Alexander Byrne

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Education

University of Cambridge, St Catharine's College   Cambridge, 2019–pres
- MSci Natural Sciences (Astrophysics) – First Class expected
- Ranked 1st in third year Astrophysics examinations
- 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

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

Part III (Master's) Project   Cambridge, 2022–23
Surface-atmosphere interactions on warm exoplanets
- Understanding the extent to which the atmospheric compositions of warm exoplanets (such as Venus) are influenced by buffering reactions on their surfaces
- Investigating detectability of various surface buffers in atmospheric transmission spectra

Max-Planck-Institut für Astronomie, Internship   Heidelberg, Summer 2022
Turned down internship offers from Cambridge IoA and Oxford Astrophysics.
- Searching for high-redshift gravitationally-lensed quasars, using unsupervised machine learning
- Used SQL, bash scripting, astropy, to collect data from SIA service
- Applied several unsupervised ML techniques (e.g. variational autoencoders, self-organising maps), investigating different network architectures and hyperparameters
- Carried out SED fitting using MCMC techniques
- 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 a seminar

CATAM Mathematics and Physics Projects   Cambridge, Sep 2021
Computational projects and reports investigating a mathematics- or physics-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 $z = 3.0$
- Produced exemplary plots in Matplotlib

International Chemistry Olympiad 2019   Paris, Jun 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 over 770,000 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, Jun 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

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

Other Projects

2021

- Used machine learning techniques to develop handwritten number recognition software from scratch, achieved over 97% accuracy on the MNIST dataset
- Read *Deep Learning with Python* by François Chollet; improved accuracy to >99% using Keras module
- Delivered an "incredibly entertaining" talk on the Messier Catalogue at *Varsity Sci 2021*

2020

- Delivered a talk to the Cambridge University Physics Society about the dynamics of negative mass
- Wrote an article on the same subject in *BlueSci* magazine

2019-pres

- Student Ambassador for St Catharine's College, Cambridge; panellist on many Q&A sessions for prospective applicants

- Maintaining extensive document in LaTeX advising pupils on Oxbridge interviews
- Modified Excel spreadsheets for organising my school's entrance exam

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