Maxime Van de Moortel

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RESEARCH INTERESTS

General Relativity, Partial Differential Equations, Mathematical Physics

POSITIONS

JULY 2022-PRESENT
Assistant Professor, Rutgers University
Department of Mathematics.

SEPTEMBER 2019- AUGUST 2022
Instructor, Princeton University
Department of Mathematics.

MAY 2019 – AUGUST 2019
Research Associate, Imperial College London
Department of Mathematics.

EDUCATION

SEPTEMBER 2015- MAY 2019
PhD in Mathematics, University of Cambridge
Advisor: Jonathan Luk

- Visiting graduate student at **Stanford University** for the academic years 2016-2017 and 2017-2018.

SEPTEMBER 2014-JUNE 2015
Master 1 in Pure and Applied Mathematics, Université Paris-Saclay

SEPTEMBER 2013-JUNE 2014
BSc in Pure and Applied Mathematics, Université Paris-Saclay

SEPTEMBER 2013-JUNE 2016
BSc and MSc in Engineering, École CentraleSupélec

PUBLICATIONS AND PREPRINTS

- Asymptotically flat black holes with a singular Cauchy horizon and a spacelike singularity, preprint, arXiv:2510.07431.

- An extension of the r^p method for wave equations with scale-critical potentials and first-order terms, **Ann. Appl. Math.**, **41 (1), 112-154, 2025**. Special issue for the 70th birthday of Professor Avy Soffer.

- The coexistence of null and spacelike singularities inside spherically symmetric black holes, preprint, arxiv:2504.12370.

- The Strong Cosmic Censorship Conjecture, **Comptes Rendus. Mécanique, Volume 353 (2025), pp. 415-454.** Recent advances in general relativity: an issue in memory of Yvonne Choquet-Bruhat.

- Late-time tails for scale-invariant wave equations with a potential and the near-horizon geometry of null infinity *(with D. Gajic)*, preprint, arxiv:2401.13047.

- Polynomial time decay for solutions of the Klein-Gordon equation on a subextremal Reissner-Nordström black hole *(with Y. Shlapentokh-Rothman)*, preprint, arXiv:2401.00048. To appear in **Duke Math. J.**

- The asymptotics of massive fields on stationary spherically symmetric black holes for all angular momenta *(with F. Pasqualotto & Y. Shlapentokh-Rothman)*, preprint, arxiv:2303.17767.

- Kasner inversions and fluctuating collapse inside hairy black holes with charged matter *(with W. Li)*, **Annals of PDE**, 11:3, 2025.

- Violent nonlinear collapse in the interior of charged hairy black holes, **Arch. Rational. Mech. Anal.**, 248, 89, 2024.

- Nonlinear interaction of three impulsive gravitational waves II: The wave estimates *(with J. Luk)*, **Annals of PDE**, 9:10, 2023.

- Strong Cosmic Censorship in the presence of matter: the decisive effect of horizon oscillations on the black hole interior geometry *(with C. Kehle)*, **Analysis & PDE**, 17-5, 1501-1592, 2024.

- Nonlinear interaction of three impulsive gravitational waves I: Main result and the geometric estimates *(with J. Luk)*. To appear in **Amer J. Math**.

- The breakdown of weak null singularities inside black holes, **Duke Math. J.**, 172 (15), 2957-3012, 2023.

- Mass inflation and the C^2-inextendibility of spherically symmetric charged scalar field dynamical black holes, **Commun. Math. Phys.**, 382, 1263–1341, 2021.

- Decay of weakly charged solutions for the spherically symmetric Maxwell-Charged-Scalar-Field equations on a Reissner-Nordström exterior space-time, **Ann. Sci. Éc. Norm. Supér.**, 55. no. 2, 283–404, 2022.

- Stability and instability of the sub-extremal Reissner-Nordström black hole interior for the Einstein-Maxwell-Klein-Gordon equations in spherical symmetry**, Commun. Math. Phys.**, 360, 103–168, 2018.

- Charged scalar fields on black hole spacetimes. Ph.D. Thesis, **University of Cambridge**.

AWARDS AND GRANTS

- **National Science Foundation Grant** DMS-2247376, July 2023.
- **Research Fellowship of the Royal Commission for the Exhibition of 1851**, May 2022 (declined).
- **Smith-Knight & Rayleigh-Knight Prize**, University of Cambridge, January 2017.
- **EPSRC PhD scholarship**, grant EP/L016516/1, October 2015-October 2019.
- **Centrale Talents Award**, Ecole Centrale-Supélec, July 2015.

