**Curriculum Vitae, Nathan Thomas Carruth (盧天賜)**

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## Employment

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| 2024 – present | Postdoctoral researcher, Shenzhen International Center for Mathematics. |
| 2021 – 2024 | Postdoctoral researcher, Yau Mathematical Sciences Center, Tsinghua. |
| 2021 | Postdoctoral researcher, Sunnybrook Research Institute (Toronto). |

## Research Experience

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| 2025 – present | Mechanisms of trapped surface formation in general relativity. SUSTech. |
| 2018 – present | Focussed solutions to the Einstein equations. Toronto, Tsinghua, SUSTech. |
| 2022 – present | Mathematical knowledge management. Tsinghua, SUSTech. |
| 2026 | Error-detecting solid codes (side project). SUSTech. |
| 2023 – 2024 | Studies of nonabsolutely convergent integrals. 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 Europan oceans). Berkeley and Toronto. |
| 2009 – 2010 | Quantum time in $\mathbb{R}^1 \times S^1$. Utah State University. |
| 2004 – 2007 | Isometric embeddings of metric spaces in Banach and Hilbert spaces. |

## Education

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| 2015 – 2021 | PhD, Mathematics, University of Toronto; thesis topic: Focussed Solutions to the Einstein Vacuum Equations (available 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 at https://digitalcommons.usu.edu/etd/708/). |
| 2004 – 2007 | Bachelor's of Science, Mathematics and Physics, Utah State University, Summa Cum Laude. |

## Professional Service

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| 2024 | Helped manage the 2nd International Congress of Basic Science, Beijing, China. |
| 2022 – 2024 | Editor, ICCM Notices. Translated articles, solicited and conducted interviews with visiting scholars, and prepared interview drafts for publication. |

**Research 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. Carruth, N. T. Trapped surface formation via radial boosts. arXiv:2608.11706.
2. Carruth, N. T. Error-detecting solid codes. arXiv:2603.20298.
3. Alexakis, S., Carruth, N. T. Squeezing a fixed amount of gravitational energy to arbitrarily small scales, in $U(1)$ symmetry. arXiv:2205.05526.

**Talks**

1. Trapped surface formation: physical foundations. ICGAC 16, Shenzhen, China, August 10 2026.
2. Highly localised gravitational waves in polarised translational symmetry. CMS 75th + 1 Anniversary Summer Meeting (on Zoom), June 7 2021.

**Theses**

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| 2020 | Focussed solutions to the Einstein vacuum equations. Doctoral thesis, University of Toronto. Available online at https://hdl.handle.net/1807/104929. |
| 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**

(See https://www.glaux-yonah.org/ncarruth/archive/UofT/.)

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| 2020 | Lecture notes for undergraduate complex variables. |
| 2019 | Lecture notes for undergraduate applied partial differential equations. |

**Interviews**

1. Carruth, N. Toposes and their place in mathematics: in conversation with Olivia Caramello. ICCM Notices **11** 2 (2024), 38 – 60.
2. Carruth, N. In conversation with Jintai Ding. ICCM Notices **11** 1 (2023), 28 – 47.
3. Carruth, N., Heller, S. In conversation with Maxim Kontsevich. ICCM Notices **11** 1 (2023), 64 – 76.

**Translations**

1. Yau, Shing-Tung. A century of legends: Remembering Calabi. ICCM Notices **11** 2 (2024), 69 – 78.
2. Yau, Shing-Tung. Remembering John Coates, the great friend of Chinese mathematics. ICCM Notices **11** 2 (2024), 79 – 87.

**Teaching Experience**

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| 2025 | Organized and taught a graduate seminar on mathematical general relativity. SUSTech. Language of instruction: Mandarin and English. |
| 2021 – 2024 | Undergraduate mentor, Qiuzhen College, Tsinghua University (求真书院益友学者). Language of interaction: Mandarin. |
| Fall 2023 | Organized an informal discussion course on categorical logic and topos theory, YMSC, Tsinghua. Language of instruction: Mandarin. |
| 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. |
| 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. |
| 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. |

## Programming

C, TEX, SNOBOL, UNIX (`ksh`, `sed`, `awk`), HTML/CSS/JavaScript, 8086 assembly, IDL (data processing and analysis), Asymptote, MetaPost, METAFONT (see typescript of Goursat's Functions of a Complex Variable, available at `https://www.glaux-yonah.org/ncarruth/archive/UofT/goursat/index.html`, for an example).

## Awards and Recognitions

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| 2022, 2023 | Outstanding undergraduate mentor, Qiuzhen College, Tsinghua University (求真书院优秀益友学者) |
| 2021 – 2024 | 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 – 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

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| 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 – 2024 | 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, Hebrew (biblical), French (reading only), Enpinghua (southeast Chinese dialect).