**Dr. Cédric BEAUME**

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# Associate Professor in Applied Mathematics
# University of Leeds

## Research interests

Fluid instabilities and patterns: doubly diffusive convection, transition to turbulence, dry salt lakes
Pattern formation: spatial localization
Numerical methods: pseudo-spectral discretizations, numerical continuation, machine learning

## Positions

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| since 01/2025 | **Extended Committee Member for the Newton International Fellowship**<br>Royal Society |
| since 01/2024 | **Deputy Director of Research and Innovation**<br>School of Mathematics, University of Leeds |
| since 2019 | **Associate Professor in Applied Mathematics**<br>School of Mathematics, University of Leeds |
| 2016–2019 | **Lecturer in Applied Mathematics**<br>School of Mathematics, University of Leeds |
| 2014–2015 | **Assistant Professor in Computational Aerodynamics**<br>Department of Aeronautics, Imperial College London |
| 2012–2014 | **Postdoctoral Scholar (Prof. E. Knobloch)**<br>Department of Physics, University of California, Berkeley |
| 2012 | **Geophysical Fluid Dynamics Fellow**<br>Woods Hole Oceanographic Institution |
| 2009–2012 | **PhD in Fluid Dynamics and Teaching Assistant (Prof. A. Bergeon)**<br>Institut de Mécanique des Fluides de Toulouse, Université de Toulouse |

## Awards and indicators of esteem

Invited Quick Study in Physics Today (American Institute of Physics), including magazine cover (2024)
Research Project Grant (Leverhulme Trust): Principal Investigator, RPG-2018-311 £150k (2019–2022)
Faculty Partnership Supervisor Award (University of Leeds): shortlisted (2020)
Seal of Excellence (European Commission, 2017)
Invited Media Gallery (Society for Industrial and Applied Mathematics, 2015)
Joseph Ford Fellowship (Georgia Institute of Technology): $93k (2014–2016)
Newton International Fellowship (Royal Society): £96k (2013–2014)
Research Highlight Award from the editorial board of *Phys. Fluids* (2013)
Geophysical Fluid Dynamics Fellowship (Woods Hole Oceanographic Institution): $7k (2012)
PhD Studentship (French research ministry): €72k (2009–2012)
Travel grants: 7 awards for approximately £10k (since 2010)

# Research (1/2)

Recorded talks and posters available at http://cbeaume.com/en/publications.html

I have authored over 30 publications in top-tier peer-reviewed journals in the fields of nonlinear science and fluid dynamics. My activity centers around the field of spatially localized pattern formation, where I have, in particular, computed the first steady, spatially localized state in three dimensional fluid flows. I also study transitional flows and their instabilities to unravel underpinning mechanisms and in order to control them. My work on the formation of polygons on the surface crust of dry salt lakes received mediatic attention and ranks in the top 99$^{\text{th}}$ percentile of all research output tracked by Altmetric.