MENTORING

- **PhD Students**
  Kangbai Yan: *2024-present*
  Taehoon Lee: *2023-present*
  Weihao Zheng: *2022-present*
- **Undergraduate Students**
  Aniruddha Madhava: *graduated May 2025*, *currently a PhD student at Stony Brook University.*

WORKSHOPS AND CONFERENCES ORGANIZED

- **Analysis of Partial Differential Equations arising in Physics** *(with F. Cakoni, A. Nahmod, T. Nguyen, A. Soffer)*. Satellite conference of the 2026 ICM, Rutgers University, July 2026.
- **Winter School on General Relativity** *(with L. Lehner, R. Teixeira da Costa, Y. Shlapentokh-Rothman)*. Fields Institute, Canada, January 2026.
- **Black holes in General Relativity, from transient behavior to long time dynamics** *(with L. Lehner, R. Teixeira da Costa, Y. Shlapentokh-Rothman)*. General Relativity Conference, Fields Institute, Canada, May 2026.

- **Singularities and Cosmic Censorship, from Vacuum to Matter** *(with L. Lehner, R. Teixeira da Costa, Y. Shlapentokh-Rothman)*. General Relativity Conference, Fields Institute, Canada, May 2026.
- **Hyperbolic & Dispersive Equations on Curved Geometries: Connections to Physics and General Relativity** *(with A. Ionescu, E. Giorgi, A. Soffer)*. Simons Center for Geometry and Physics workshop, NY, April 2025.

SEMINARS ORGANIZED

- **Joint Princeton-Rutgers Seminar on Analysis of fluids** *(with Y. Li, D. Kriventsov, A. Ionescu, P. Constantin)*. Bi-semesterly research seminar, January 2023-present.
- **Hyperbolic & Dispersive Partial Differential Equations Seminar** *(with A. Soffer)*. Rutgers University, weekly research seminar, September 2022-present.
- **Analysis Seminar** *(with T. Buckmaster)*. Princeton University, 2020-2022.

SELECTED INVITED TALKS

- *Sanya Waves,* Tsinghua Sanya International Mathematics Forum, China, February 2026.
- *Extremal Black Holes and the Third Law of Black Hole Thermodynamics*, ICERM Topical Workshop, January 2026.
- *Analysis and Applied Mathematics Seminar,* University of Toronto, October 2026.
- *PDE Seminar,* GeorgiaTech, September 2026.
- *Geometry, Analysis, and Physics in Lorentzian Signature*, Mini-course, BIRS workshop, University of Granada (IMAG), Spain, May 2025.
- *The 14th AIMS Conference*, Special session, Abu Dhabi, December 2024.
- *Mathematics Department Colloquium,* University of Pittsburg*,* October 2024.
- *126th Statistical Mechanics Conference*, Plenary Speaker, Rutgers University, May 2024.
- *Analysis and PDE Seminar*, Stanford, April 2023.
- *PDE Seminar*, Brown University, March 2023.
- *Analysis and PDE Seminar*, Yale University, February 2023.
- *Workshop on Nonlinear Aspects of General Relativity*, Princeton, October 2023.
- *Singularities and Curvature in General Relativity,* Radboud University, June 2023.
- *Singularity formation in general relativity and dispersive PDEs'*, ICMS, UK, May 2023.
- *23rd International Conference on General Relativity and Gravitation "GR23",* July 2022.
- *Black Hole Initiative Conference, "Beyond the Horizon*", Harvard University, May 2022.
- *Partial Differential Equations seminar*, University of Oxford, May 2022
- *General Relativity Program Conference*, CMSA, Harvard University, April 2022.
- *Analysis and PDE Seminar*, John Hopkins University, March 2022.
- *VandyGRAF Colloquium,* Vanderbilt University, December 2021.
- *General Relativity & Geometric Analysis seminar*, Columbia University, December 2021.
- *Mathematical aspects of General Relativity*, Oberwolfach Workshop, September 2021.
- *American Mathematical Society Meeting*, Brown University, March 2021.
- *Pure Analysis and PDEs seminar*, joint Imperial College London/ University College

London, February 2021.
- *Analysis and PDE Seminar*, Stanford, January 2021.
- *Analysis seminar*, Caltech, October 2020.
- *Analysis and PDE seminar*, UC Berkeley, October 2020.
- *PDE seminar*, Brown University, April 2020.

