

Jack Borthwick.

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Research Interests

Projective/conformal differential geometry, Cartan geometries, geometric analysis, asymptotic analysis, inverse problems, scattering theory, spectral analysis, scattering resonances, variational equations and non-linear equations

Employment

- 2023 – ···· **Post-doc (2 years)**, McGill University, Montréal.
Advisor: Niky Kamran
- 2021 – 2022 **Post-doc (18 months)**, University of Bourgogne-Franche Comté.
Advisors: Thierry Daudé, Nabile Boussaïd, Geneviève Dusson
- 2020 – 2021 **Temporary Research and Teaching Assistant (ATER)**, University of Western Brittany.

Education

- 2017 – 2021 **PhD in Mathematics**, University of Western Brittany.
Thesis title: *Analytical and projective scattering on spacetimes with positive cosmological constant*¹,
Advisor: Jean-Philippe Nicolas.
- 2016 – 2017 **Master's degree in Mathematics**, Paris VI.
Préparation à l'agrégation.
- 2014 – 2016 **MSc in Theoretical Physics**, Lund University.
Thesis title: *The kaon electromagnetic mass difference in AdS/QCD*²,
Supervisor: Johan Bijnens.
Double degree with École Centrale de Lille.
- 2013 **BSc in Mathematics**, Université de Lille 1.
- 2012 – 2016 **Diplôme d'ingénieur**, École Centrale de Lille.
- 2010 – 2012 **Classe préparatoire MPSI, MP***, Lycée Michel Montaigne, Bordeaux.
- 2009 – 2010 **Baccalauréat général série Scientifique mention mathématiques.**
Mention "Très Bien".

Skills

- Languages **Fluent in English and French.**
- Computer skills **C/C++, SageMath, L^AT_EX, Moodle, Webwork, Crowdmark**

Research Publications

Journal Articles

- J. Borthwick**, X. Chang, L. Jeanjean, and N. Soave, *Bounded Palais-Smale sequences with Morse type information for some constrained functionals*, Accepted in Transactions of the AMS, Oct. 2024. [DOI: 10.48550/arxiv.2210.12626.](#)

¹Online access: <https://theses.hal.science/tel-03652254>

²Online access: <http://lup.lub.lu.se/student-papers/record/8878371>

- 2 **J. Borthwick** and Y. Herfray, “Asymptotic symmetries of projectively compact order one Einstein manifolds,” *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, vol. 382, no. 2267, Mar. 2024. [DOI: https://doi.org/10.1098/rsta.2023.0042](https://doi.org/10.1098/rsta.2023.0042).
- 3 **J. Borthwick**, N. Boussaïd, and T. Daudé, “Inverse Regge poles problem on a warped ball,” *Inverse Problems and Imaging*, pp. 0-0, Jun. 2023, ISSN: 1930-8337. [DOI: 10.3934/ipi.2023031](https://doi.org/10.3934/ipi.2023031).
- 4 **J. Borthwick**, X. Chang, L. Jeanjean, and N. Soave, “Normalized solutions of L^2 -supercritical nls equations on noncompact metric graphs with localized nonlinearities,” *Nonlinearity*, vol. 36, no. 7, p. 3776, Jun. 2023. [DOI: 10.1088/1361-6544/acda76](https://doi.org/10.1088/1361-6544/acda76).
- 5 **J. A. Borthwick**, “Scattering theory for Dirac fields near an extreme Kerr–de Sitter black hole,” en, *Annales de l’Institut Fourier*, vol. 73, no. 3, pp. 919–997, May 2023. [DOI: 10.5802/aif.3553](https://doi.org/10.5802/aif.3553).
- 6 **J. Borthwick**, “Corrigendum: Maximal Kerr–de Sitter spacetimes (2018 Class. Quantum Grav. 35 215006),” *Classical and Quantum Gravity*, vol. 39, no. 21, p. 219 501, Sep. 2022. [DOI: 10.1088/1361-6382/ac8d42](https://doi.org/10.1088/1361-6382/ac8d42).
- 7 **J. Borthwick**, “Maximal Kerr de Sitter spacetimes,” *Classical Quantum Gravity*, vol. 35, no. 21, p. 215 006, May 2018. [DOI: 10.1088/1361-6382/aae3dc](https://doi.org/10.1088/1361-6382/aae3dc).

