., Maksimovic, M., Martínez-Oliveros, J.C., Moncuquet, M., Saint-Hilaire, P., Seitz, D., Sundkvist, D. The Solar Probe Plus Radio Frequency Spectrometer: Measurement requirements, analog design, and digital signal processing. *Journal of Geophysical Research* **122** (2017), 2836-2854. doi:10.1002/2016JA023345

Preprints

1. Alexakis, S., Carruth, N. Squeezing a fixed amount of gravitational energy to arbitrarily small scales, in $U(1)$ symmetry. arXiv:2205.05526.

Theses

- 2020 Focussed solutions to the Einstein vacuum equations. Doctoral thesis, University of Toronto. Available online at http://www.math.toronto.edu/ncarruth/Carruth_Nathan_T_20213_PhD_thesis.pdf.
- 2010 Classical foundations for a quantum theory of time in a two-dimensional spacetime. Master's thesis, Utah State University. Available online at <https://digitalcommons.usu.edu/etd/708/>.

Lecture notes

- 2020 Lecture notes for undergraduate complex variables. Available online at http://www.math.toronto.edu/ncarruth/MAT334_S20/notes/mat334_comp.pdf.
- 2019 Lecture notes for undergraduate applied partial differential equations. Available online at http://www.math.toronto.edu/ncarruth/APM346_S19/notes/apm346_comp.pdf.

Programming

C, T_EX, SNOBOL, UNIX (ksh, sed, awk), 8086 assembly, IDL (data processing and analysis), Asymptote, MetaPost, METAFONT (see typescript of Goursat's Functions of a Complex Variable, available at <http://www.math.toronto.edu/ncarruth/goursat/>, for an example).

Awards and Recognitions

- 2021 – present Recipient of a Chinese government International Postdoctoral Exchange Talent-Introduction Program (博士后国际交流计划引进项目) grant
- 2021 Nominated for the CMS Blair Spearman Doctoral Prize and CAIMS Cecil Dissertation Award by the University of Toronto Mathematics Department
- 2010 David Peak Award, Utah State University Physics Department
- 2010 Offered Connaught Fellowship, University of Toronto; declined, pursuing studies at Cambridge instead
- 2010 Awarded US National Science Foundation Graduate Research Fellowship (held for five years, 2010 – 2015)
- 2007, 2009 Honorable Mention, National Science Foundation Graduate Research Fellowship competition
- 2005 Passed with distinction the introductory real analysis and advanced calculus qualifying exam given to graduate students in the Mathematics Department, Utah State University.
- 2005 – 2007 Outstanding Undergraduate Award, Mathematics Department, Utah State University (annually, each year)
- 2004 – 2007 Neville and Annie Hunsaker Scholarship, Mathematics Department, Utah State University
- 2004 – 2007 Undergraduate Research Fellowship, Utah State University

Other Experience

- 2009 – present Served in various official and unofficial capacities in English- and Mandarin-speaking congregations of the Church of Jesus Christ of Latter-day Saints in the United States, England, Canada, and China (government-approved, English-speaking congregations only). Service included teaching classes as well as performing other pastoral and administrative duties.
- 2008 – present Extensive experience in English-Mandarin and Mandarin-English interpretation, both simultaneous (meetings/conferences, including remote interpretation) and consecutive.
- 2007 – 2009 Served a voluntary full-time proselyting mission for the Church of Jesus Christ of Latter-day Saints among the Chinese population of the Toronto, Canada area. Learned to speak Mandarin and to read and write Chinese (traditional and simplified).

Languages

English (native), Mandarin (fluent), German (basic). Some acquaintance with Cantonese, Russian, French, Spanish, Hebrew (biblical), Enpinghua.