TEACHING EXPERIENCE

- *Course head and instructor for 01:640:495: Selected topics in Mathematics*, Rutgers University, Spring 2025.
- *Course head and instructor for 16:640:507: Functional Analysis (graduate)*, Rutgers University, Fall 2024.
- *Course head and instructor for 16:640:507: Selected topics in Analysis (graduate)*, Rutgers University, Spring 2024.
- *Course instructor for 01:640:251: Multivariable Calculus,* Rutgers University, Fall 2023.
- *Course instructor for 01:640:477: Mathematical Theory of Probability,* Rutgers University, Spring 2023.
- *Course head and instructor for 16:640:507: Functional Analysis (graduate)*, Rutgers University, Fall 2022.
- *Course head and instructor for Math425:* Analysis III: Integration Theory and Hilbert Spaces, Princeton University, Fall 2021.
- *Course head and instructor for Math104: Calculus II*, Princeton University, Spring 2021.
- *Course instructor for Math104: Calculus II*, Princeton University, Fall 2020.
- *Course head and instructor for Math429, Topics in Analysis: Distribution Theory, PDE & Basic Inequalities of Analysis*, Princeton University, Spring 2020.
- *Course instructor for Math201: Multivariable calculus*, Princeton University, Fall 2019.
- *Course supervisor for "Probability and Measure" (Part II)*, University of Cambridge, Michaelmas (Fall) 2018.

SERVICE

- **Rutgers University Committees**
    - *Graduate Admission Committee* (Spring 2024).
    - *Rutgers Global Grant* review committee (Spring 2024).
    - *PhD Oral Qualification Exam* committees: Kangbai Yan (May 2025), Weihao Zheng (May 2023), Lawrence Frolov (April 2023).
    - *PhD Written Qualification Exam* committee: Analysis (Fall 2024).
- **PhD Thesis committees**: Warren Li (Princeton University, 2025), Ryan Unger (Princeton University, 2024).
- **Peer-Review**: Birkhäuser Research Monograph, Annals of Mathematics, Inventiones Mathematicae, International Mathematical Research Notices (IMRN),

Archive for Rational Mechanics and Analysis (ARMA), Annals of PDE, Journal of Functional Analysis, Communications in Mathematical Physics, Annales Henri Poincaré, Journal of Statistical Physics, General Relativity and Gravitation, Classical and Quantum Gravity.

OUTREACH ACTIVITIES

- **Youtube Lecture**, Allan I. Carswell Observatory, York University, Toronto, July 2025.
- **Research Discovery Sessions**: "*The World according to PDEs*", Rutgers University, October 2024.
- **VIASM Summer School**: "*Strong Cosmic Censorship Conjecture and black hole dynamics*", Huế, Vietnam, August 2024.
- **Science Club International**: Public Lecture for High School Students, "*The mysteries of black holes*", Guanajuato, Mexico, July 2024.
- **Science Club International**: organizer of a mini-course for high-school students: "*Gravity: from Newton's Apple to the frontier of Black Holes*", Oaxaca, Mexico, August 2023.
- **Research Glimpse**: talk destined at PhD students, "*Mathematical Analysis and black holes: the inside story*", Rutgers University, August 2022.
- **Propective Maths Major Series:** talk destined at undergraduate students, "*The world according to Partial Differential Equations*", Princeton University, April 2021.
- **Kiddie Colloquium**: "*An overview of mathematical general relativity: how wave equations enlighten the theory of Black Holes*", Stanford University, February 2017.
- **Research days**: talk destined at the Robinson College academic community, "Space-*time, waves and black holes*", University of Cambridge, April 2016.

REFERENCES

- Prof. **Igor Rodnianski**, Professor of Mathematics, Princeton University irod@princeton.edu
- Prof. **Mihalis Dafermos**, Professor of Mathematics, Princeton University
  Lowndean Professor of Astronomy and Geometry, University of Cambridge
  dafermos@math.princeton.edu
- Prof. **Patrick Gérard**, Professeur de Mathématiques, Université Paris-Saclay
  patrick.gerard@universite-paris-saclay.fr
- Prof. **Jonathan Luk**, Professor of Mathematics, Stanford University
  jluk@stanford.edu
- Prof. **András Vasy**, Professor of Mathematics, Stanford University
  andras@math.stanford.edu
- Prof. **Sung-Jin Oh**, Associate Professor of Mathematics, University of California, Berkeley
  Miller Professor, Miller Institute for Basic Research in Science
  sjoh@math.berkeley.edu