## Publications (1/2)


– *Convectons in unbalanced natural doubly diffusive convection*,
J. Tumelty, C. Beaume & A. Rucklidge, *Phys. Rev. Fluids* **10**, 044401 (2025)
– *Hidden fluid dynamics of dry salt lakes*,
C. Beaume, L. Goehring & J. Lasser, *Physics Today* **4**, 62–63 (2024)
– *Toward convectons in the supercritical regime: Homoclinic snaking in natural doubly diffusive convection*,
J. Tumelty, C. Beaume & A. Rucklidge, *SIAM J. Appl. Dyn. Sys.* **22**, 1710–1742 (2023)
– *Salt polygons and porous media convection*,
J. Lasser, J. Nield, M. Ernst, V. Karius, G. Wiggs, M. Threadgold, C. Beaume & L. Goehring, *Phys. Rev. X* **13**, 011025 (2023)
– *Training a neural network to predict dynamics it has never seen*,
A. Pershin, C. Beaume, K. Li & S. M. Tobias, *Phys. Rev. E* **107**, 014304 (2023)
– *Optimizing the control of transition to turbulence using a Bayesian method*,
A. Pershin, C. Beaume, T. Eaves & S. M. Tobias, *J. Fluid Mech.* **941**, A25 (2022)
– *Near-onset dynamics in natural doubly diffusive convection*,
C. Beaume, A. M. Rucklidge & J. Tumelty, *J. Fluid Mech.* **934**, A42 (2022)
– *Transition to doubly diffusive chaos*,
C. Beaume, *Phys. Rev. Fluids* **5**, 103903 (2020)
– *A probabilistic protocol for the assessment of transition and control*,
A. Pershin, C. Beaume & S. M. Tobias, *J. Fluid Mech.* **895**, A16 (2020)
– *Dynamics of spatially localized states in transitional plane Couette flow*,
A. Pershin, C. Beaume & S. M. Tobias, *J. Fluid Mech.* **867**, 414–437 (2019)
– *Three-dimensional doubly diffusive convectons: instability and transition to complex dynamics*,
C. Beaume, A. Bergeon & E. Knobloch, *J. Fluid Mech.* **840**, 74–105 (2018)
– *Adaptive Stokes preconditioning for steady incompressible flows*,
C. Beaume, *Commun. Comput. Phys.* **22**, 494–516 (2017)
– *Modulated patterns in a reduced model of a transitional shear flow*,
C. Beaume, E. Knobloch, G. P. Chini & K. Julien, *Phys. Scr.* **91**, 024003 (2016)
– *Time-periodic forcing of spatially localized structures*,
P. Gandhi, C. Beaume & E. Knobloch, *Springer Proc. Phys.* **173**, 303–316 (2016)
– *Dynamics of phase slips in systems with time-periodic modulation*,
P. Gandhi, E. Knobloch & C. Beaume, *Phys. Rev. E* **92**, 062914 (2015)
– *A new resonance mechanism in the Swift–Hohenberg equation with time periodic forcing*,
P. Gandhi, C. Beaume & E. Knobloch, *SIAM J. Appl. Dyn. Sys.* **14**, 860–892 (2015)
– *Reduced description of exact coherent states in parallel shear flows*,
C. Beaume, G. P. Chini, K. Julien & E. Knobloch, *Phys. Rev. E* **91**, 043010 (2015)
– *Exact coherent structures in an asymptotically reduced description of parallel shear flows*,
C. Beaume, E. Knobloch, G. P. Chini & K. Julien, *Fluid Dyn. Res.* **47**, 015504 (2015)
– *Localized states in periodically forced systems*,
P. Gandhi, C. Beaume & E. Knobloch, *Phys. Rev. Lett.* **114**, 034102 (2015)
– *Spatial localization in heterogeneous systems*,
H.-C. Kao, C. Beaume & E. Knobloch, *Phys. Rev. E* **89**, 012903 (2014)
– *Localized rotating convection with no-slip boundary conditions*,
C. Beaume, H.-C. Kao, E. Knobloch & A. Bergeon, *Phys. Fluids* **25**, 024105 (2013)
– *Nonsnaking doubly diffusive convectons and the twist instability*,
C. Beaume, E. Knobloch & A. Bergeon, *Phys. Fluids* **25**, 114102 (2013)

# Research (2/2)

Recorded talks and posters available at http://cbeaume.com/en/publications.html

## Publications (2/2)

- *Convectons and secondary snaking in three-dimensional natural doubly diffusive convection*, C. Beaume, A. Bergeon & E. Knobloch, *Phys. Fluids* **25**, 024105 (2013)
- *Convectons in a Rotating Fluid Layer*, C. Beaume, A. Bergeon, H.-C. Kao & E. Knobloch, *J. Fluid Mech.* **717**, 417–448 (2013)
- *A reduced model for exact coherent states in high Reynolds number shear flows*, C. Beaume, *Proc. Geophysical Fluid Dynamics Program*, Woods Hole, 389–412 (2012)
- *États spatialement localisés dans les systèmes fluides : Application à la double diffusion*, C. Beaume, PhD thesis, Université de Toulouse (2012)
- *Homoclinic snaking of localized states in doubly diffusive convection*, C. Beaume, A. Bergeon & E. Knobloch, *Phys. Fluids* **23**, 094102 (2011)
- *Electrolyte Stability in a Nanochannel with Charge Regulation*, C. Beaume, F. Plouraboué, A. Bergeon & E. Knobloch, *Langmuir, 27* (17), 11187–11198 (2011)
- *Etats spatialement localisés dans la convection de double diffusion*, C. Beaume, A. Bergeon & E. Knobloch, *Proc. Congrès Français de Mécanique*, 2296–2301 (2011)
- *Analyse de stabilité d'un électrolyte confiné*, C. Beaume, MRes thesis, Université de Toulouse (2009)

## Seminars

I have given over 20 invited seminars at leading international institutions including in the USA (e.g. UC Berkeley, Brown University, Woods Hole Oceanographic Institution), in France (EPSCI, LIMSI), in Spain (Universitat Politècnica de Catalunya) and in Australia (Monash University).

