Tobias Barker

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Employment

Sep 2021–	**Lecturer in Analysis** (permanent).
	Department of Mathematical Sciences, **University of Bath.**
July 2020–	**Leverhulme Early Career Fellow**.
31st Aug 2021	Mathematical Institute, **University of Warwick.**
	Mentor: Professor Jose Rodrigo.
1st Oct 2018–	**Fondation Sciences Mathématiques de Paris postdoctoral fellowship**.
30th Jun 2020	Département de Mathématiques et Applications, **École Normale Supérieure.**
	Mentor: Professor Isabelle Gallagher.
22nd Jan 2018–	**EPSRC Doctoral Prize.**
20th July 2018	Mathematical Institute, **University of Oxford.**
	Mentor: Professor Gregory Seregin.

Education

Oct 2013–	**Doctor of Philosophy (DPhil) in Mathematics.**
23rd Aug 2017	Mathematical Institute, **University of Oxford** (St Edmund Hall).
	Thesis title: 'Uniqueness Results for Viscous Incompressible Fluids'.
	Primary Supervisor: Professor Gregory Seregin.
	Granted leave to supplicate on 23rd August 2017.
2009–2013	**Master of Mathematics (MMath). Grade: First Class.**
	University of Oxford, Wadham College.
	In the 4th year examinations, I ranked 2nd amongst all candidates.

Main Research Interests

Mathematical hydrodynamics, partial differential equations, Navier-Stokes equations.

Accepted papers

1) Albritton, D.; Barker, T.; Prange, C. Localized smoothing and concentration for the Navier-Stokes equations in the half space. December 2021. arXiv:2112.10705. To appear in *Journal of Functional Analysis.*
2) Barker, T.; Prange, C. Quantitative regularity for the Navier-Stokes equations via spatial concentration.*Communications in Mathematical Physics* (2021). https://doi.org/10.1007/s00220-021-04122-x
3) Barker, T.; Prange, C. Mild criticality breaking for the Navier-Stokes equations. *Journal of Mathematical Fluid Mechanics* (2021). https://doi.org/10.1007/s00021-021-00591-1
4) Barker, T. About local continuity with respect to L_2 initial data for energy solutions of the Navier-Stokes equations. *Mathematische Annalen* (2020). https://doi.org/10.1007/s00208-020-02020-6
5) Albritton, D.; Barker, T. Localised necessary conditions for singularity formation in the Navier-Stokes equations with curved boundary.

Journal of Differential Equations. Volume 269, Issue 9, 15 October 2020, Pages 7529-7573. https://doi.org/10.1016/j.jde.2020.06.009

6) Barker, T.; Prange, C. Scale-Invariant Estimates and Vorticity Alignment for Navier-Stokes in the Half-Space with No-Slip Boundary Conditions.
Archive for Rational Mechanics and Analysis. 235, 881-926 (2020).
https://doi.org/10.1007/s00205-019-01435-z

7) Barker, T.; Prange, C. Localised Smoothing for the Navier-Stokes Equations and Concentration of Critical Norms Near Singularities.
Archive for Rational Mechanics and Analysis. 236, 1487-1541 (2020).
https://doi.org/10.1007/s00205-020-01495-6

8) Albritton, D.; Barker, T. On Local Type I Singularities of the Navier-Stokes Equations and Liouville Theorems. *Journal of Mathematical Fluid Mechanics.* 21, 43 (2019).
https://doi.org/10.1007/s00021-019-0448-z

9) Albritton, D.; Barker, T. Global Weak Besov Solutions of the Navier-Stokes Equations and Applications.
Archive for Rational Mechanics and Analysis. 232, 197-263 (2019).
https://doi.org/10.1007/s00205-018-1319-0

10) Barker, T.; Seregin, G.; Šverák, V. On stability of weak Navier-Stokes solutions with large $L^{3,\infty}$ initial data.
Communications in Partial Differential Equations. 43.4 (2018): 628-651.
https://doi.org/10.1080/03605302.2018.1449219

11) Barker, T. Uniqueness Results for Weak Leray-Hopf Solutions of the Navier-Stokes System with Initial Values in Critical Spaces.
Journal of Mathematical Fluid Mechanics. 20, 133-160 (2018).
https://doi.org/10.1007/s00021-017-0315-8

