

## RAHIL VALANI

Adelaide, Australia

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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**, 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](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

**Best presentation** in the ‘Dynamical systems methods in Natural Sciences’ symposium  
Nonlinear Science & Complexity (NSC) conference online 2022, Greece

2022

<b>Award for research communication</b> Australasian Fluid Mechanics Society (AFMS) Retreat, University of Melbourne	2022
<b>Robert Street Doctoral Prize</b> for best PhD thesis School of Physics and Astronomy, Monash University	2021
<b>T.M. Cherry award</b> for best student presentation at ANZIAM conference	2021
<b>Postgraduate Publication Award</b> by Faculty of Science, Monash University Awarded \$5000 for preparation and publication of PhD research	2020
<b>2020 Norris Family Award</b> for Outstanding Research Output by a Graduate Research Student Faculty of Science, Monash University	2020
<b>Runner-up</b> for 3-minute thesis (3MT) competition in the Faculty of Science, Monash University	2019
<b>‘Best student presentation award’</b> at the 8 <sup>th</sup> Meeting on Hydrodynamics Quantum Analogs Brown University, Rhodes Island, USA	2018
JL William Postgraduate Top Up <b>Scholarship</b> \$5000 (AUD) per year, awarded to high achieving PhD students	2017
<b>Best in School Award</b> – School of Physics and Astronomy at Monash University Awarded for achieving highest score in 3 <sup>rd</sup> year Physics undergraduate units	2016
<b>Dean’s List for Outstanding Academic Achievement</b> 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) <b>Summer Research Scholarship</b> Awarded \$500(AUD) per week for 6 weeks to undertake a summer research project	2015

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## CONFERENCE PRESENTATIONS & TALKS

<b>Inertial particle focusing in curved ducts: Bifurcation and dynamics</b> 75 <sup>th</sup> Annual Meeting of the American Physical Society’s Division of Fluid Dynamics	22 <sup>nd</sup> Nov 2022 Indianapolis, USA
<b>Inertial particle focusing dynamics in curved ducts</b> Statistics and Mathematical Modelling in Combination Conference (SMMC 2022)	16 <sup>th</sup> Nov 2022 Melbourne, Australia
<b>Bifurcations and dynamics in inertial particle focusing in curved ducts</b> SA ANZIAM Meeting 2022	7 <sup>th</sup> Nov 2022 Adelaide, Australia
<b>Bifurcations and dynamics in inertial particle focusing in curved ducts</b> Nonlinear Science & Complexity (NSC) conference 2022	28 <sup>th</sup> Sep 2022 Online
<b>Anomalous transport in a Lorenz-like system modelling the dynamics</b> 2022 <b>of a classical wave-particle entity</b> ( <i>Best presentation award in symposium</i> ) Nonlinear Science & Complexity (NSC) conference 2022	27 <sup>th</sup> Sep   Online

