

## EDUCATION

### Doctor of Philosophy in Physics

2017 – 2020

Monash University, Australia

**Thesis title:** Superwalking Droplets and Generalised Pilot-Wave Dynamics

**Supervisors:** Assoc. Prof. Anja Slim, Assoc. Prof. Tapio Simula, Prof. Kristian Helmerson

### Dual Degree: Bachelor of Aerospace Engineering (Honours) and Bachelor of Science

2012 – 2016

Monash University, Australia

**Majors:** Aerospace Engineering, Physics, Mathematics

GPA/WAM=3.861/86.879

**Thesis title:** A numerical study of flow past a forced oscillating circular cylinder at low Reynolds number

## AWARDS & PRIZES

### Research/Academic Excellence

- [2024 Edward N. Lorenz Early Career Award](#) by the American Institute of Physics (AIP) journal Chaos - 2025
- [Robert Street Doctoral Prize for best PhD thesis](#) presented by the School of Physics and Astronomy, Monash University - 2021
- [Postgraduate Publication Award](#) by Faculty of Science, Monash University - awarded \$5000 (AUD) for preparation and publication of PhD research – 2020
- [2020 Norris Family Award for Outstanding Research Output by a Graduate Research Student](#) by the Faculty of Science, Monash University - 2020
- [J L William Postgraduate Top Up Scholarship](#) - \$5000 (AUD) per year, awarded to high achieving PhD students - 2017
- [Best in School Award](#) – School of Physics and Astronomy at Monash University - awarded for achieving highest score in 3<sup>rd</sup> year Physics undergraduate units - 2016
- [Dean's List for Outstanding Academic Achievement](#) - awarded for 4 consecutive years, awarded to students achieving an average of 85% or above in that year – 2012-16
- Australian Mathematical Science Institute (AMSI) [Summer Research Scholarship](#) - awarded \$500 (AUD) per week for 6 weeks to undertake an undergraduate summer research project - 2015

### Research Communication

- The [QJMAM Travel Fund](#) for Applied Mathematics to attend MATRIX workshop in Creswick, Australia - 2025
- [Travel award from The CASS Foundation](#) to present at the Society of Industrial and Applied Mathematics Dynamical Systems (SIAMDS23) conference in Portland, USA – 2023
- [Best presentation award](#) in the 'Dynamical systems methods in Natural Sciences' symposium at the Nonlinear Science & Complexity (NSC) conference (online) – 2022
- [Award for research communication](#) for poster presentation at the Australasian Fluid Mechanics Society (AFMS) Retreat, University of Melbourne – 2022
- [T.M. Cherry award for best student presentation](#) at ANZIAM conference (online) - 2021
- [Runner-up](#) for 3-minute thesis (3MT) competition in the Faculty of Science, Monash University - 2019
- [Best student presentation award](#) at the 8<sup>th</sup> Meeting on Hydrodynamics Quantum Analogs, Brown University, Rhodes Island, USA - 2018

### Outreach

- [First place](#) in Maths Outreach & [Third place](#) in Maths Art for the CARMA-Matrix Maths Art/Poster Competition – 2022
- [Second place](#) in Maths Outreach for the CARMA-Matrix Maths Art/Poster Competition – 2023

## LIST OF PUBLICATION

Publication list can be found at: <https://rahilvalani.com/publications/>

## GRANTS/FUNDING

- **Awarded Leverhulme-Peierls fellowship** at the University of Oxford
- **Awarded** (did not accept) an Australian Research Council Discovery Early Career Research Award (DECRA) DP250100435 (2025-2028) – Attractor-driven matter (465,331 AUD)
- **Partner Investigator** on Australian Research Council Discovery Project DP240101089 (2024-2027) - Mathematics to underpin and drive novel inertial microfluidic technologies (454,573 AUD)

## PROFESSIONAL RESEARCH POSITIONS

|  |                     |
|--|---------------------|
| University of Oxford – Oxford, UK<br><b>Leverhulme-Peierls fellow at Rudolf Peierls Centre for Theoretical Physics</b> | Apr 2024 – Current  |
| University of Adelaide - Adelaide, SA<br><b>ARC Grant Funded Postdoctoral Researcher</b>                               | Feb 2021 – Apr 2024 |
| School of Mathematical Sciences - Monash University, Clayton, VIC<br><b>Research Assistant</b>                         | Jun 2015 - Feb 2017 |

