

CATHERINE BRUCE

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CURRENT RESEARCH INTERESTS

Ergodic theory and dynamical systems, fractal geometry, probability theory, geometric measure theory: CP-chains, symbolic dynamical systems, projection theorems, random cascade measures.

EDUCATION

PhD in Mathematics, University of Manchester, UK Expected completion Spring 2020

- **Supervisors:** Dr Xiong Jin and Dr Charles Walkden
- **Thesis Title:** *Hyperbolic dynamical systems and Markov chains*

MMath Mathematics, First Class (Hons), University of Manchester, UK 2011 – 2015

- **Final Year Project:** *Cookie cutters* written under the supervision of Dr Xiong Jin
- **Achievements/Recognitions:** IMA prize for final year outstanding project related to Mathematics June 2016

GRANTS AND AWARDS

Financial Awards

- **EPSRC/School of Mathematics PhD studentship** University of Manchester 2016 – 2020
- **President's Doctoral Scholar award** University of Manchester 2016 – 2020

PUBLICATIONS

In peer-reviewed journals:

[1] *Projections of Gibbs measures on self-conformal sets* (with X. Jin), *Nonlinearity* 32.2, 603 – 621, (2019).

Preprints:

[2] *Projections of random ergodic measures on products of Cantor sets and a random Furstenberg sunset conjecture*, in preparation.

[3] *The Hausdorff dimension of quasi-circles: a result of Ruelle and Bowen*, preprint, [arXiv:1509.07558](https://arxiv.org/abs/1509.07558), 9 pages, (2015).

Other:

[4] *Examples of invariant measures*, extended abstract from the “Arbeitsgemeinschaft: Rigidity of stationary measures” Oberwolfach Report No. 47, (2018).

RESEARCH VISITS

- University of Rennes 1, France 21 – 23 January 2019
Host: Barbara Schapira

WORKSHOPS AND CONFERENCES

Invited Talks

- **Thermodynamic formalism in dynamical systems**, ICMS, Edinburgh, 18 – 22 June 2018.
Invited Talk: *Projections of Gibbs measures on self-conformal sets*

Workshop talks

- **Arbeitsgemeinschaft: Rigidity of stationary measures**, Oberwolfach, 8 – 12 October 2018.
Talk: *Examples of invariant measures* (Talk 2 of 21)

Contributed talks

- **Fractals and Dimensions**, Institut Mittag Leffler, Sweden, 4 – 8 December 2017.
Talk: *Projections of Gibbs measures on self-conformal sets in the plane*
- **Manchester Research Students' Conference**, University of Manchester, UK, 27 September 2019.
Talk: *Generating Fractals*
Awarded IBM prize for best talk

Posters

- **Fractal Geometry and Stochastics 6**, Bad Herrenalb, 30 September – 5 October 2018.
Poster: *Projections of Gibbs measures on self-conformal sets*,
Awarded best poster
- **Manchester Research Students' Conference**, University of Manchester, 28 September 2018.
Poster: *Projections of Gibbs measures on self-conformal sets*,
Awarded IBM prize for best poster

Selected Participations

- **Heilbronn Annual Conference**, University of Bristol, 12 – 13 September 2019.
- **Thermodynamic Formalism: Ergodic Theory and Geometry**, University of Warwick, 22 – 26 July 2019.
- **Thermodynamic Formalism: Modern Techniques in Smooth Ergodic Theory**, CIRM, Marseille Luminy, France, 1 – 5 July 2019.
- **Number Theory and Dynamics**, University of Cambridge, 25 – 29 March 2019.
- **Arbeitsgemeinschaft: Rigidity of Stationary Measure**, Mathematisches Forschungsinstitut Oberwolfach, 7 – 12 October 2018.
- **Fractal Geometry and Stochastics 6**, Bad Herrenalb, 30 September – 5 October 2018.
- **British Mathematical Colloquium 2018**, University of St Andrews, 11 – 14 June 2018.
- **Probability, Analysis and Dynamics**, University of Bristol, 3 – 6 April 2018.
- **Fractals and dimensions**, Institut Mittag Leffler, Sweden, 4 – 8 December 2017.
- **Arbeitsgemeinschaft: Additive Combinatorics, Entropy, and Fractal Geometry**, Mathematisches Forschungsinstitut Oberwolfach, 9 – 13 October 2017.
- **One Day Ergodic Theory Meeting**, various UK locations and dates, September 2016 – present.
- **Manchester Research Students' Conference**, University of Manchester, September 2016, 2017, 2018, 2019.

