# Tyler Cassidy

Lecturer in Mathematical Biology
University of Leeds.

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**Interests:** Mathematical medicine, immunology, treatment response and resistance, dynamical systems, delay differential equations, structured population models

## Education

**Ph.D.** Mathematics and Statistics 2015-2019
McGill University, Montréal, Canada
**B.Sc. (Honors)** Applied Mathematics, First Class Honors 2011-2015
University of Alberta, Edmonton, Canada

## Academic Positions

**Lecturer (Assistant Professor) in Mathematical Biology** 2022-Present
University of Leeds

**Senior Scientist** 2021-2022
Pfizer Inc: Oncology Research Unit

**Postdoctoral Research Associate** 2019-2021
Theoretical Biology and Biophysics, Los Alamos National Laboratory

**Junior Fellow** 2018
Institut Mittag-Leffler

## Publications

### Manuscripts under review

A Hamis, S., Browning, A.P., Jenner, A.L., Villa, C., Maini, P.K., **Cassidy, T.**, Growth rate-driven modelling reveals how phenotypic adaptation drives drug resistance in BRAFV600E-mutant melanoma, biorXiv: 2024.08.14.607616, *revisions requested*

B **Cassidy, T.**, Belluccini, G., Iyaniwura, S.A., Ribeiro, R.M., Perelson, A.S., Inheritance of intracellular viral RNA in a multiscale model of hepatitis C infection, arXiv: 2506.00939, *Submitted*

C **Cassidy, T.**, Iyaniwura, S.A., Ribeiro, R.M., Perelson, A.S., Early dynamics of hepatitis B virus RNA directly inform capsid assembly modulator effectiveness, *Submitted*

D **Cassidy, T.**, Johnston, S.T, Plank, M., Botha, I., Flegg, J.A., Murphy,R.J., Hamis, S., A nonparametric approach to practical identifiability of nonlinear mixed effects models, *Submitted*, arXiv:....

### Publications

1. Villa, C., Maini, P.K., Browning, A.P., Jenner, A.L., Hamis, S., **Cassidy, T.**, Reducing phenotype-structured partial differential equations models of cancer evolution to systems of ordinary differentail equations: a generalised moment dynamics approach, *to appear*, *Journal of Mathematical Biology*, arXiv:2406.01505.
2. Browning, A.P., Crossley, R.M., Villa, C., Maini, P.K., Jenner, A.L., **Cassidy, T.**, Hamis, S., Identifiability of heterogeneous phenotype adaptation from low-cell-count experiments and a stochastic model, to appear, *PLOS Computational Biology* biorXiv: 2024.08.19.608540.
3. **Cassidy, T.**, Using multi-delay discrete delay differential equations to accurately simulate models with distributed delays, *Studies in Applied Mathematics*, 154:e70069, 2025, https://doi.org/10.1111/sapm.70069
4. Iyaniwura*, S.A., **Cassidy***, **T.**, Ribeiro, R.M., Perelson, A.S., A multiscale model of the action of a capsid assembly modulator for the treatment of chronic hepatitis B, *PLOS Computational Biology*: e1012322, 2025, doi: 10.1371/journal.pcbi.1012322