12) Barker, T.; Seregin, G. A necessary condition of potential blowup for the Navier-Stokes system in half-space.
Mathematische Annalen. 369, 1327-1352 (2017).
https://doi.org/10.1007/s00208-016-1488-9

13) Barker, T. Local Boundary Regularity for the Navier-Stokes Equations in Nonendpoint Borderline Lorentz Spaces.
Journal of Mathematical Sciences. 224, 391-413 (2017).
https://doi.org/10.1007/s10958-017-3424-2

14) Barker, T.; Seregin, G. Ancient Solutions to Navier-Stokes Equations in Half-Space.
Journal of Mathematical Fluid Mechanics. 17, 551-575 (2015).
https://doi.org/10.1007/s00021-015-0211-z

Preprints

15) Barker, T. Higher integrability and the number of singular points for the Navier-Stokes equations with a scale-invariant bound. November 2021. arXiv:2111.14776

16) Barker, T; Wang, W. Estimates of the singular set for the Navier-Stokes equations with supercritical assumptions on the pressure. January 2022. arXiv:2111.15444

17) Barker, T. Localized quantitative estimates and potential blow-up rates for the Navier-Stokes equations. October 2022. arXiv:2209.15627

Research Funding

Oct 2018–2020	**Fondation Sciences Mathématiques de Paris postdoctoral fellowship. Based at École Normale Supérieure.** Awarded by: *Fondation Sciences Mathématiques de Paris.*
2018	**EPSRC Doctoral Prize (based at University of Oxford).** Aimed at the *best 10 percent of EPSRC funded Dphil students* at the University of Oxford in the fields of mathematical, physical and life sciences.
2013–2017	**EPSRC studentship (based at the University of Oxford).**

Other Grants and Prizes

2022	Invited professorship, CY Advanced Studies, Université de Cergy-Pontoise, France. *Co-I*: Dr Christophe Prange
2016	Grant to attend the 7th European Congress in Mathematics. Awarded by the 'London Mathematical Society'.
2016	St Edmund Hall MCR 50th Anniversary Grant. Awarded by St Edmund Hall, University of Oxford.
2014-2016	St Edmund Hall Postgraduate Grant. Awarded by St Edmund Hall, University of Oxford.
2013	Gibbs Prize and IMA Prize for performance in Mathematics 'Part C' examinations. Awarded by the University of Oxford.
2010-2012	Undergraduate scholarship awarded by Wadham College, University of Oxford.
2010	'Stephen Corcoran Prize' for performance in undergraduate 'Preliminary Examinations'. Awarded by Wadham College, University of Oxford.
2009-2013	BP Enhancement Bursary. Awarded by the University of Oxford.

Talks

▷ 'Mathflows' conference (plenary speaker). CIRM, Luminy, France. December 2022.

▷ Analysis and PDE Seminar. The Chinese University of Hong Kong, University of Hong Kong and Ulsan National Institute of Science and Technology (via Zoom). October 2022.

▷ PDE and applications seminar. University of Warwick, UK. October 2022.

▷ 'Mathematical Hydrodynamics: the Legacy of Olga Ladyzhenskaya and Modern Perspectives'. Euler International Mathematical Institute, St.-Petersburg, Russia. May 2022 (postponed indefinitely).

▷ OxPDE Seminar. University of Oxford, Oxford, UK. May 2022.

▷ Fudan International Seminar on Analysis, PDEs, and Fluid mechanics. Fudan University (via Zoom). May 2022.

▷ Shanghai Jiao Tong University Colloquium. School of Mathematical Sciences, Shanghai Jiao Tong University (via Zoom). March 2022.

▷ GEDP Seminar. Université de Cergy-Pontoise, France. December 2021.

▷ Bath Analysis Seminar. Department of Mathematical Sciences, University of Bath. October 2021.

▷ 8th European Congress of Mathematics (online contributed talk). June 2021.

▷ USC Analysis and PDE Seminar. Department of Mathematics, University of Southern California (via Zoom). March 2021.

▷ China-Russia online seminar. School of Mathematical Sciences, Peking University (via Zoom). November 2020.

▷ CIRM online conference 'Vorticity, Rotation and Symmetry (V)- Global Results and Nonlocal Phenomena'. October 2020.

