Xander Byrne

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Education

University of Cambridge   **Cambridge, 2019-23**

- MSci Natural Sciences, graduated 1st class with distinction; 87/100
- Ranked top of the class in third year Astrophysics examinations
- Awarded 'Winifred Georgina Holgate-Pollard Memorial Prize' from the University of Cambridge
- Awarded 'John Spencer Wilson Prize in Natural Sciences' and 'Skerne (1745) Scholarship' from St Catharine's College

King Edward VI Camp Hill School for Boys   **Birmingham, 2012-19**

- A-levels (all A*): Further Maths, Physics, Chemistry, Maths
- Twelve GCSEs, all at A*/9

Research Experience

Institute of Astronomy – PhD   **Cambridge, 2023-pres**

Supervisor: Amy Bonsor

My PhD research involves the study of exoplanet bulk composition, applying a wide range of data science techniques to datasets of polluted white dwarf stars, from DESI, SDSS-V and in future 4MOST, WEAVE

Institute of Astronomy – Masters' Project/Summer Internship   **Cambridge, 2022-24**

Atmospheres as a window to rocky exoplanet surfaces – **Byrne, Shorttle, Jordan and Rimmer 2024**

- Inferring the presence of surface minerals on the surfaces of Venus-like exoplanets, exploiting thermochemical equilibrium between surface and atmosphere
- Identified a strong association relating the sulfur chemistry of the two phases
- Awarded MASt/Part III Bursary to continue project that following summer

MPIA – Summer Internship   **Heidelberg, 2022**

Quasar Island – three new $z\sim6$ quasars, including a lensed candidate, identified with contrastive learning – **Byrne, Meyer et al. 2024**

- Applied several unsupervised ML techniques (e.g. VAEs, SOMs; settling on contrastive learning)
- Optimised network architectures and hyperparameters
- Applied a variety of clustering techniques (e.g. Gaussian mixture models, DBSCAN)
- Attended workshops on git, bash, astropy, and structuring python projects
- Presented my work at *Galaxy Coffee* seminar
- Awarded observing time: *Finding the missing gravitationally-lensed $z>6$ quasars*, Gemini/GMOS-South (1.64h, PI: E. Farina), to observe two candidates. Both were found to be high-redshift quasars

Talks

Contrastive Learning and High-Redshift Quasars   **Cambridge, Feb 2024**

Cambridge Astro Data Science Discussion Group; MPhil in Data Intensive Science seminar series

Atmospheres as a Window to Rocky Planet Surfaces   **Heidelberg, Feb 2024**

Exocoffee, MPIA

Searching for Lensed High-Redshift Quasars with ML   **Heidelberg, Sep 2022**

Galaxy Coffee, MPIA

Skills Modules   University of Cambridge

CDT Data Intensive Science   2023-24
Lecture courses, supervisions, coursework, and examinations from MPhil in Data Intensive Science
- Principles of Data Science – common distributions, parameter estimation methods, hypothesis testing
- Applied Data Science – data pre-processing; supervised and unsupervised learning; training methods
- Statistics for Data Science – Bayesian modelling: MCMC; nested sampling; Gaussian processes
- Application of Machine Learning – MLPs; CNNs; VAEs; diffusion models; transformers

Introduction to Python and Jupyter Lab   Feb 2022
Developing Python skills in an astrophysical context
- Wrote an orbital integrator, investigating the effects of changing timestep and energy
- Visualisation of gravitational field in a binary system
- Analysis of SDSS and exoplanet.eu data; visualisation of colour and conversion of units using Astropy

Introduction to Computing in C++   Feb 2021
- Simulation of planetary orbits using Euler, Leapfrog, and RK4 methods
- Numerically estimating the specific heat ratio for a one-dimensional gas
- Estimation of ln(2) using a Monte Carlo method

Physics Research Skills Module   Feb 2021
- Presented a poster and delivered a presentation on the Schiehallion Experiment
- Wrote a scientific essay on the Sources of Cosmic Rays
- Peer reviewed colleagues' essays on Bernoulli's Principle, Relativity of Simultaneity, the Arago Spot

Computer Practicals in Excel/VBA   Jan 2021
- Eigenfunction Expansion in a Sturm-Liouville ODE. Effect of number of expansion functions on accuracy
- Gauss-Jordan Elimination. Effect of rounding errors and partial pivoting
- Solution of Laplace's Equation using Jacobi and Gauss-Seidel methods, with and without relaxation.
Effect of step size and relaxation parameter on accuracy. Rate of convergence

Outreach

- Delivered a talk to the Birmingham Schools Science Network: *Worlds Anew: Quasars, Exoplanets, and the Search for Life*
- Delivered numerous talks for the St Catharine's College Physics Evening Initiative
- Several appearances on *The Naked Scientists* live on BBC Radio Cambridgeshire and on their podcast
- Delivered an "incredibly entertaining" talk on the Messier Catalogue at *Varsity Sci 2021*
- Delivered a talk to the Cambridge University Physics Society about the dynamics of negative mass; authoring an article on the subject in *BlueSci* magazine
- Student Ambassador for St Catharine's College, Cambridge. Delivered talks at various state schools in North Yorkshire to support applications to Cambridge from underrepresented groups. Panellist on many Q&A sessions and webinars for prospective applicants
- Maintaining extensive document advising prospective students on Oxbridge interviews

Other Projects

CATAM Mathematics and Physics Projects   Cambridge, 2021
Computational projects and reports investigating an astrophysics-related theme
- Simulated accretion discs, analysing trajectories of individual particles and angular momentum
- Calculated cosmological lookback times; measured distances for a range of cosmological models; tested uniformity of comoving density for a sample of 114 quasars up to $z = 3.0$

International Chemistry Olympiad 2019   Paris, 2019
- Represented the United Kingdom at the IChO 2019; ranked 41st in the world
- Required learning extensive amounts of chemistry (both theoretical and practical) in just two weeks

Extended Project – *Where do Cosmic Rays Originate?*   Birmingham, 2018
- A report investigating the sources of cosmic rays at various energies
- A literature review as well as primary research; awarded A*
- Wrote software in Python/MATLAB to analyse data from muon detectors to triangulate 190 000 events

HiSPARC Project & Conference   Bath, 2018
- Initiated my school's participation in the HiSPARC cosmic ray project
- Constructed a muon detector to be installed on the roof; carried out repairs/troubleshooting
- Used data collected from detector for Extended Project Qualification (above)
- Presented my research at the HiSPARC Conference 2018; received the Gold Award

Cavendish Laboratory   Cambridge, Jul 2017
- Shadowed a PhD student using DNA-driven colloids to create structural colour
- Synthesised my own iridescent gel
- Learned some principles of soft condensed matter, Bragg reflection, and SEM

VDI Schülerforum 2016   Frankfurt, 2016
- Five-month group research project on drone technology
- Delivered a presentation of the project (partially in German), to an audience of ~100 at the Frankfurt University of Applied Sciences

Languages
- A* GCSEs in German, French and Mandarin
- Basic ability in Italian

Other Interests
- Piano – ARSM performance diploma; composed many solo pieces. Performed in countless concerts and shows, occasionally in an ensemble
- Long-distance running – ran half marathons in Birmingham (2017; 1h58) and Cambridge (2024; 1h43)
- Football – Captained local youth team for 6 years, ascended through 5 divisions
- Squash – Played for college team for 5 years