

# Gianmarco BROCCHI

Curriculum Vitæ atque Studiorum

Updated: April, 2024

## PERSONAL DETAILS

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Born on 9<sup>th</sup> October 1990 in Taranto, Italy

ADDRESS:

Mathematical Sciences,  
Chalmers University of Technology  
and the University of Gothenburg,  
SE-412 96, Göteborg, Sweden

CITIZENSHIP: Italian

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## MAIN EDUCATION

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OCT 2021 Ph.D. in PURE MATHEMATICS, **University of Birmingham**, UK  
Thesis: “**Sharp and Optimal Inequalities in Harmonic Analysis**”  
Supervisors: Dr. Maria Carmen REGUERA and Prof. Jonathan BENNETT

SEPT 2017 M.Sc. in MATHEMATICS, **University of Bonn**, Germany  
Thesis: “**Sharp Fourier restriction theory and Strichartz estimates**”  
Advisor: Dr. Diogo OLIVEIRA E SILVA

OCT 2014 B.Sc. in MATHEMATICS, **University of Pisa**, Italy  
Thesis: “**Condizioni Tauberiane e Spazi di Hardy**”  
Advisor: Prof. Vladimir GEORGIEV

## APPOINTMENTS

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2022 – 2024 **Wallenberg Postdoc** with **Andreas Rosén**  
at Chalmers University of Technology and the University of Gothenburg

2021 – 2022 **Teaching Fellow** at the University of Birmingham

## PREPRINTS & PUBLICATIONS

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5. THE METRIC FOR MATRIX DEGENERATE KATO SQUARE ROOT OPERATORS,  
with Andreas Rosén, [arXiv:2404.09580](https://arxiv.org/abs/2404.09580)
4. REFINED TWO WEIGHT ESTIMATES FOR THE BERGMAN PROJECTION,  
in *Collectanea Mathematica* (2023), [arXiv:2110.15936](https://arxiv.org/abs/2110.15936)
3. QUADRATIC SPARSE DOMINATION AND WEIGHTED ESTIMATES FOR NON-INTEGRAL SQUARE FUNCTIONS,  
with Julian Bailey and Maria Carmen Reguera, *The Journal of Geometric Analysis*, 33, # 20 (2023).
2. A SPARSE QUADRATIC  $T1$  THEOREM,  
*New York J. Math.* 26 (2020), 1232–1272.
1. SHARP STRICHARTZ INEQUALITIES FOR FRACTIONAL AND HIGHER ORDER SCHRÖDINGER EQUATIONS,  
with Diogo Oliveira e Silva and René Quilodrán, *Analysis & PDE* 13 (2020) 477–526. [arXiv:1804.11291](https://arxiv.org/abs/1804.11291)

## Proceedings

- WHAT IS SPARSE DOMINATION AND WHY IS IT SO PLENTIFUL? ,  
Proceedings of the 3<sup>rd</sup> BYMAT conference (2020) TEMat monográficos (ISSN 2660-6003)

## GRANTS AND AWARDS

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2018: 2<sup>nd</sup> prize in the poster competition, awarded by the University of Birmingham.

2017–2021: EPSRC Doctoral training grant. Three and a half year grant for tuition fees and stipend.

2015–2016: One year ERASMUS+ scholarship, awarded by the University of Pisa.

## OTHER KEY ACADEMIC MERITS

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Referee for the *Journal of Mathematical Analysis and Applications* (1), the *Journal of Fourier Analysis and Applications* (1), and *Publicacions Matemàtiques* (1).

**Co-organiser** of the *Analysis and Probability seminar* at Chalmers, the *Analysis Reading Seminar* at the University of Birmingham, and the following workshops:

*June 2019*      **Harmonic Analysis in non-homogeneous settings and applications**  
with *Julian Bailey and Maria Carmen Reguera*  
Funded by: the [Heilbronn Institute For Mathematical Research](#); the (EPSRC) Engineering and Physical Sciences Research Council; the [University of Birmingham](#); and [The London Mathematical Society](#)

*Apr 2019*      **British Young Mathematicians Colloquium 2019**  
with *Alexander Brune, Jen Duncan, Cara Neal, Jack Saunders, Karoline van Gemst*  
Funded by the [Magic Maths Consortium](#) and the [University of Birmingham](#)

## TEACHING EXPERIENCE

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As **Teaching Fellow** at the University of Birmingham (2021–2022)

I organised and held weekly tutorials for Year 1 and Year 2 students covering

- Real Analysis, Mechanics, Vectors, Geometry & Linear Algebra, Sequences and Series
- Multivariable & Vector Analysis, Real & Complex Analysis, Differential Equations

I was in charge of marking exams in

- *Multivariable and Vector Analysis*, 226 scripts, half of the questions
- *Sequences and Series*, 228 scripts
- *Vectors, Geometry & Linear Algebra* ~ 140 scripts
- *Real Analysis* (Year 1), 62 scripts, half of the questions
- *Differential Equations* (Year 2), ~ 50 scripts

I have organised **resit support sessions** in *Real Analysis*, *Probability & Statistics*, and *Sequences and Series*, and served as **Senior Invigilator** for Supplementary examinations.