▷ 'Workshop on nonlinear fluid and dispersive PDEs'.
 Université de Cergy-Pontoise, France. June 2020 (postponed due to COVID-19).
▷ PDE Seminar via Zoom. Institute of Mathematical Sciences, ShanghaiTech University (via Zoom). April 2020.
▷ Seminar at the 'School of Mathematical Sciences'. Fudan University, Shanghai, China. March 2020 (postponed due to COVID-19).
▷ Séminaire EDP-Analyse. Institute Camille-Jordan, Lyon, France. February 2020.
▷ Tuesday Seminar of Analysis. Graduate School of Mathematical Sciences, University of Tokyo, Tokyo, Japan. December 2019.
▷ Seminar of the Department of Mathematics. Chung-Ang University, Seoul, South Korea. December 2019.
▷ PDE seminar of the Department of Mathematics. Yonsei University, Seoul, South Korea. December 2019.
▷ Séminaire de Physique Mathématique. Université de Bordeaux, Bordeaux, France. June 2019.
▷ Navier-Stokes seminar. University of Minnesota, Minneapolis, USA. April 2019.
▷ GEDP Seminar. Université de Cergy-Pontoise, France. April 2019.
▷ PDE CDT seminar series. University of Oxford, Oxford, UK. February 2019.
▷ Analysis seminar. TU Darmstadt, Darmstadt, Germany. January 2019.
▷ CIRM conference 'Non-standard diffusions in fluids, kinetic equations and probability' (poster presentation). CIRM, Marseille, France. December 2018.
▷ Analysis half day. École Normale Supérieure, Paris, France. October 2018.
▷ Conference at Evry: 'Journées Kolmogorov à Evry'. Université d'Évry, Evry, France. September 2018.
▷ 'Workshop on Mathematical Fluid Dynamics'. Bad Boll, Germany. May 2018.
▷ University of Sussex workshop: 'Mathematical Analysis of Incompressible Fluid Flows' (poster presentation). University of Sussex, Brighton, UK. September 2017.
▷ 'Dynamics and PDE'. Winter school hosted by Université Nice Sophia Antipolis. Saint-Étienne-de-Tinée, France. January 2017.
▷ Analysis seminar. University of Warwick, Coventry, UK. November 2016.
▷ 7th European Congress of Mathematics (poster presentation and contributed talk). Berlin, Germany. July 2016.
▷ Analysis and PDEs seminar. University of Sussex, Brighton, UK. April 2016.
▷ Oxbridge PDE conference. University of Cambridge, Cambridge, UK. March 2016.
▷ PDE CDT seminar series. University of Oxford, Oxford, UK. November 2015.
▷ 'Mathflows' conference. Porquerolles, France. September 2015.
▷ Young Researchers in Mathematics conference (contributed talk). University of Oxford, Oxford, UK. August 2015.
▷ Oberwolfach workshop: 'Mathematical Aspects of Hydrodynamics' (poster presentation). Mathematisches Forschungsinstitut Oberwolfach. Germany. August 2015.
▷ Summer School on Transport, Fluids and Mixing (poster presentation). Levico Terme, Trento, Italy. July 2015.
▷ PDE CDT seminar series. University of Oxford, Oxford, UK. November 2014.

Research Stays

▷ Invited professorship, CY Advanced Studies, Université de Cergy-Pontoise, France (upcoming).
 Contact: Dr Christophe Prange.
▷ Isaac Newton Institute for Mathematical Sciences, Cambridge, UK.
 Programme: Mathematical aspects of turbulence: where do we stand?

January-June 2022.
▷ Université de Cergy-Pontoise, France.*Contact*: Dr Christophe Prange. December 2021.
▷ School of Mathematical Sciences, Fudan University, China (postponed due to COVID-19). *Contact*: Dr Kuijie Li.
▷ Graduate School of Mathematics, University of Tokyo, Japan. *Contact*: Professor Yoshikazu Giga. December 2019.
▷ Yonsei University, South Korea. *Contact*: Professor Kyungkeun Kang. December 2019.
▷ Insitute of Mathematics, Polish Academy of Sciences, Poland. *Contact*: Dr Jan Burczak. September-October 2019.
▷ University of Minnesota, USA. *Contact*: Professor Vladimir Šverák and Dr Dallas Albritton. April-May 2019.
▷ École Normale Supérieure, Paris, France. *Contact*: Professor Isabelle Gallagher. March 2018, July 2018.
▷ University of Sussex, UK. *Contact*: Dr Gabriel Koch. October 2016, August 2018.
▷ Seconda Università degli Studi di Napoli, Italy. *Contact*: Professor Paolo Maremonti. June-July 2016.

