

# Dr Lucy Eve HAM

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I am a senior postdoctoral researcher at the ARC Centre of Excellence for the Mathematical Analysis of Cellular Systems (MAC-SYS) at the University of Melbourne and a member of the Theoretical Systems Biology group. My research bridges mathematics, computational biology, and theoretical biophysics, with a particular focus on developing mathematical models to understand complex biological systems.

My work primarily explores the control mechanisms governing stochastic gene expression and signaling processes that influence cell fate decisions. By combining mathematical theory with computational approaches, I aim to uncover the fundamental principles underlying molecular networks and their role in cellular function and development.

With a PhD in pure mathematics—spanning logic, algebra, and theoretical computer science—I bring a rigorous approach to the study of stochastic biological processes. My contributions to the theory of stochastic processes include insights into gene expression dynamics and first-passage time problems, providing new analytical solutions with broad applications in biology.

## EMPLOYMENT

Present March 2024	<b>MACSYS Postdoctoral Research Fellow   The University of Melbourne, MELBOURNE, Australia</b> <b>ARC Centre of Excellence in the Mathematical Analysis of Cellular Systems</b> <ul style="list-style-type: none"><li>➤ Lead research in whole cell modelling within the world's largest focused research initiative in mathematical biology</li><li>➤ Contribute to the training and professional development of students and ECRs</li><li>➤ Assist in the coordination of research projects across centre nodes and themes</li></ul>
March 2024 Nov 2018	<b>Postdoctoral Research Fellow   The University of Melbourne, MELBOURNE, Australia</b> <b>Theoretical Systems Biology Group (lead by Prof Michael Stumpf)</b> <ul style="list-style-type: none"><li>➤ Change of field from Pure Mathematics to Mathematical Systems Biology</li><li>➤ Nine publications (eight first-authored) in high-impact journals such as <i>Physical Review Letters</i>, <i>Nature Communications</i>, <i>Cell Systems</i>, <i>Journal of Chemical Physics</i>, and <i>eLife</i></li></ul>
Nov 2018 Sept 2013	<b>Casual Demonstrator and Support Tutor   La Trobe University, MELBOURNE, Australia</b> <b>School of Engineering and Mathematical Sciences</b> <ul style="list-style-type: none"><li>➤ Instruct and oversee classes of up to 30 students for a range of first-year and second-year undergraduate university subjects including Discrete Mathematics, Calculus and Differential Equations, Applied Algebra and Number Systems</li><li>➤ Improve overall engagement, retention, success and well-being of first-year undergraduate students</li></ul>

## EDUCATION

June 2017 Oct 2013	<b>Doctor of Philosophy (Pure Mathematics)   La Trobe University, MELBOURNE, Australia</b> <b>Thesis - Definability and Complexity: Universal Horn classes of finite structures</b> <ul style="list-style-type: none"><li>➤ Supervisors : Prof Brian Davey and Prof Tomasz Kowalski</li><li>➤ Passed with no amendments, five publications including three sole-authored.</li></ul>
July 2013 Jan 2012	<b>Bachelor of Science (Honours in Mathematics)   La Trobe University, MELBOURNE, Australia</b> <b>Thesis - Residual Bounds of Algebras and Boolean Topological Algebras</b> <ul style="list-style-type: none"><li>➤ Highest overall performance in the Faculty of Science across all campuses</li><li>➤ First Class Honours</li></ul>

Oct 2011	Bachelor of Science   La Trobe University, MELBOURNE, Australia
March 2008	<ul style="list-style-type: none"> <li>&gt; Major in Mathematics and Statistics</li> <li>&gt; Weighted Average Mark (WAM) : 95%</li> </ul>

## ACADEMIC DISTINCTIONS

- 2017 Architect Michael Kaufman Scholarship (awarded to highest achieving student entering the Master of Architecture at the University of Melbourne)
- 2017 Nomination for the Nancy Millis Award (awarded to authors of outstanding PhD theses)
- 2013 D.M. Myers University Medal (awarded to the most outstanding undergraduate student graduating in the faculty of science across all campuses)
- 2013 Prof C.J. Eliezer Prize in 4th Year Mathematics (highest overall mark in fourth year mathematics)
- 2013 Third Year Prize in Statistics (highest overall mark in third year statistics)
- 2012 E.J. Hannan Prize for Third Year of Accredited Major in Statistics (highest overall mark in third year statistics for students taking a major in both statistics and mathematics)
- 2012 La Trobe Alumni Prize (best overall academic performance in the final year of their degree university-wide)
- 2011 Awarded an AMSI Vacation Research Scholarship
- 2011 National Bank of Australia Prize in 3rd Year Mathematics (highest overall mark in third year mathematics)
- 2010 Dean's Honours List
- 2009 Second Year Prize in Statistics (highest overall mark in second year statistics)
- 2008 Dean's Honours List

## PUBLICATIONS

### Under review

- 2023 **L. Ham** and M. Jackson, Finite model theory for pseudovarieties and universal algebra : preservation, definability and complexity, *The Journal of Symbolic Logic* (Submitted), arXiv:2212.02653