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As **Teaching Assistant** at the University of Birmingham (2017–2021)

- *Differential Equations* (Year 2), Spring 2021

- *Computer lab & Programming* (Year 3), Spring 2020
- *Real and Complex Analysis* (Year 2), Winter 2019
- *Numerical Methods & Programming* (Year 2), Spring 2019
- *Support classes Mathematics* (Year 1), Winter 2020, Spring 2019
- *Methods in Partial Differential Equations* (Year 3), Spring 2018
- *Mathematics in Industry* (Year 2), Tutorial and marking, Winter 2020, Spring 2018
- *Continuum Mechanics* (Year 3), Tutorial and marking, Winter 2017
- *Mathematical Modelling and Problem Solving* (Year 1), Winter 2017

I was **grader** for homework in

- *Real and Complex Analysis*, Spring 2020
- *Engineering Mathematics*, Winter 2019, Spring 2019, Winter 2018

As **Teaching assistant** at the University of Pisa

- *Complementi di Analisi Matematica* (Calculus Year 2), Spring 2015  
Department of Energy, Systems, Territory and Construction Engineering

**Support activities and outreach**

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| 2017–2020 | <b>Volunteer</b> in the <i>Maths Support Center</i><br>Drop-in support aimed at undergraduate students.                    |
| Feb 2015  | <b>Tutor</b> at <i>XI Settimana Matematica</i>   |
| Feb 2012  | <b>Tutor</b> at <i>VIII Settimana Matematica</i><br>Open week at the Department of Mathematics, University of Pisa, Italy. |

## SEMINARS

In winter 2023 I co-organised a reading seminar on **Decoupling inequalities** at *Chalmers University of Technology*. Below, seminars on my original research<sup>•</sup>, expository<sup>◦</sup>, and by invitation are indicated with ☆.

- **Degenerate Boundary Value Problems**
  - ☆ Jan 2024 | *III Young Researchers Workshop in Harmonic Analysis, Università di Genova*
  - ☆ Feb 2024 | *Analysis seminar, Lund*
  - ☆ Mar 2024 | *Analysis seminar, BCAM, Bilbao*
- **Kato square root problem on pasta**
  - ☆ Jun 2023 | *Seminari M.A.P, University of Pisa*
- **Kato & Cauchy**
  - ☆ Jan 2023 | *Young Researchers Workshop in Harmonic Analysis, Politecnico di Torino*
- **Two weight estimates for the Bergman projection**
  - ☆ Jan 2022 | *Analysis seminar, Bonn*
  - ☆ Oct 2021 | *Workshop CHAP: Complex and Harmonic Analysis in Padova*
- **The real Kempf–Ness theorem, [1, 2]**

Sept 2021 | *Summer School on Brascamp-Lieb inequalities*, Kopp, Germany

- **Sparse  $T_1$  theorems**

- ☆ Jun 2021 | *Harmonic Analysis E-Seminars*, (virtual seminar)
- Jul 2020 | *British Early Career Mathematicians' Colloquium*, (virtual colloquium)
- ☆ Jun 2020 | *Virtual Harmonic Analysis Seminars*, UK Harmonic Analysis group, on Zoom

- **What is Sparse Domination and why is it so plentiful?**

Dec 2020 | *BYMAT 2020: Bringing Young Mathematicians Together*

- **Quadratic Sparse Domination**

- ☆ May 2022 | *Miniworkshop on Harmonic Analysis*, Lund, Sweden
- ☆ Dec 2020 | *LMS Harmonic Analysis and PDEs Meeting*

- **Random shifted dyadic grids and what they can do for you**

☆ May 2020 | *Analysis & PDE Working Seminar*, University of Minnesota, on Zoom

- **The Bourgain–Milman (via Hörmander's) theorem, [3]**

Oct 2019 | *Summer School on Sphere Packings and Optimal Configurations*, Kopp, Germany  
Presented with Constantin Bilz

- **Sparse domination via sizes and outer measures**

Nov 2018 | *Analysis Reading Seminar*, University of Birmingham

- **What does extremise a Strichartz estimate?**

- ☆ Feb 2021 | *Graduate Analysis Seminar*, University of Toronto, Canada
- ☆ Mar 2019 | *Pure Maths Postgraduate Seminar*, University of Sheffield, UK