## Conferences

- International Couette–Taylor Workshop, Durham (Spain, 2025)
- Bifurcations and Instabilities in Fluid Dynamics, Edinburgh (UK, 2024)
- Mathematical and Computational Modelling of Anti-Diffusive Phenomena, Cambridge (UK, 2024)
- Dynamics Days Europe, Naples (Italy, 2023)
- International Couette–Taylor Workshop, Barcelona (Spain, 2023)
- UK Fluids Conference, Sheffield (UK, 2022)
- International Congress of Theoretical and Applied Mechanics, online (2021)
- SIAM Conference on Applications of Dynamical Systems, online (2021) *poster*
- Bifurcations and Instabilities in Fluid Dynamics, Limerick (Ireland, 2019)
- SIAM Conference on Applications of Dynamical Systems, Snowbird (USA, 2019)
- Dynamics Days Europe, Loughborough (UK, 2018)
- Pattern formation in fluids and soft matter, Leeds (UK, 2018)
- British Applied Mathematics Colloquium, Surrey (UK, 2017)
- Recurrence, Self-Organization, and the Dynamics of Turbulence, Santa Barbara (USA, 2017)
- Dynamics Days Europe, Corfu (Greece, 2016)
- Dynamics Days Europe, Exeter (UK, 2015)
- European Turbulence Conference, Delft (Netherlands, 2015)
- Bifurcations and Instabilities in Fluid Dynamics, Paris (France, 2015)
- SIAM Conference on Applications of Dynamical Systems, Snowbird (USA, 2015)
- SIAM Conference on Nonlinear Waves and Coherent Structures, Cambridge (UK, 2014)
- Turbulent Mixing and Beyond Workshop, Trieste (Italy, 2014)
- Dynamics Days US, Atlanta (USA, 2014)
- Annual Meeting of the APS Division of Fluid Dynamics, Pittsburgh (USA, 2013)
- SIAM Conference on Applications of Dynamical Systems, Snowbird (USA, 2013)
- Dynamics Days US, Denver (USA, 2013)
- Annual Meeting of the APS Division of Fluid Dynamics, San Diego (USA, 2012)
- Dynamics Days Europe, Göteborg (Sweden, 2012)
- Annual Meeting of the APS Division of Fluid Dynamics, Baltimore (USA, 2011)
- Congrès Français de Mécanique, Besançon (France, 2011)
- Bifurcations and Instabilities in Fluid Dynamics, Barcelona (Spain, 2011)

# Teaching

Teaching material available at http://cbeaume.com/en/teaching.html

I have over 15 years of experience teaching at university level, in 3 countries and in 2 languages. I mainly teach fluid dynamics but have also taught a variety of physics, mathematics and numerics courses with student satisfaction rate above 95%. I have successfully trained 5 PhD students and supervised over 10 year-long MSc projects. I designed and manage an annual livestreamed competition on the optimization of Formula 1 strategies which has been among the most popular undergraduate projects offered at the School of Mathematics of the University of Leeds.