Professional Memberships

November 2021-	Ordinary member of the *London Mathematical Society.*
May-November 2021	Associate member of the *London Mathematical Society.*

Supervision

September 2022-	**Lead PhD supervisor** for Henry Popkin, University of Bath.
September 2021-	Pedro Gabriel Fernández-Dalgo, **postdoctoral fellow**, Cergy Paris Université, France. I am his co-mentor with Christophe Prange.
2020-2021	Donnell Obovu, **masters research dissertation. University of Warwick.** Dissertation title: *Quantitative Regularity and Uniqueness Features of the Navier-Stokes Equations.* Current position: PhD student in Mathematics at UCL.
July 2015	Golo Wimmer, **undergraduate summer research project** (joint supervisor). OxPDE, **University of Oxford**. The project was partly funded by the Met Office.

Teaching Experience

Spring 2023 Spring 2022	**Undergraduate course lecturer** at the **University of Bath.** 'MA30062 Analysis of Nonlinear Ordinary Differential Equations' Third year undergraduate course containing 40 students (2022). Role involves curriculum design, lecturing, marking problem sheets and examination duties.
Winter 2021	**Class Tutor** at the **University of Bath.** 'MA10230 Multivariable Calculus and Differential Equations' Directed a first year undergraduate class containing 20 students. Role also involved marking problem sheets.
Spring 2021	**Undergraduate course lecturer** at the **University of Warwick.** 'MA113 Differential Equations A' First year undergraduate course containing 120 computer science, physics and statistics students. Role involves curriculum design and examination duties.

Winter 2020	**Undergraduate course** 'Maths Tours' at the **University of Warwick**. Consists of 4×1 hour outreach talks to third year undergraduate students concerning the Navier-Stokes equations.
2016-2017	**Class Tutor** at the **University of Oxford.** B4.2: Hilbert Spaces. C4.3: Functional Analytic Methods for PDEs. Parabolic Equations (graduate level course).
2015-2016	**External Tutor** at St Hilda's College, **University of Oxford.** A2: Metric Spaces and Complex Analysis. A4: Integration. ASO: Calculus of Variations.
2013-2015	**Teaching Assistant** at the **University of Oxford**. B4.2: Hilbert Spaces. C4.3: Functional Analytic Methods for PDEs. Parabolic Equations (graduate level course).

Other Professional Experience

2022–	**External Grant Reviewer for National Science Center, Poland.**
2022 Autumn–	**Member of 'Board of Examiners for Programmes', University of Bath.**
2022–	**Involvement in 'Curriculum Transform' of Analysis of ODEs, University of Bath**.
2016–	**Referee for journals** including 'Analysis & PDE', 'Annales de l'Institut Henri Poincaré C, Analyse Non Linéaire', 'Annales Polonici Mathematici', 'Annali della Scuola Normale Superiore di Pisa', 'Archive for Rational Mechanics and Analysis', 'Discrete and Continuous Dynamical Systems','Journal of the European Mathematical Society', 'Journal of Mathematical Fluid Mechanics', 'manuscripta mathematica', 'Mathematische Annalen', 'Mathematische Nachrichten', 'Nonlinear Analysis: Real World Applications', 'Proceedings of the Royal Society of Edinburgh Section A: Mathematics', 'Proceedings of the American Mathematical Society', 'Results in Engineering' and 'SIAM Journal on Mathematical Analysis'.
2021-	**Co-organizer of 'Analysis Seminar'**, University of Bath.
2021	**Co-organizer of online reading seminar**, with Dr Jan Burczak, Universität Leipzig. Subject: 'Turbulence' by Uriel Frisch.
2018	**Co-organizer of the 'Navier-Stokes Group Seminar'** (with Dr Jan Burczak), University of Oxford.
2018	**Volunteer at undergraduate mathematics open day**, University of Oxford.
2013-2017	**Marker of undergraduate mathematics admissions tests,** University of Oxford.
2015	**Volunteer at postgraduate mathematics open day**, University of Oxford.