<b>Inertial particle focusing in curved ducts</b> Australasian Fluid Mechanics Society (AFMS) Retreat	18 <sup>th</sup> Jul 2022 University of Melbourne, Melbourne, Australia
<b>Strange-attractor-driven matter</b> 8 <sup>th</sup> Statistical Mechanics of Soft Matter Conference	15 <sup>th</sup> Jul 2022 Monash University, Melbourne, Australia
<b>Inertial particle focusing dynamics in curved ducts</b> 2022 NSW ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) meeting	5 <sup>th</sup> Jul Virtual
<b><u>Superwalking Droplets &amp; Generalised Pilot-Wave Dynamics</u></b> AFMS (Australasian Fluid Mechanics Society) Conversations in Fluids Seminar Series	24 <sup>th</sup> May 2022 Virtual
<b>Anomalous transport of a classical wave-particle entity</b> 2022 ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) Annual Conference	10 <sup>th</sup> Feb Virtual
<b>Bifurcations and dynamics in inertial focusing of particles in curved rectangular ducts</b> ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) Annual Conference	7 <sup>th</sup> Feb 2022 Virtual
<b>Bifurcations in inertial focusing of particles in curved rectangular ducts</b> 16 <sup>th</sup> International Conference on Dynamical Systems Theory and Applications (DSTA)	9 <sup>th</sup> Dec 2021 Virtual
<b>Superwalking droplets</b> ( <i>Best student presentation</i> ) ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) Annual Conference	1 <sup>st</sup> Feb 2021 Virtual
<b>Stop-and-go motion of Superwalking droplets</b> Statistical Mechanics of Soft Matter Meeting	14 <sup>th</sup> Dec 2020 Virtual
<b>Emergence of Superwalking droplets</b> 73 <sup>rd</sup> Annual Meeting of the American Physical Society's Division of Fluid Dynamics	24 <sup>th</sup> Nov 2020 Virtual
<b>Superwalking droplets</b> Statistical Mechanics of Soft Matter Meeting	17 <sup>th</sup> Dec 2019 University of Adelaide, Adelaide, Australia
<b>Superwalking droplets</b> Australian Institute of Physics Summer Meeting	6 <sup>th</sup> Dec 2019 RMIT, Melbourne, Australia
<b>Superwalking droplets</b> 72 <sup>nd</sup> Annual Meeting of the American Physical Society's Division of Fluid Dynamics	26 <sup>th</sup> Nov 2019 Seattle, USA
<b>Superwalking droplets</b> Fluids Seminar Series	7 <sup>th</sup> May 2019 Monash University, Melbourne, Australia
<b>Many droplet dynamics and superwalkers</b> ( <i>Best student talk</i> ) 8 <sup>th</sup> Meeting on Hydrodynamic Quantum Analogs	24 <sup>th</sup> Jul 2018 Brown University, Providence, Rhode Island, USA
<b>Many-droplet Hydrodynamic Quantum Analogs</b> Victorian ULtraCold Atoms Network (VULCAN) Workshop	22 <sup>th</sup> Sep 2017 Swinburne University, Melbourne, Australia

## Einstein-Bose Condensation of Onsager Vortices

2016

Conference on Optics, Atoms and Laser Applications (KOALA)

27<sup>th</sup> Nov

Monash University, Melbourne, Australia

## A Numerical Study of Flow past a Forced Oscillating Cylinder

American Institute of Aeronautics and Astronautics (AIAA)

Student Conference

21<sup>th</sup> Nov 2016

Monash University, Melbourne, Australia

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### 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
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### PROFESSIONAL RESEARCH WORK EXPERIENCE

University of Adelaide - Adelaide, SA

Feb 2021 - Current

#### ARC Grant Funded Postdoctoral Researcher

##### Key Responsibilities:

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- 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
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AMOG Consulting - Melbourne, VIC

Jun 2016 - Jul 2016

#### Vacation Student Engineer

##### Key Responsibilities:

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- 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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School of Mathematical Sciences - Monash University, Clayton, VIC

Jun 2015 - Feb 2017

## Research Assistant

### Key Responsibilities:

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- 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

Monash College - Melbourne, VIC

Feb 2019- Dec 2020

### Teaching Professional

Courses: MCD4160 – Physics for Engineering, MCD1200 – Physics A

### Key Responsibilities:

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- 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
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Monash University - Melbourne, VIC

Mar 2017 – Dec 2020

### Teaching Assistant

Courses: ECE3093 – Optimisation, Estimation and Numerical Methods (*Semester 1 – 2019*), MTH3360 – Fluid Dynamics (*Semester 1 – 2017 and 2018*) and PHS2061 and PHS2062 – 2<sup>nd</sup> year Physics (*Semester 1 and 2 – 2017*)

### Key Responsibilities:

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- 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:

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- 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
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## VOLUNTARY WORK AND EXTRA-CURRICULAR ACTIVITIES

**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**

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