

Xander Byrne

1st year Astrophysics PhD Student
Institute of Astronomy, Cambridge, UK
ajnb3@cam.ac.uk • 07391 788913
xbyrne.github.io

Education

University of Cambridge

Cambridge, 2019–2023

- MSci Natural Sciences, graduated 1st class with distinction; 87/100
- Awarded 'Winifred Georgia 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
- Ranked 1st in class in third year Astrophysics examinations

King Edward VI Camp Hill School for Boys

Birmingham, 2012–2019

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

Research Experience

Institute of Astronomy – Masters' Project/Summer Internship

Cambridge, 2022–23

Atmospheres as a window to exoplanet surfaces

- 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
- Supervised by Oliver Shorttle & Paul Rimmer

Max-Planck-Institut für Astronomie – Summer Internship

Heidelberg, 2022

Discovery of two high-redshift (potentially lensed) quasars with unsupervised machine learning

- Applied several unsupervised ML techniques (e.g. variational autoencoders, self-organising maps); experimenting with different network architectures and hyperparameters
- Used SQL, bash scripting, astropy, to collect data from SIA service
- Carried out SED fitting using MCMC and the emcee package
- 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
- Supervised by Romain Meyer

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 university-level chemistry (both theoretical and practical) in just two weeks

Extended Project Qualification – *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*
- Developed software in Python and MATLAB to analyse data from muon detectors to suggest sources for nearly 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

Outreach

- 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; authored 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 pupils on Oxbridge interviews

Relevant Modules University of Cambridge

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

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 the Birmingham Half Marathon in under 2 hours
- Football – Captained local youth team for 6 years, ascended through 5 divisions
- Squash – Played for college team for 4 years