Austen GW Wallis

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Higher Education

University of Southampton Southampton, UK
PhD in (Astro)Physics Sept 2022 – Expected Q3 2026
Research Thesis: *"Emulator-based inference of imperfect and complex astrophysical models: Reducing Millions of Computational Hours to Minutes".*
– 3-Minute Thesis Faculty of Engineering and Physical Sciences Runner-Up 2026
– STAG research prize for 'Best Publication in Astrophysics' 2025.
– 'Best PhD Poster' at the South East Physics Network's Employers Exhibition 2024.

University of Southampton Southampton, UK
MPhys in Astrophysics with a Year of Research – **First Class Honours (80% Average)** Sept 2017 – July 2021
Research Thesis (87.5%): *"The Creation of a New Cosmological Standard Candle Using Active Galactic Nuclei: Model Calibration of the Torus's Time-Lag Response".*
– 2× **"Top-cohort"** invites onto UoS's UK leading astronomy research and field-trip programmes.

Research Experience

University of Southampton Southampton, UK
Postgraduate Researcher Sept 2022 – Present

- Developed SPECULATE, a user-friendly, machine-learning-based emulator and high-dimensional inference framework for the rapid determination of accretion outflow properties from their observed spectral profiles.
- Refined an analytical diagnostic method for the detection of cataclysmic variable (CV) outflows from equivalent-width asymmetries in the shape of optical emission lines.
- Released a 164,000+ synthetic (SIROCCO-based) spectral library of various CV and AGN outflows.
- Part of the SIROCCO international collaboration between Oxford, STScI, QUB, UoS, UGA that works on the development of the Monte-Carlo radiative transfer code and magnetohydrodynamic simulations of outflows.

University of Southampton Southampton, UK
Undergraduate Researcher (Master's Year in Research) Sept 2020 – July 2021

- Optimised Bayesian MCMC model fitting across 22 AGN optical/IR time series through testing parameter correlations, distributions and convolution functions to improve accuracy.
- Calibrated a key theoretical linear regression model (the lag-luminosity relation) to account for observational biases to predict the absolute luminosity of an type-1 AGN through reverberation mapping with the torus.

Instituto de Astrofísica de Canarias × University of La Laguna Tenerife, Spain
Student Researcher Jan 2019 – June 2019

- Determined the mass and rotational flattening of Jupiter from measurement of its rotational velocity through photometric observation of surface feature movement along a zonal band.
- Operated large astronomical observatories (IAC-80/TCS/Mons) and coordinated multi-site data collection.
- Analysed telescope design and model trade-offs using Monte Carlo and regression analysis for a hypothetical X-ray Binary space mission.

Technical Skills

Languages:	Python (Advanced), C (Beginner), Julia (Beginner)
Frameworks:	Machine Learning (TensorFlow, PyTorch, JAX, Scikit-Learn, NumPy, SciPy), Datasets (Pandas, Polars, Dask, Xarray), Data Visualisation (Matplotlib, PyScript, Vega-Altair, Streamlit)
Tools:	HPC (SLURM, LSF), Linux, Mac, Git (GitHub, HuggingFace), Code Testing and Profiling, VS Code, Jupyter, Marimo, AI Agents (Claude, Co-Pilot, Gemini, OpenAI)
Algorithmic:	Surrogate Modelling, Probabilistic ML (Ensembles, Gaussian Processes, Bayesian/Approximate Inference), Optimisation Methods, Dimensionality Reduction, MCMC, Time-series

Industrial Research

IBM Research Daresbury, UK
AI Research Scientist June 2025 – Sept 2025

- Co-designed a novel, non-gradient optimisation method that scores PDE solution spaces to highlight regions of regime change in dynamical systems, applied to SpeedyWeather.jl's primitive equation model.
- Curated 4 TBs of signal-rich synthetic weather data from WRF, a high-fidelity, mesoscale numerical simulator, to improve forecast skill on extreme events by IBM–NASA's Prithvi foundational weather model.
- Submitted an associated invention patent for review within IBM's IP department.

UK Atomic Energy Authority Culham, UK
Machine Learning Research Scientist June 2024 – Sept 2024

- Built a deep-ensemble surrogate model that predicts plasma pressures with uncertainty 2,000,000x faster with a 90% improvement in accuracy, enabling real-time control for experiments and a digital twin tokamak.
- Presented research to cross-divisional fusion stakeholders (UKAEA × STFC Hartree Centre × DigiLab).