## PROFESSIONAL TEACHING POSITIONS

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| University of Oxford – Oxford, UK<br><b>Tutor</b>                      | Jan 2025- Current<br><u>Courses:</u> B1 Fluids   |
| The University of Adelaide - Adelaide, SA<br><b>Course coordinator</b> | Feb 2023- Jun 2023<br><u>Courses:</u> APP MTH 4046 – Chaos with applications Honours/Masters course  |
| Monash College - Melbourne, VIC<br><b>Teaching Professional</b>        | Feb 2019- Dec 2020<br><u>Courses:</u> MCD4160 – Physics for Engineering, MCD1200 – Physics A   |
| Monash University - Melbourne, VIC<br><b>Teaching Assistant</b>        | Mar 2017 – Dec 2020<br><u>Courses:</u> ECE3093 – Optimisation, Estimation and Numerical Methods ( <i>Semester 1 – 2019</i> ), MTH3360 – Fluid Dynamics ( <i>Semester 1 – 2017 and 2018</i> ) and PHS2061 and PHS2062 – 2 <sup>nd</sup> year Physics ( <i>Semester 1 and 2 – 2017</i> ) |

## MENTORING & SUPERVISION

- Jack Dring – Summer research undergraduate student – Monash University – July 19
- James Day – Summer research undergraduate student – University of Adelaide – Dec 20/Jan 21
- Joshua Perks – Summer research undergraduate student – University of Adelaide – Jan 21/Feb 23
- Runze Xu – Summer research undergraduate student – University of Adelaide – Dec 23/Jan 24
- Simranjeet Dahia – Summer research undergraduate student – University of Adelaide – Dec 23/Jan 24
- Oliver Preest – Undergraduate research project – University of Oxford – Sep 24/May 25