*Equal contribution

5. Braniff, N., Joshi, T., **Cassidy, T.**, Trogdon, M., Kumar, R., Poels, K., Allen, R., Musante, C.J., and Shtylla, B., An integrated quantitative systems pharmacology virtual population approach for calibration with oncology efficacy endpoints, *CPT: Pharmacometrics & Systems Pharmacology*, 2024, doi:10.1002/psp4.13270
6. **Cassidy, T.**, Stephenson K.E, Barouch, D.H., and Perelson, A.S., Modeling resistance to the broadly neutralizing antibody PGT121 in people living with HIV-1, 20(3): e1011518, 2024, *PLOS Computational Biology*, doi: 10.1371/journal.pcbi.1011518.
7. **Cassidy, T.**, A continuation technique for maximum likelihood estimators in biological models, 85, 90, *Bulletin of Mathematical Biology*, 2023, doi: 10.1007/s11538-023-01200-0,
8. **Cassidy, T.**, Gillich[†], P., Humphries, A.R., and van Dorp, C.H., Numerical methods and hypoexponential approximations for Gamma distributed delay differential equations, Volume 87, Issue 6, December 2022, Pages 1043–1089, *The IMA Journal of Applied Mathematics*
9. Sanche, S., **Cassidy, T.**, Chu, P., Perelson, A.S., Ribeiro, R.M., and Ke, R., A simple model of COVID-19 explains disease severity and the effect of treatments, *Scientific Reports*, 12, 14210, 2022, DOI: 10.1038/s41598-022-18244-2
10. Stephenson, K.E., Julg, B., Tan, C.S., Zash, R., Walsh, S.R., Rolle, C-P., Monczor, A.N., Lupo, S., Gelderblom, H.C., Ansel, J.L., Kanhilal, D.G., Maxfield, L.F., Nkolola, J., Borducchi, E.N., Abbink, P., Liu, J., Peter, L., Chandrashekar, A., Nityanandam, R., Lin, Z., Setaro, A., Sapiente, J., Chen, Z., Sunner, L., **Cassidy, T.**, Bennett, C., Sato, A., Mayer, B., Perelson, A.S., deCamp, A., Priddy, F.H., Wagh, K., Giorgi, E.E., Yates, N.L., Arduino, R.C., DeJesus, E., Tomaras, G.D., Seaman, M.S., Korber, B., and Barouch, D.H., Safety, pharmacokinetics, and antiviral activity of PGT121, a broadly neutralizing monoclonal antibody against HIV-1: a randomized, placebo-controlled, phase 1 clinical trial, *Nature Medicine*, 27, 1718–1724, 2021, DOI: 10.1038/s41591-021-01509-0.
11. **Cassidy, T.**, Nichol, D., Robertson-Tessi, M., Craig, M., and Anderson, A.R.A., The role of memory in non-genetic inheritance and its impact on cancer treatment resistance, *PLOS Computational Biology*, 17(8), 2021, e1009348, DOI: 10.1371/journal.pcbi.1009348
12. Ismail, S.D., Riou, C., Joseph, S.B., Archin, N.M., Margolis, D.M., Perelson, A.S., **Cassidy, T.**, Abrahams, M-R., Moeser, M., Council, O.D., McKinnon, L.R., Osman, F., Karim, Q.A., Abdool Karim, S.S., Swanstrom, R., Williamson, C., Garrett, N.J., Burgers, W.A., Immunological correlates of the HIV-1 replication-competent reservoir size, *Clinical Infectious Diseases*, 73, 8 (2021), 1528–1531, https://doi.org/10.1093/cid/ciab587.
13. **Cassidy, T.**, Distributed Delay Differential Equation Representations of Cyclic Differential Equations, *SIAM Journal on Applied Mathematics*, 81(4), 1742–1766, DOI: doi.org/10.1137/20M1351606
14. Jenner, A.L., **Cassidy, T.**, Belaid[†], K., Bourgeois-Daigneault, M.C., and Craig, M., In silico trials predict that combination strategies for enhancing vesicular stomatisis oncolytic virus are determined by tumour aggressivity, *Journal for ImmunoTherapy of Cancer* (2021), 9:e001387. doi: 10.1136/jitc-2020-001387
15. **Cassidy, T.**, Humphries, A.R., Craig, M., and Mackey, M.C., Characterizing chemotherapy-induced neutropenia and monocytopenia through mathematical modelling, *Bulletin of Mathematical Biology* 82, 104, (2020), DOI: 10.1007/s11538-020-00777-0
16. **Cassidy, T.** and Craig, M., Determinants of combination GM-CSF immunotherapy and oncolytic virotherapy success identified through in silico treatment personalization, *PLOS Computational Biology*, 15(11), 2020,: e1007495, DOI: 10.1371/journal.pcbi.1007495
17. **Cassidy, T.** and Humphries, A.R., A Mathematical Model Of Viral Oncology As An Immuno-Oncology Instigator, *Mathematical Medicine and Biology: A Journal of the IMA*, 37(1):117-151, (2020), DOI:10.1093/imammb/dqz008.
18. **Cassidy, T.**, Craig, M. and Humphries, A.R., Equivalences Between Age Structured Models and State Dependent Distributed Delay Differential Equations, *Mathematical Biosciences and Engineering*, (2019), 16(5): 5419-5450. DOI: 10.3934/mbe.2019270
19. De Souza, D.C, Craig, M., **Cassidy, T.**, Li, J., Nekka, F., Bélair, J. and Humphries, A.R., Transit and lifespan in neutrophil production: implications for drug intervention, *Journal of Pharmacokinetics and Pharmacodynamics*, (2018) 45: 59. DOI: 10.1007/s10928-017-9560-y
20. **Cassidy, T.**, Gaudreau, P., and Safouhi, H. On the Computation of Eigenvalues of the Anharmonic Coulombic Potential. *Journal of Mathematical Chemistry*, (2018) 56: 477. https://doi.org/10.1007/s10910-017-0801-5

[†]Undergraduate student under my supervision

## Selected Awards

**NSERC Postdoctoral fellowship**: Wolfson Center for Mathematical Biology, University of Oxford — Declined
Government of Canada
Declined for permanent position at University of Leeds

