

# Alexander Rawlings

## Theoretical Extragalactic Astrophysics

 [linkedin.com/in/alex-rawlings-008478119](https://www.linkedin.com/in/alex-rawlings-008478119)  [alexander.rawlings@helsinki.fi](mailto:alexander.rawlings@helsinki.fi)  
 Helsinki, Finland  Australian Citizen  ORCID: 0000-0003-1807-6321

I am a doctoral candidate in theoretical extragalactic astrophysics at the University of Helsinki, Finland. I am modelling gas-free simulations of massive galaxy mergers to constrain the merger timescale of supermassive black hole binary systems. The simulations are conceptualised with observations in mind, providing physically-motivated models which bring us a step closer to understanding the distribution of supermassive black hole binary systems in the observed universe.

## PROFESSIONAL EXPERIENCE

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<b>Present</b> <b>Sep 2021</b>	<b>Doctoral Candidate, University of Helsinki, Helsinki, Finland</b> <ul style="list-style-type: none"><li>&gt; Design and analysis of gas-free merger simulations with realistic initial conditions</li><li>&gt; Orbit modelling</li><li>&gt; Bayesian hierarchical modelling and Gaussian processes</li><li>&gt; Mock integral field unit observations</li><li>&gt; Reference: <b>Prof. Peter JOHANSSON</b> · <a href="mailto:peter.johansson@helsinki.fi">peter.johansson@helsinki.fi</a></li></ul> <div><div>Python</div><div>C/C++</div></div>
<b>Feb 2021</b> <b>Sep 2020</b>	<b>Research Assistant, University of Helsinki, Helsinki, Finland</b> <ul style="list-style-type: none"><li>&gt; Design and analysis of galaxy merger simulations to investigate the stalling of supermassive black hole binary systems at parsec scales</li><li>&gt; Reference: <b>Prof. Peter JOHANSSON</b> · <a href="mailto:peter.johansson@helsinki.fi">peter.johansson@helsinki.fi</a></li></ul> <div><div>Python</div><div>C/C++</div></div>
<b>Nov 2019</b> <b>Jan 2019</b>	<b>Research Scholar, Sydney Institute for Astronomy, Sydney, Australia</b> <ul style="list-style-type: none"><li>&gt; Determine the relationship between galaxy ellipticity and the spin parameter <math>\lambda_R</math></li><li>&gt; Academic writing</li><li>&gt; Reference: <b>Dr. Caroline FOSTER</b> · <a href="mailto:caroline.foster@sydney.edu.au">caroline.foster@sydney.edu.au</a></li></ul> <div><div>R</div><div>bash</div></div>
<b>Jun 2019</b> <b>Dec 2018</b>	<b>Research Assistant, University of Southern Queensland, Toowoomba, Australia</b> <i>with Observatoire de Paris</i> <ul style="list-style-type: none"><li>&gt; Creation of parameter lists for all stars within the BRITePol survey by script programming for literature searching</li><li>&gt; Reference: <b>Assoc. Prof. Stephen MARSDEN</b> · <a href="mailto:stephen.marsden@usq.edu.au">stephen.marsden@usq.edu.au</a></li></ul> <div><div>SQL</div><div>R</div></div>
<b>Dec 2018</b> <b>Feb 2014</b>	<b>Research Assistant, University of Southern Queensland, Toowoomba, Australia</b> <i>with James Cook University</i> <ul style="list-style-type: none"><li>&gt; Analysis and collection of UV data, including the calibration and use of UV and IR detectors to determine correlation between solar UV and solar IR exposure</li><li>&gt; Analysis of trends and modelling of results</li><li>&gt; Modelling of climate trends</li><li>&gt; Reference: <b>Dr. Nathan DOWNS</b> · <a href="mailto:nathan.downs@usq.edu.au">nathan.downs@usq.edu.au</a></li></ul> <div><div>MATLAB</div></div>

## PUBLICATIONS

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- 2025 Identifying supermassive black hole recoil in elliptical galaxies — MNRAS vol. 537 pp. 3421-3447
- 2024 The supermassive black hole merger-driven evolution of high-redshift red nuggets into present-day cored early-type galaxies — MNRAS vol. 535 pp. 1202-1227
- 2023 Reviving stochasticity: uncertainty in SMBH binary eccentricity is unavoidable — MNRAS vol. 526 pp. 2688-2695
- 2023 KETJU - resolving small-scale supermassive black hole dynamics in GADGET-4 — MNRAS vol. 524 pp. 4062-4082
- 2022 Modelling the accretion and feedback of supermassive black hole binaries in gas-rich galaxy mergers — MNRAS vol. 520 pp. 4463-4489
- 2022 Signatures of the Many Supermassive Black Hole Mergers in a Cosmologically Forming Massive Early-Type Galaxy — ApJ vol. 929 pp. 167-176
- 2020 The SAMI Galaxy Survey: Rules of Behaviour for Spin-Ellipticity Radial Tracks in Galaxies — MNRAS vol. 491 pp. 324-343