## PRESENTATIONS & TALKS

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|---|--------------------------------------|
| <b>Dynamics of an active wave-particle entity in a non-smooth potential</b>                         | 9 <sup>th</sup> Dec 2025             |
| Euromech Colloquium on Recent Advances in Non-smooth Dynamics                                       | University of Exeter, UK             |
| <b>Nematic order from phase synchronization of shape oscillations</b>                               | 4 <sup>th</sup> Dec 2025             |
| Slender and Active conference, Institute of Physics (IOP)   | University of Edinburgh, UK          |
| <b>Hamiltonian formalism for active particles in channel flow</b>                                   | 20 <sup>th</sup> Nov 2025            |
| 3 <sup>rd</sup> London workshop on Active Matter  | Kings College London, UK             |
| <b>Nonlinear dynamics of a microswimmer in channel flows</b>  | 22 <sup>th</sup> Sep 2025            |
| Oxford-Japan Symposium on Cell Behaviors  | Mathematical Institute, Oxford       |
| <b>Nonlinear dynamics of passive and active particles in microchannel flows (<i>Invited</i>)</b>    | 24 <sup>th</sup> Jul 2025            |
| Melbourne Mathematical Biology Seminar  | University of Melbourne, Australia   |
| <b>Nonlinear dynamics of particle-fluid interactions (<i>Invited</i>)</b>                           | 15 <sup>th</sup> Jul 2025            |
| MATRIX workshop on slow viscous flows with interfaces   | Creswick, Australia                  |
| <b>Attractor-driven matter</b>  | 24 <sup>th</sup> Jul 2025            |
| NODYCON 2025  | Online                               |
| <b>Nonlinear dynamics of passive and active particles in channel flows (<i>Invited</i>)</b>         | 20 <sup>th</sup> Jun 2025            |
| Mathematical Biology and Ecology Seminar Series, Mathematical Institute                             | University of Oxford, UK             |
| <b>Asymmetric Limit Cycles within Lorenz Chaos Drive Uphill Motion for an Active Particle</b>       | 12 <sup>th</sup> May 2025            |
| SIAMDS25 (Society of Industrial and Applied Mathematics Dynamical Systems) Conference               | Denver, USA                          |
| <b>Active wave-particle entities</b>  | 28 <sup>th</sup> Apr 2025            |
| 2 <sup>nd</sup> London Workshop on Active Matter  | London, UK                           |
| <b>Intermittent migration of a cell cluster in a confluent tissue (Poster)</b>                      | 25 <sup>th</sup> Mar 2025            |
| Institute of Physics, Physics of Life conference  | Harrogate, UK                        |
| <b>Intermittent migration of a cell cluster in a confluent tissue</b>                               | 20 <sup>th</sup> Mar 2025            |
| American Physical Society's Global Physics Summit   | Anaheim, USA                         |
| <b>Anomalous transport of a memory-driven active particle (Poster)</b>                              | 19 <sup>th</sup> Mar 2025            |
| American Physical Society's Global Physics Summit   | Anaheim, USA                         |
| <b>Nonlinear dynamics of passive and active particles in channel flows (<i>Invited</i>)</b>         | 3 <sup>rd</sup> Feb 2025             |
| Mathematical Modelling for Biology, Health, and Environment Seminar Series                          | Queens Mary University of London, UK |
| <b>Attractor-driven matter</b>  | 17 <sup>th</sup> Sep 2024            |
| Nonlinear dynamics in Electronic Systems (NDES) 2024  | Graechen, Switzerland                |
| <b>Tipping phenomena in inertial focusing of particles</b>  | 5 <sup>th</sup> Sep 2024             |
| Metastability & Tipping conference 2024   | Leicester, UK                        |
| <b>Lorenz-like systems and active wave-particle entities</b>  | 26 <sup>th</sup> Aug 2024            |
| Nonlinear Science & Complexity (NSC) conference 2024  | Online                               |
| <b>Active particle motion in Poiseuille flow through rectangular channels</b>                       | 23 <sup>rd</sup> May 2024            |
| EUROMECH Colloquium on Nonlinear Dynamics at Zero Reynolds Number                                   | London, UK                           |
| <b>Tipping phenomena in inertial focusing and separation of particles</b>                           | 14 <sup>th</sup> Feb 2024            |
| ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) Conference                   | Adelaide Hills, Australia            |
| <b>Attractor-driven matter</b>  | 13 <sup>th</sup> Jan 2024            |
| Days of Applied Nonlinearity and Complexity (DANOC) 2024  | Online                               |
| <b><u>Inertial particle focusing in curved ducts: Bifurcation and dynamics</u> (<i>Invited</i>)</b> | 5 <sup>th</sup> July 2023            |
| Physics of Fluid Cassyni Seminar Series   | Online                               |
| <b>Inertial particle focusing in curved ducts: Bifurcation and dynamics</b>                         | 16 <sup>th</sup> May 2023            |
| SIAMDS23 (Society of Industrial and Applied Mathematics Dynamical Systems) Conference               | Portland, USA                        |
| <b>Inertial particle focusing in curved ducts: Bifurcation and dynamics</b>                         | 9 <sup>th</sup> Feb 2023             |
| ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) Annual Conference            | Cairns, Australia                    |
| <b>Attractor-driven matter</b>  | 8 <sup>th</sup> Feb 2023             |
| ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) Annual Conference            | Cairns, Australia                    |
| <b>Inertial particle focusing in curved ducts: Bifurcation and dynamics</b>                         | 22 <sup>nd</sup> Nov 2022            |
| 75 <sup>th</sup> Annual Meeting of the American Physical Society's Division of Fluid Dynamics       | Indianapolis, USA                    |
| <b>Inertial particle focusing dynamics in curved ducts</b>  | 16 <sup>th</sup> Nov 2022            |
| Statistics and Mathematical Modelling in Combination Conference (SMMC 2022)                         | Melbourne, Australia                 |