- **Estimates for a  $\bar{\partial}$ -problem, [4]**

Sept 2018 | *Summer School on Unique Continuation and Inverse Problems*, Kopp, Germany  
Presented with Xian Liao and Pavel Zorin-Kranich

- **Existence of extremizers for a Strichartz estimate for the 4<sup>th</sup> order Schrödinger equation**

- July 2018 | *Mini-courses in Mathematical Analysis*, Padova, Italy
- June 2018 | *BMC 2018* (speed talk), St Andrews, Scotland
- May 2018 | *ICMAT*, Madrid, Spain
- Apr 2018 | *BYMC 2018*, University of Birmingham, England
- ☆ Feb 2018 | *Workshop on Harmonic analysis and Nonlinear Evolution Equations*, Pisa, Italy
- July 2017 | Master Thesis seminar, Universität Bonn, Germany

- **Behaviour of the Schrödinger evolution for initial data near  $H^{\frac{1}{4}}$ , [5], [6]**

Oct 2017 | *Summer School on Decoupling and Polynomial Methods in Analysis*, Kopp, Germany

- **Modulation spaces and Brownian motion, [7]**

- July 2017 | *Summer School on Harmonic Analysis and Partial Differential Equations*  
BCAM, Bilbao, Spain
- July 2017 | *Graduate seminar on Time-Frequency Analysis and Its Applications*,  
Universität Bonn, Germany

- **Extremizers for Strichartz estimates for perturbed Schrödinger equations, [8]**

Mar 2017 | *Atelier d'Analyse Harmonique*, University of Nantes, France

- **Endpoint Strichartz Estimates**, [9]  
Feb 2017 | Course “Geometric Aspects of Harmonic Analysis”, University of Bonn, Germany
- **Controlling rough paths**, [10].  
Sept 2016 | *Summer School on Paraproducts and Analysis of Rough Paths*, Kopp, Germany  
Presented with Cristina Benea
- **Asymptotics, frequency modulation, and low regularity ill-posedness for canonical defocusing equations**, [11]  
Dec 2015 | *Graduate seminar on Nonlinear Fourier Transform*, University of Bonn, Germany
- **Minimax methods and geodesics**, after Michael Struwe  
Sept 2015 | *Course in Calculus of Variations*, University of Pisa, Italy

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REFERENCES FOR THE EXPOSITORY<sup>◊</sup> TALKS.

- [1] G. Kempf and L. Ness, in, Vol. 732, *Lecture Notes in Math.* (1979), pp. 233–243.
- [2] C. Böhm and R. A. Lafuente, *Real geometric invariant theory*, (2017)
- [3] F. Nazarov, in , Vol. 2050, *Lecture Notes in Math.* (Springer, Heidelberg, 2012), pp. 335–343.
- [4] A. I. Nachman, I. Regev, and D. I. Tataru, 2017.
- [5] L. Carleson, in, Vol. 779, *Lecture Notes in Math.* (Springer, Berlin, 1980), pp. 5–45.
- [6] B. E. J. Dahlberg and C. E. Kenig, in, Vol. 908, *Lecture Notes in Math.* (Springer, Berlin-New York, 1982), pp. 205–209.
- [7] Á. Bényi and T. Oh, *Adv. Math.* **228**, 2943 (2011).
- [8] D. Oliveira e Silva and R. Quilodrán, *Trans. Amer. Math. Soc.* **370**, 6871 (2018).
- [9] M. Keel and T. Tao, *Amer. J. Math.* **120**, 955 (1998).
- [10] M. Gubinelli, *J. Funct. Anal.* **216**, 86 (2004).
- [11] M. Christ, J. Colliander, and T. Tao, *Amer. J. Math.* **125**, 1235 (2003).

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CONFERENCES, SCHOOLS AND WORKSHOPS

Partial<sup>◊</sup> and full<sup>☆</sup> financial support received from the institution is acknowledged.