**Institut Mittag-Leffler Junior Fellowship** — 2018
Institut Mittag-Leffler

**NSERC Postgraduate Scholarships: Doctoral Award** — 2018-2021
Government of Canada

**FRQNT Doctoral Scholarship** — Declined
Government of Quebec
Declined for NSERC PGS award

**Sir James Lougheed Award of Distinction** — 2015, 2017
Government of Alberta

## Research Grants

**EPSRC Small Maths Grants** (£99 810) — 2024-25
The dynamics of waning and boosting of immunity: new modelling and numerical tools
Role: Co-lead. University of Leeds

**EPSRC Summer Vacation Internship** (£3700) — 2024
Mathematical modelling of Antibody Mediated Prevention of HIV-1 Infection
University of Leeds, EPSRC

**Heilbronn Small Grant** (£1300) — 2023
Workshop on continuous adaptation to treatment, University of Leeds
Heilbronn Institute

**Travel awards** — 2018-present
SIAM Student Travel Award (2018, 2019)
LMS Travel Award (2022, 2024)
QJMAM Fund for Applied Mathematics (2024)
ISM Travel Award (2019)

## Student Mentoring

*Graduate Students*

- Rachel Sousa: Development of resistance in the MAPK pathway, Pfizer Oncology Research Unit-Boulder, 2022
- Merion Flower: Modelling antiviral effects of broadly neutralizing antibodies against HIV-1 (MSc thesis), University of Leeds, 2024-2025.
- Linjie Huang: Intracellular models of the HIV life-cycle, MSc thesis, University of Leeds, 2025

*Undergraduate Honours Research Project*

- Jean Chillet: Characteristic Roots of Gamma Distributed Delay Differential Equations, McGill University
- Peter Gillich: Numerical Methods for Gamma Distributed Delay Differential Equations, McGill University

*Undergraduate Summer Research*

- Merion Flower: Mathematical modelling of Antibody Mediated Prevention of HIV-1 Infection, EPSRC Summer Vacation Internship, 2024, University of Leeds
- Harry Coldwell: Dynamics in Structured Epidemic Models with infinite delays, School of Mathematics Summer Bursary, 2024, University of Leeds
- Peter Gillich: Numerical Methods for Gamma Distributed Delay Differential Equations, NSERC USRA, 2019, McGill University
- Katia Belaid: Optimizing Combination Oncolytic Virus Therapies, 2019, Université de Montréal

## Teaching

*Instructor of Record*:

- MATH 1005: Core mathematics (Ordinary differential equations), 2023, University of Leeds
- MATH 2391: Nonlinear differential equations, (2024, 2025), University of Leeds

*Supervisor*:

- MATH 3001: Project in Mathematics, Mathematical biology, (2023-present), University of Leeds
- MATH 8001: Undergraduate industrial placement, University of Leeds, (2024-present)

*Examiner*:

- MATH 3001: Project in Mathematics, Symmetry in Escher's Drawings, Dynamics on Networks (2022-present), University of Leeds
- MATH 5001/5003/5004: MSc/MMath dissertations, 2024-present, University of Leeds

*Teaching Assistant*:

- MATH 141: Calculus II (2017, 2018) [Departmental Teaching Assistant Award, 2017 and 2018], McGill University
- MATH 122: Calculus for Management (2016), McGill University
- STATQ 151: Applied Statistics (2013), University of Alberta
- MATHQ 100: Beginner Calculus I (2013), University of Alberta
- MATHQ 101: Beginner Calculus II (2014, 2015), University of Alberta
- MATHQ 102: Applied Linear Algebra (2013, 2014, 2015), University of Alberta
- MATHQ 113: Introductory Calculus I (2013, 2014), University of Alberta

## Invited Talks

1. SIAM/CAIMS Joint Annual Meeting, 07/2025
   Session: Advances in Modeling Cancer Progression and Treatment Part
2. Society of Mathematical Biology Annual Meeting, 07/2025
   Session: Delayed and structured dynamics of infection and epidemic models
3. Society of Mathematical Biology Annual Meeting, 07/2025
   Session: Bioinference: diverse approaches to inference and identifiability in biology
4. Roskilde University Mathematical Biology Seminar, 06/2025
5. Grinnell College Mathematics Colloquium, 04/2025
6. University of British Colombia Microbiology & Immunology and Mathematics Departmental Seminar, 01/2025
7. Colby College Mathematics Departmental Seminar, 12/2024
8. Centre de Recherches Mathématiques Applied Mathematics Seminar, 10/2024
9. Plenary presentation: Fields Institute Workshop on Tumour Immune Interactions, 10/2024
10. University of Melbourne Seminar on Mathematical Biology, 09/2024
11. MATRIX Institute Workshop on Parameter Identifiability in Biological Models, 09/2024
12. Queensland University of Technology School of Mathematics Seminar, 09/2024
13. Los Alamos National Laboratory Theoretical Biology and Biophysics Seminar, 08/2024
14. University of Exeter Dynamical Systems Seminar, 06/2024
15. Cornell College Mathematics Seminar, 04/2024
16. University of Iowa Mathematical Biology Seminar, 04/2024
17. University of Oxford Mathematical Biology and Ecology Seminar, 11/2023
18. University of Sheffield Mathematical Biology Seminar, 11/2023