### Refereed Journal Publications

- 2025 C. D. Madsen, A. Barbensi, S. Y. Zhang, **L. Ham**, A. David, D. E.V. Pires, M. P. H. Stumpf, The Topological Properties of the Protein Universe, *Nature Communications* (to appear), bioRxiv : 2023.09.25.559443. (IF 16.6, Q1 Scimago JR)
- 2024 **L. Ham**, T. Woodward, M. A. Coomer, M.P.H. Stumpf\*, Mapping, modeling, and reprogramming cell-fate decision making systems, *Annual Review of Biomedical Data Science* (to appear). (IF 7, Q1 Scimago JR) \* corresponding author
- 2023 **L. Ham**, M. A. Coomer, K. Ocal, R. Grima and M. P. H. Stumpf. A stochastic vs deterministic perspective on the timing of cellular events, *Nature Communications*, bioRxiv : 2023.07. 20.549956. (IF 16.6, Q1 Scimago JR)
- 2022 **L. Ham\***, M. A. Coomer\* and M. P. H. Stumpf. The chemical Langevin equation for biochemical systems in dynamic environments. *Journal of Chemical Physics*, 157 (9), 094105. \*Joint first authorship, (IF 4.4, Q1 ScimagoJR).
- 2022 M. A. Coomer\*, **L. Ham\***, and M. P. H. Stumpf. Noise distorts the epigenetic landscape and shapes cell-fate decisions. *Cell Systems*, 13(1), 83-102. \* Joint first authorship. Selected for the January issue cover, featuring my own illustration. Featured on UniMelb "Newsroom" website. (IF 9.3, 64 citations, Q1 ScimagoJR)
- 2021 **L. Ham**, M. Jackson, and M. P. H. Stumpf, Pathway dynamics can delineate the sources of transcriptional noise in gene expression, *eLife*, 10, e69324. (IF 8.7, 32 citations, Q1 ScimagoJR)
- 2020 **L. Ham**, D. Schnoerr, R. D. Brackston, M. P. H. Stumpf, Exactly solvable models of gene transcription, *The Journal of Chemical Physics*, 152, 144106. Appeared on the cover, and selected for "highlights 2020 collection" with a feature in Scilight. (IF 4.4, 47 citations, Q1 ScimagoJR)
- 2020 **L. Ham\***, R. D. Brackston\*, M. P. H. Stumpf, Extrinsic noise and heavy-tailed laws in gene expression, *Physical Review Letters*, 124, 108101, (2020). (IF 9.16, 71 citations, Q1 ScimagoJR).
- 2018 **L. Ham** and M. Jackson, Axiomatisability, preservation and hardness for hypergraph quasivarieties, *Algebra Universalis*, 79 (2), 1-17. (IF 0.63, 8 citations, Q2 ScimagoJR; foremost specialist journal for universal algebra)
- 2017 **L. Ham**, Gap theorems for robust satisfiability : Boolean CSPs and beyond, *Theoretical Computer Science*, 676, 69-91. (IF 1.50, 11 citations, Q2 ScimagoJR).

- 2017 L. Ham, Relativised homomorphism preservation at the finite level, *Studia Logica* 105, 761-786. (IF 0.93 , 4 citations, Q1 ScimagoJR).

#### Refereed Conference Proceedings

- 2017 L. Ham and M. Jackson, All or Nothing : toward a promise problem dichotomy for constraint problems, Principles and Practice of Constraint Programming (CP 2017), Lecture Notes in Computer Science, 10416, 139-156, (2017). (CORE rank A, 7 citations).
- 2016 L. Ham, A gap trichotomy for Boolean constraint problems : extending Schaefer's Theorem, 27th International Symposium on Algorithms and Computation (ISAAC 2016), 36:1-36:12, (2016). (CORE rank A, 3 citations).

#### TEACHING EXPERIENCE

- 2025 (current) **Mathematics and Statistics for Biomedicine (MAST10024, undergraduate level 1), University of Melbourne**
- Coordinate and lecture large service subject
  - Topics covered include mechanistic modeling (ODEs and mass-action kinetics), epidemics (compartmental models), and statistical/data analysis techniques (hypothesis testing and linear regression).
- 2024 **The fundamentals of whole cell modelling : stochastic simulation in Julia, BioInfoSummer Workshop, University of Melbourne**
- Develop and deliver interactive materials on stochastic modelling of biochemical systems in Julia programming language
- 2023 **Thinking Scientifically (SCIE20001, undergraduate level 2), University of Melbourne**
- Manage student queries for data science module for over 800 students on online platform Ed Discussion
  - Overhaul learning exercises and Minitab worksheets and data
- 2013-2018 **Tutor and Maths Hub subject support, La Trobe University**
- **Mathematics:** Discrete Mathematics (level 1), Calculus and Differential Equations (level 1), Number Systems (level 1), Mathematics for Biology (level 1), Applied Algebra (level 2), Vector Calculus (level 3), Complex Analysis (level 3), Model Theory (level 4)
  - **Statistics:** Applied Statistics (level 2), Probability Models (level 2), Biostatistics (level 3)