Preprints

- 1 **J. Borthwick**, E.ourgoulhon, and J.-P. Nicolas, *Peeling at extreme black hole horizons*, Mar. 2023. arXiv: 2303.14574 [gr-qc].
- 2 **J. Borthwick** and N. Kamran, “Boundary rigidity, and non-rigidity, of projective structures,” Mar. 2023. eprint: 2305.02266. [URL: https://arxiv.org/pdf/2305.02266.pdf](https://arxiv.org/pdf/2305.02266.pdf).
- 3 **J. Borthwick**, *Projective differential geometry and asymptotic analysis in general relativity*, 2021. [DOI: 10.48550/arxiv.2109.05834](https://doi.org/10.48550/arxiv.2109.05834).

Scientific popularisation articles

- 1 **J. Borthwick**, “La géométrie du spin,” *Quadrature*, no. 124, 2022.

Teaching Experience

<i>McGill University (39h)</i>				
Year	Type	Title	Level	Duration
2023	Lectures	Intermediate calculus		39h
<i>École doctorale Carnot-Pasteur (10h)</i>				
Year	Type	Title	Level	Duration
2022	Lectures	Differential geometry	Doctoral	10h
<i>University of Western Brittany (UBO) (304h)</i>				
Year	Type	Title	Level	Duration
2020-21	Tutorials	Reduction of endomorphisms	L2	27,5h
2020-21	Tutorials	Topology and functional analysis	L3	27,5h
2020-21	Tutorials	Commutative algebra	L3	27,5h
2020-21	Tutorials	Groups and geometry	L3	27,5h
2020-21	Lectures/Tutorials	Euclidean spaces	L2	27,5h
2020-21		Orals and practice exams - PMRC	L2/L3	35h
2020-21	Tutorials	Preparation for the "agrégation"	M2	4h
2019-20	Tutorials	Analysis 1	L1	27,5h
2019-20	Tutorials	Groups and geometry	L3	27,5h
2019-20		Orals PMRC	L3	8h
2019-20	Tutorials	Preparation for the "agrégation"	M2	1h
2018-19	Tutorials	Analysis 1	L1	30h
2018-19	Tutorials	Analysis 2 (MIASHS)	L2	30h
2018-19		Orals PMRC	L1	4h

PMRC: "Parcours Mathématiques Renforcées et Concours"; this is the selective program at the University of Western Brittany that prepares university students for the competitive entry examinations to the Grandes Écoles.

MIASHS: "Mathématiques et informatique appliquées aux sciences humaines et sociales", which translates to "Mathematics and computer science applied to social and human sciences".

In France, an undergraduate degree is a "Licence" and is obtained after 3 years of study: L1, L2 and L3. This can be followed by a Master's degree obtained after a further two years of study: M1 and M2.

Supervision


- 2020 ■ I hosted a job shadow 6th-form student (Sacha Le Hir Mazé) from lycée Charles de Foucault (Brest).
- Project title: *Spin geometry*. Students: Sofia Billault, Taran Carluer, Marius Rodrigues (Second year of the Mathematical Physics (Bachelor) degree at the University of Western Brittany).
- 2018 ■ Project title: *Geodesics in black holes*.
I participated in a program called "les Cordées de la Réussite" that aims to introduce 6th-form students to research by working on a short project supervised by a PhD student. I supervised four students from Collège et Lycée Jean-Marie Le Bris (Douarnenez). We studied time-like geodesics in Kerr-de Sitter spacetime.

