

# Calum Hughes

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## CONTACT

### INFORMATION

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## RESEARCH

### INTERESTS

2-category theory, homotopy theory, 2-dimensional topos theory and logic. I am also particularly interested in the interface between Category Theory and other areas of study.

## EDUCATION

**University of Manchester** PhD in pure mathematics funded by the Dame Kathleen Ollerenshaw PhD Studentship, supervised by Dr Nicola Gambino. The working title is “*Logic in 2-categories of internal categories*.” Finishing date estimated March 2026.

**University of Sheffield** MMath in Mathematics, first class honors, 2022. Master’s Thesis: “*The Dold-Kan Correspondence*” supervised by Prof. Sarah Whitehouse.

## RESEARCH

### OUTPUT

1. The elementary theory of the 2-category of small categories, with Adrian Miranda. Published *Theory and application of categories*, Vol. 43, 2025, No. 8, pp 196-242.
2. Colimits of internal categories, with Adrian Miranda, 2025.  
Preprint: [arXiv:2501.17769](https://arxiv.org/abs/2501.17769).
3. The algebraic internal groupoid model of Martin-Löf type theory, 2025.  
Preprint: [arXiv:2503.17319](https://arxiv.org/abs/2503.17319).

## SELECTED TALKS

1. *Internal categories, algebraic model structures and type theory*— international category theory conference, July 18 2025.
2. *An algebraic internal groupoid model of Martin-Löf type theory*— TYPES 2025, June 9 2025.
3. *Colimits of internal categories* — 110th Peripatetic Seminar on Sheaves and Logic (PSSL 110), May 3 2025. Abstract, Slides
4. *The elementary theory of the 2-category of small categories*— Masaryk University Algebra Seminar, June 5 2024.
5. *Models of Martin-Löf type theory and algebraic model structures*— University of Birmingham theoretical computer science seminar, May 17 2024.
6. *The elementary theory of the 2-category of small categories*— The University of Sheffield ShEAF seminar, March 12 2024.
7. *Homotopy Theory and Logic*— British Mathematics Colloquium 2024, June 19th 2024.
8. *A Mathematical Interlude: Winning the Lottery with 27 tickets* — Mathematics Students’ Research Conference 2023, September 29 2023.
9. *A visual introduction to homotopy and homotopy*— The University of Sheffield Pizza Seminar, April 28 2022.
10. *An Introduction to Simplicial Sets*— [Tomorrow’s Mathematicians Today conference](#), The University of Greenwich, March 2021.

## TEACHING EXPERIENCE

I have taught tutorials in the following modules as a Graduate Teaching Assistant.

1. MATH32072: Number Theory Spring 2025.
2. MATH20062 Mathematical Communication and Group Projects, Spring 2025.
3. MATH 19661 Mathematics 1M1, Autumn 2024.
4. MATH 34011 Complex Analysis and Complex Analysis with applications, Autumn 2024.
5. MATH20062 Mathematical Communication and Group Projects, Spring 2024.
6. MATH 34011 Complex Analysis and Complex Analysis with applications, Autumn 2023.
7. MATH11112 Analysis, Spring 2023.

Other related activities:

- Creating Tikz Diagrams for the lecture notes of MATH 34011 (Complex Analysis and Complex Analysis with applications).
- Marking for MATH11412/11422 (Introduction to Ordinary Differential Equations/ Ordinary Differential Equations and Applications).
- Marking for MATH19861 (0N1 Mathematics for Foundation Year).
- Invigilating for MATH32012 (Commutative Algebra).
- Invigilating for MATH32072 (Number Theory Spring).
- Attended Teacher Training modules in the following: FSE GTA Learning Outcomes and Lesson Plans, FSE GTA Teaching Skills, FSE GTA Roles and Expectations, Data Protection and Cyber Security.

## ORGANISATIONAL EXPERIENCE

- Organiser of Student logic seminar, the University of Manchester, 2023-2024.
- Creator and maintainer of the website for the University of Manchester category theory group ([manchester-ct.github.io](https://manchester-ct.github.io)), 2024-present.
- Local organiser for [Categorical Logic and Higher Categories](#) conference, The University of Manchester, 16-19th Decemeber 2024.
- Organiser for the Mathematics Students' Research Conference 2023 (29/09/2023). This conference which had over 60 attendants and involved sourcing £1500 funding from two institutes (Heilbronn Institute of Pure Mathematics and The University of Manchester School of Mathematics), organising catering, speakers and a poster session.
- Co-organiser for the Topos Theory Reading Group (2024-present).
- Local helper for the British Mathematics Colloquium 2024.
- Secured £350 from the Sustainable Travel Top-Up Fund to travel sustainably to Brno, Czechia from Manchester UK.

## PRIZES AND AWARDS

- **Dame Kathleen Ollerenshaw PhD Studentship**
- **T. M. Flett Prize in Pure Mathematics** for the best performance in Pure Mathematics modules 2022.
- Awarded Undergraduate Research Bursary from the London Mathematical Society 2021.
- **T. M. Flett Prize in Pure Mathematics** for the best performance in Pure Mathematics modules 2020.
- Awarded Undergraduate Research Internship bursary from the University of Sheffield School of Mathematics and Statistics, 2020.
- Best pure mathematical poster at Mathematics Students' Research Conference, September 27 2024. ([See here](#))
- **Best Team Submission** in the School of Mathematics and Statistics annual team Mathematics challenge, 2018.

## OTHER RELATED ACTIVITIES

- Presented a poster at the international category theory conference 2024.
- I have tutored students in GCSE Maths, A-level Maths and A-level English Literature.
- Programming: competency in Python, L<sup>A</sup>T<sub>E</sub>X, R, Adga.

## OUTREACH

- I was part of the academic panel for [MIMUC 2024](#), the Manchester Interdisciplinary Mathematics Undergraduate Conference. This involved answering students' questions about academia and PhD life.
- In 2022, 2023, and 2024 I gave feedback on 30 minute talks that Manchester Masters' students gave in preparation for the presentation component of their Masters' Project module.
- I helped out with the University of Sheffield's open days for the School of Mathematics and Statistics. This involved helping out on the open desks, chatting to people about what doing a maths degree was like, and giving a talk about my experience in the SURE internship scheme.

## OTHER ROLES

- President of the University of Sheffield Allotment Society, 2019-2020.
- Treasurer of the University of Sheffield Allotment Society, 2020-2021.
- Finance and Development Officer of the University of Sheffield Allotment Society, 2021-2022.
- Assistant Pit Manager, Glyndebourne Opera house, 2018-2021.
- Music Library Assistant, Glyndebourne Opera house, 2021.