#### CONFERENCE AND SEMINAR PRESENTATIONS

- 2024 Invited speaker at Modeling and Inferences of Stochastic Processes in Cells, Flatiron Institute, New York.
- 2024 Keynote invited speaker at CSIRO's Annual Conference for Advanced Engineering FSP, Fortitude Valley, Brisbane, Australia.
- 2024 Seminar speaker, Elowitz Lab, Caltech, Los Angeles.
- 2024 Seminar speaker, Covert Lab, Stanford, California.
- 2023 Keynote invited speaker at Annual Conference for the Australian Research Council Centre of Excellence in Synthetic Biology, Sunshine Coast, QLD, Australia.
- 2023 Speaker at the annual conference of the Australia Mathematical Society, The University of Queensland, Brisbane, Australia.
- 2022 Invited speaker at 12th European Conference on Mathematical and Theoretical Biology, Mini-Symposium on Stochastic Modelling of Genetic and Biochemical Systems, Heidelberg, Germany
- 2022 Plenary speaker at VicANZIAM, Melbourne, Australia
- 2022 Plenary speaker at BioInfoSummer 2022, The University of Melbourne, Australia
- 2022 Invited speaker at the British Applied Mathematics Conference, Loughborough University, UK
- 2022 Speaker at the Biomathematics seminar, Imperial College, London, UK
- 2022 Speaker at the Systems and Synthetic Biology seminar, University College London, London, UK
- 2021 Shaping the Epigenetic Landscape: Complexities and Consequences, Society for Mathematical Biology Annual Meeting, Virtual on behalf of University of California Riverside (UCR)
- 2020 Sounding out the noise, Theoretical Systems Biology research seminar, The University of Melbourne
- 2019 Extrinsic noise in gene transcription: models and heavy-tailed laws, 63rd Annual Meeting of the Australian Mathematical Society, Monash University, Melbourne
- 2016 A gap trichotomy for Boolean constraint problems: extending Schaefer's Theorem, ISAAC 2016 : The 27th Symposium on Algorithm and Computation, Sydney

- 2016 A gap trichotomy for Boolean constraint problems, 34th Victorian Algebra Conference, La Trobe University, Melbourne
- 2016 A gap trichotomy for Boolean constraint problems, 17th International Workshop on Logic and Computational Complexity, Aix-Marseille Université, France
- 2016 Mind the gap, 60th Annual Meeting of the Australian Mathematical Society, Australian National University, Canberra
- 2015 Definability of SP-classes of uniform hypergraphs, 59th Annual Meeting of the Australian Mathematical Society, Flinders University, Adelaide
- 2014 Preservation theorems on finite structures: algebra vs relations, 32nd Victorian Algebra Conference, Monash University, Melbourne
- 2014 Preservation theorems on finite structures: algebra vs relations, 38th ACCMCC, Victoria University of Wellington, New Zealand

## PROFESSIONAL ACTIVITIES

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- 2025 Interview selection panels for MACSYS and Cell Bauhaus
- 2024/2025 MACSYS Early Career Researcher Representative (Operations Committee)
- 2024 AustMS B. H. Neumann Prize Committee
- 2024 Organiser of AMSI BioInfoSummer conference (Whole Cell Modelling theme)
- 2023 Co-coordinator of the Artist in Residence Program of the ARC Centre of Excellence for Mathematical Analysis of Cellular Systems (MACSYS)
- 2023 Organiser of the ARC Centre of Excellence for Mathematical Analysis of Cellular Systems (MACSYS) webinar series
  - › Coordinate a series of talks by high-profile plenary speakers from both inside and outside of Australia focused on whole cell modelling and in silico biology
- 2018–2025 Reviewer for many journals, including Journal of Chemical Physics, European Journal of Applied Mathematics and Current Opinion in Systems Biology
- 2022 Judge for student prize at the annual Australian Biophysics Society meeting
- 2022 Judge for student prize at the annual Australia Algebra conference
- 2019 AustMS B. H. Neumann Prize Committee - Judge for esteemed student prize at annual national conference
- 2019 AMSI Choose Maths Day Q&A Panellist - raise mathematical enjoyment and aspirations of girls in Year 9 & 10
- 2017/18 Open day volunteer, La Trobe University
- 2017 Marker for the Simon Marais Mathematics Competition
- 2017 Assistant organiser of the following workshops and conferences
  - › Universal Structures in Mathematics and Computing Workshop, LTU
  - › 34th Victorian Algebra Conference, La Trobe University
  - › General Algebra and its Applications, La Trobe University

## GRANTS AND TRAVEL AWARDS

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- 2024 Melbourne Mathematical Biology Seed Funding grant, The University of Melbourne (\$25, 000)
- 2024 BioSciences ECR grant, The University of Melbourne (\$2000)
- 2024 MACSYS travel grant (\$12000)
- 2018 AMSI Choose Maths Travel Grant (full support to participate in BioInfoSummer, University of Western Australia) (\$1000)
- 2017 Prof Ed Smith Travelling Scholarship (awarded to a full-time PhD student of outstanding merit to spend a significant amount of time overseas to further pursue research) (\$10, 000)