OTHER TALKS

Seminar talks

- *Projections of random measures on products of $\times m, \times n$ -invariant sets and a random Furstenberg sumset conjecture*
University of Warwick, Ergodic Theory and Dynamical Systems seminar February 2020
- *Projections of random measures on products of $\times m, \times n$ -invariant sets and a random Furstenberg sumset conjecture*
University of Manchester, Analysis and Dynamics seminar February 2020
- *Projections of random measures on products of $\times m, \times n$ -invariant sets and a random Furstenberg sumset conjecture*
University of St Andrews, Pure Colloquium February 2020
- *Using Furstenberg's CP-chain method to prove strong projection theorems*
University of St Andrews, Analysis seminar February 2020
- *Projections of random measures on products of $\times m, \times n$ -invariant sets and a random Furstenberg sumset conjecture*
University of Edinburgh, Analysis seminar February 2020
- *Projections of fractals: the theory of a digital sundial*
University of Warwick, Dynamics and Group Geometry Early Researchers seminar October 2019
- *Projections of Gibbs measures on self-conformal sets*
University of Bristol, Ergodic Theory and Dynamical Systems seminar May 2019
- *Projections of Gibbs measures on self-conformal sets*
University of Rennes, Ergodic Theory seminar January 2019
- *Projections of fractals: the theory of a digital sundial*
University of Manchester, Pure Postgraduate seminar November 2018
- *Projections of Gibbs measures on self-conformal sets*
University of York, Number Theory seminar June 2018
- *Projections of Gibbs measures on self-conformal sets in the plane*
University of Manchester, Analysis and Dynamics seminar November 2017
- *An introduction to fractal geometry*
University of Manchester, Pure Postgraduate seminar March 2017

Other

- *Maths PhD at the University of Manchester*
University of Cambridge, Research in the UK November 2017
- *Life of a Mathematician*
University of Manchester, Taking Maths Further March 2017
- *Why I chose Mathematics*
University of Manchester, Ada Lovelace celebration October 2014

TEACHING EXPERIENCE

At the University of Manchester:

- **Supervisor for various courses in pure and applied mathematics**, leading weekly support classes for first year undergraduate course with groups of roughly 10–15 students and to mark and provide feedback on submitted written work. January 2015 – present
- **Service course tutorial leader** leading a support class of up to 30 students, undergraduate course for non-mathematicians. Autumn 2017 – present
- **Exam marking, invigilating and scribing for various courses in pure and applied mathematics**,
Autumn 2016 – present

- **Manchester Access Programme academic tutor**, university’s flagship widening participation scheme, meet with 2 tutees to guide them through an academic assignment before marking and giving feedback on first and final drafts.

Summer 2019

- **Workshop leader**, first year undergraduate course including help in MATLAB classes, leading group project sessions with up to 35 students, marking multiple courseworks.

Autumn 2017

- **Teaching assistant in LMS Summer School - Fractal geometry and dimension theory**, for high achieving third year undergraduates.

Summer 2017

Other Experience:

- **Assistant for Year 12 (age 16–17) Problem Solving/STEP Preparation Classes**, Xavar-ian College, Manchester.

November 2018 – May 2019

- **Private tutor for first year undergraduate student in mathematics**, Manchester.

Summer 2018

- **Mathematics tutor for The Tutor Trust**, various primary and secondary schools, Manchester.

April 2011 – June 2015

POSITIONS OF RESPONSIBILITY

- **Co-organiser of University of Manchester women and minority gender maths men-
toring scheme**

January 2019 – present

- **University of Manchester Athena Swan Committee PGR representative**

September 2017 – present

- **Co-organiser of ‘Women in Mathematics Research’**, outreach event for year 12 (age 16–17) students hosted at the University of Manchester.

June 2018, 2019, 2020

We were granted £900 of Dame Kathleen Ollerenshaw funding to support this event, and we received a commendation from the University’s Making a Difference awards.

- **Co-organiser of the University of Manchester Pure Postgraduate seminar**

September 2017 – June 2018

- **Co-organiser of Manchester Research Students’ Conference**

September 2017

- **Organiser and coordinator of ‘Turing’s Wondrous Workshop’**, a mathematics outreach stand at Green Man festival.

Brecon Beacons

August 2017

OUTREACH

Widening Participation Fellow

September 2016 – July 2019

- **Developed and delivered multiple mathematical workshops to groups of up to 30 primary or secondary school students**, various venues including University of Manchester, Manchester Museum.

- **Delivered talks such as ‘Why study Maths?’**, ‘**Fractals in Nature**’, secondary schools in Manchester, events at University of Manchester including British Science Week.

Other Activities

- **Delivered “Sustainability Challenge”**, all day workshop as part of a welcome event for new undergraduate students. University of Manchester

September 2018, 2019

- **Workshop leader and panel member at Managing my Future**, careers event for mathe-matics undergraduates. University of Manchester

September 2017, 2018

- **Assisted at Making Maths @ Manchester**, two day residential event for UK sixth form students. University of Manchester July 2017
- **Volunteer at “University of Manchester Community Festival”**
University of Manchester June 2017

LANGUAGE SKILLS

- **A-Level French**, obtained in 2011 with grade A.