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| <p><i>Jan</i> <b>III Young Researchers Workshop in Harmonic Analysis</b><br/>Università di Genova, Italy.</p> <p><i>July</i> <b>Summer School on Unique Continuation and Applications</b><br/>Castro Urdiales, Cantabria.</p> <p><i>April</i> <b>Some conjectures and questions in Harmonic Analysis. Lectures by Anthony Carbery</b><br/>Padova, Italy.</p> <p><i>Sept</i> <b>Summer School on Brascamp-Lieb inequalities</b><br/>Kopp, Germany. ◊ Hausdorff Center</p> <p><i>Sept</i> <b>Summer School on Sphere Packings and Optimal Configurations</b><br/>Kopp, Germany. ◊ Hausdorff Center</p> <p><i>July</i> <b>4th BCAM-UPV/EHU summer school on harmonic analysis and PDEs: Restriction theory.</b> Bilbao, Spain</p> <p><i>June</i> <b>Mini-courses in Mathematical Analysis</b><br/>2019 University of Padova, Italy</p> <p><i>May</i> <b>Lectures in Fourier Analysis. A confer-</b></p> | <p><i>Feb</i> <b>Explorations in Harmonic Analysis and other realms. A conference honoring Alexander Olevskii’s 80th birthday</b><br/>☆ Weizmann Institute of Science, Israel</p> <p><i>Sept</i> <b>Summer School on Unique Continuation and Inverse Problems</b><br/>2018 Kopp, Germany. ◊ Hausdorff Center ◊ UoB</p> <p><i>July</i> <b>Mini-courses in Mathematical Analysis</b><br/>2018 University of Padova, Italy</p> <p><i>June</i> <b>Geometric Aspects of Harmonic Analysis: a conference on the occasion of Fulvio Ricci’s 70th birthday</b><br/>2018 Cortona, Italy ◊ INdAM</p> <p><i>June</i> <b>British Mathematical Colloquium 2018</b><br/>2018 St Andrews, Scotland ◊ LMS</p> |
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- May* Real HA and its Applications to PDEs  
– and GMT: on the occasion of the 60<sup>th</sup>  
*June* birthday of Steve Hofmann ◇ ICMAT,  
*2018* Madrid
- Apr* **British Young Mathematicians Collo-**  
*2018* **quium 2018**  
University of Birmingham
- Apr* **Young Researchers Workshop in Har-**  
*2018* **monic Analysis**  
Politecnico di Torino, Italy
- Feb* **Workshop on Harmonic analysis and**  
*2018* **Nonlinear Evolution Equations**  
☆ Università di Pisa, Italy
- Dec* **LMS Network on Harmonic Analysis**  
*2017* **and PDEs** University of Warwick, UK
- Sept* **Summer School in Harmonic Analysis,**  
*2017* **PDE and Spectral theory**  
◇ Università La Sapienza, Roma, Italy
- July* **Harmonic analysis and its interactions:**  
*2017* **in honour of Tony Carbery**  
☆ ICMS, University of Edinburgh, UK
- July* **Third Summer School on Harmonic**  
*2017* **Analysis and Partial Differential Equations** ◇ BCAM, Bilbao, Spain
- Mar* **Atelier d'Analyse Harmonique**  
*2017* ☆ University of Nantes, France
- Dec* **Workshop “Young Women in Har-**  
*2016* **monic Analysis and PDE”**  
Universität Bonn, Germany
- Nov* **Fall School on “PDEs and Probability”**  
*2016* AIMS, Mbour, Senegal. ☆ DAAD grant
- Oct* **Workshop: New trends in Partial Dif-**  
*2016* **ferential Equations**  
Centro di Ricerca Ennio De Giorgi, Pisa, Italy
- Sept* **Mathematics and Its Applications**  
*2016* **PISA-HOKKAIDO Summer School**  
University of Pisa and Scuola Normale Superiore, Pisa, Italy
- Sept* **Summer School on Paraproducts and**  
*2016* **Analysis of Rough Paths**  
Kopp, Germany ◇ Hausdorff Center
- July* **Summer School on Spectral theory and**  
*2016* **applications**  
☆ Université Laval, Québec City, Canada
- Aug* **Summer School on Differential Equations**  
*2015* **and Differential Geometry**  
◇ Hokkaido University, Sapporo, Japan
- July* **Summer School on Mathematical and**  
*2015* **Statistical Models of Economic Growth**  
◇ Hokkaido University, Sapporo, Japan

## LANGUAGES

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ITALIAN (mother-tongue), ENGLISH (fluent), SWEDISH (intermediate), GERMAN (basic).

## COMPUTER SKILLS

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Advanced	GNU/LINUX, Bash, git, L <sup>A</sup> T <sub>E</sub> X, HTML, CSS
Intermediate	C, Python, FORTRAN, L <sup>A</sup> T <sub>E</sub> X BEAMER, OCTAVE
Basic	TikZ, OCAML, C++ , Vala

## SOFTWARE PROJECTS

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**Hashtags**, Tweets analyser in C  
~ 1000 lines, (2014)

**Face Feature Extraction**, FORTRAN, Python, Bash  
~ 800 lines, (2013)

**Iterative Filtering in Reputation Systems**, FORTRAN  
95  
~ 300 lines, (2012)