

RAHIL VALANI

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EDUCATION

- Doctor of Philosophy in Physics/Applied Mathematics** 2017 – 2020
Monash University
Thesis title: Superwalking Droplets and Generalised Pilot-Wave Dynamics
- Dual Degree: Bachelor of Aerospace Engineering (Honours) and Bachelor of Science** 2012 – 2016
Monash University
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

LIST OF PUBLICATIONS

- **Rahil N. Valani**, David M. Paganin. *Attractor-driven matter*, Chaos **33**, 023125 (2023). <https://doi.org/10.1063/5.0107401>
- David Müller-Bender, **Rahil N. Valani**, Günter Radons, *Pseudo-laminar chaos from on-off intermittency*, Physical Review E, **107**, 014208 (2023) <https://doi.org/10.1103/PhysRevE.107.014208>
- **Rahil N. Valani**, Brendan Harding and Yvonne Stokes. *Utilizing bifurcations to separate particles in spiral inertial microfluidics*, Physics of Fluids, **35**, 011703 (2023). <https://doi.org/10.1063/5.0132151>
- **Rahil N. Valani**, Brendan Harding and Yvonne Stokes. *Bifurcations and dynamics in inertial focusing of particles in curved rectangular ducts*, SIADS **21**, 2371-2392 (2022). <https://doi.org/10.1137/21M1451919>
- **Rahil N. Valani**. *Lorenz-like systems emerging from an integro-differential trajectory equation of a one-dimensional wave-particle entity*, Chaos **32**, 023129 (2022). <https://doi.org/10.1063/5.0076162>
- **Rahil N. Valani**. *Anomalous transport of a classical wave-particle entity in a tilted potential*, Physical Review E (Letter) **105**, L012101 (2022). <https://doi.org/10.1103/PhysRevE.105.L012101>
- **Rahil N. Valani**, David M. Paganin, A.C. Slim, T. Simula and Theodore Vo. *Unsteady dynamics of a classical particle-wave entity*, Physical Review E **104**, 015106 (2021). <https://doi.org/10.1103/PhysRevE.104.015106>
- **Rahil N. Valani**, A.C. Slim and T. Simula. *Stop-and-go locomotion of superwalking droplets*, Physical Review E, **103**, 043102 (2021). <https://doi.org/10.1103/PhysRevE.103.043102>
- **Rahil N. Valani**, Jack Dring, Tapio P. Simula and Anja C. Slim, *Emergence of superwalking droplets*, Journal of Fluid Mechanics **906**, A3 (2021). <https://doi.org/10.1017/jfm.2020.742>
- **Rahil N. Valani**, Anja C. Slim, Tapio P. Simula, *Superwalking Droplets*, Physical Review Letters **123**, 024503. (2019). <https://doi.org/10.1103/PhysRevLett.123.024503>
 - Focus story published in APS Physics <https://physics.aps.org/articles/v12/80>
 - Media article published in phys.org <https://phys.org/news/2019-07-droplets-liquid-surface.html>
 - Media article published in physicscentral.com <https://www.physicscentral.com/buzz/blog/index.cfm?postid=5353019309395046474>
 - Featured on ‘Tom Rocks Maths’ youtube channel for Maths outreach https://www.youtube.com/watch?v=RaqbTswDF9A&ab_channel=TomRocksMaths
- **Rahil N. Valani**, Anja C. Slim, *Pilot-wave dynamics of two identical, in-phase bouncing droplets*, Chaos **28**, 096114 (2018). <https://doi.org/10.1063/1.5032128> (Editor’s pick)
- **Rahil N. Valani**, Anja C. Slim, Tapio P. Simula, *Hong-Ou-Mandel-like two-droplet correlations*, Chaos **28**, 096104 (2018). <https://doi.org/10.1063/1.5032114>
- **Rahil N. Valani**, Andrew J. Groszek, Tapio P. Simula, *Einstein-Bose condensation of Onsager Vortices*, New Journal of Physics **20**, 053038 (2018). <https://doi.org/10.1088/1367-2630/aac0bb>