## University of Leeds

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| **Level 5** | MATH5453 Foundations of Fluid Dynamics: module leader (2020–2024) |
| **Level 3** | MATH3620 Fluid Dynamics II: module leader (2016–2024) |
| | MATH3001 Faster than Hamilton: supervision, competition organizer (2018–2025) |
| | MATH3001 The Lorenz System: supervision (2016–2019) |
| **Level 2** | MATH2375 Linear Differential Equations and Transforms: tutor (2022) |
| | MATH2640 Introduction to Optimization: tutor (2017) |
| | MATH2365 Vector Calculus: tutor (2019) |
| **Level 1** | MATH1005/MATH1000 Core Mathematics: tutor (2023, 2024) |
| | MATH1710 Probability and Statistics 1: tutor (2022) |
| | MATH1055 Numbers and Vectors: tutor (2017) |
| | MATH1010 Mathematics: tutor (2016, 2018) |

## Imperial College London

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| **MSc** | AEM-ADV07 Fundamentals of Fluid Mechanics: module leader (2014–2015) |

## Université de Toulouse

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| **MRes** | High-order numerical methods: tutor (2010) |
| **MSc** | Computational environment: lecturer (2010) |
| **Year 2** | Fluid Mechanics: lecturer (2012) |
| | Mechanics: tutor (2010) |
| **Year 1** | Mechanics: tutor (2010–2011) |
| | Physics: tutor (2009–2010, 2012) |

## Research supervision

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| **Postdoc.** | 1 funded by a Leverhulme Trust Research Project Grant (University of Leeds, 2019–2022) |
| **PhD** | Ellen Bartle (University of Leeds, since 2024): TBD |
| | Laura Pinkney (University of Leeds, since 2022): TBD |
| | Hamza Liaquet (University of Leeds, since 2020): TBD |
| | Matthew Threadgold (University of Leeds, 2020–2024): Three-dimensional convection in dry salt lakes |
| | Reece Coyle (University of Leeds, 2018–2024): Spatially localized states in the Zhang–Viñals equation |
| | Joanna Tumelty (University of Leeds, 2018–2022): Localised states in natural doubly diffusive convection |
| | Anton Pershin (University of Leeds, 2017–2020): Assessment and control of transition to turbulence in plane Couette flow |
| | Punit Gandhi (University of California at Berkeley, 2013–2016): Localized states in driven dissipative systems with time-periodic modulation |
| **Master** | University of Leeds: 8 year-long MSc supervised from 2017 until 2024 (many more in smaller projects) |
| | Imperial College London: 2 MSc supervised in 2015 |
| | Université de Toulouse: 1 MSc supervised in 2010 |

# Professional service

## Reviewing

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| **Journal** | Applied Mathematics: Chaos, IMA J. Appl. Math., J. Eng. Math., J. Nonlinear Sci., Physica D, SIAM J. Appl. Dyn. Sys.<br>Fluid Dynamics: Fluid Dyn. Res., J. Fluid Mech., Phys. Fluids, Phys. Rev. Fluids<br>Other: J. Atmos. Oceanic Technol., J. Phys. Chem., Phys. Rev. Lett. |
| **Grant** | UK: Royal Society, EPSRC<br>Belgium: FWO<br>Netherlands: NWO<br>Germany: DFG<br>Chile: FONDECYT |
| **PhD** | École Polytechnique Fédérale de Lausanne<br>Imperial College London<br>University of Leeds<br>University of Loughborough<br>University of Southampton |

## Organization

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| **Conference** | Perspectives in Nonlinear Sciences, Cargèse (France, 2018): http://www.cbeaume.com/pins18 |
| **Minisymposia** | Spatial localisation in fluids, British Applied Mathematics Colloquium, Surrey (UK, 2017)<br>Spatial localization: recent progress in theory and applications, SIAM Conference on Nonlinear Waves and Coherent Structures, Cambridge (UK, 2014) |
| **University of Leeds** | Formula 1 Strategy Competition, online (2018–2025): http://www.cbeaume.com/en/teaching_f1.html<br>Leeds Applied Mathematics Seminar series (2016–2023)<br>Teaching Enhancement Scheme group on "Teaching Induction for New Lecturers" (2016–2017) |
| **UC Berkeley** | Founder and organizer of the Berkeley Fluids Seminar series: https://www.cbeaume.com/berkeleyfluids (2013–2014), https://berkeleyfluidsseminar.github.io/index.html (2014–2020) |
| **IMFT** | Editor of the book of PhD theses (2011)<br>Graduate students day (2011)<br>Open Days: Aerodynamics workshop and windtunnel visit (2010) |
| **University of Toulouse** | Open Days: Aerodynamics & numerics workshops (2010, 2011)<br>Administration of the Linux computer network of the Department of Mechanics (2009–2012) |