## EDUCATION

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<b>Present</b>	<b>Doctoral Researcher, School of Particle Physics and Universe Sciences, University of Helsinki, Helsinki, Finland</b>
<b>Sep 2021</b>	<ul style="list-style-type: none"><li>&gt; Doctoral thesis: 2 of 3 required first author publications complete</li><li>&gt; 8 coauthor publications</li><li>&gt; High performance computing courses</li><li>&gt; Galactic dynamics</li><li>&gt; Personal development courses</li></ul>
<b>May 2021</b>	<b>Master's of Particle Physics and Astrophysical Sciences, University of Helsinki, Helsinki, Finland</b>
<b>Sep 2019</b>	<ul style="list-style-type: none"><li>&gt; GPA: 4.85/5.00</li><li>&gt; <i>The Final Parsec Problem in Massive Early-Type Galaxies</i> A suite of collisionless galactic merger simulations were performed to investigate previous numerical results suggesting supermassive black hole binaries may be unable to merge. The galactic models were motivated from observational data, where it was found that the mass resolution between stellar particles and the supermassive black hole binary is critical in the final distribution of stellar particles that are able to interact with the binary.</li><li>&gt; Studies: Galactic dynamics and evolution, observational astronomy, general relativity, radiative transfer, and Monte Carlo methods.</li></ul>
<b>Nov 2018</b>	<b>Bachelor of Science (Physical Sciences), University of Southern Queensland, Toowoomba, Australia</b>
<b>Feb 2016</b>	<ul style="list-style-type: none"><li>&gt; GPA: 6.96/7.00</li><li>&gt; <i>Insights into Stellar Dynamo Evolution: the Young Sun HD 106506</i> Doppler imaging and Zeeman Doppler imaging were performed on spectropolarimetric data of HD 106506. A prevailing polar starspot and a strong azimuthal magnetic field indicate the stellar dynamo is dominated by the toroidal component.</li><li>&gt; Studies: astronomical sciences, statistics, and programming.</li></ul>
<b>Jan 2018</b>	<b>Exchange Studies, University of Zürich, Zürich, Switzerland</b>
<b>Aug 2017</b>	<ul style="list-style-type: none"><li>&gt; Studies: Computational astrophysics (N-body simulations and smoothed particle hydrodynamics), mathematical methods for physics, and astrobiology</li></ul>

## FUNDING AND AWARDS

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2025	University of Helsinki 30 under 30 recipient
2021	UH Research Foundation Doctoral Researcher — University of Helsinki
2019	Fully-Paid Tuition and Study Grant — University of Helsinki
2019	Denison Research Scholar — University of Sydney
2016	Chancellor's Scholarship — University of Southern Queensland

## SKILLS

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### Communication

- > Confident and apt public speaker
- > Concise, professional academic writing
- > Effective group communicator

### Languages

- > English (native)
- > German (intermediate)
- > Finnish (basic)

## PROGRAMMING LANGUAGES

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Python	● ● ● ● ○
C/C++	● ● ● ● ○
Stan	● ● ● ● ○
R	● ● ● ○ ○
bash	● ● ● ○ ○
L <sup>A</sup> T <sub>E</sub> X	● ● ● ○ ○
MATLAB	● ● ● ○ ○
SQL	● ● ○ ○ ○
IRAF	● ● ○ ○ ○

## + SPECIFIC INTERESTS

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- > Galactic dynamics
- > Galaxy formation & evolution
- > Supermassive black hole dynamics
- > Computational astrophysics
- > Bayesian Statistics
- > Hierarchical Modelling

## TEACHING AND MENTORING

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2021–Present	<i>University of Helsinki</i> : Graduate course assistant (astrophysics & statistics)
2019–2020	<i>University of Helsinki</i> : English language assistant
2017–2018	<i>University of Southern Queensland</i> : Undergraduate course assistant (physics)
2017–2019	Private Tutor

## “ REFERENCES

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### Prof. Peter Johansson

*Department of Physics*

UNIVERSITY OF HELSINKI

✉ peter.johansson@helsinki.fi

### Dr. Thorsten Naab

*Max Planck Institut für Astrophysik*

MAX PLANCK GESELLSCHAFT

✉ naab@MPA-Garching.MPG.DE