AWARDS and PRIZES

First place in Maths Outreach CARMA-Matrix Maths Art/Poster Competition 2022	2022
Third place in Maths Art CARMA-Matrix Maths Art/Poster Competition 2022	2022
Best presentation in the ‘Dynamical systems methods in Natural Sciences’ symposium Nonlinear Science & Complexity (NSC) conference online 2022, Greece	2022
Award for research communication Australasian Fluid Mechanics Society (AFMS) Retreat, University of Melbourne	2022
Robert Street Doctoral Prize for best PhD thesis School of Physics and Astronomy, Monash University	2021
T.M. Cherry award for best student presentation at ANZIAM conference	2021
Postgraduate Publication Award by Faculty of Science, Monash University Awarded \$5000 for preparation and publication of PhD research	2020
2020 Norris Family Award for Outstanding Research Output by a Graduate Research Student Faculty of Science, Monash University	2020
Runner-up for 3-minute thesis (3MT) competition in the Faculty of Science, Monash University	2019
‘Best student presentation award’ at the 8 th Meeting on Hydrodynamics Quantum Analogs Brown University, Rhodes Island, USA	2018
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 rd 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 a summer research project	2015

CONFERENCE PRESENTATIONS & TALKS

Inertial particle focusing in curved ducts: Bifurcation and dynamics ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) Annual Conference	9 th Feb 2023 Cairns, Australia
Attractor-driven matter ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) Annual Conference	8 th Feb 2023 Cairns, Australia

Inertial particle focusing in curved ducts: Bifurcation and dynamics 75 th Annual Meeting of the American Physical Society's Division of Fluid Dynamics	22 nd Nov 2022 Indianapolis, USA
Inertial particle focusing dynamics in curved ducts Statistics and Mathematical Modelling in Combination Conference (SMMC 2022)	16 th Nov 2022 Melbourne, Australia
Bifurcations and dynamics in inertial particle focusing in curved ducts SA ANZIAM Meeting 2022	7 th Nov 2022 Adelaide, Australia
Bifurcations and dynamics in inertial particle focusing in curved ducts Nonlinear Science & Complexity (NSC) conference 2022	28 th Sep 2022 Online
Anomalous transport in a Lorenz-like system modelling the dynamics of a classical wave-particle entity (<i>Best presentation award in symposium</i>) Nonlinear Science & Complexity (NSC) conference 2022	27 th Sep 2022 Online
Inertial particle focusing in curved ducts Australasian Fluid Mechanics Society (AFMS) Retreat	18 th Jul 2022 University of Melbourne, Melbourne, Australia
Strange-attractor-driven matter 8 th Statistical Mechanics of Soft Matter Conference	15 th Jul 2022 Monash University, Melbourne, Australia
Inertial particle focusing dynamics in curved ducts NSW ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) meeting	5 th Jul 2022 Virtual
<u>Superwalking Droplets & Generalised Pilot-Wave Dynamics</u> AFMS (Australasian Fluid Mechanics Society) Conversations in Fluids Seminar Series	24 th May 2022 Virtual
Anomalous transport of a classical wave-particle entity ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) Annual Conference	10 th Feb 2022 Virtual
Bifurcations and dynamics in inertial focusing of particles in curved rectangular ducts ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) Annual Conference	7 th Feb 2022 Virtual
Bifurcations in inertial focusing of particles in curved rectangular ducts 16th International Conference on Dynamical Systems Theory and Applications (DSTA)	9 th Dec 2021 Virtual
Superwalking droplets (<i>Best student presentation</i>) ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) Annual Conference	1 st Feb 2021 Virtual
Stop-and-go motion of Superwalking droplets Statistical Mechanics of Soft Matter Meeting	14 th Dec 2020 Virtual
Emergence of Superwalking droplets 73rd Annual Meeting of the American Physical Society's Division of Fluid Dynamics	24 th Nov 2020 Virtual
Superwalking droplets Statistical Mechanics of Soft Matter Meeting	17 th Dec 2019 University of Adelaide, Adelaide, Australia