19. City, University of London School of Mathematics Seminar, 10/2023
20. University of Udine Computational Dynamics Seminar, 10/2023
21. British Society of Immunology Mathematical Immunology and Virology Meeting, 05/2023
22. Quantitative T-cell Immunology and Immunotherapy conference, 05/2023
23. Grinnell College Mathematics and Statistics Colloquium, 04/2023
24. LMS workshop on the mathematics of delayed phenomena, 03/2023
25. University of Leeds Applied Mathematics Seminar, 03/2023
26. Pfizer Excellence: Scientific Seminar Series, 07/2022
27. Colorado School of Mines Quantitative Biosciences and Engineering Seminar, 04/2022
28. Symposium Annuel en Mathématiques pour un Avenir en Recherche et en Industrie, 03/2022
29. Creighton University Mathematical Medicine Seminar, 01/2022
30. CRM Computational Modelling of Cancer Biology and Treatments, 07/2021
31. Albion College FURSCA Seminar , 06/2021
32. Pfizer, Inc. Early Clinical Development Seminar, 05/2021
33. SIAM/CAIMS Joint Annual Meeting, 07/2020 Session: Delay equations for structured dynamics: theory, numerics and applications
34. York University Laboratory of Industrial and Applied Mathematics Seminar, 05/2020
35. Los Alamos National Laboratory Theoretical Biology and Biophysics Seminar, 02/2020
36. Université de Montréal Student Seminar, 10/2019
37. Society for Mathematical Biology Annual Meeting, 07/2019
    Session: Quantitative approaches to unravel immune function and immunity
38. Canadian Applied and Industrial Mathematics Society Annual Meeting, 06/2019
    Session: Quantitative Systems Pharmacology
39. Helmholtz Center for Infection Research Systems Immunology Seminar, 03/2019
40. Pfizer Inc. Quantitative Systems Pharmacology in Early Clinical Development Seminar, 02/2019
41. Moffitt Cancer Center Integrated Mathematical Oncology Seminar, 02/2019
42. Université de Montréal Séminaire de biologie quantitative et computationnelle, 01/2019
43. University of Nottingham Centre for Mathematical Medicine and Biology Seminar, 11/2018
44. Center for Applied Mathematics in Biology and Medicine Seminar, 01/2017
45. Society of Industrial and Applied Mathematics Life Sciences Meeting, 07/2016
    Session: Better Medicine Through Mathematics

## Professional Service

**Journal editorial board**
Academic editor, *PLoS Computational Biology* 2025-present

**Grant review**
Expert Reviewer: Engineering and Physical Sciences Research Council, UKRI, 2025
Expert Reviewer: Medical Research Council, UKRI, 2025
Expert Reviewer: Pancreatic Cancer UK, 2025

**Committee membership**
*University of Leeds School of Mathematics Research and Innovation Committee* 2023-present
Early career representative

**Seminar Organizer**
*University of Leeds Mathematical Biology Seminar* 2023-present

**Workshop Organizer**
2.*Workshop on continuous adaptation to treatment*
University of Leeds, 2023

1. *Problems and solutions in lifting individual behaviour to population level dynamics*
CRM-CAMBAM Workshop in Mathematical Biology 2020

**Session Organizer**

4. *Delayed and structured dynamics of infection and epidemic models*
Society for Mathematical Biology Annual Meeting 2015

3. *Delay equations in biology*
IFAC-TDS 2024

2. *Numerical methods for population models in biology*
SCICADE 2022

1. *Quantitative approaches to unravel immune function and immunity*
Society for Mathematical Biology Annual Meeting 2019

**Reviewer**

*Lancet Global Health, SIAM Journal on Dynamical Systems, Royal Society Interface, npj Systems Biology, Infectious Disease Modelling, Royal Society Open Science, Journal of Theoretical Biology, Journal of Biological Systems, Bulletin of Mathematical Biology, eLife, Journal of Pharmacokinetics and Pharmacodynamics, PLOS Computational Biology, Mathematical Medicine and Biology, ImmunoInformatics, Journal of Biological Dynamics, Physical Review E, Frontiers in Oncology, Applied Mathematics and Computation, PLOS One, Computers and Mathematics with Applications, Mathematical Biosciences and Engineering, Chaos: An Interdisciplinary Journal of Nonlinear Science, Journal of Mathematical Biology, Progress in Biophysics and Molecular Biology, International Journal for Numerical Methods in Biomedical Engineering*

**CAMBAM Student Seminar** 2016-2018
Organizer of a Montréal wide weekly mathematical biology student seminar
Montréal, Quebec, Canada