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|--|---|
| <b>Bifurcations and dynamics in inertial particle focusing in curved ducts</b>                     | 7 <sup>th</sup> Nov 2022                        |
| SA ANZIAM Meeting 2022   | Adelaide, Australia                             |
| <b>Anomalous transport in a Lorenz-like system</b> ( <i>Best presentation award in symposium</i> ) | 27 <sup>th</sup> Sep 2022                       |
| Nonlinear Science & Complexity (NSC) conference 2022   | Online  |
| <b>Inertial particle focusing in curved ducts</b>  | 18 <sup>th</sup> Jul 2022                       |
| Australasian Fluid Mechanics Society (AFMS) Retreat  | University of Melbourne, Melbourne, Australia   |
| <b>Strange-attractor-driven matter</b>   | 15 <sup>th</sup> Jul 2022                       |
| 8 <sup>th</sup> Statistical Mechanics of Soft Matter Conference                                    | Monash University, Melbourne, Australia         |
| <b>Inertial particle focusing dynamics in curved ducts</b>   | 5 <sup>th</sup> Jul 2022                        |
| NSW ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) meeting                 | Virtual   |
| <b><u>Superwalking Droplets &amp; Generalised Pilot-Wave Dynamics</u></b> ( <i>Invited</i> )       | 24 <sup>th</sup> May 2022                       |
| AFMS (Australasian Fluid Mechanics Society) Conversations in Fluids Seminar Series                 | Virtual   |
| <b>Bifurcations and dynamics in inertial focusing of particles in curved rectangular ducts</b>     | 7 <sup>th</sup> Feb 2022                        |
| ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) Annual Conference           | Virtual   |
| <b>Bifurcations in inertial focusing of particles in curved rectangular ducts</b>                  | 9 <sup>th</sup> Dec 2021                        |
| 16th International Conference on Dynamical Systems Theory and Applications (DSTA)                  | Virtual   |
| <b>Superwalking droplets</b> ( <i>Best student presentation</i> )                                  | 1 <sup>st</sup> Feb 2021                        |
| ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) Annual Conference           | Virtual   |
| <b>Stop-and-go motion of Superwalking droplets</b>   | 14 <sup>th</sup> Dec 2020                       |
| Statistical Mechanics of Soft Matter Meeting   | Virtual   |
| <b>Emergence of Superwalking droplets</b>  | 24 <sup>th</sup> Nov 2020                       |
| 73rd Annual Meeting of the American Physical Society's Division of Fluid Dynamics                  | Virtual   |
| <b>Superwalking droplets</b>   | 17 <sup>th</sup> Dec 2019                       |
| Statistical Mechanics of Soft Matter Meeting   | University of Adelaide, Adelaide, Australia     |
| <b>Superwalking droplets</b>   | 6 <sup>th</sup> Dec 2019                        |
| Australian Institute of Physics Summer Meeting   | RMIT, Melbourne, Australia                      |
| <b>Superwalking droplets</b>   | 26 <sup>th</sup> Nov 2019                       |
| 72nd Annual Meeting of the American Physical Society's Division of Fluid Dynamics                  | Seattle, USA                                    |
| <b>Superwalking droplets</b> ( <i>Invited</i> )  | 7 <sup>th</sup>                                 |
| May 2019   |   |
| Fluids Seminar Series  | Monash University, Melbourne, Australia         |
| <b>Many droplet dynamics and superwalkers</b> ( <i>Best student talk</i> )                         | 24 <sup>th</sup> Jul 2018                       |
| 8 <sup>th</sup> Meeting on Hydrodynamic Quantum Analogs  | Brown University, Providence, Rhode Island, USA |

## SCIENCE OUTREACH

### Gallery of fluid motion posters & videos 2019-2022

I created videos and posters about my research that are accessible to the general public and visually aesthetic.

Videos: [Superwalking droplets](#), [DIY superwalking droplets](#), [Inertial particle focusing in curved ducts](#)

Posters: [Superwalking droplets](#), [Fun with superwalking droplets](#), [Inertial particle focusing in curved ducts](#)

### Mathscraft workshops Nov 2021

Assisted as a Mathematician at the workshop to provide school maths teachers an experience of doing maths like a research mathematician

### Youtube outreach video Nov 2021

I was interviewed by **Dr. Tom Crawford (University of Oxford)** for my PhD work on superwalking droplets. The video is uploaded on his **Maths outreach channel 'Tom Rocks Maths'**: <https://youtu.be/RaqbTswDF9A>

### Biophysics impact day – Oxford Physics June 2025

Interactive activity showing active matter with superwalking droplets and Boids flocking algorithm for Grade 10 students during Biophysics impact day 2025 at University of Oxford