Superwalking droplets Australian Institute of Physics Summer Meeting	6 th Dec 2019 RMIT, Melbourne, Australia
Superwalking droplets 72nd Annual Meeting of the American Physical Society's Division of Fluid Dynamics	26 th Nov 2019 Seattle, USA
Superwalking droplets Fluids Seminar Series	7 th May 2019 Monash University, Melbourne, Australia
Many droplet dynamics and superwalkers (<i>Best student talk</i>) 8 th Meeting on Hydrodynamic Quantum Analogs	24 th Jul 2018 Brown University, Providence, Rhode Island, USA
Many-droplet Hydrodynamic Quantum Analogs Victorian ULtraCold Atoms Network (VULCAN) Workshop	22 th Sep 2017 Swinburne University, Melbourne, Australia
Einstein-Bose Condensation of Onsager Vortices Conference on Optics, Atoms and Laser Applications (KOALA)	27 th Nov 2016 Monash University, Melbourne, Australia
A Numerical Study of Flow past a Forced Oscillating Cylinder American Institute of Aeronautics and Astronautics (AIAA) Student Conference	21 th Nov 2016 Monash University, Melbourne, Australia

MENTORING

- *Jack Dring* – Summer research project undergraduate student – Monash University – July 2019
 - Worked on experiments of superwalking droplets and theoretical modelling of bouncing and walking droplets. This work led to a publication in the Journal of Fluid Mechanics
- *James Day* – Summer research project undergraduate student – University of Adelaide – Dec 2020/Jan 2021
 - Worked on integrability of Lorenz-like dynamical systems emerging from the walking-droplet system and investigating a wave-particle entity in a harmonic potential
- *Joshua Perks* – Summer research project undergraduate student – University of Adelaide – Jan 2021/Feb 2021
 - Worked on dynamics and stability of a wave-particle entity in a sinusoidal potential

PROFESSIONAL RESEARCH WORK EXPERIENCE

University of Adelaide - Adelaide, SA

Feb 2021 - Current

ARC Grant Funded Postdoctoral Researcher

Key Responsibilities:

- Undertaking cutting edge research in mathematical analysis of particle dynamics in fluid flows inside curved ducts using analytical and computational tools. *This research will have potential application in 'liquid biopsy' – the isolation of circulating tumor cells (CTCs) from blood samples*
- Communicate the research outputs by publishing in high impact international journals and presenting at both national and international conferences

Vacation Student Engineer**Key Responsibilities:**

- Developing flow charts to understand data flow of a cable simulator software
 - Understanding and implementing analytical models for a cable/strand under tension and bending loads
 - Investigating analytical models for enhancing wave energy production and performing numerical analysis in MathCAD and MATLAB
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Research Assistant**Key Responsibilities:**

- Developing a mathematical model to perform quantitative study of a dynamical system of two bouncing droplets on a vibrating bath
 - Working independently to analyze the numerical results obtained from MATLAB and verifying with analytical approximations and experiments
 - Using effective communication skills to convey the work to colleagues and academics through clear explanations of unfamiliar concepts during group meetings
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PROFESSIONAL TEACHING EXPERIENCE**Teaching Professional****Courses:** MCD4160 – Physics for Engineering, MCD1200 – Physics A**Key Responsibilities:**

- Teaching Physics and Engineering to a class of diverse senior international diploma students
 - Conducting Lab session where I guide students in performing Physics experiments and help them connect the theoretical concepts to hands-on experiments
 - Occasionally conducting lectures and tutorials where I teach them theoretical concepts in Physics and Engineering
-

Teaching Assistant**Courses:** ECE3093 – Optimisation, Estimation and Numerical Methods (*Semester 1 – 2019*), MTH3360 – Fluid Dynamics (*Semester 1 – 2017 and 2018*) and PHS2061 and PHS2062 – 2nd year Physics (*Semester 1 and 2 – 2017*)**Key Responsibilities:**

- Reviewing content covered in lectures and concepts that the students are struggling with
- Identifying students' learning gaps and assisting them in understand and applying the concepts learned in lecture to solve problem set

- Giving feedback to students on their work and help them become independent learners
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Teach Me Tutoring - Melbourne, VIC

Feb 2017- Current

Mathematics/Physics Tutor

Key Responsibilities:

- Assisting students one-on-one with high school Mathematics and Physics
 - Explain concepts to students and identifying and addressing their learning gaps
 - Help them develop good study habits and assist them in becoming independent learners
-

VOLUNTARY WORK AND EXTRA-CURRICULAR ACTIVITIES

Various roles - Community Centre, Vermont, Melbourne, VIC

2017 - Current

Conducted Science Workshops for primary school students at the local community center.

- Create hands-on experiments and engaging content every second school holidays for these students.
 - Train youth volunteers to assist in conducting this session.
 - Managing the full program by working effectively with different teams
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Mathscraft workshops

2021 - Current

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