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

- 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.

WORKSHOPS AND CONFERENCES ORGANIZED

- **Hyperbolic & Dispersive Equations on Curved Geometries: Connections to Physics and General Relativity***,* Simons Center for Geometry and Physics workshop, NY, April 2025.

- **Winter School on General Relativity**, Fields Institute, Canada, January 2026.

- **Black holes in General Relativity, from transient behavior to long time dynamics***,* General Relativity Conference*,* Fields Institute, Canada, May 2026.

- **Singularities and Cosmic Censorship, from Vacuum to Matter**, General Relativity Conference, Fields Institute, Canada, May 2026.

- **Analysis of Partial Differential Equations arising in Physics**, Satellite conference of the 2026 ICM, Rutgers University, July 2026.

SELECTED INVITED TALKS

- *Extremal Black Holes and the Third Law of Black Hole Thermodynamics*, ICERM Topical Workshop, January 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.

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.

- C*ourse 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.

OUTREACH ACTIVITIES

- **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 destined to 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.

- **Special seminar**: "*Why should you love Maths*?", Schiller University, September 2015.