Teaching Experience

University of Southampton Southampton, UK
Teaching Assistant, Demonstrator and Outreach Coordinator Jan 2023 – Present

- *PHYS2011 Design and Observation in Astronomy (TA, 2022-2026):* Delivered 57 workshop hours to 2nd year undergraduates teaching literature review tools/techniques, astronomical coordinate systems/catalogues, data acquisition/reduction/calibration, and error propagation methods for optical photometric and spectroscopic astronomy. Provided support for a wide range of student-led projects on all astronomical scales from moon craters to AGN.
- *PHYS2022 Physics from Evidence I (Demo, 2023-2024):* Mentored 150+ students in scientific Python/data analysis; assessed students through marked assignment work and viva voces.
- *PHYS1005 Introduction to Astronomy and Space Science (Demo, 2022):* Assessed student problem sheets.
- *Southampton Astrodome (Outreach, 2023):* Inspired secondary school students through mobile planetarium talks.

Other Work Experience

Wallco Ltd Winchester, UK
Planning and Development Research Assistant - Part-Time Jan 2023 – Present

- Enhanced development profitability from data mining optimal architectural design.
- Conducted in-depth research on parliamentary legislative acts and local/national planning policies, ensuring full compliance and smooth project execution.
- Developed detailed planning statements, utilising Vision AI for CAD architectural renders.

Publications (□ Co-authored / △ In Prep)

Wallis, A.G.W. et al., MNRAS (2025): "A diagnostic kit for optical emission lines shaped by accretion disc winds", DOI: 10.1093/mnras/staf1450

□ **Scepi, N. et al., MNRAS (2026)** *Title:* "Radiation-ionization hydrodynamic simulations of AGN line-driven winds lead to transient shielding and BAL/UFO signatures"

□ **Mosallanezhad, A. et al., MNRAS (2025):** "The critical role of clumping in line-driven disc winds", DOI: 10.1093/mnras/staf2183

□ **Mosallanezhad, A. et al., MNRAS (2025):** "Monte Carlo radiation hydrodynamic simulations of line-driven disc winds: relaxing the isothermal approximation" DOI:10.1093/mnras/staf1101

□ **Matthews, J. H. et al., MNRAS (2024):** "SIROCCO: a publicly available Monte Carlo ionization and radiative transfer code for astrophysical outflows" DOI:10.1093/mnras/stae2677

△ **Wallis, A.G.W. et al., MNRAS (in prep, Q2 2026):** *Draft Title:* "Expanding SPECULATE for the rapid inference of AGN accretion disc wind properties"

△ **Wallis, A.G.W. et al., MNRAS (in prep, Q1 2026):** "SPECULATE: A rapid emulator-based inference framework and synthetic spectral library for cataclysmic variable disc winds"

△ □ **Ward, M. et al., MNRAS (in prep, Q2 2026):** *Draft Title:* "A methodology for the detection of self-lensing binaries in transit surveys"

Presented Talks and ○ Conferences

EAS & COSPAR 2026: "Speculate: An Emulator-Based Framework for Inferring the Physical Properties of Accretion Disc Winds from Observations" & "Faster Models, Faster Answers: Designing Emulator-Based Inference Frameworks for Scientific Discovery" (July/Aug 2026)

PyData London 2026 Annual Conference Speaker: "Fast-Forward(ing) Models: Accelerating High-Dimensional Inference with AI Emulators (June 2026)

Royal Astronomy Society 3rd Machine Learning and Artificial Intelligence applied to Astronomy Meeting: "SPECULATE: A rapid emulator framework for physical inference of accretion outflows (Jan 2026)".

Trinity College Business School: "The WRF Weather Forge - Generating Global-Scale Forecasts" (July 2025).

2× PyData Southampton: "Predicting Extreme Weather Events: Augmenting AI Models to Improve Reliability" (Oct 2025) / "Faster Models, Faster Answers. Discover Emulation for your workflow" (Oct 2024).

Southampton Physics Journal Club: "Attention is all you need and Google Illuminate" (Nov 2024).

GRADnet Induction Programme: "Placement Showcase: Neural Networks in the Energy Sector" (Oct 2024).

STFC Hartree Centre: "Generating Fast Particle Predictions using Ultra-Fast Neural Emulators" (Sept 2024).

PyData London 2024 Annual Conference / PyData Southampton Lightning Talks: "Optimising Your Journey for a Satisfyingly Speedier Commute with Google Maps" (June/Jan 2024).

○ **SEPnet Annual Student/Employer Exhibition:** GRADnet Student Ambassador/Organising Committee/Poster Session Participant (Nov 2025/Nov 2024).

○ **Research Software Community Event with NVIDIA:** AI and GPU Research at Southampton (Feb 2024).

Other Awards and Courses

– 2nd Place 2024 DISCnet LIV.INNO Machine Learning Kaggle competition for particle classifications (July 2024).
– 2025 IBMer watsonx Challenger for the development of AI agents (Aug 2025).
– Imperial College's ICIC (Bayesian) Data Analysis Workshop 2022.
– JPMorgan and Chase Co's Software Engineering Virtual Experience (Aug 2020).