Miscellaneous Experience




Internships

- 2014  *Synchrotron SOLEIL*, Accelerator Physics department (4 months),
Supervisors: M. Thomas Bourdeaud'huy, Dr. Ryutaro Nagaoka.



Awards and Achievements

- 2022  *Prix d'excellence des thèses de la Fondation UBO*³

Responsibilities




- 2020 – 2021  **PhD student representative** on the Scientific Council, IBNM (Institut Brestois Numérique Mathématiques).
- 2019 – 2021  **PhD student representative** on the Laboratory Council, LMBA (Laboratoire de Mathématiques de Bretagne Atlantique).
- 2017 – 2018  **Member of the Mathematics department council**, University of Western Brittany.

Review and referee reports


- 2023  Referee in the journals: *Journal of Mathematical Physics*, *Philosophical Transactions of the Royal Society A*
-  Reviews: zbMath

Research experience












Talks in conferences

- Nov 2022  *Journée de la fédération de mathématiques de Bourgogne*, Franche-Comté, Besançon.
- Jun. 2022  *Geometric structures, Compactifications and Group actions*, Strasbourg.
- Feb. 2022  *14th Meeting of the GDR Dynqua*, Toulouse.

Posters

- May 2022  *Herglotz-Nevanlinna functions and their applications*, CIRM - Marseille.



Talks in seminar sessions

- May 2023  Geometry and Topology seminar, LMBA, Brest
- Dec. 2022  Theoretical physics seminar, Institut Denis Poisson, Tours
- Oct. 2022  Geometric analysis seminar, McGill University, Montréal
- Mar. 2022  Mathematical physics seminar, Institut Fourier, Grenoble
- Feb. 2022  MathPhys seminar, Dijon
- Jan. 2022  Geometry seminar, Institut Denis Poisson, Tours
- Apr. 2021  Quantum fields interacting with geometry seminar, Cergy Paris University
-  PDE Seminar, Laboratoire de mathématiques de Besançon
- Oct. 2020  Doctoral seminar, University of Western Brittany
- Apr. 2020  ~~Geometry seminar~~, LMBA - Brest, Cancelled due to the coronavirus pandemic
- Mar. 2020  ~~Geometry seminar~~, LMPT - Tours Cancelled due to the coronavirus pandemic





³<https://ed-mathstic.doctorat-bretagne.fr/fr/actualites/prix-dexcellence-des-theses-decernes-par-la-fondation-ubo>

Research experience (continued)







Organisation

- 2022  *Mathematical aspects of black hole theory*, Observatoire de Paris
- 2018  *Lebesgue PhD Meeting*, Brest, (Scientific committee)



Research trips

- Dec 2022  Institution: *Institut Denis Poisson*, Tours. Visiting: Yannick Herfray.
- Nov 2022  Institution: *Heriot-Watt University*, Edinburgh. Visiting: Matteo Capoferri.
- Oct 2022  Institution: *University of Western Brittany*, Brest. Visiting: Jean-Philippe Nicolas and Eric Gourgoulhon.
- Oct.-Dec. 2019  Institution: *Auckland University*, New Zealand. Visiting: A. R. Gover.

Attended conferences

- Jul. 2022  *The Dirac Equation*, Institut de Mathématiques de Bordeaux.
-  *Carter fest: Black holes and other cosmic systems*, IAP Paris.
- Nov. 2021  *Resonances Inverse Problems and Seismic Waves*, Reims.
- May 2019  *Relativistic mathematics in Grenoble*, Institut Fourier - Grenoble.
- May 2018  *QFT, scattering and spacetime horizons : mathematical challenges*, École de Physique des Houches.
- Nov. 2017, Jan. 2020  *Quimpériodiques*, Quimper.

Workshops and summer schools

- Jul. 2023  *IMJ-PRG Summer School 2023: "Microlocal and Probabilistic methods in geometry and dynamics"*, Paris VI.
- Jul. 2022  *Workshop on Microlocal Analysis & PDEs*, University College London.

References

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