Alexander Byrne

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Education

University of Cambridge, St Catharine's College **Cambridge, 2019-pres**

- BA (Hons) Natural Sciences (Astrophysics) – First Class expected
- Ranked 17th out of 566 in 2nd year: 8th in Mathematics; 8th in Physics A; 15th in Physics B
- Awarded Skerne (1745) Scholarship

King Edward VI Camp Hill Boys **Birmingham, 2012-2019**

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

Experience

Introduction to Python and Jupyter Lab **Cambridge, 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

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 lookback times; measured cosmological 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 using Matplotlib

Introduction to Computing in C++ **Cambridge, Feb 2021**

- Simulation of planetary orbits using Euler, Leapfrog, and RK4 methods
- Numerically estimating the specific heat ratio for a one-dimensional gas
- Calculation of ln(2) using a Monte Carlo method
- Finding roots of a transcendental equation
- Generation of the Collatz sequence of a number
- Calculation of triangle-based pyramidal numbers

Physics Research Skills Module **Cambridge, 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 other essays on Bernoulli's Principle, Relativity of Simultaneity and the Arago Spot

Computer Practicals in Excel/VBA **Cambridge, 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
- Root finding using Bisection, Newton-Raphson, Linear Interpolation, and Secant methods. Investigation of rates of convergence
- Solution of ODEs using Euler and RK4 methods, and investigating their stabilities
- Numerical Integrations of complicated functions using Simpson's and Trapezium Rules, including investigation of errors and behaviours near singularities

IChO 2019 **Paris, Jun 2019**

- Represented the United Kingdom at the International Chemistry Olympiad 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 & HiSPARC Conference **Bath, 2018-pres**

- Initiated my school's participation in the HiSPARC cosmic ray project
- Constructed a muon detector; installed it 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
- Return annually to inspire and oversee future students' research projects

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

Extracurriculars

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 (youtu.be/ovptNlUAtto)
- Wrote an article on the same subject in *BlueSci* magazine

2019-pres

- Maintaining extensive document in LaTeX advising pupils on Oxbridge interviews
- Modified Excel spreadsheets for organising my school's entrance exam
- Student Ambassador for St Catharine's College, panellist on many Q&A sessions for prospective applicants

2017-19

- Gave a series of well-attended talks about the Schrödinger Equation to school colleagues

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, often in an ensemble
- Long-distance running – ran the Birmingham Half Marathon in under 2 hours
- Captained local youth football team for 6 years, ascended through 5 divisions